VOT 74270

DEVELOPMENT OF AUTOMATED CADASTRAL DATABASE SELECTION AND VISUALIZATION SYSTEM TO SUPPORT THE REALIZATION OF MODERN CADASTRE IN MALAYSIA

(PEMBANGUNAN SISTEM PEMILIHAN DAN VISUALISASI PANGKALAN DATA KADASTER BAGI MENYOKONG PERLAKSAAN KADASTER MODEN DI MALAYSIA)

Dr Abdullah Hisam Omar
Prof Dr Abd Majid A Kadir
Mr Rosnizam Mudin Shah b Sidek

IRPA VOTE NO :
74270

FAKULTI KEJURUTERAAN DAN SAINS GEOINFORMASI
Universiti Teknologi Malaysia
81310 UTM SKUDAI, JOHOR

2006

ACKNOWLEDGEMENTS

This report is the result of 2 years of research in the Department of Geomatics Engineering, Faculty of Geoinformation Science and Engineering, Universiti Teknologi Malaysia. The research was funded by the Ministry of Science, Technology and Inovation under the e-IRPA (Intensification of Research Priority Area) 8^{h} Malaysian Plan. The authors wish to express their sincere appreciation to all individuals involved during the preparation and execution of this research for their assistance, contribution and making this research a success. Throughout the duration of this research, assistance from research colleagues and staff members were received and acknowledge.

Project Leader : Dr Abdullah Hisam Omar

Researcher :

1. Prof Dr Abd Majid A Kadir
2. Mr.Rosni Zamuddin Shah Bin Sidek

DEVELOPMENT OF AUTOMATED CADASTRAL DATABASE SELECTION AND VISUALIZATION SYSTEM TO SUPPORT THE REALIZATION OF MODERN CADASTRE IN MALAYSIA

(Keyword: Cadastral Database, Automated Process, Modern Cadastre, NDCDB)

The process of extracting land records information especially cadastral data for a large number of land title was tedious and time consuming. The development of State Digital Cadastral Database (SDCDB) by Department of Survey and Mapping Malaysia (DSMM) is one of the initiatives to shift to modern cadastral system. Cadastral data need to be adjusted in order to verify the network closure. In order to move to a new adjustment approach, a so-called Least Squares, an Intelligence Based Automated Cadastral Database Conversion System must be developed. The automated functions of the said system are;i) generate of zones and overlapping areas, ii)extracting cadastral information from existing SDCDB,iii) automatically conduct an intelligence cadastral survey concept self- checking procedure, iv) re-compute or rebuild the cadastral records based on mathematical cadastral survey rules, v) automatically prepare corrected data input files (SDCDB and GPS) for a particular zone and vi) reformatting of data for input into least squares adjustment software.

The advantages of automation can be exploited in order to solve or to minimize the needs of manual approach. In order to support the development of survey accurate cadastral system, an automatic programming approach will be adopted. Database selection system will conduct several outliers integrity checking, rebuild cadastral spatial topology (cadastral lot) and make self-correction procedures based on cadastral survey concepts and mathematical model respective to the cadastral lots selected. This is to ensure that all cadastral lots are kept in a closed polygon and provide accurate and "clean" cadastral information.. This system was developed in windows environment.

Analyses show that the system is functional efficiently. This system is essential and important towards the implementation of computerized Coordinated Cadastral System in Malaysia and it is highly depends on the automated system.. Therefore an Intelligence Based Automated Cadastral Database Selection System is highly potential as a main system application for DSMM or private sector.

Key Researcher :
Dr. Abdullah Hisam Omar (Head)
Prof. Dr. Abd Majid A Kadir
En. Rosni Zamuddin Shah Bin Sidek
E-mail : a.hisham@fksg.utm.my
Tel. No. : 07-5530945
Vote No. : 74270

DEVELOPMENT OF AUTOMATED CADASTRAL DATABASE SELECTION AND VISUALIZATION SYSTEM TO SUPPORT THE REALIZATION OF MODERN CADASTRE IN MALAYSIA

(Keyword: Cadastral Database, Automated Process, Modern Cadastre, NDCDB)

Proses pengekstrakan maklumat rekod berkaitan tanah terutamanya data kadaster bagi kawasan yang besar melibatkan tempoh masa yang lama serta tenaga yang banyak. Pembangunan Pangkalan Data Kadaster (PDUK) oleh Jabatan Ukur dan Pemetaan Malaysia (JUPEM) merupakan satu inisiatif kearah system kadaster moden di Malaysia. Kadaster data perlu dilaraskan bagi mempastikan tutupan jaringan. Bagi mengubah pendekatan pelarasan yang baru iaitu menggunakan pelarasan ganda dua terdikit, Sistem Pemilihan dan Visualisasi Pangkalan Data Kadastra Secara Automasi telah dibangunkan. Fungsi-fungsi automatic yang terlibat adalah: i)menjanakan zon dan kawasan tindihan, ii) mengekstrak maklumat kadaster fari PDUK, iii) melaksanakan prosedur penyemakan konsep ukur kadaster secara automatic, iv) mengira dan membangunkan rekod kadaster berasaskan model matematik ukur kadaster, v) menyediakan input data yang telah diperbetulkan (PDUK dan GPS) bagi zon terlibat, vi) memformat input data bagi perisian pelarasan ganda dua terdikit.

Kelebihan-kelebihan automasi boleh diekploitasikan untuk menyelesaikan dan meminimakan keperluan pendekatan manual. Bagi menyokong pembangunan sistem ukur kadaster berketepatan tinggi, pendekatan pengaturcaraan automatik telah diaplikasikan. Sistem Pemilihan Pangkalan Data melaksanakan beberapa prosedur penyemakan integriti, membentuk topologi spatial (lot kadaster) serta pembetulan cerapan berasaskan model matematik serta peraturan ukur kadaster bagi lot kadaster yang terlibat. Ini bagi memastikan kesemua lot kadaster disimpan didalam bentuk poligon tertutup dan menyediakan maklumat kadaster yang tepat dan ”bersih”. Senario ini kritikal di dalam proses pelarasan. Sistem ini dibangunkan berasaskan persekitaran *windows.*

Analisis-analisis menunjukkan sistem ini berfungsi secara efisyen. Sistem ini merupakan asas dan penting kearah implementasi Sistem Kadaster Berkoordinat berkomputer di Malaysia dan amat bergantung kepada sistem automasi. Oleh itu Sistem Pemilihan dan Visualisasi Pangkalan Data Kadastra Secara Automasi berpotensi sebagai sistem aplikasi utama bagi JUPEM atau sektor swasta.

Penyelidik :
Dr. Abdullah Hisam Omar (Ketua)
Prof. Dr. Abd Majid A Kadir
En. Rosni Zamuddin Shah Bin Sidek

E-mail : a.hisham@fksg.utm.my
Tel. No. : 07-5530945
Vot No. : 74270

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABREVIATIONS

CP	-	Certified Plan
CV	-	Calculation Volume
CAD	-	Computer Aided Design
CALS	-	Computer Assisted Land Survey System
CAM	-	Computer Aided Mapping
CCS	-	Coordinated Cadastral System
CCI	-	Cadastral Control Infrastructure
CCDB	-	Cadastral Control Database
CDMS	-	Cadastral Database Management System
CDSV	-	Data Selection and Visualization Interfacing Program
CEFB	-	Cadastral Electronic Field Book
CLRS	-	Computerised Land Registration System
CMM	-	Cadastral Measurement Management
CSS	-	Counter Service System
DBMS	-	Database Management System
DSMM	-	Department of Survey and Mapping Malaysia
EDM	-	Electronic Distance Measurement
E-R	-	Entity-Relationship
FIG	-	International Federation of Surveyors
F2F	-	Field-to-Finish

LIST OF ABREVIATIONS

GDM2000	-	Geocentric Datum of Malaysia
GIS	-	Geography Information System
IGAC	-	Geographical Institute Agustin Codazzzi
INAC	-	Northern Affairs Canada
IT	-	Information Technology
LINZ	-	Land Information New Zealand
LIS	-	Land Information System
LSA	-	Least Squares Adjustment
MACGDI.	-	Malaysian Center For Geospatial Data Infrastructure
NaLIS	-	National Infrastructure for Land Information System
NDCDB	-	National Digital Cadastral Database
NGDI	-	National Geospatial Data Infrastructure
NRCan	-	Natural Resources Canada
PDA	-	Personnel Digital Assistant
QAS	-	Quality Assurance System
RSO	-	Rectified Skew Orthormorphic
RTK	-	Real Time Kinematic

LIST OF ABREVIATIONS

SAPD	-	District Survey Office Automation System
SDCDB	-	State Digital Cadastral Database
SKDK	-	Digital Cadastral Integrity System
SPID	-	Image Document Management System
SRIS	-	Survey Record Information System
SUM	-	Virtual Survey System
TSM	-	Total Survey Module
VB	-	Visual Basic
VRML	-	Virtual Reality Modeling Language

LIST OF APPENDICES

CHAPTER I

INTRODUCTION

1.1 Introduction

Sustainable development has been, since not too long ago, the concern of most nations as it was accepted as one of the factors affecting human survival. In ensuring sustainable development, the cadastre has been widely recognised as having an important role to play and this had consequently imposed increasing demands on the traditional cadastral systems. As a result, the need then arises for cadastral systems to adapt to new expectations and standards and particularly to implement improved cadastral systems. This situation had, amongst other reasons, led to the many ongoing cadastral reforms throughout the world, over the last decade or so (Kaufmann, 1999).

Cadastral reform has had a resurgence world-wide and interest in it has apparently been mounting as it was increasingly recognised to be of significance to economic development, social stability and the environment. This was very evident in the last decade or so, in all continents and in many United Nations member states, as observed by Williamson (1997(a)). An indication of this increased interest is the emphasis given to it in both the local as well as international conferences, seminars, meetings, workshops etc. One such congregation (of minds) was the United Nations sponsored joint meeting of cadastral experts in Bogor, Indonesia in March 1996, wherein substantial attention was conferred to the discussion on matters related to cadastral reforms. Another example is the XIX Congress of the International Federation of Surveyors (FIG) at Helsinki, Finland in June, 1990 where, as noted by

Williamson (1991), arguably the largest number of papers presented, dealt with the common theme on cadastral reforms.

Malaysia was not to be left behind in this progressive development. Spurred on by domestic demands and taking cue from developments overseas, it had unceasingly taken initiatives to continually and strategically implement cadastral reforms whenever and wherever appropriate. One fitting example was the introduction of computerised systems to the surveying component of the cadastre by the Department of Survey and Mapping, Malaysia (DSMM). According to Abdul Majid Mohamed (1994), the initiative was for the purpose of not only increasing the efficiency and productivity of computations and plan drawings, but also to introduce the concept of digital databases. That first step was then accompanied by other initiatives by the same department through the continuous and still on-going reforms of the cadastral surveying system. The most recent of these initiatives is the endeavour to introduce the Coordinated Cadastral System (CCS) for the purpose of further improving and increasing the efficiency of the cadastral surveying system (Abd Majid A. Kadir et.al., 1998).

The desire and enthusiasm for this introduction arises out of the perception that the coordinated cadastre offers, in the midst of current technological advancements, numerous advantages with regard to various aspects of the cadastral operations. Furthermore, it was duly noted that other countries, notably Australia had already made headway in implementing the CCS and that the prospects of its introduction in Malaysia appeared to be potentially feasible. The optimism on the feasibility of introducing the system however emanated from the positive outcomes of the pilot studies conducted by research groups, as reported by Abd Majid A. Kadir, et.al (1999(a)).

The benefits of CCS have been much talked about and these include the opening up of opportunities in coping with and in accruing benefits from the advances in technology. One example is its compatibility for use with modern survey equipments and systems. Since coordinates are the basic input/output of equipments such as Electronic Total Stations and systems such as the Global Positioning System (GPS), the introduction of CCS would thus be synergistic with the operations of such equipments and systems. Moreover, it will also facilitate the integration of cadastral and map-based information as well as the use of rapid data acquisition, storage, processing and management techniques. Apart from that, much of the developed world have also recognised that the CCS underpins the Land/Geographical Information System (LIS/GIS), and in considering that land/geographic information itself is a very valuable resource, it is evident that the CCS is of essence.

In view of the above developments, it is consequently the intention of this study to look into the various aspects of the introduction and implementation of the CCS in Malaysia. Since the practises and operations of the cadastre in the states of Peninsular Malaysia are distinctly different from those of Sabah and Sarawak in East Malaysia, due to historical (and constitutional) reasons, this study is thus specifically confined to Peninsular Malaysia.

The cadastral reform is inevitable in this new millennium to handle and manage the constant proliferation throughout the world. This is to some extent due to technological advancement in computerization, information acquisition and communication. Cadastral reform may relate to various aspects of cadastral system such as office automation, field measurement, and cadastral database development. These will lead to the concept and realization of the Coordinated Cadastral System (CCS) in some countries today.

The cadastral reform is inevitable in this new millennium to handle and manage the constant proliferation throughout the world. This is to some extent due

to technological advancement in computerization, information acquisition and communication. Cadastral reform may relate to various aspects of cadastral system such as office automation, field measurement, and cadastral database development. These will lead to the concept and realization of the Coordinated Cadastral System (CCS) in some countries today.

In the previous studies of CCS (1997-1999), main input data for cadastral network adjustments are bearing and distance for boundary lots which have been keyed-in manually. This method is not practical to be implemented on the large cadastral network due to tedious task and time consuming. The existence of the State Digital Cadastral Database (SDCDB) that has been developed by DSMM has triggered the idea to develop one system that can be applied leading to automated system for data conversion.

It has been realized from the previous studies that Coordinated Cadastral System could potentially be implemented in Malaysia. DSMM has taken a step to become leading organization in providing modern spatial data in the country. The increasing demand by the public and private sector on the digital spatial data leads to the formation of National Infrastructure for Land Information System (NaLIS). NaLIS was formed to fulfill the users demand for spatial data and functions as data bank for all land related data. Land Information Systems (LIS) comprise of four important elements: i) adequate geodetic reference system; ii) base map or topography map; iii) cadastral system and; iv) linking mechanism that integrate all the land related data. LIS concept employs a homogenous coordinate reference system for integrating and overlaying all land related information. According to DOL (1986), most advance countries realized that the coordinate-based cadastral is an important element in forming an efficient Land Information System.

1.2 Research Objectives

i. To develop an Intelligence Based Database Integrity and Self Correction Mechanisms.

ii. To develop an Intelligence Based Cadastral Database Selection and Visualization System.

1.3 Problem Statement

The process of extracting land records information especially cadastral data for a large number of land title was tedious and time consuming. The development of State Digital Cadastral Database (SDCDB) by Department of Survey and Mapping Malaysia (DSMM) is one of the initiatives to shift to modern cadastral system. Cadastral data need to be adjusted in order to verify the network closure. Adjustment techniques used in the development of SDCDB are Transit and Bowditch. In order to move to a new adjustment approach, a so called Least Squares , a cadastral database selection must be developed. The functions of the system are;

i) Execute an Intelligence database integrity mechanism (spatial and cadastral records).
ii) Generate of zones and overlapping areas.
iii) Extracting cadastral information from existing SDCDB.
iv) Automatically conduct an intelligence cadastral survey concept self-checking procedure.
v) Re-compute or rebuild the cadastral records based on mathematical cadastral survey rules.
vi) Automatically prepare corrected data input files (SDCDB and GPS) for a particular zone.
vii) Reformatting of data for input into least squares adjustment software

In order to support the adjustment process, data selection engine will filter out all the hanging lines respective to the occurred when cadastral lots selected. This is to ensure that all cadastral lots are kept in a closed polygon. This scenario is critical in the adjustment process. Cadastral information for a large number of land records can be extracted more efficient digitally than by a manual approach. The success of the development of National Digital Cadastral Database greatly depends on the efficiency of the integrity and extracting of cadastral information. This prototype system will give DSMM and other land authorities a guideline to shift to a modern cadastral system.

1.4 Research Scope

i) Data input based on State digital cadastral database (SDCDB) from Department of Survey and Mapping Malaysia.
ii) Development of interfacing software for database selection and visualization using object-oriented programming language (Visual Basic) and developer language (Map Object).
iii) Mathematical models will be used such as misclosure determination, coordinate computation, bearing and distance computation, and filtering algorithms.
iv) Integration of menu-driven interfacing program and spatial menus.

1.5 Research Contributions

i. Algorithm such as Spatial Filtering Algorithm and survey-based intelligence algorithm

ii. Method/technique for automation in large scale cadastral data processing and manipulation towards development of National Digital Cadastral Database

iii. Fully Developed an intelligent prototype application for DCDB data selection that include various software such as database integrity module, database selection module, spatial and attribute data computation and correction module, visualization module and data selection module.

1.6 Research Methodology

The research methodology will encompass the following:

i. Selection of the study area

Two study areas covering an area of 10 km x 10 km will be selected for this study. These areas are located within a two different states. The selected area should consists of rural, semi-urban and urbanized areas. This is particularly important for the analysis of DCDB structure in the different states DCDB.

ii. Modeling and Design of Interfacing Program

A proper system design concept is needed in order to achieve research objectives. The conceptual model and unified modeling language are developed to guide the development and the implementation of the system. The interface design involved several tasks, as following; i) the overall amount of functionality including cadastral survey algorithms, filtering algorithm, navigation, configuration, analysis option; ii) tool appearance will involve types of the design elements such as map images, graphical icons, spatial editor; and iii) arrangement of interface elements means the arrangement of the focal point element (maps). Metadata design

iii. Development of Intelligence Based Automated Cadastral Database Selection and Visualization System

a) Identifying problem/errors and the solutions.

In previous study, there are some main issues have been identified. All this issues will be stored as the knowledge base with its solutions method. With an automation mechanism, the system will expert enough to identify the problem and searching the possible solutions to solve the problem.

b) Closed Polygon Recognition

In this system features, it includes the capability to identify a closed polygon in order to have a quality data for further adjustment. This can be defining as one of intelligence mechanism because to identify one closed polygon is require a human knowledge to identify a closed polygon and how to identify the features of closed polygon.

c) Data Error Correction

Identifying data error and how to solve it is also one of the characteristics of intelligence process. At initial stage of this research proposal there some error occurs at existing database due to human error and technical problem. By using intelligence mechanism, the system could be used to identify the data error, the type of data error and also can recognize the method to correct the data error without affecting the quality of data.

d) Matching data from different table.

Inconsistency of data in different tables also can be solving by using an intelligence implementation mechanism. Sometimes the mark identities in each table are different even each point is having same location. By using intelligence-based process, the system systematically and automatically identifies the problems by searching the best method of corrections in various possibilities.

e) Spatial and attribute computation based on survey concepts and Mathematical model

Outliers and errors in the database must be corrected in order to provide a good data input for adjustment process. All computations will be done automatically and the use of survey mathematical model is to ensure the reliability of the cadastral records in the database

f) Automated

Automation in data selection, filtering and manipulation.

iv. Intelligence Based Automated Cadastral Database Selection System Test-Bed

Prior to make a commitment to a new technology like AI, it is important to consider testing concepts and physical designs for development of the such a system within survey communities. The purpose of a benchmark is to evaluate the performance and functionality of the developed system with the different datasets, hardware, software configurations in a controlled environment.

1.7 Overview of The Report

This report is arranged in six Sections. **Chapter 1** deals with the conceptual background and the objectives of the research. The scope as well as approach that have been utilized in undertaking the research are also reviewed.

In **Chapter 2**, This chapter reviews the international trend of development and cadastral reform. It starts with the ideas and clear explanations of cadastral reform. Then, briefly introduces some significant cadastral system and reforms in certain countries. The last part of this chapter elaborates on the office and field reforms in Malaysia.

Chapter 3 deals with the development of Digital Cadastral Database done by Department of Survey and Mapping Malaysia.

Chapter 4 presents the development process of Automated Cadastral Database Selection And Visualization System which is divided into the following sub-modules for database selection application design:

a. ArcView
b. MapObject
c. Visual Basic
d. Interfacing program

Each module explains the important elements of the function for the system that has been developed.

Chapter 5 deals with the research analysis for this project. This section provides information on DCDB production process. This process includes development of Automated Cadastral Database Selection And Visualization System and National Cadastral Database (NDCDB).

Chapter 6 concludes the overall prototype development process. Recommendations for further research are also highlighted.

CHAPTER 2

CADASTRAL REFORM

2.1 Introduction

Cadastral reform is concerned with improving the operation, efficiency, effectiveness and performance of the cadastral system in a state or jurisdiction. Cadastral reform is being undertaken in many and diverse parts of the world. Different countries have different needs for a cadastre at different stages of development.

Due to their different stages of development, different countries have different capacities for the development of cadastral systems. In particular, human, technological and financial resources will determine the most appropriate form of cadastral system to meet the needs of individual countries. Thus, a simple low cost manual cadastre recording only private ownership rights may be appropriate for one country, while a sophisticated and relatively expensive fully computerized cadastre recording a wide range of ownership and land use rights may be appropriate for another country.

In order to improve a cadastral system the importance of focusing on the cadastral processes to identify bottlenecks, inefficiencies and duplication was recognized. Once the processes have been fully documented and understood it is possible to re-engineer them to improve efficiency and effectiveness in the delivery of cadastral services to the user. Such re-engineering often requires changes to legislation, modified institutional and administrative arrangements, and the use of different technologies.

2.2 Factors of Cadastral Reform

Tang (2002) stated that the general trend of cadastral reforms can be seen from the change of demands of society in a country. First, the change is in regards to user needs – in other words, the public is demanding better service. Secondly, the rapid improvement of new surveying and mapping technology is driving these changes. Thirdly, the need to trim down government expenditure helps to fuels the reform. Lastly, probably also a consequence of the above three, political decision of a government is perhaps the most important reason to effect a reform. Whilst, as mentioned by Williamson (2002), the global drivers for cadastral reform are:

i. Technology
ii. Micro-economic reform such as privatization, decentralization, downsizing
iii. Urbanization
iv. Globalization
v. Sustainable Development

Tremendous technological progress, social change, globalization, and the increasing interconnection of business relations with their legal and environmental consequences have also put a strain on the traditional systems. The traditional systems cannot adapt to all the new developments.

2.3 Common Aspects of Cadastral Reform and Trends

Some countries may have a cadastral reform planned, in progress or accomplished. Although the purposes of the reforms differ from country to country, here are common aspects. According to Steudler and Kaufmann (1998), reform projects may focus to:

i. Improve customer services with increased efficiency and an improved cost/benefit ratio;
ii. Involve more of the private sector;
iii. Provide more data in better quality;
iv. Provide data that are sufficiently accurate;
v. Have data available at the right time.

The development trends of the cadastral systems are the:

i. Introduction of digital cadastral maps based on national reference systems;
ii. Transformation of land registry information into digital form;
iii. Embedding of cadastre into land information systems by linking different databases;
iv. Unification of real property and land property registration systems;
v. Reduction of staff in the cadastral organizations and land management;
vi. Introduction of cost recovery mechanisms to at least cover the processing costs or to recoup the investment costs.

2.4 Global Cadastral Reform

Cadastral reform has been an international trend, starting with the United Nations Summit on Social Development in 1995, the United Nations City Summit in 1996, the Bogor Declaration on Cadastral Reform in 1996, and the multi-million dollar cadastral projects in Thailand, Indonesia, Malaysia, the Phillipines, South Korea, China, Australia, New Zealand, South Africa, most countries of Western Europe as well as Argentina and Brazil in recent years. These prove that great majority of the developed countries and many developing countries have entered cadastral reform program (Williamson, 1998).

In developed countries, survey and mapping organization undergo various degrees of privatizing and budget cut. Most of them have their cadastral maps digitized. Few leading countries are now converting their cadastral map from map accuracy to survey-accuracy and developing internet data communication facilities.

The Netherlands, Canada, Sweden and Singapore are the forerunners in these areas. The reforms are for better economics and efficiency. There are also cadastral system reforms. The force, which drives a cadastral system reform, always comes from political changes. Eastern European countries and South Africa are examples of this group (Tang, 2002).

Commission 7 of FIG had set up a working group in 1994 to develop a vision for a modern cadastre 20 years into the future. The resulting research named ‘Cadastre 2014’ is an important document, which will impact on cadastral reform world-wide for many years. The cadastral vision developed fully recognizes the changing role of governments in society, the changing relationship of humankind to land, the dramatic influence of technology on cadastral reform, the changing role of surveyors in society and the growing role of the private sector in the operation of the cadastre. Based on studies of existing cadastral systems all around the world, the working group agreed to six statements on the development of cadastre in the next twenty years. The statements are:

i. Modern cadastres should encompass the entire legal status of the land including public rights and restrictions.

ii. The separation between ‘maps’ and ‘registers’ will be abolished.

Most countries have a land recording system consisting of cadastre and land registration components. The cadastral part is normally handled by surveyors, while notaries and lawyers take care of the land registration part. This subdivision has often resulted in two different organizational units dealing with the same matter. If future cadastral systems are to meet the requirements, the function of maps must be re-defined. Maps will lose the function of information storage. They will serve in future

simply to represent information derived from data stored in databases. The abolition of paper and pencil. The traditional land recording procedures are increasingly computerized. Computer assisted work has proven to be much more efficient. That is why bookkeeping all over the world is handled with help of computer programs.

There is no reason why land recording should not make use of this technology. Public systems tend to be less flexible and customer oriented than those of private organizations. Free economies demand flexibility in land markets, land planning and land utilization. Flexibility may be provided better by private institutions. For necessary security, however, public involvement is indispensable. Cadastral systems need considerable investment. The investment and operation costs have to be paid back at least partially by those who profit. Cost and benefit analysis will be a very important aspect of cadastre reform and implementation. Surveyors will have to deal more with economic questions in future.

The second statement indicates the separation between land registers and maps should be abolished, is gaining a continually increasing amount of support. Good examples of this approach are such as the Land*online* in New Zealand and the best practices employed by Hungary, the Netherlands, and the Baltic States. The third and fourth statements; pertaining to cadastral modelling and the abolition of paper and pencil are of even greater importance. Of the 42 countries reviewed in UN/ECE/WPLA (2001), 20 countries have entirely digital land registers and 15 have entirely digital cadastral maps; the other countries are making progress in the introduction of digital systems.

Privatization in fifth statement has been actively implemented in certain countries. In Australia, government tends to keep only policy and regulatory roles, and the service provision is open to competition amongst government and private sectors. While, in New Zealand, it is open solely for private sector competition for contracts. Looking into Malaysia itself, the recent introduction of JUPEM GeoPortal and CCS implementation by the DSMM is developed and assisted by private companies.

As mentioned by Molen (2003), some 30 to 50 countries are either possess, or will shortly possess cadastral systems with an appropriate performance, and the other 140 to 160 that will not have implemented appropriate systems within the near future. Many countries still have a great deal of work to do before they can meet the challenges laid down in ‘Cadastre 2014’, although they could adopt its propositions as guiding principles. Below are some significant approaches done by certain countries.

2.4.1 Land*online* in New Zealand

Department of Survey and Land Information (DOSLI) in New Zealand have incrementally moved towards a total cost recovery policy. In 1996, a restructuring of DOSLI resulted in commercial activities and 25% of staff being transferred into a government owned commercial company named Terralink, and the remainder of DOSLI was renamed Land Information New Zealand (LINZ). Cadastral survey is provided by the private sector. Not all reforms are successful such as the recent commercial GIS production firm Terralink has been reported to be facing some financial difficulties.

Land*online* is an electronic system, which holds and manages land information in a national database. It is introduced to integrate all survey and title processes, to provide them in digital form, to reduce the costs of both provision and compliance, to utilise technological development, and to meet the growing community demand for improved quality and delivery. The existing DCDB which contain varying, unpredictable and unquantified errors has been replaced by Landonline and no longer available as a product.

The system provides land professionals with secure access to New Zealand's only authoritative titles register and digital cadastre maintained by LINZ. The functionally smart system enables registered users to conduct secure electronic title and survey transactions in real time, automating and speeding up traditional (and sometimes prolonged and complex) manual processes. It allows remote digital lodgement for surveyors of e-surveys, and electronic registration of e-dealings for conveyancers. Besides, Land*online* also allows comprehensive searching of the database.

e-Survey in Land*online* enables surveyors to undertake virtually all aspects of their surveys electronically. They can extract digital survey data from the system while a new survey will be able to be submitted on-line from a surveyor's office. The survey dataset is subject to a high degree of automated validation and processing against the existing record. The format for the transfer of the submitted data sets (LandXML) is being developed. As all the data that is transferred is textual, spatial transfer formats (eg. DXF) are not appropriate. LINZ has been collaborating with international survey software vendors and other interested agencies to extend the LandXML schema to enable "submission" of completed surveys. Development of this XML format is expected to overcome the problems that have commonly occurred with the transfer of survey data and should lead to acceptance by survey software vendors at the international level.

Consequently, the system is flexible which allows surveyors to capture and process the survey dataset on any of their own survey software that support the format. Figure 2.1 below explains the Land*online* e-Survey process.

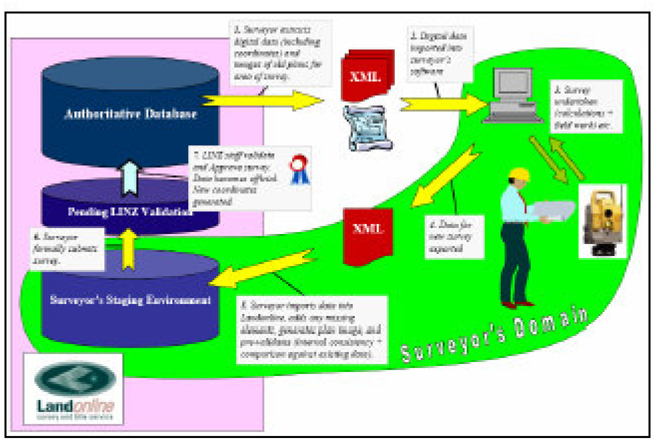


Figure 2.1: Land*online* e-Survey process

As the core national land information repository, Land*online* has also enabled LINZ to streamline its own business functions, resulting in faster processing of both manual and electronic survey and title lodgements and registration. Today, all lodgements are processed straight into Land*online*. In conclusion, Land*online* is an approach initiated by New Zealand, which provides full automation. e-Survey has been designed to remove most if not all of a surveyor's manual workload. Surveyors found that e-Survey allowed them to allocate resources that were previously engaged in the paper process to other more productive areas of their business.

2.4.2 Cadastral Electronic Field Book (CEFB) in Florida

Florida is a state located in the southeastern United States. By 1988, PC's began going along with the field surveyor to remote projects. The first use of the PC in BLM was to assist in preparation of the official record field note returns required in cadastral work. This was enhanced by the emerging automation of the Field-to-Finish cycle. As a result of the testing and feedback, Cadastral Electronic Field Book EFB) is introduced.

CEFB is an electronic survey data collector developed by the University of Maine in cooperation with the U.S. Bureau of Land Management. The design of CEFB is to provide cadastral surveyors with a tool with which they could more easily collect, analyze, and automate cadastral field surveying and computational processes. CEFB is not intended to be a collection package for all types of surveying. Specifically, CEFB is designed for cadastral surveys where large amounts of traverse data, evidentiary information, and geodetic computations are involved. Survey data collected using CEFB is stored in a binary field file.

In order to analyze this observational data it must first be transformed from binary to ASCII format and, secondly, it must also be reduced. Observation data is then transferred to Cadastral Measurement Management (CMM) analysis routine for verification and cadastral survey type geometry computations. The results of this process, new coordinates, may then be transferred back to CEFB for use with any ensuing field work. Thus, CEFB and CMM are mutually supportive of each other. CEFB provides easy data input for CMM and CMM provides CEFB with up-to-date coordinate information.

The CEFB is a system of software, computer platform and surveying instrument, mainly the total station. The computer platform for field operations is a rugged, hand-held personal computer (PC). The computer platform for office operations is a desktop PC. Both operate under DOS. Files may be transferred to any other operating system as desired. CEFB is “freeware”. Thus, the approved version can be downloaded from a site. Hintz told the author that CEFB is still in use.

2.4.3 ArcCadastre System in Colombia

Recently, ESRI has won a contract with the Geographical Institute Agustin Codazzzi (IGAC) to replace its existing automated mapping and cadastre system. The new system is based on ESRI’s ArcGIS software and ArcCadastre, which was developed by Lantmäteriet, the national land survey agency for Sweden, with the help of ESRI. It wanted to replace its existing INFOCAM system with a modern one that would provide a comprehensive GIS-based information management solution for the national cadastre.
ArcCadastre is a cadastre workflow management software system that is used for capturing, processing, maintaining, and using survey and cadastre information. It consists of a core ArcGIS software-based product and customer/country-specific extensions.

The core product is the basic cadastral software that covers the majority of the functionality that is common to the cadastral workflow of different countries. The ArcCadastre system is built from the core technology of ESRI's ArcGIS desktop products and the ArcGIS Survey Analyst extension along with Feature Manipulation Engine (FME) data conversion software from Safe Software. ArcGIS Survey Analyst includes tools that allow professional surveyors and GIS technicians to work together in an integrated system. Surveyors can use ArcGIS Survey Analyst to store and manage survey measurements collected in electronic or paper field books.

2.4.4 Cadastral Reform in Canada

Recently, 'Cadastre 2014' has been used as guidelines and measures for the extent of cadastral reform in Canada. Consequently, it is identified that Canada has no reform at the scale of the complete legal situation of land, including public rights and restrictions. However, there is movement towards integration with national geospatial data infrastructure (CGDI). There are trends of combining land survey and registration systems' business processes and databases. Many provinces in Canada have started the INAC-NRCan Integration project where the Natural Resources Canada (NRCan) work together with Indian and Northern Affairs Canada (INAC) to integrate the survey and registry systems. Common IDs will be used by both organizations. Canada has adopted a national cadastral data model to support coordinated access to national information. However, it is not ready for giving legal status to coordinate. This cadastral model is now in transition to meet the changing needs and demands of society from a sustainable development perspective. The traditional land recording procedures have been fully computerized such as Survey Record Information System (SRIS). In addition, most of the province in Canada has been fully privatised where the government only provide policies and infrastructure.

Private sectors are such as AltaLIS, TeraNet and Service New Brunswick. Canada has a long-term vision to ensure all Canadians benefit from an integrated cadastral infrastructure on Canada Lands, including the offshore. This will facilitate decision-making that will ensure a sustainable economy and contribute to Canada's domination.

2.4.5 Cadastral Reform in Asia Pacific Region

It can be categories to three main groups of countries from the point of view of cadastral development. Firstly, developed countries such as Australia, New Zealand, Singapore, Korea and Japan. These countries a strong economy and basically a wealthy country to afford the system therefore, they possess a very well established cadastral system supporting an efficient land market which ability to use the latest technology and in turn linked to a strong education system for the participants in the cadastral system primarily the government administrators, lawyers and surveyors. Then, the developing countries which can be divided into countries in transition and countries at an early stage of development. Malaysia, Thailand, Indonesia, China falls in the category of newly industrialized countries or in other words, countries which are in transition. These countries have the ability to use latest technologies and good education systems but insufficient graduates to serve market. They have good technician level operators of cadastral system.

However, these countries face major environmental problems in both rural and urban. Vietnam, Laos, Burma and Cambodia are the countries that are at an early stage of development due to the agrarian societies. Cambodia is one of the poorest countries in Asia. The country is lack of land tenure security and restricted access to common property resources. The key factors of the land problems are the inadequate land law, weak governance in provinces and the wholesale privatization of common property forest and wetland.

Furthermore, the country uses outdated information for land use classification and planning. However, in recent years, Suon and Lor (2001) indicate that new Land Law is drafted and national commission have been established to resolve lands conflicts out of court. On March 2000, the sub-decree on the procedure of establishing cadastral index map and land register has been adopted. The German Government has been very supportive to Cambodia for the comprehensive reform developed. Based on the positive experiences by German and Finnish, together they formulate a comprehensive land policy framework and a national program for Systematic Land Registration. Cadastral in Thailand is very different from other countries. There is no private cadastral survey profession in Thailand, as all cadastral surveys being the sole responsibility of the Department of Lands. Thailand has continually re-assessed the performance of its cadastral survey system over the years and where the system has been found wanting, it has been flexible enough to change direction accordingly (Angus-Leppan and Williamson, 2001).

In Taiwan, the ownership of a piece of land is considered to be of paramount importance. Cadastral maps were surveyed and georeferenced in land information system (LIS). A project namely e-Taiwan has been undertaken with the ultimate objective of building a comprehensive Cadastral Information Database. According to Tien (2005), the foremost goal of this project is the creation of computerized cadastral data. Upon successful completion of this project, land authorities and other related governmental agencies can function with enhanced efficiency. One of the specialties of this system is the three dimensional (3D) building management system, which uses the existent cadastral map to produce the 3D building models. The system links the 3D building models to their information, and employs Geographic Information System (GIS) and Virtual Reality Modeling Language (VRML) to depict the 3D image of building. Then, the web surfer can see the 3D virtual world, and simultaneously search the attribute data.

2.5 Cadastral Reform in Malaysia

In Malaysia, cadastral survey is a responsibility of the federal government. However, land is exclusively a state matter. Therefore, although the DSMM is a federal department tasked with the responsibility for carrying out cadastral survey, land alienation and dealings remain a prerogative of the respective state governments (Abdul Majid Mohamed, 1998).

DSMM has experienced the tide of technological advancement for more than a decade due to the advent of computer technology in the field of surveying and mapping. The Department's mission changes from issuing land titles basing on the Torrens System in the early days to providing efficient and high quality land survey and mapping services and geographical information dissemination system suitable for national requirements in recent years. In tandem with the cadastral reforms, DSMM has taken various steps to modernize both its field and office operations. The most significant technological reforms in the field of cadastral surveying are the shift from conventional analog data to digital data and consequently the introduction of the concept of digital database.

This digital database forms the base component for a Land Information Systems (LIS), which plays an important role in national development as it aids the process of decision making in resource management and planning. Besides, cadastral reforms also give significant impact on the legal and organization.

2.5.1 Office Reforms

In 1986, a system to accelerate the processing and draughting of survey work as well as at creating the digital cadastral database (DCDB) was started. Computer Assisted Land Survey System (CALS) has been initiated starting in Johor. CALS was the pioneer computerized land survey system in South East Asia to create a cadastral survey database and to produce base maps both in graphical and digital forms. Its success led to the introduction of the Mini-CALS system for all remaining states in peninsular Malaysia in 1995.

The new Mini-CALS system differ from its pioneer sister in that it incorporates a decentralized "client-server" workstation configuration, boasts of a "seamless" database and hosts a GIS suite of software for future integration with information systems of clientele departments. Also of significance is the fact that the systems were additionally configured to accept direct digital input from electronic total stations. In this regard, observed field data using the said equipment are stored in a memory card in digital form and later downloaded into the system, hence eliminating the need for manual key-in of reduced data that used to be the norm some time back (Abdul Majid Kadir, 2003).

Then, an Image Document Management System (SPID) is introduced. All Certified Plans (CP) have been scanned, indexed and stored in disk arrays located at every State DSMM. However, the CALS database later turned out to become a data source that is in demand by other government departments and private agencies. In addition, it also has become increasingly significant with the widespread proliferation of GIS and the inception of the MACGDI.

Thus, DSMM undertook initiatives to accelerate the populating of the DCDB. In order to make sure that the DCDB to have complete latest information, data capturing work was needed. Due to the department's shortage of manpower, it was contracted-out to the private sector surveying firms. Better DCDB means larger database and the need to process the large volume of out-sourced data submitted. In addition, existing surveyed data in certified plans, primarily in the form of bearings and distances between boundary marks have been keyed into the systems by the employees of DSMM, to complement the task of populating the DCDB. Ancillary to that, DSMM prompted to enhance and upgrade the Mini-CALS to the Cadastral Database Management System (CDMS).

CDMS provides a network for the Department to access the DCDB and the Image Library from any Personal Computer within the network, with a single window and single point access. Apart from that, CDMS expedite the processing of cadastral activities of the department. The system also capable of receiving orders from clients through remote access, email, dial-up and provide automatic invoicing, billing and accounting system.

In 2006, DSMM has introduced JUPEM GeoPortal. This portal is an access point to a collection of spatial data and gathering all types of DSMM data from Cadastral and Mapping Divisions for the purpose of backing up and recovery, as well as for the purpose of public dissemination through the web or the new One-Stop Centre. DSMM is now implementing Prepaid E-Commerce where a customer could register with any state DSMM front counter, deposits some amount of money to enable downloading information through the web. The next step will be the full implementation the use of credit card e-wallet as mode of payment system, and Secure Electronic Transaction (SET) as a method to secure payment over open networks. Data dissemination over the internet would not only make DSMM's products and services known to a wider clientele but would also dramatically increase its revenue.

Besides DSMM, there are quite a number of computerized systems initiated and developed by related departments in Malaysia in order to capitalize on current Technologies as well as to meet the said needs. The land registration component of the cadastre has moved in tandem with the survey component in terms of automating related work processes. The Land Office has introduced Computerised Land Registration System (CLRS) since 1990 to cope with the reformation. MaCGDI (formerly NaLIS) has also been established in 1997 through a directive from the Secretary General of the Government to coordinate and facilitate the collection, production and dissemination of land related data among government agencies through the provision of technological and organizational infrastructure, on a national scale.

Taking “Cadastre 2014” as a reference, Malaysia still lack behind to achieve the second statement that is the abolition of the separation between ‘maps’ and ‘registers. Currently, separate systems are used where cadastral is handled by the DSMM using CDMS, while land registration is done by Land Office through CRLS. This subdivision has often resulted in two different organizational units dealing with the same matter. Efforts had been made to integrate them with a pilot project being initiated in Kuala Lumpur.

In the recent Ninth Malaysia Plan (RM9), DSMM introduces eKadaster, which includes three main projects: Virtual Survey System (SUM), Digital Cadastral Integrity System (SKDK) and Coordinated Cadastral System (CCS). SUM will introduce a whole new method of cadastral survey using modern GPS equipment and techniques namely Real Time Kinematic (RTK). Survey data will be transmitted to the office and processed online. However, Malaysia is still far behind for the implementation compared to many developed countries such as Japan, Australia who have already implemented RTK techniques in cadastre. Figure 2.2 depicts the concept of SUM.

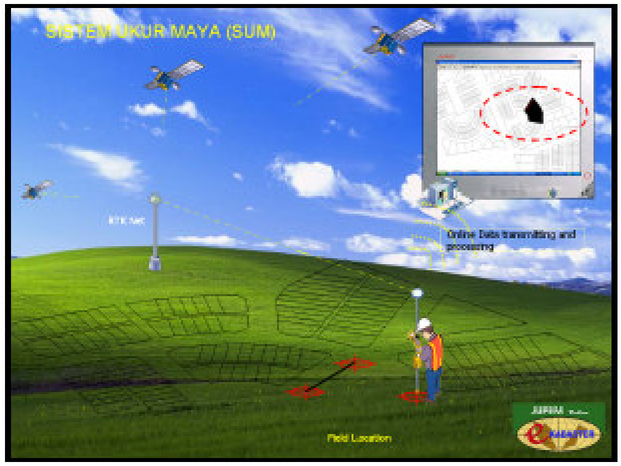


Figure 2.2: Virtual Survey System (DSMM, 2005)

The SKDK project will involve the replacement of CDMS current infrastructure, upgrade Local Area Network (LAN) to broadband, upgrade of the Quality Assurance System (SPEK) as well as the development of 3D strata, stratum and marine database system. The system will be developed to support SUM, which allows surveyed data from the field to be transmitted to state office using near real time verification system.

Coordinated Cadastral System (CCS) is one of the modern elements. Upon completion of a joint study with the Universiti Teknologi Malaysia to determine the feasibility of CCS for the country, the project is in the progress of preparing a basic dataset of CCS. Currently, DSMM has outsourced the CCS data collection to LLS to ensure faster implementation of CCS. Thus, by the end of RM9, the country will be expecting a basic dataset of CCS adjusted with respect to Geocentric Datum of Malaysia (GDM2000) that enriches and develops an effective GIS for Malaysia.

2.5.2 Field Reforms

It is inevitable that equipment used changes to suit with the technological change introduced in the office. The equipment changes from vernier and optical theodolites to digital and total station. Due to rapid technological advancement in computerization and automation, Field-to-Finish (F2F) concept was practiced. The concept started with removable RAM-Cards, palm top, DCPS program to the current Title Survey Module (TSM), Tablet PC, PDA and GPS Card.

Research had been done Wan Aziz et al. (2002) indicating that the GPS modern techniques such as Stop & Go, Rapid Static and Real Time Kinematic could efficiently increase productivity, reduce costs as well as producing results compatible with the conventional Total Station techniques and this technology can well accommodate the characteristic of cadastral survey.

2.5.2.1 Before The 70's

During early 1920 until the 70's, mechanical survey instruments such as vernier theodolite was utilized to measure bearing and vertical angle. It was then being substituted by the optical theodolite with direct reading microscope, which made readings of both angles so much easier compared to vernier reading with magnifying glasses. Both instruments require steel chains for distance measurement and all collected data were recorded manually to field books. Surveyed data was then calculated using mechanical calculators namely 'Brund Viga', 'Curta' together with trigonometry cipher books such as 'Short Ridge', 'Bruns' and 'Chambers'. Then, in the late 70's, Arithmatic calculator is used. All calculations were then recorded in Calculation Volume (CV). The last output would be the hand-drawn Certified Plan (CP). Cadastral survey workflows before 70's are shown in Figures 2.3 and 2.4 below.

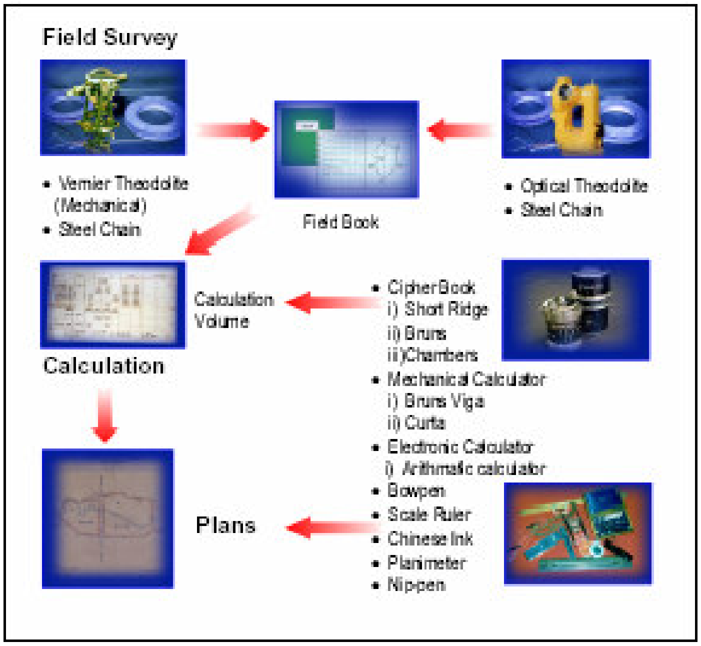


Figure 2.3: Cadastral survey process before 70's. (DSMM, 2005)

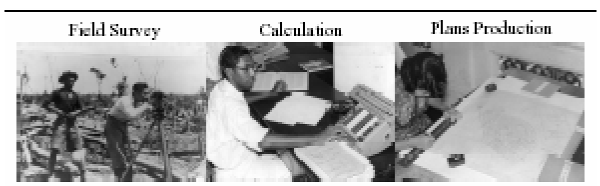


Figure 2.4: Three stages for cadastral survey workflow before 70's

2.5.2.2 During The 80's

The DSMM's modernization programme began in the early 1980's. Electronic Distance Measurement (EDM) was introduced eliminating the usage of steel chains and expecting better accuracy for distance measurement. The trends kept going on until the introduction of Total Stations in the late 80's. Although the instrument possessed elements of automation, surveyors still recorded their data to field books manually due to unfamiliarity. Yet, programmable electronic calculator was used for calculations without the reference of cipher book. CALS in 1985 was the first step towards computerization. Through CALS, digital Calculation Volume (CV) and Certified Plans (CP) were produced and stored in a database. Figure 2.5 depicts the survey process during 80's.

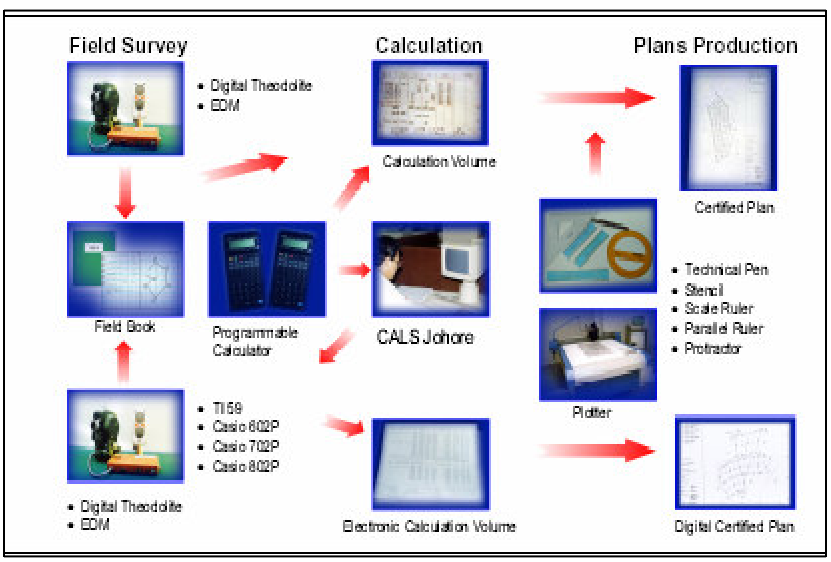


Figure 2.5: Cadastral survey process during 80's. (DSMM, 2005)

2.5.2.3 During The 90's

In 1995, Total Stations were used in all District Survey Offices as well as private survey firm. The survey instruments came with on-board memory, removable RAM/Data Cards and cadastral on-board software. The integration of Total Station GTS 6A with RAM Card and DCPS 16 (Version 1) software was the first attempt for "field-to-finish" concept during late 1998 to 1999. The on-board software was programmed for cadastral title survey, solar observation computation and refixation.

In tandem with District Survey Office Automation System (SAPD), another configuration was introduced. DCPS16 was substituted by DCPS32 due to incompatibility with the new system. RAM Card was then realized to have deficiencies with insufficient storage for crucial cadastral project, on-board 'C' and 'M' correction. Consequently, it was replaced by Palmtop such as Jornada 545 and HP 2001x. It is a small general-purpose, programmable, battery-powered computer capable of handling both numbers and text, which can be operated comfortably while held in one hand. Although all data was recorded in memory card, field books were still needed as backup.

The F2F concept has reformed concurrently with the technological enhancement. Many approaches have been done to fully actualize its F2F concept. The most recent one is the integration of surveying Total Survey Module (TSM), Tablet PC or Personnel Digital Assistant (PDA) and GPS Card for reconnaissance and coordinates assumption. While, Bluetooth enables wireless connection which eliminates cable running between Field Communicator and Total Station. The original field book has evolved to electronic field book. Insufficient storage is no longer a problem for the new integration.

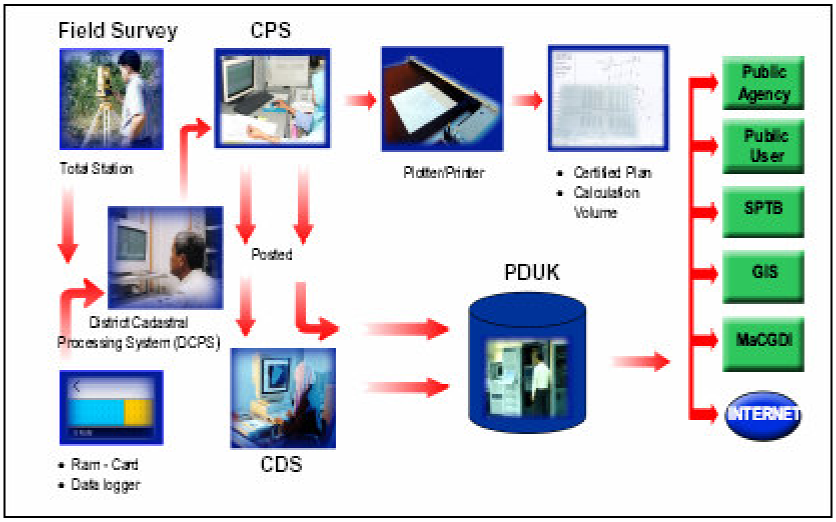


Figure 2.6: Cadastral survey process using earlier version of F2F during 90's. (DSMM, 2005)

CHAPTER 3

DIGITAL CADASTRAL DATABASE (DCDB)

3.1 Introduction

The DCDB is a spatial representation of the legal land parcel boundaries within South Australia. It comprises approximately 920,000 land parcels, together with their legal identifiers. The DCDB was created to rationalize map based record maintenance within government and provide a single source of up-to-date mapping.

The DCDB also provides a common and spatially consistent boundary framework for client use that promotes consistency among dependent data sets; thus facilitating improved data integration and analysis across government. The DCDB is the fundamental reference layer for spatial information systems in South Australia (Williamson, 1997).

A complete Digital Cadastral Database (DCDB) that would depict all land parcels in its cadastral fabric, including all privately owned, leased and State lands, roads, rivers and reserves. The DCDB would be a key component of the nation's spatial data infrastructure and provide one of the core spatial data sets, which would be able to be integrated with other spatial data sets. The DCDB would provide the legal definition of land parcels, and the boundary coordinates that it maintains would serve as contributory evidence to that effect. Each parcel would have a unique identifier that links the parcel on the cadastral map to the land register, apart from enabling cross-referencing to other information needed by. The DCDB is to be based on coordinates determined by ground survey. The storage of data in the DCDB would be in an appropriate form that will allow for easy creation and updating as well as the flexibility of the use of information, including for the creation of mapped products (Ahmad Fauzi, 2001).

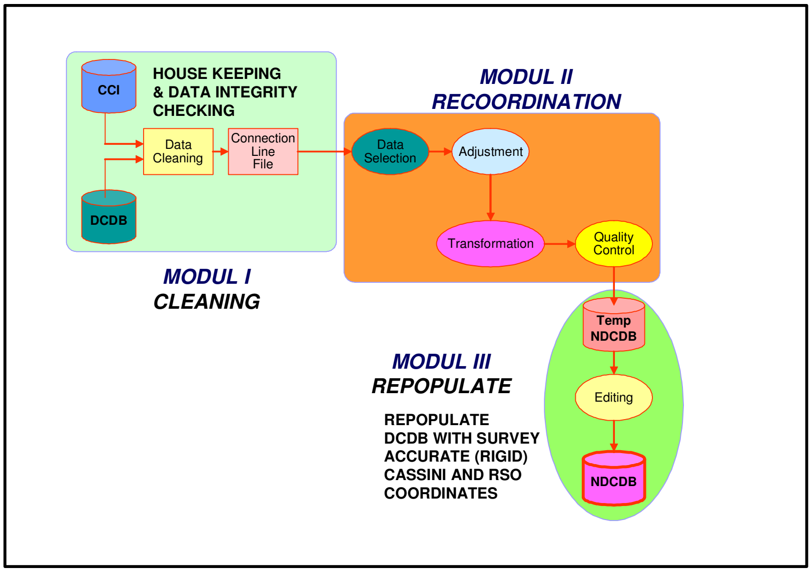


Figure 3.1: Flowchart of NDCDB Development

Figure 3.1 shows the conceptual model for National Digital Cadastral Database that based on the survey accurate database. Defining a database involves specifying the data types, structures and constraints for the data to be stored in the database. Constructing the database is the process of storing the data itself on some storage medium that is controlled by the DBMS. Manipulating a database includes such functions as querying the database to retrieve specific data, updating the database to reflect changes in the mini-world, and generating reports from the data. The advantages that can be identified can be summarized as follows:

i) Centralized Control

A single Database Management System (DBMS) or GIS under control of one person or group can ensure that data quality standards are maintained, security restrictions are enforced, conflicting requirements are balanced, and the integrity of the data base is maintained.

ii) Data can be shared efficiently

Using a DBMS, the information in a database can be shared in a flexible manner. Also facilitate the development of new applications of the existing database.

iii) Data Independent

Application programs are independent of the physical form in which the data are stored.

iv) Easy implementations of new data base applications.

v) Redundancy can be controlled

A DBMS can be used to monitor and reduce the level of redundancy and multiple copies of data are retained.

vi) User views

A GIS/DBMS can provide a convenient user interface to create and maintain multiple user views.

3.2 Digital Cadastral Database (DCDB)

Information Technology (IT) has revolutionized our life. One of its impact is the shifting from conventional analogue data to digital data and consequently introducing the concept of digital database, which form the basic component for a Land Information Systems (LIS). This database plays an important roles for resource management and planning.

The DSMM modernisation programme began in the early 1980's. After a successful pilot project in computerizing its cadastral operation in the state of Johor, the initial phase of computerisation exercise was completed in 1995 with the Nationwide implementation of the Computer Assisted Land Survey (CALS) system. The CALS system not only enables electronic processing of cadastral surveys but also introduced the concept of a Digital Cadastral Data Base (DCDB). Eventually, the enhancement process was carried out with the upgrading of the Mini-CALS to the Cadastral Database Management System (CDMS).

The CDMS was established for Quality Assurance of the outsourced data and optimising the performance of the entire system. Apart from that, it was also designed for enhancing the efficiency of the information dissemination mechanism. In short, the main elements of the said system as an addition to the existing Mini-CALS and CALS (of Johor and Pahang) could be summarised as follows:

(a) Quality Assurance System (QAS) that checks and validate submitted outsourced data, before being posted to the DCDB.
(b) Document Image Management System (DIMS) that creates and manages the library of scanned images of certified plans. This will consequently allow for the supply of CPs in digital form to be made to users.
(c) Counter Service System (CSS), which uses state-of-the-art Information Technology for efficient dissemination of digital spatial data to end-users.

Being the government agency organization responsible for cadastral survey activities in the country, DSMM has undertaken the initiative to create and maintain the National DCDB (NDCDB) as well as the dissemination of digital spatial information to the end users. With the widespread proliferation of Geographic Information Systems (GIS) and the recently launched National Infrastructure for Land Information System (NaLIS), the database that forms the basic building block of a GIS is becoming increasingly significant. It was estimated that about 5.5 million cadastral lots need to be converted into digital form for the creation of the future NDCDB for the whole Peninsular Malaysia.

3.2.1 DCDB Data Structure Overview

Overview of the DCDB data model are based on model developed by DSMM. We will explain how the DCDB was created in the GIS and DBMS environment. A data model is a formal definition of the data required in a GIS. The data model can take one of several forms namely, a structured list and an entity-relationship diagram. The purpose of the data model, and the process of specifying the model are to ensure that the data has been identified and described in a completely rigorous and unambiguous fashion. The data model will allow the formal specification for the entities, their attributes and all relationships between the entities for the GIS. There are four steps involved in the database development which are external assessment, conceptual modeling, logical design, and physical database.

DSMM has undertaken the initiative to create and maintain the national DCDB as well as the dissemination of digital spatial information to the end-users. Due to the shortage of manpower the Department has planned to contracting-out the data capture process to populate its DCDB. DSMM has standardized the out-source format for data capture process to populate its DCDB. Table 3.1 and Table 3.2 show the standard Malaysian digital out-source format that need to be followed by the contractor or License Surveyor firms. The out-sourced datasets act as an input data in the Cadastral Data Management System (CDMS). CDMS will function as "mechanism" used to populate the DCDB and will provides a window as a single point of access from any PC within the network, to information in any of the database.

Table 3.1 : DCDB Out-Source Format

	File 1		File 2		File 3	
	Lot		**Lot Boundary**		**Footnotes**	
	Field Desc.	Char	Field Desc.	Char	Field Desc.	Char
1	UPI	16	UPI	16	Cert. Plan No.	12
2	Centroid X Coord	12	From Mark Desc.	13	Name of Approver	35
3	Centroid Y Coord	12	From Stone No.	10	Name of Surveyor	35
4	Area	16	From X Coord	12	Survey File No.	18
5	Unit for Area	3	From Y Coord	12	Land Office File No.	18
6			From Coord Type	1	Survey Completed	10
7			Bearing	9	Data Approved	10
8			Distance	10	Standard Sheet No.	20
9			Unit For Distance	3		
10			To Mark Desc.	13		
11			To Stone No.	10		
12			To X Coord	12		
13			To Y Coord	12		
14			To Coord Type	1		
15			Class of Survey	1		
16			Survey Line Code	2		
17			Survey Value Code	2		
18			Cert. Plan No.	12		
19			Remark	12		
File Name	**JOBREF.LOT**		**JOBREF.BDY**		**JOBREF.NOT**	

Table 3.2 : Out-Source ASCII file

JOBREF.LOT

14020100011256	27225.2	15401.5	1072	M
14020100011257	27225.6	15453.3	771	M
1	17	29	41	57

JOBREF.BDY

14020100011256	BKB		27222.4	15401.5	P	86.2750	45.422	M	BKB		27225.2	15446.8	P	1	1	1	112265	0
14020100011256	BKB		27225.2	15446.8	P	164.2630	35.76	M	BKB		27190.7	15456.4	P	1	1	1	112265	0
14020100011256	BKB		27190.7	15456.4	P	247.2930	29.111	M	BKB		27179.6	15429.5	P	1	1	1	112265	0
14020100011256	BKB		27179.6	15429.5	P	326.4600	45.123	M	BKB		27217.3	15404.8	P	1	1	1	112265	0
14020100011256	BKB		27217.3	15404.8	P	326.5040	6.039	M	BKB		27222.4	15401.5	P	1	1	1	112265	0
14020100011257	BKB		27225.6	15453.3	P	96.2450	112.367	M	BKB	12/676	27227.3	15480.1	P	1	1	1	112265	0
14020100011257	BKB	12/676	27227.3	15480.1	P	96.2450	112.367	M	BKB		27204.7	15490.0	P	1	1	1	112265	0
14020100011257	BKB		27204.7	15490.0	P	96.2450	112.367	M	BKB		27204.7	15490.0	P	1	1	1	112265	0
14020100011257	BKB		27193.1	15462.1	P	96.2450	112.367	M	BKB		27225.6	15453.3	P	1	1	1	112265	0
1	17	30	40	52	64	65	74	83	87	100	110	122	134	135	136	138	110	152

JOBREF.NOT

11265	LEE BONG PEE	ZAINAL BIN AZIZ	PUPGH 123/1989	PTK 211/45/88	18/09/1988	19/12/1989	536 B
1	13	48	83	101	119	129	139

DCDB has utilized the relational data base approach for its development. DCDB consists of three main different files or layers which have been presented by three entities such as cadastral lot, boundary mark and boundary stone. All entities are represented by unique spatial object for geographic representation for example polygon for cadastral lot, point for cadastral mark and polyline is used for boundary mark. The design process of DCDB and CCDB consists of five phases as shown in Figure 3.2.

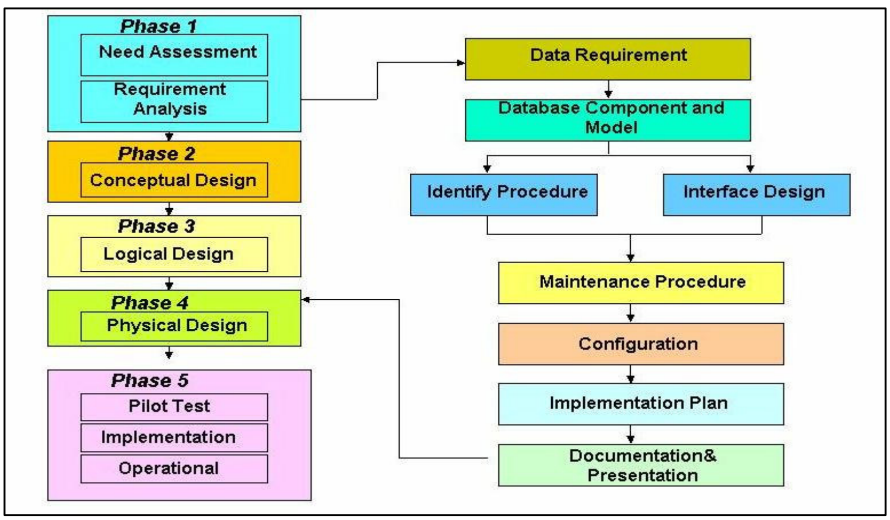


Figure 3.2: The Design Process of DCDB

DCDB conceptual model shown in Table 3.3 is used to identify data content and to describe data at an abstract, or conceptual level.

Table 3.3 : DCDB Master Data List

ENTITY	ATTRIBUTES	SPATIAL OBJECT
Boundary Mark	Pointkey, Apdate, Mark_desc, Serial, Coord_type, R_east, R_north, S_comment, Status, GID	Point
Boundary Line	Apdate, Parcel_key, Bearing, Distance, Units, Class, Line_code, Line_type, Entry_mode, PA, Fnode,Tnode, AdjParcel, Status, GID	Polyline
Cadastral Lot	Negeri, Daerah, Mukim, Seksyen, Lot, Svy_area, Area_unit, Apdate, Status,Lock_ID, GID	Polygon

Spatial relationship (entity-relationship/ E-R) between entities in the DCDB is an explicit recognition of user defined objects, zero or more associated spatial objects and sets of attributes for each defined object. The process of building the E-R diagram involves taking entities from the master data list one at a time and placing each one on the diagram (Figure 3.3) (Abdullah Hisam, 2004). For each new entity, any relationship to any previously entered entity should be entered. Relationships are found by examining the application requirement and determine if the DCDB require a specified operation. The DCDB E-R diagram shown in the Table 3.3 will be used to verify the data content. Once verified by the users, the E-R representation can be mapped into a detailed database design.

Logical database design means translation of the conceptual database model into the data model of a specific software system. A logical data model is an abstraction of the objects that we encounter in a particular DBMS application. This abstraction is converted into database elements. These are the basic elements of the logical data model and their corresponding database elements. Table 3.4 shows the basic elements of the logical data model while Table 3.5 shows the logical schema for existing DCDB (using logical concept shown in Table 3.5).

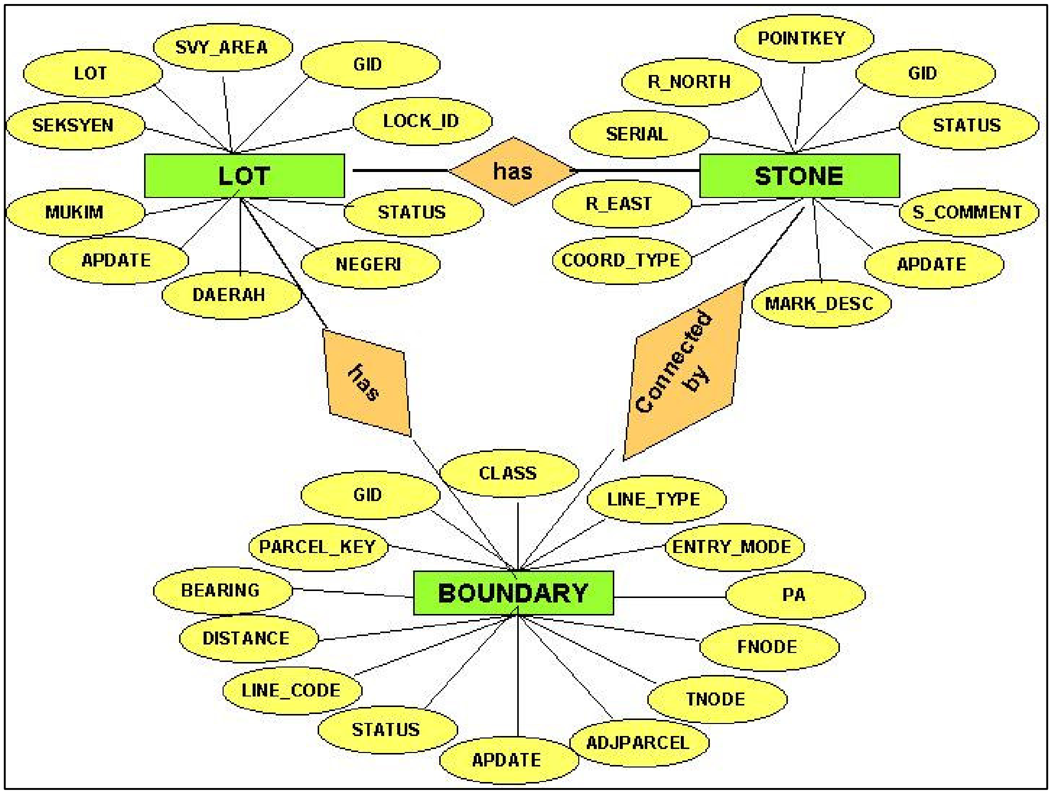


Figure 3.3: The Process of Building The E-R Diagram (Abdullah Hisam, 2004)

Table 3.4: Basic elements of the Logical Data Model

Logical elements	Database elements
Object	Row
Attribute	Column, Field
Class	Table

Table 3.5: Logical Scheme For DCDB

Boundary Line

Apdate	Parcelkey	Bearing	Distance	Units	Class	Line_code	Line_type	Entry_mode	Plan	Fnode
19710323	0402180003234	314.5730	776.100	L	2	0	1	1	PA20030	71PA20030
19710323	0402180003234	4.4930	685.400	L	2	0	1	1	PA20030	72PA20030

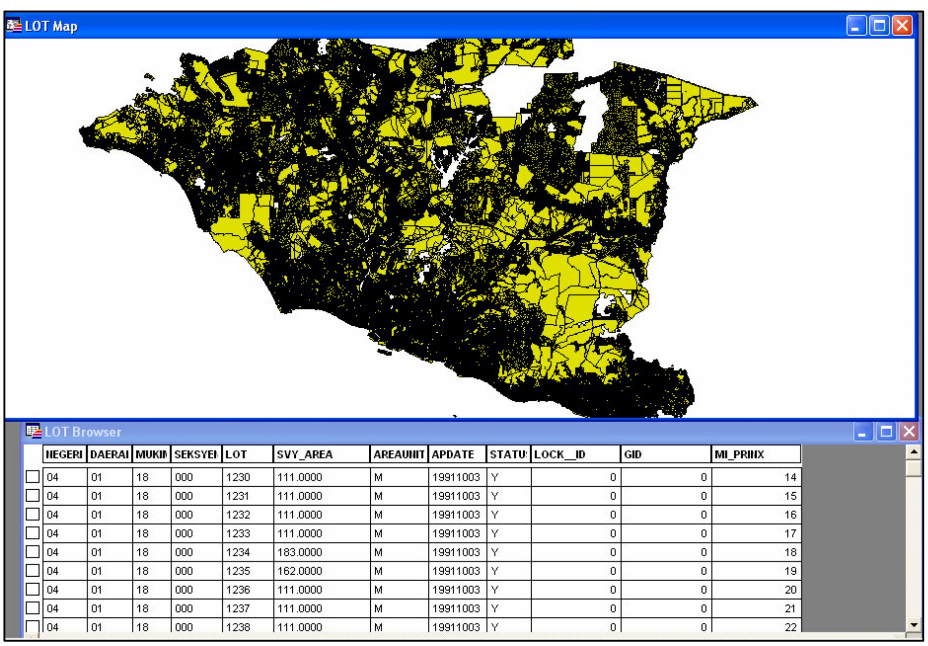
Cadastral Lot

Negeri	Daerah	Mukim	Seksyen	Lot	Svy_area	Areaunit	Apdate	Status	Lock_id	Gid
04	02	18	000	3889	960	M	19900618	Y	0	186844
04	02	18	000	3890	2.407	H	19900618	Y	0	186845

Boundary Mark

Pointkey	Apdate	Mark_desc	Serial	Coord_type	R_east	R_north	S_comment
21811234	19650408	B.K.B		P	0.0000	0.0000	
11811234	19650408	B.K.B		P	318161.100	-329867.30	

Database implementation can be carried out after logical scheme was built. The process of physical database design is to represent the logical data model in the schema of the software. Example of the physical DCDB is shown in Figure 3.4. This example is based on the ArcInfo software used for DCDB management in the several states in Peninsular Malaysia.



NEGERI	DAERAI	MUKIM	SEKSYEI	LOT	SVY_AREA	AREAUNIT	APDATE	STATU	LOCK__ID	GID	MI_PRINX
04	01	18	000	1230	111.0000	M	19911003	Y	0	0	14
04	01	18	000	1231	111.0000	M	19911003	Y	0	0	15
04	01	18	000	1232	111.0000	M	19911003	Y	0	0	16
04	01	18	000	1233	111.0000	M	19911003	Y	0	0	17
04	01	18	000	1234	183.0000	M	19911003	Y	0	0	18
04	01	18	000	1235	162.0000	M	19911003	Y	0	0	19
04	01	18	000	1236	111.0000	M	19911003	Y	0	0	20
04	01	18	000	1237	111.0000	M	19911003	Y	0	0	21
04	01	18	000	1238	111.0000	M	19911003	Y	0	0	22

Figure 3.4: Example of Physical Database Model for DCDB

CHAPTER 4

DEVELOPMENT OF AUTOMATED CADASTRAL DATABASE SELECTION AND VISUALIZATION SYSTEM

4.1 Introduction

Research area has been identified in this research which covering state of Melaka as shown in Figure 4.1. About 90% of the total lots are located in rural and semi urban areas and traditionally used for agricultural purposes, while in some areas the lots are used for residential purposes. The area of the lots varies from few hundreds square meters to more than tens of hectares.

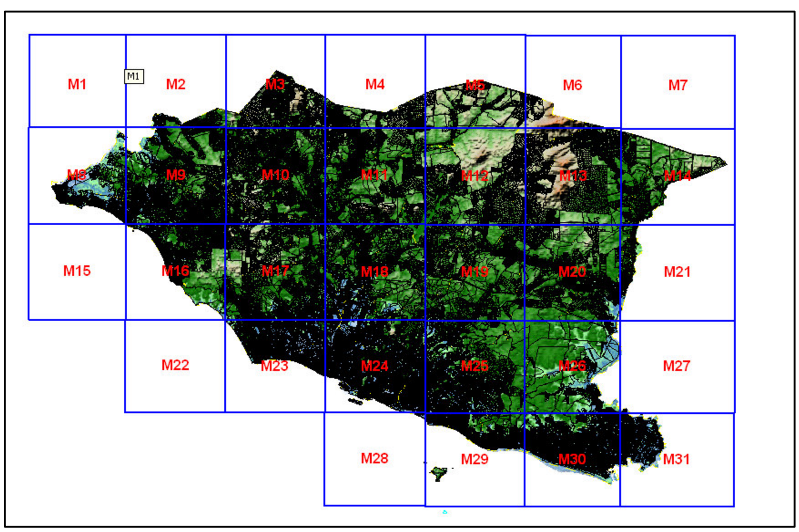


Figure 4.1 : Research Area Melaka

4.2 Database Selection and Visualization Design

The designing of this database its using an integrated approach between ArcView, Map Object and Visual Basic software.

4.2.1 ArcView

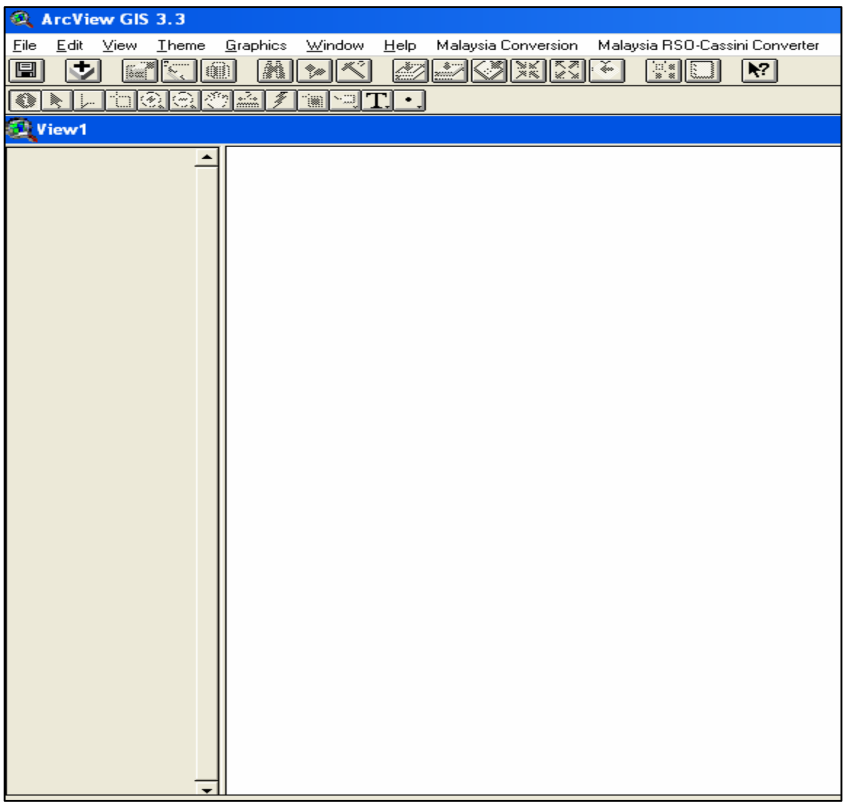


Figure 4.2 : The ArcView Screen

ArcView is a desktop mapping program that makes it easy to: display GIS data, create maps, query GIS data, analyze GIS data and more (Figure 4.2). The analytical techniques of ArcView are:

i. Display map information.
ii. Visually overlay map layers.
iii. Identify features on a map.
iv. Load new information into ArcView.
v. Create maps based on your data classifications.
vi. Analyze spatial data.
vii. Understand the tables that are the databases for ArcView.
viii. Create charts to help interpret spatial data.
ix. Create new variables from existing data.
x. Print your maps.

A few ArcView terms (Figure 4.2 –Figure 4.6) :-

i) Project:

A project is the file in which ArcView stores your work. You can keep all related work in a single project, including tables, charts, spatial views of your data, map layouts, etc. A project is saved with an .apr file extension. Thus, the file "xxx.apr" would have all material, such as maps and tables, related to that project. When you open that project file again, all its component parts will be just as you left them, ready to use again. Each project has a window.

ii) Project Window:

The project window is the smaller window on the left of the initial ArcView window. When you first open ArcView, the title of the Project window is "Untitled." After you save a project, this window contains the project file's name (with an .apr extension). It lists all the components of the project, organized by type (Views, Tables, Charts, etc.). You use this window to add new components to a project or to open existing ones.

iii) View:

A view is the interactive map that you use to display, query, and analyze data in ArcView. Several map layers called THEMES are normally displayed in a single view. You can have more than one view in a project (The name of each View will be listed in the Project Window).

iv) Theme:

"Theme" is the term used for a map layer in ArcView containing both spatial and attribute data (the latter are in database tables, which you do not see at first). A Theme is a file containing graphic information required to draw a set of geographic features together with information about those features. Themes are listed on the left side of the view window in the Table of Contents along with their legends that represent them on the map. Examples of themes are streets, buildings, cities, rivers, countries, railroads, etc. Themes can cover geographic phenomena at any scale, from small gardens to the entire world.

v) Table:

A Table is a data file that contains rows of information about items in a particular geographic category (such as hotels, cities, streets, counties, countries, etc.), with each row representing a different named item (ie, for states, one row could represent Virginia, another Alabama, etc.). Tables also have numerous columns, with each column representing a particular attribute (variable); for example, one column might represent income, another population size, etc.

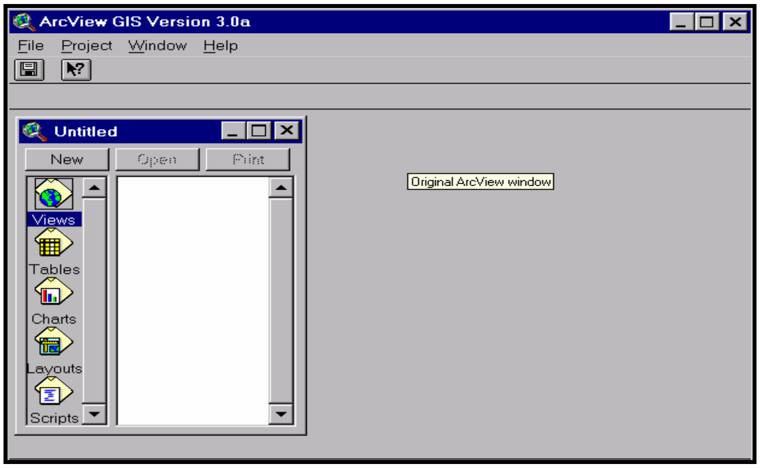


Figure 4.3 : ArcView Starts With An Empty Window.

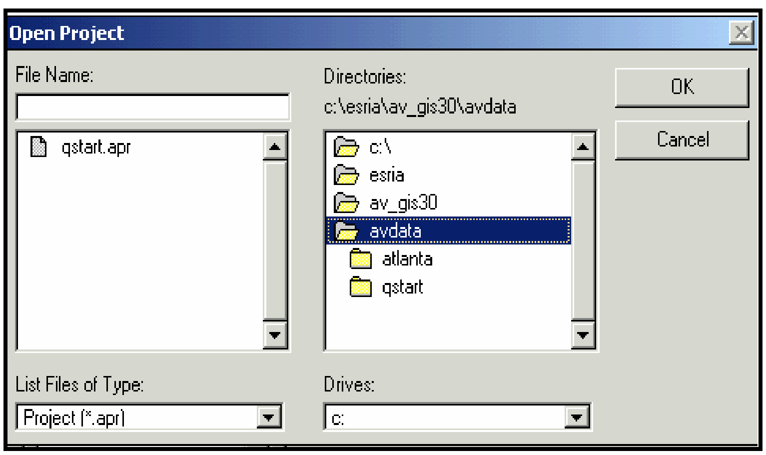


Figure 4.4 : Open Project Dialog Box

Figure 4.5 : The Title Project (qstart.apr) Appear In The 'Project Window'.

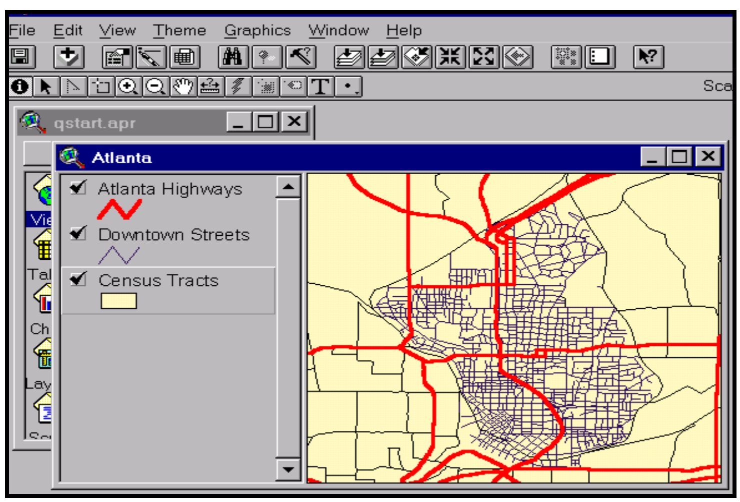


Figure 4.6 : View of Project With Interactive Map And Various Features (Themes)

Table 4.1 : Arc View Control Keys

Tables	**View**
• Ctrl+S Save Project • Ctrl+P Show Symbol Window • Ctrl+X Cut Selected Cell to Clipboard • Ctrl+C Copy Selected Cell to Clipboard • Ctrl+V Pastes Contents of Clipboard • Ctrl+Z Undo Last Edit on Table • Ctrl+Y Redo Last Edit on Table • Ctrl+A Add New Record to Table • Ctrl+F Find Row in Table using Text String • Ctrl+Q Displays Query Builder Dialogue Box • Ctrl+J Joins Two Tables	• Ctrl+S Save Project • Ctrl+Z Undo Graphics Edit • Ctrl+Y Redo Graphics Edit • Ctrl+X Cut Selected Graphics to Clipboard • Ctrl+C Copy Selected Graphics to Clipboard • Delete Delete Selected Graphics • Ctrl+V Paste Contents of Clipboard • Ctrl+P Show Symbol Window • Ctrl+T Add Theme • Ctrl+F Find Feature using Text String • Ctrl+A Align Selected Graphics • Ctrl+G Groups Selected Graphics • Ctrl+U Un-groups Selected Graphics • Ctrl+Q Displays Query Builder Dialogue Box • Ctrl+L Auto Label
Project	**Charts**
• Ctrl+N Creates New Project • Ctrl+S Save Project • Ctrl+R Rename Project • Delete Delete Selected Document • Ctrl+P Show Symbol Window	• Ctrl+S Save Project • Ctrl+P Show Symbol Window • Ctrl+F Find Row in Table using Text String

Layout	Scripts
• Ctrl+S Save Project • Ctrl+P Show Symbol Window • Ctrl+Z Undo Last Edit • Ctrl+X Cut Selected Graphics to Clipboard • Ctrl+C Copy Selected Graphics to Clipboard • Delete Delete Selected Graphics • Ctrl+V Paste Contents of Clipboard • Ctrl+A Align Selected Graphics • Ctrl+G Group Selected Graphics • Ctrl+U Un-group Selected Graphics	• Ctrl+S Save Project • Ctrl+P Show Symbol Window • Ctrl+Z Undo Last Change to Script • F3 Finds Next Occurrence of the String • Ctrl+X Cut Selection to Clipboard • Ctrl+C Copy Selected to Clipboard • Ctrl+V Pastes Contents of Clipboard • Ctrl+U Deletes Text from Cursor to Left Margin • F8 Step Through the Compiled Script one Request at a Time • F5 Run Script • Ctrl+E Examine Variable Values

An ArcView Project is simply a file that stores all of the information you work with in one location (i.e., the Project file). In this file, you will be working with GIS data, the components of ArcView (Views, Tables, Layouts, Charts), and Images and Graphics. An ArcView Project file has an .APR extension. When you save your ArcView Project, the .APR extension will automatically be placed at the end of your file name.

4.2.2 Map Object

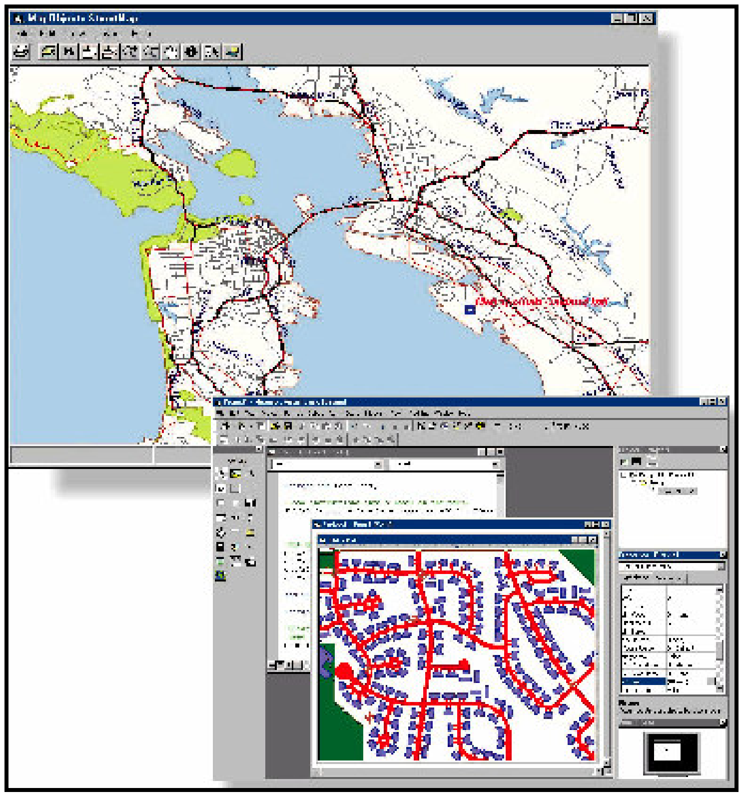


Figure 4.7 : The MapObject Screen

MapObjects software (Figure 4.7) provides application tools that have dynamic, interactive maps and Geographic Information System (GIS) capabilities. MapObject gives developers a powerful collection of mapping components that can be plugged into many standard development enviroment. With nearly 50 ActiveX® automation objects, MapObject provides developers with all the tools they need to build customize mapping ang GIS application.

Key features of MapObjects include the following :

i) Extensive Data Support MapObjects supports a wide variety of data sources such as:-

- Standard GIS formats - ArcInfo ™ coverages, ESRI ® shapefiles, and ESRI GRID.
- Computer-aided design (CAD) formats (DGN, DXF, and DWG), CAD world files, and AutoCAD ® 2000 DWG files.
- Access to external databases through ActiveX Data Objects (ADO), Data Access Objects (DAO), and Open Database Connectivity (ODBC)
- Image catalogs as well as a variety of image formats such as GeoTIFF, TIFF, JPEG, GIF, ERDAS ®,and MrSID ™
- ESRI 's ArcView ® StreetMap ™ for geocoding
- ArcSDE ™ (ESRI 's spatial database engine) databases
- Common military formats such as Vector Product Format (VPF) and ASRP/USRP

ii) Advanced Data Handling

MapObjects provides powerful spatial and attribute filters to optimize performance. As an option, developers can access the ArcSDE application programming interface (API) directly from MapObjects applicationsn. MapObjects also supports image transparency, display, and output, as well as the rotation of both vector and raster data layers.

iii) On-the-Fly Projection

MapObjects users can quickly combine data from any projection into a common projection for viewing and analysis. In addition, any map layer can be exported into a new projection. To optimize your ability to create a wide variety of projections in a minimal amount of time, MapObjects is now integrated with ESRI 's ArcInfo projection engine.

iv) Sophisticated Geocoding Capabilities

MapObjects lets you do quick and accurate address matching including international addresses and reject processing. With StreetMap support, you can read, display, and geocode a street address from the highly compressed StreetMap database. StreetMap files cover the entire United States and include features such as
local landmarks, streets, parks, and water bodies.

v) Global Positioning System Management

MapObjects supports dynamic tracking for points, lines, polygons, rectangles, and ellipses, making it easy to manage global positioning system (GPS) activities.

vi) Run-Time Deployment Utility

Once you have successfully built your application, deployment becomes the critical factor. The MapObjects run-time deployment utility helps you to distribute your applications easily and efficiently.

vii) Versioning capabilities

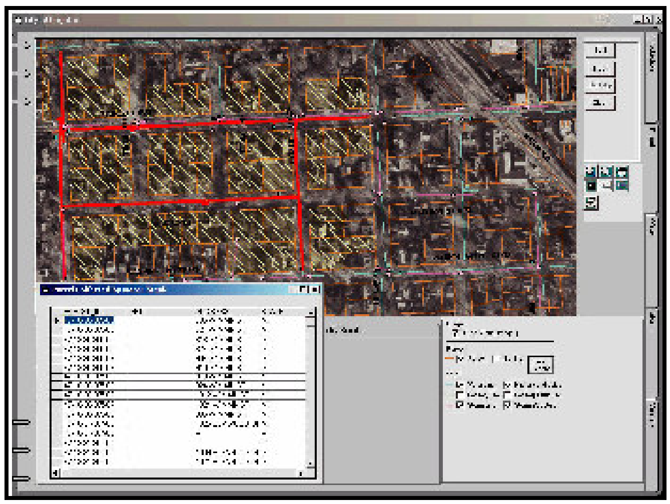
MapObjects supports versioning for ArcSDE layers; it can connect to any ArcSDE version and allow you to view it. In addition,you can identify and select versions based on version names.

viii) Helpful Controls

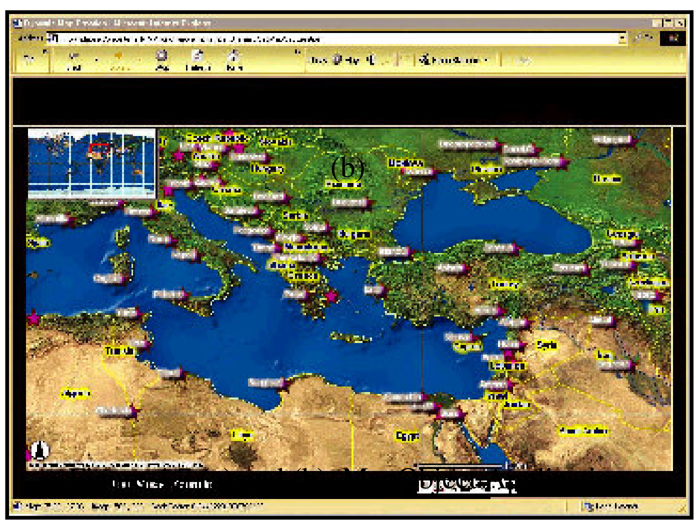
MapObjects offers a legend and scale bar control, including source code,designed to make it easier for you to develop your applications. These are based on the same controls that are used in ArcExplorer ™ software, ESRI 's GIS data browser distributed free of charge.

ix) Build Web-Based Mapping and GIS Applications

MapObjects (Figure 4.7 (a) and (b)) has built-in compatibility with ESRI 's ArcIMS ® Web connectiv-ity middleware. This means you can use MapObjects to put dynamic,cus-tomizable maps on the Internet via the ArcIMS technology. Me/NT 4.0/2000.



(a)



(b)

x) Add Mapping Components to User Software Development Tools

MapObjects is built on the Microsoft ActiveX architecture, which allows robust software integration in desktop computing. The MapObjects ActiveX control can be plugged into a wide variety of development frameworks including Visual Basic, Visual Basic for Applications (VBA),Visual C++®,Delphi ®,Borland ® C++Builder,VisualFoxPro ®,and PowerBuilder ®.

xi) System Requirements

MapObjects can be used with any development environment that supports custom controls. It requires a 32-bit Intel ®-based Windows ® operating system such as Windows 95/98/Me/NT 4.0/2000

xii) Plenty of Resources to Help User Get Started Quickly

MapObjects includes a large collection of sample applications and source code that enable you to begin building applications immediately. MapObjects software 's robust online help includes many examples that you can cut and paste directly into your applications. MapObjects also comes with excellent printed references including *Building Applications with MapObjects,Getting Started with MapObjects,*and *MapObjects Programmer 's Reference.*Also,ESRI 's Developer Connection pages at www.esri.com/ devconnection offer the most up-to-date resources for technical topics,downloads,samples,and online discussions. MapObjects also includes in-the-box *ESRI Data &Maps,* a multivolume CD –ROM collection that contains more than 4 GB of ready-to-use data. This valuable resource consists of data for the entire world as well as detailed data for the United States.

4.2.3 Visual Basic

Visual Basic (Figure 4.8) is a highly popular language in the commercial world because it allows for the rapid development of Windows based programs. VB is particularly strong at creating front ends for databases. This can be done in amazing time through the use of wizards.

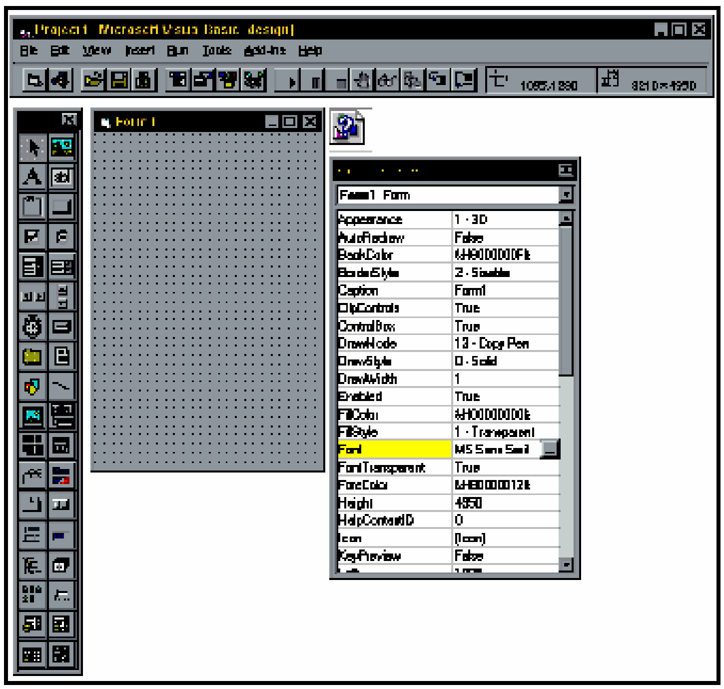


Figure 4.8 : The Visual Basic Screen

This page does not cover all aspects of VB, it does not show how to do the basics like layout a form, neither does it cover all the built in functions, as there is already plenty of help provided for these, and a lot of it is self-evident. A more limited version of Visual Basic is also included in several other Microsoft Applications such as MS Access. Most of the information here applies to that version. There is also VB Script for creating web pages. Much of the information on this page applies, but VB Script only has one basic data type - the Variant type.

Visual Basic is an object-oriented programming language that uses the Microsoft Windows platform. The programs that are created using Visual Basic will look and act like standard Windows programs. Visual Basic provides one the tools to create windows with elements such as menus, text boxes, command buttons, option buttons, list boxes and scroll bars.

i) Procedural vs. Non-Procedural Languages

a) Procedural Languages

Programming languages that have a set plan that follow to execute a program. A series of statements that execute starting with the first statement. The statements are executed in order from beginning to end. The program terminates after the last statement is executed. Examples of Procedural Languages are FORTRAN, COBOL, BASIC, C and PASCAL

b) Non-Procedural Languages

Object-Oriented programming languages that are Event-driven. Only the code for that event is executed (Figure 4.9) . Examples of Procedural Languages are Visual Basic, C++, DELPHI and JAVA.

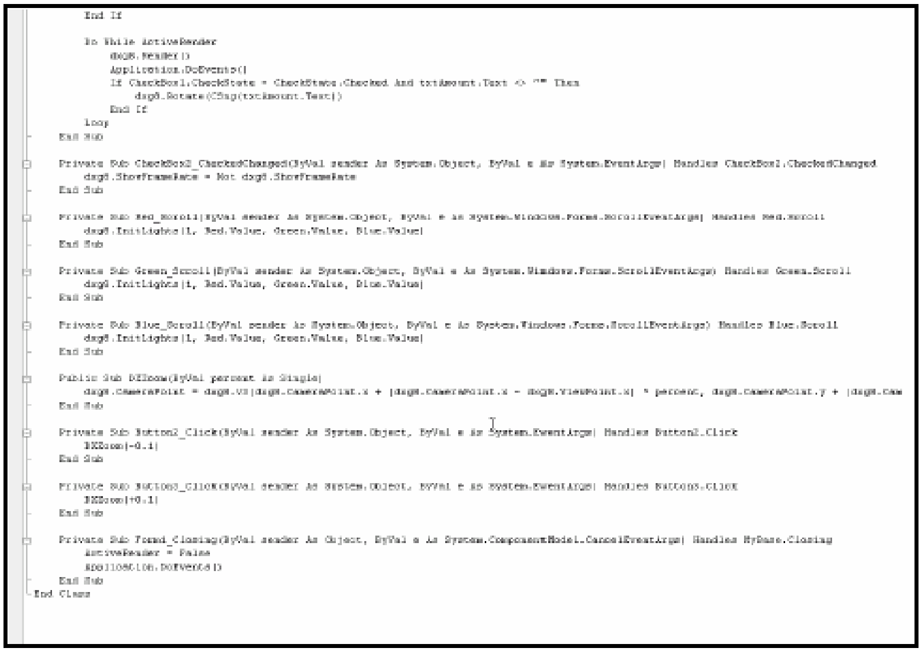


Figure 4.9 : Visual Basic Code Is Written In The Code Window.

4.2.4 Mathematical Model

This mathematical model acts as basic converter of bearing and distance (that is being extracted from DCDB using data selection module) into the RSO coordinate system. Transformation of bearing from one system into another is a changing of the orientation of the reference meridian/north between two systems. Even though the direction of reference north between Cassini and RSO is not related directly but their relation with respect to true north is known.

4.2.4.1 Bearing Transformation

Bearing and distance transformation from one system into another is a process of converting meridian orientation or the north reference between two system. Even though the northern reference between the Cassini system and RSO did not have the direct relationship, both systems sharing common direction to the true north. Bearing transformation can be done in two steps. First step involves correction on convergence in order to convert the Cassini bearing that refers to north grid to the true bearing. Second step involves the correction on meridian map by converting the true bearing into the RSO bearing that refer to the RSO north grid.

For bearing transformation from Cassini system to RSO system, the following equation is used:

$$\beta_{RSO} = \beta_{CS} + \gamma_R + \mu$$

where

β_{RSO} = RSO bearing

β_{CS} = Cassini bearing

γ_R = map meridian convergence correction

μ = convergence correction

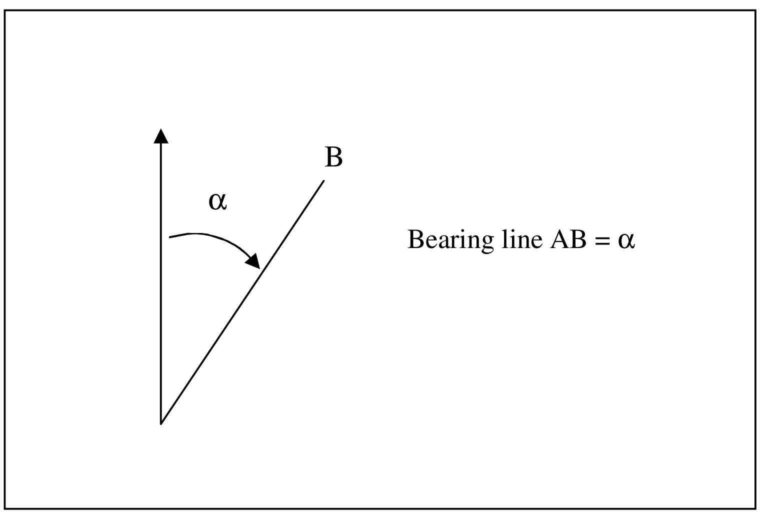


Figure 4.10: Bearing Measurement

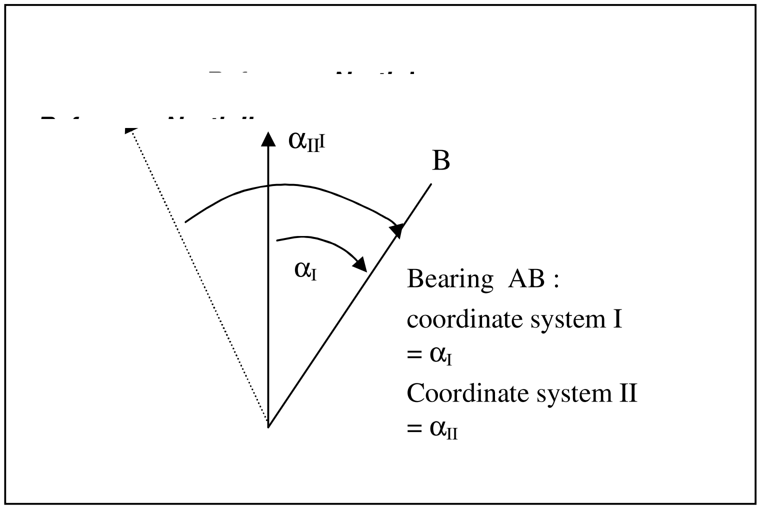


Figure 4.11: Northern Reference Orientation Relationship between Two Coordinate Systems

Convergence is a correction that converts the Cassini bearing to the true north, which is the angle between true north and the Cassini grid north. The convergence correction for Cassini System, C, can be computed using the following formula :

$$C = \Delta\lambda \text{ Sin } \varphi_i$$

Where $\Delta\lambda$ is the cadastral point longitude difference (φ_i,λ_i) to the state origin (φ_o,λ_o).

Cadastral latitude point (φ_i) can be calculated by:

$$\varphi_i = \varphi_o + \Delta\varphi$$

where

$$\Delta\varphi = (\Delta U \times F_1) / 3600$$

ΔU is the difference of northern coordinate between northern coordinate point with northern coordinate state origin in meter and F_1 = 0.03256 is the latitude conversion factor taken from *solar observation form*.

By this, $\Delta\lambda$ can be calculated as:

$$\Delta\lambda = (\Delta T \times F_2) / 3600$$

where F_2 = 0.03246 is the longitude conversion factor given in solar observation form.

Map meridian convergence correction (γ_R) is an angle between the true north and the RSO grid north or the correction that convert reference bearing to RSO north grid. This correction equation is taken from Projection *Table for Malaya* :

$$\gamma_R = \gamma + \gamma_o$$

where

$$\text{Tan}\,\gamma = \frac{\text{Tan}\gamma_o - \text{Sin}B(\omega_o - \omega)\text{Sinh}(B\psi + C)}{\text{Cos}B(\omega_o - \omega)\text{Cosh}(B\psi + C)}$$

with

B, C = RSO projection constant

ω_o = base longitude

ω = station longitude

ψ = station latitude isometric

$$= \log_e \text{Tan}\left(\frac{\pi}{4} + \frac{\phi}{2}\right) - \frac{k}{2}\log_e \frac{1 + k\,\text{Sin}\,\phi}{1 - k\,\text{Sin}\,\phi}$$

γ_o = Sin^{-1} (-0.6)

= - 36° 52’ 11.6314”

4.2.4.2 Distance Transformation

Scale factor used in Cassini system is a full scale that is 1: 1, while the scale factor in RSO system begins with 0.99984 along the great circle that passed the point of origin and increasing further away from the circle. Hence, distance transformation from the Cassini system to the RSO can be done if the scale factor in RSO system is known. The distance in the RSO can be calculated by multiplying the distance in Cassini system with the scale factor calculated in RSO, that is:

$$D_{RSO} = D_{Cassini} \times m_{RSO}$$

where

D_{RSO} = RSO distance

$D_{Cassini}$ = Cassini distance

m_{RSO} = scale factor in RSO system

Mathematic model used to calculate the scale factor in RSO system is as follows:

$$m_{RSO} = \frac{Am_o}{p} \frac{\text{Cos}\frac{Bx}{Am_o}}{\text{Cos}B(\omega_o + \omega)}$$

$$\text{Tan}\,\frac{Bx}{Am_O} = \frac{\text{Cos}\,\gamma_O\ \text{Sinh}\,(B\psi + C) - \text{Sin}\,\gamma_O\,\text{Sin}\,B(\omega_O - \omega)}{\text{Cos}\ B(\omega_O - \omega)}$$

where

A & B = RSO projection constants

m_o = scale factor at origin

x = oblique x grid coordinate

γ_o = Sin^{-1} (-0.6)

ω_o = base longitude

ω = station longitude

ϕ = station latitude

ψ = station isometric latitude

k = eccentrically ellipsoid

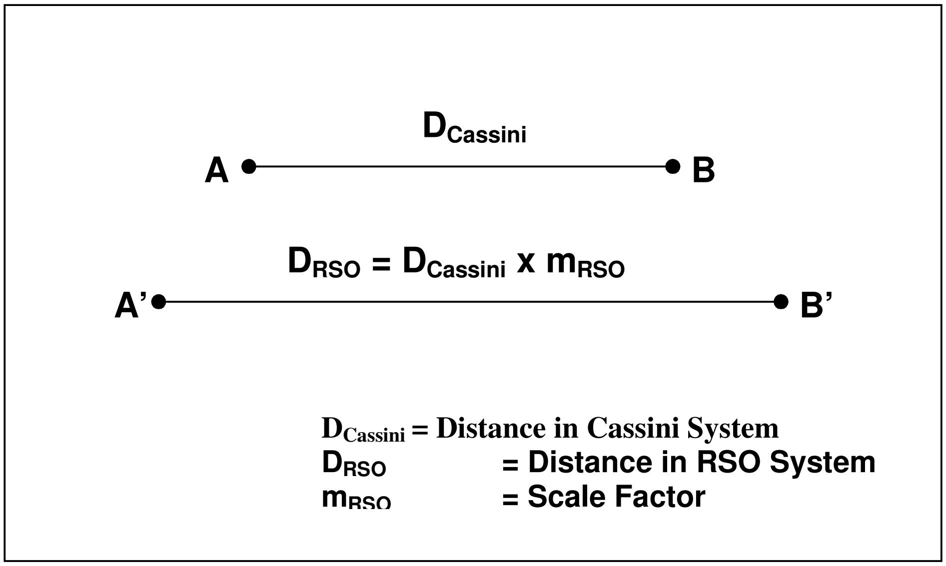


Figure 4.12: ***Relationship Between Two Different Scale Factors***

4.3 Data Selection and Visualization Interfacing Program (CDSV)

This is the most important module in Cadastral Database Selection and Visualization system because result of the adjustment depends on the effectiveness of this module. This module has been developed in Windows environment by integrating the Visual Basic (VB) and ESRI Map Object Developer Software.

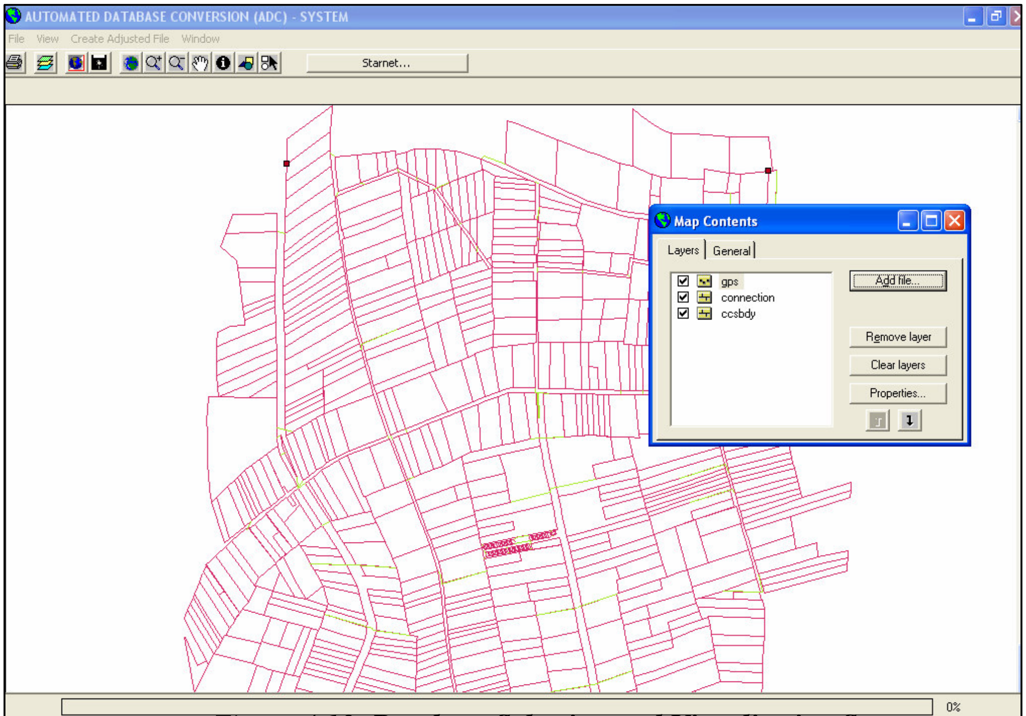


*Figure 4.13: **Database Selection and Visualization System***

Based on that purpose, a methodology for filtering algorithm has been developed. Figure 4.14 shows how the data selection process begin by supplying DCDB (stone.shp and boundary.shp) and CCDB (GPS.shp) files into the module and finally the user will identify the area that need to be adjusted (involving at least 4 cadastral control stations). A window (box) will be formed to show the selected area. The filtering process or rejection of hanging line that being shown in Figure 4.15 will be conducted and the closed lots will be formed.

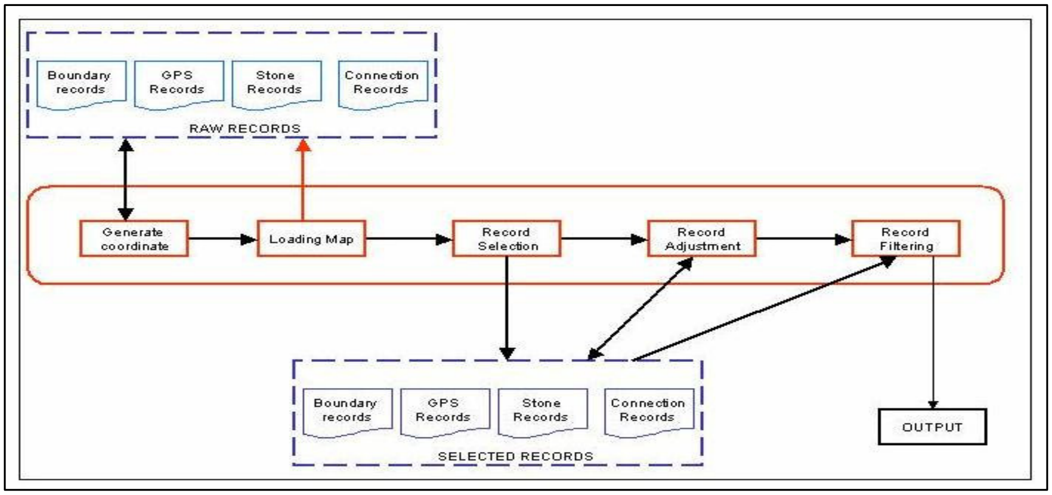


Figure 4.14 : Overall Data Selection Unified Modeling Language

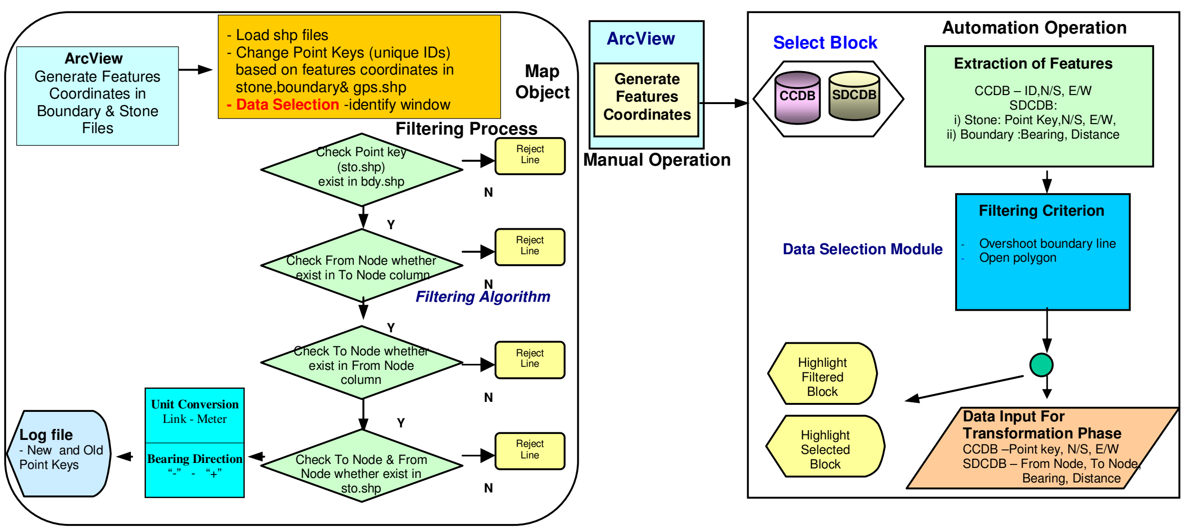


Figure 4.15 : Data Selection Methodology and Editing

Figure 4.16 shows the layer properties for spatial features specifically DCDB, GPS layer and connection line layer. Layer property provides functionalities for changing features visualization.

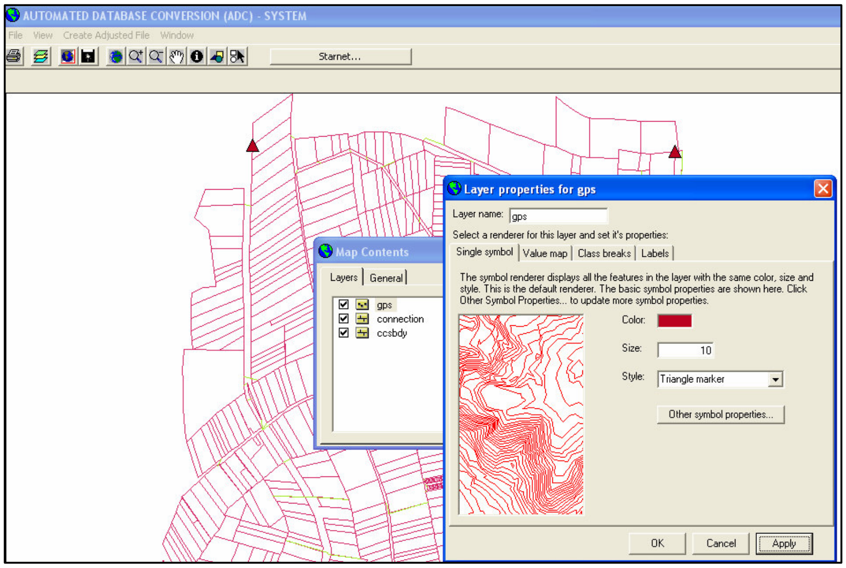


Figure 4.16 : Spatial properties Menu

While Figure 4.17-Figure 4.25 visualize the main menus of the system consisting tabular table, map control, legend, Navigator for browser, Layer information, identifying spatial features and database, graphics, and spatial selection.

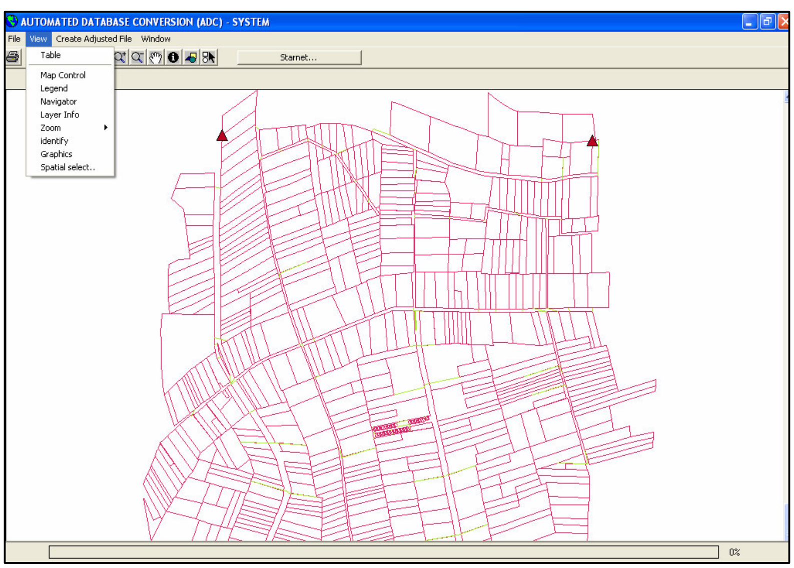


Figure 4.17: Main Menus of CDSV

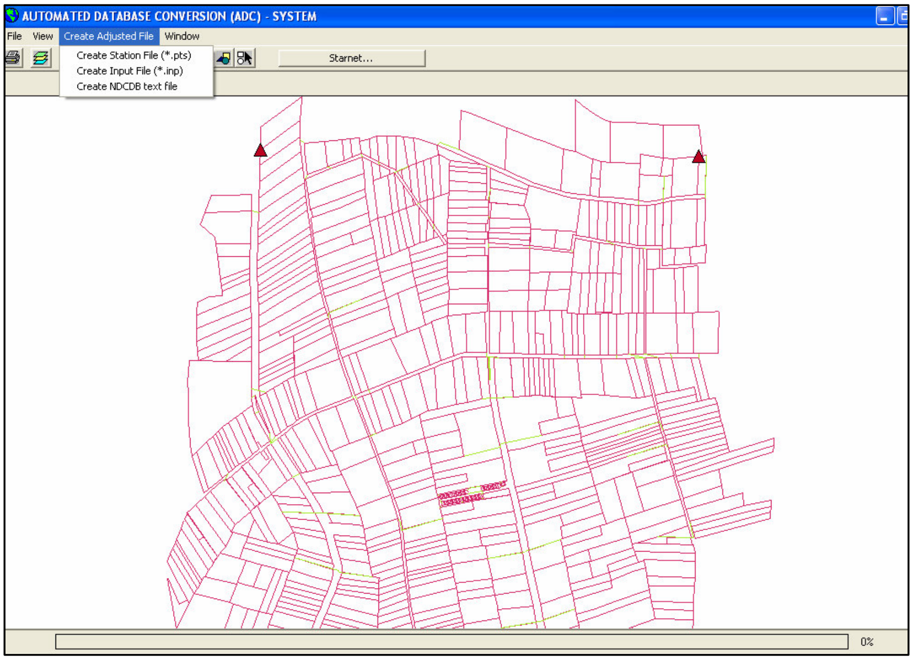


Figure 4.18: Reformating Menus

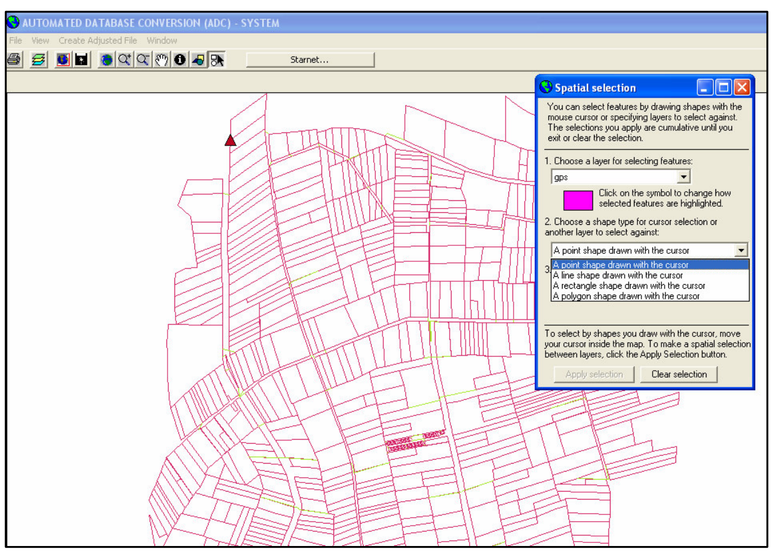


Figure 4.19: Spatial Selection

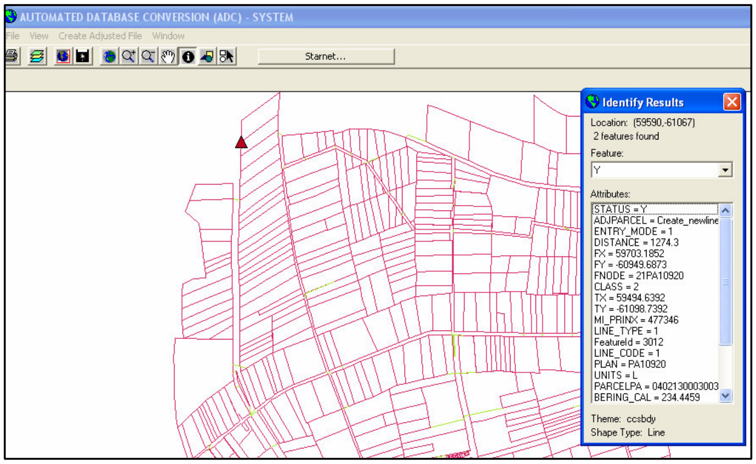


Figure 4.20: Identify Spatial Information

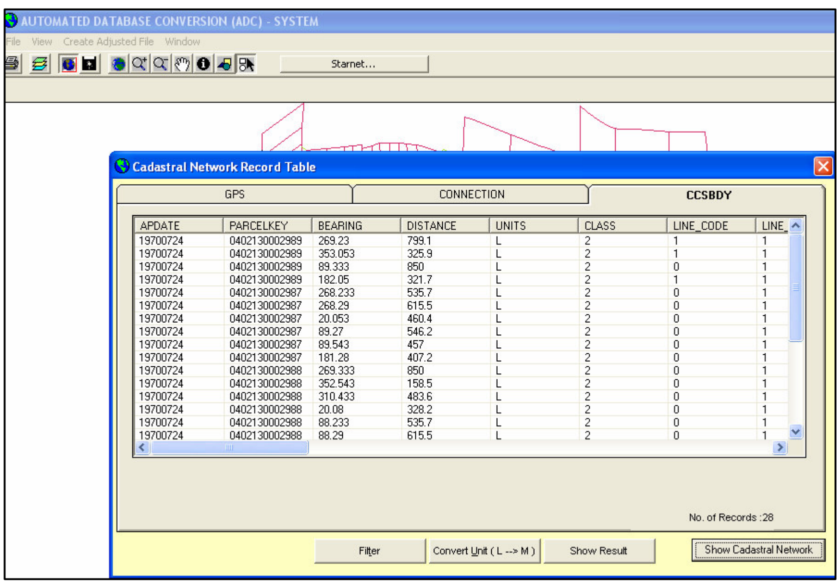


Figure 4.21: Cadastral Network Record

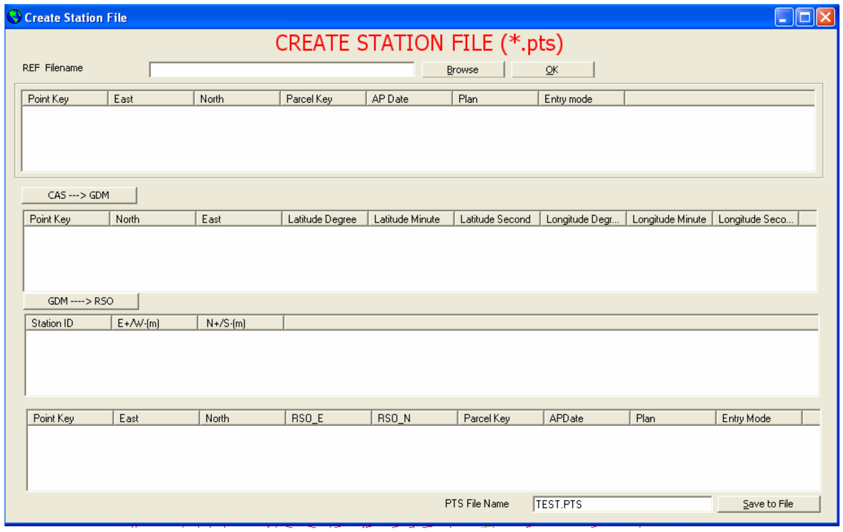


Figure 4.22: Creating Input File for NDCDB (Point File)

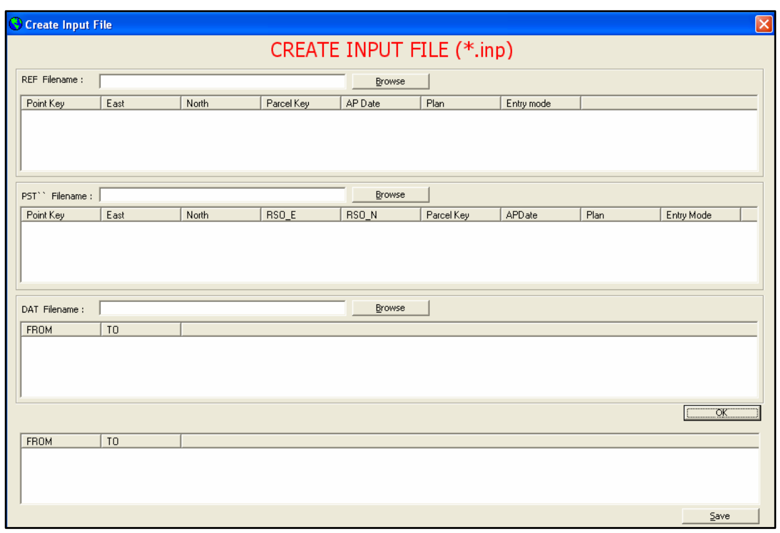


Figure 4.23: Creating Input File for NDCDB (Boundary File)

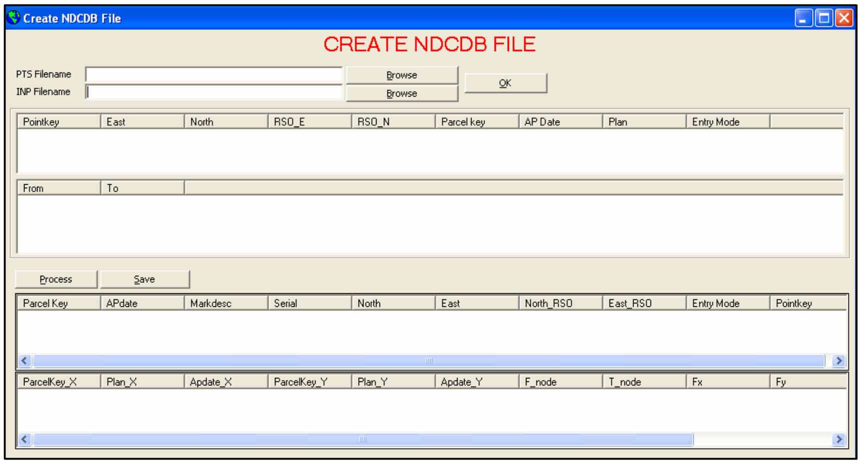


Figure 4.24: Creating Input File for NDCDB (Combine File)

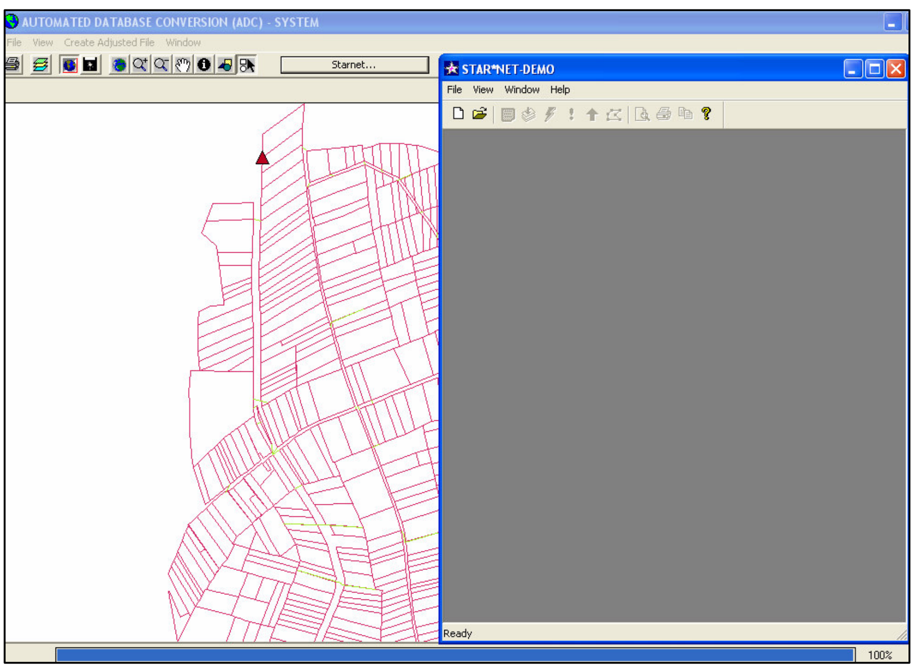


Figure 4.25: Running Starnet Least Squares Adjustment Software From Prototype System

4.4 NDCDB Converter

In this study, the works were divided to 3 levels, which are extracting data from StarNet report (ndcdb.lst and ndcdb.ref), data entry in dBASE format using Microsoft Office Excel and developing GIS DCDB using ArcView 3.1 (Figure 4.26 and Figure 4.27). The study area is around Melaka where CCS was implemented and consists of a small block of lots.

Extracting data from StarNet report (ndcdb.lst and ndcdb.ref) is done by using Visual Basic version 6 Enterprise with MapObjects version 1.2. An interfacing Visual Basic programme was created to extract some data from that will be use in producing the database. The result will be in text files format (create as Adjbdy.txt for boundary line and Adjsto.txt for stone or boundary mark of a lot)

The data entry in Microsoft Office Excel consists of the text file after from the extracting procedure. The data entry will be done using keyboard. Then the information will be save in dBASE format as boundary line database (ndcdb_bdy.dbf) and boundary mark database (ndcdb_sto.dbf).

By using ArcView 3.1 software, an interfacing programs Avenue was created to generate spatial entity of GIS DCDB from the boundary line database (ndcdb_bdy.dbf) and boundary mark database (ndcdb_sto.dbf) files. The result are a graphic view of the lots in Shape file (*.shp) format and its database encircle of all the information about the lot consists boundary mark, boundary line and lot.

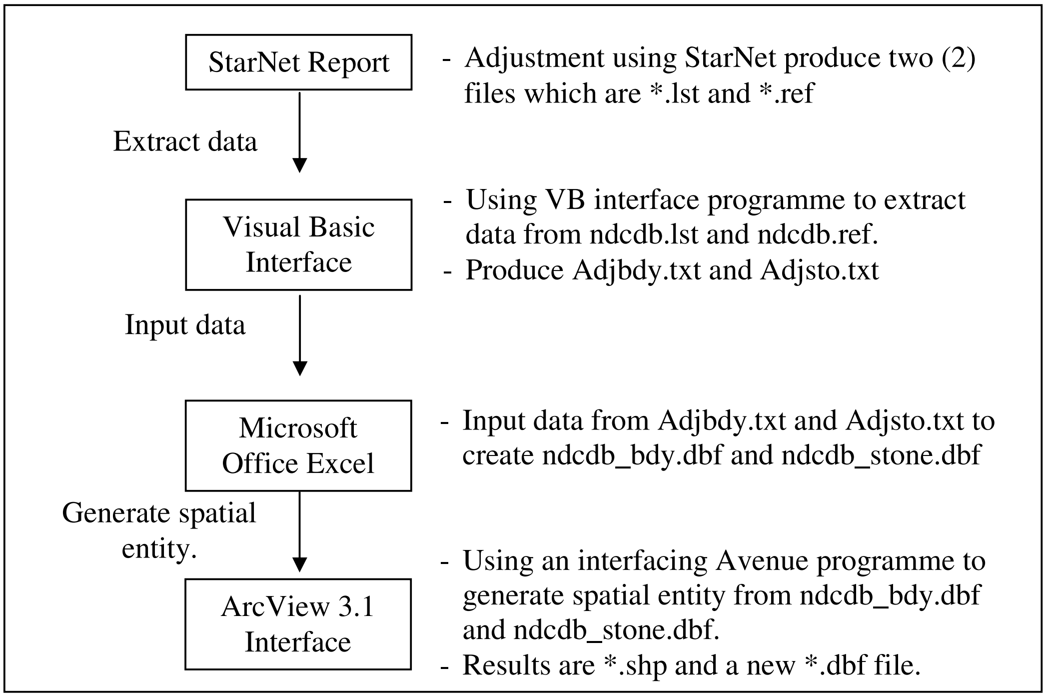


Figure 4.26: NDCDB Implementation Methodology.

```
                    STAR*NET-PRO Version 6.0.23
              Copyright 1988-2002 Starplus Software, Inc.
  Licensed for Use by University of Technology Malaysia - Educational Usd
                  Run Date: Thu January 18 2007 16:03:29


               Summary of Files Used and Option Settings
               =========================================

                     Project Folder and Data Files

    Project Name    NDCDB
    Project Folder  E:\PSM\NDCDB
    Data File List  ndcdb.dat

                        Project Option Settings

    STAR*NET Run Mode                   : Adjust with Error Propagation
    Type of Adjustment                  : 2D
    Project Units                       : Meters; DMS
    Coordinate System                   : LOCAL
    Default Project Elevation           : 0.0000 Meters
    Apply Average Scale Factor          : 1.0000000000
    Input/Output Coordinate Order       : East-North
    Angle Data Station Order            : At-From-To
    Distance/Vertical Data Type         : Hor Dist/DE
    Convergence Limit; Max Iterations   : 0.010000; 10
    Default Coefficient of Refraction   : 0.070000
    Earth Radius                        : 6372000.00 Meters
    Create Coordinate File              : Yes
    Create Ground Scale Coordinate File : No
    Create Dump File                    : No
```

Figure 4.27 (a): StarNet™ Report (ndcdb.lst)

Adjusted Coordinates (Meters)

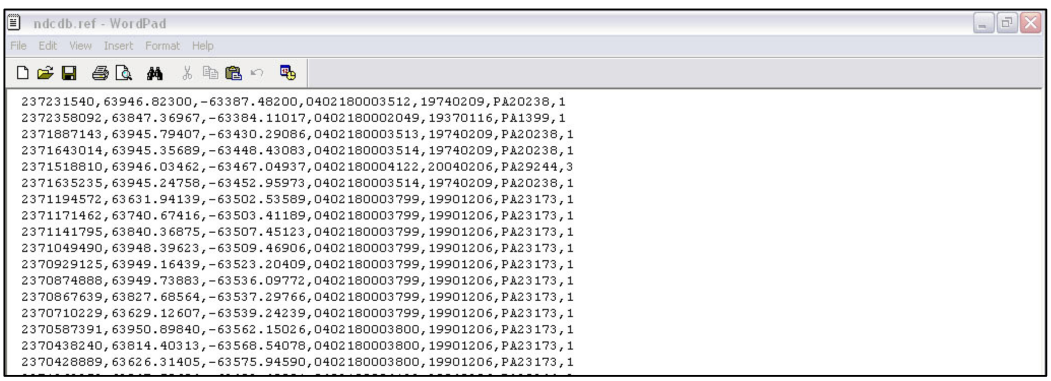
Station	E	N	Description
237231540	63946.8230	-63387.4820	0402180003512,19740209,PA20238,1
2372358092	63847.3697	-63384.1102	0402180002049,19370116,PA1399,1
2371887143	63945.7941	-63430.2909	0402180003513,19740209,PA20238,1
2371643014	63945.3569	-63448.4308	0402180003514,19740209,PA20238,1
2371518810	63946.0346	-63467.0494	0402180004122,20040206,PA29244,3
2371635235	63945.2476	-63452.9597	0402180003514,19740209,PA20238,1
2371194572	63631.9414	-63502.5359	0402180003799,19901206,PA23173,1
2371171462	63740.6742	-63503.4119	0402180003799,19901206,PA23173,1
2371141795	63840.3687	-63507.4512	0402180003799,19901206,PA23173,1
2371049490	63948.3962	-63509.4691	0402180003799,19901206,PA23173,1
2370929125	63949.1644	-63523.2041	0402180003799,19901206,PA23173,1

Figure 4.27 (b): Input Data of Adjusted Coordinate

Adjusted Azimuth/Bearing Observations (DMS)

From	To	Bearing	Residual	StdErr	StdRes
237231540	2372358092	N88-03-29.54W	0-00-00.46	30.00	0.0
2371887143	237231540	N01-22-36.71E	-0-00-23.29	30.00	0.8
2371643014	2371887143	N01-22-50.13E	-0-00-09.87	30.00	0.3
2371518810	2371635235	N03-11-50.01W	-0-00-20.01	30.00	0.7
2371635235	2371643014	N01-22-57.54E	-0-00-02.46	30.00	0.1
2371194572	2371171462	S89-32-18.27E	0-00-11.73	30.00	0.4
2371171462	2371141795	S87-40-47.31E	0-00-12.69	30.00	0.4
2371141795	2371049490	S88-55-47.66E	0-00-12.34	30.00	0.4
2371049490	2370929125	S03-12-03.74E	-0-00-03.74	30.00	0.1
2370929125	2370874888	S02-33-03.49E	-0-00-03.49	30.00	0.1
2370874888	2370867639	S89-26-12.21W	0-00-12.21	30.00	0.4
2370867639	2370710229	S89-26-19.87W	0-00-19.87	30.00	0.7

Figure 4.27 (c): Input Data of Adjusted Observation




```
237231540,63946.82300,-63387.48200,0402180003512,19740209,PA20238,1
2372358092,63847.36967,-63384.11017,0402180002049,19370116,PA1399,1
2371887143,63945.79407,-63430.29086,0402180003513,19740209,PA20238,1
2371643014,63945.35689,-63448.43083,0402180003514,19740209,PA20238,1
2371518810,63946.03462,-63467.04937,0402180004122,20040206,PA29244,3
2371635235,63945.24758,-63452.95973,0402180003514,19740209,PA20238,1
2371194572,63631.94139,-63502.53589,0402180003799,19901206,PA23173,1
2371171462,63740.67416,-63503.41189,0402180003799,19901206,PA23173,1
2371141795,63840.36875,-63507.45123,0402180003799,19901206,PA23173,1
2371049490,63948.39623,-63509.46906,0402180003799,19901206,PA23173,1
2370929125,63949.16439,-63523.20409,0402180003799,19901206,PA23173,1
2370874888,63949.73883,-63536.09772,0402180003799,19901206,PA23173,1
2370867639,63827.68564,-63537.29766,0402180003799,19901206,PA23173,1
2370710229,63629.12607,-63539.24239,0402180003799,19901206,PA23173,1
2370587391,63950.89840,-63562.15026,0402180003800,19901206,PA23173,1
2370438240,63814.40313,-63568.54078,0402180003800,19901206,PA23173,1
2370428889,63626.31405,-63575.94590,0402180003800,19901206,PA23173,1
```

Figure 4.28: StarNet Report (ndcdb.ref)

Figure 4.27 (a), Figure (b) and Figure (c) also Figure 4.28 show the some of the data of ndcdb.lst and ndcdb.ref file from the StarNet report after adjustment. These data's are use to develop the GIS DCDB. Based on the report (ndcdb.lst), the coordinate were adjusted referring to the new datum, GDM2000. By using StarNet^{TM} software, the coordinate was adjusted rigorously with least square adjustment technique. The software is capable to adjust a two-dimensional (2-D) and three-dimensional (3-D) network. The output is in the form of adjusted coordinates (shows in Figure …(b)) and adjusted observation (shows in Figure ….(c)).

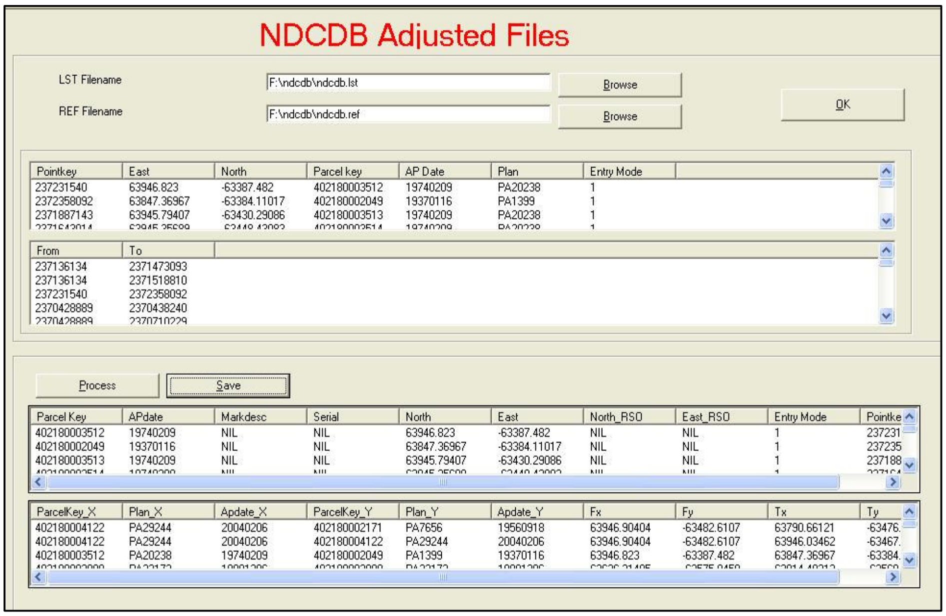
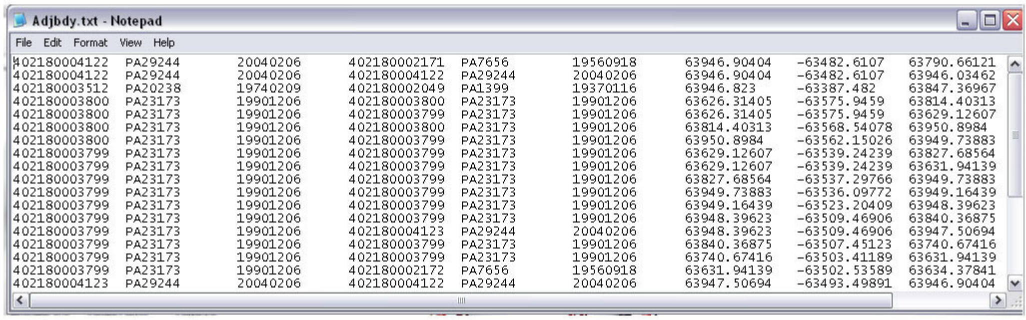


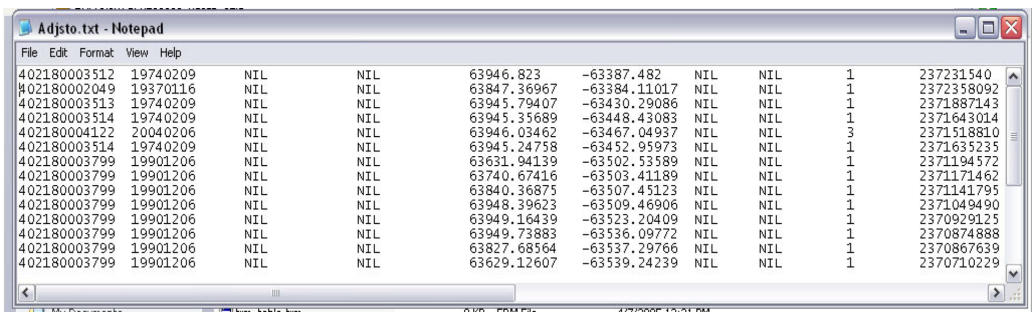
Figure 4.29: Visual Basic interface to extract data from StarNet Report (ndcdb.lst and ndcdb.ref)

Visual Basic v.6 interface programme was created to extract the data from ndcdb.list and ndcdb.ref of StarNet^{TM} Report. The outputs from the extraction are adjusted boundary line (Adjbdy.txt) as shown in Figure 4.30 and adjusted boundary mark (Adjsto.txt) as shown in Figure 4.31.



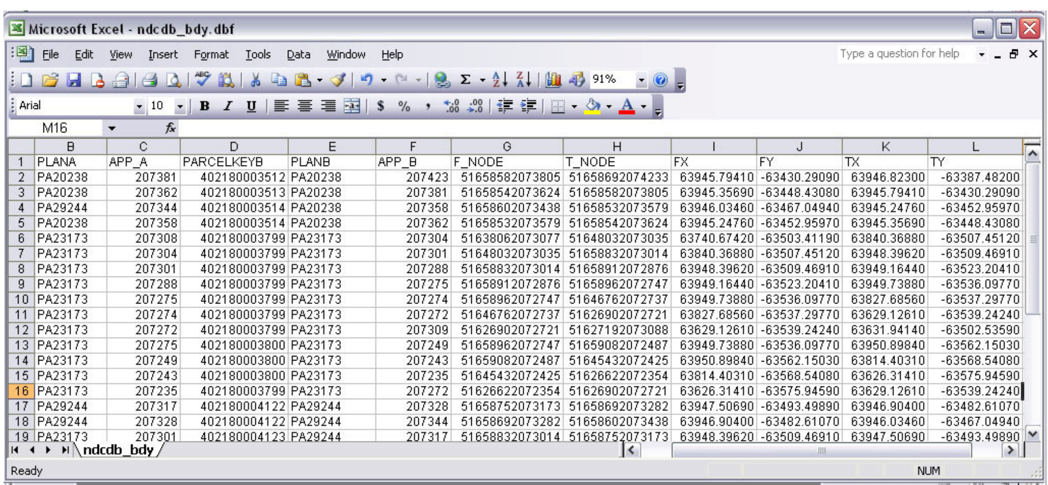
402180004122	PA29244	20040206	402180002171	PA7656	19560918	63946.90404	-63482.6107	63790.66121
402180004122	PA29244	20040206	402180004122	PA29244	20040206	63946.90404	-63482.6107	63946.03462
402180003512	PA20238	19740209	402180002049	PA1399	19370116	63946.823	-63387.482	63847.36967
402180003800	PA23173	19901206	402180003800	PA23173	19901206	63626.31405	-63575.9459	63814.40313
402180003800	PA23173	19901206	402180003799	PA23173	19901206	63626.31405	-63575.9459	63629.12607
402180003800	PA23173	19901206	402180003800	PA23173	19901206	63814.40313	-63568.54078	63950.8984
402180003800	PA23173	19901206	402180003799	PA23173	19901206	63950.8984	-63562.15026	63949.73883
402180003799	PA23173	19901206	402180003799	PA23173	19901206	63629.12607	-63539.24239	63827.68564
402180003799	PA23173	19901206	402180003799	PA23173	19901206	63629.12607	-63539.24239	63631.94139
402180003799	PA23173	19901206	402180003799	PA23173	19901206	63827.68564	-63537.29766	63949.73883
402180003799	PA23173	19901206	402180003799	PA23173	19901206	63949.73883	-63536.09772	63949.16439
402180003799	PA23173	19901206	402180003799	PA23173	19901206	63949.16439	-63523.20409	63948.39623
402180003799	PA23173	19901206	402180003799	PA23173	19901206	63948.39623	-63509.46906	63840.36875
402180003799	PA23173	19901206	402180004123	PA29244	20040206	63948.39623	-63509.46906	63947.50694
402180003799	PA23173	19901206	402180003799	PA23173	19901206	63840.36875	-63507.45123	63740.67416
402180003799	PA23173	19901206	402180003799	PA23173	19901206	63740.67416	-63503.41189	63631.94139
402180003799	PA23173	19901206	402180002172	PA7656	19560918	63631.94139	-63502.53589	63634.37841
402180004123	PA29244	20040206	402180004122	PA29244	20040206	63947.50694	-63493.49891	63946.90404

Figure 4.30: Output for adjusted boundary line



402180003512	19740209	NIL	NIL	63946.823	-63387.482	NIL	NIL	1	237231540
402180002049	19370116	NIL	NIL	63847.36967	-63384.11017	NIL	NIL	1	2372358092
402180003513	19740209	NIL	NIL	63945.79407	-63430.29086	NIL	NIL	1	2371887143
402180003514	19740209	NIL	NIL	63945.35689	-63448.43083	NIL	NIL	1	2371643014
402180004122	20040206	NIL	NIL	63946.03462	-63467.04937	NIL	NIL	3	2371518810
402180003514	19740209	NIL	NIL	63945.24758	-63452.95973	NIL	NIL	1	2371635235
402180003799	19901206	NIL	NIL	63631.94139	-63502.53589	NIL	NIL	1	2371194572
402180003799	19901206	NIL	NIL	63740.67416	-63503.41189	NIL	NIL	1	2371171462
402180003799	19901206	NIL	NIL	63840.36875	-63507.45123	NIL	NIL	1	2371141795
402180003799	19901206	NIL	NIL	63948.39623	-63509.46906	NIL	NIL	1	2371049490
402180003799	19901206	NIL	NIL	63949.16439	-63523.20409	NIL	NIL	1	2370929125
402180003799	19901206	NIL	NIL	63949.73883	-63536.09772	NIL	NIL	1	2370874888
402180003799	19901206	NIL	NIL	63827.68564	-63537.29766	NIL	NIL	1	2370867639
402180003799	19901206	NIL	NIL	63629.12607	-63539.24239	NIL	NIL	1	2370710229

Figure 4.31: Output for adjusted boundary mark



	PLANA	APP_A	PARCELKEYB	PLANB	APP_B	F_NODE	T_NODE	FX	FY	TX	TY
2	PA20238	207381	402180003512	PA20238	207423	51658582073805	51658692074233	63945.79410	-63430.29090	63946.82300	-63387.48200
3	PA20238	207362	402180003513	PA20238	207381	51658542073624	51658582073805	63945.35690	-63448.43080	63945.79410	-63430.29090
4	PA29244	207344	402180003514	PA20238	207358	51658602073438	51658532073579	63946.03460	-63467.04940	63945.24760	-63452.95970
5	PA20238	207358	402180003514	PA20238	207362	51658532073579	51658542073624	63945.24760	-63452.95970	63945.35690	-63448.43080
6	PA23173	207308	402180003799	PA23173	207304	51638062073077	51648032073035	63740.67420	-63503.41190	63840.36880	-63507.45120
7	PA23173	207304	402180003799	PA23173	207301	51648032073035	51658832073014	63840.36880	-63507.45120	63948.39620	-63509.46910
8	PA23173	207301	402180003799	PA23173	207288	51658832073014	51658912072876	63948.39620	-63509.46910	63949.16440	-63523.20410
9	PA23173	207288	402180003799	PA23173	207275	51658912072876	51658962072747	63949.16440	-63523.20410	63949.73880	-63536.09770
10	PA23173	207275	402180003799	PA23173	207274	51658962072747	51646762072737	63949.73880	-63536.09770	63827.68560	-63537.29770
11	PA23173	207274	402180003799	PA23173	207272	51646762072737	51626902072721	63827.68560	-63537.29770	63629.12610	-63539.24240
12	PA23173	207272	402180003799	PA23173	207309	51626902072721	51627192073088	63629.12610	-63539.24240	63631.94140	-63502.53590
13	PA23173	207275	402180003800	PA23173	207249	51658962072747	51659082072487	63949.73880	-63536.09770	63950.89840	-63562.15030
14	PA23173	207249	402180003800	PA23173	207243	51659082072487	51645432072425	63950.89840	-63562.15030	63814.40310	-63568.54080
15	PA23173	207243	402180003800	PA23173	207235	51645432072425	51626622072354	63814.40310	-63568.54080	63626.31410	-63575.94590
16	PA23173	207235	402180003799	PA23173	207272	51626622072354	51626902072721	63626.31410	-63575.94590	63629.12610	-63539.24240
17	PA29244	207317	402180004122	PA29244	207328	51658752073173	51658692073282	63947.50690	-63493.49890	63946.90400	-63482.61070
18	PA29244	207328	402180004122	PA29244	207344	51658692073282	51658602073438	63946.90400	-63482.61070	63946.03460	-63467.04940
19	PA23173	207301	402180004123	PA29244	207317	51658832073014	51658752073173	63948.39620	-63509.46910	63947.50690	-63493.49890

Figure 4.32: Data entry (from Adjbdy.txt)

After the data entry process completed, the two dbase IV files namely boundary line database (ndcdb_bdy.dbf) and boundary mark database (ndcdb_sto.dbf) files will be input into ArcView 3.1 software. The dBASE files are added using the ArcView 3.1window interface. The Avenue program was created to create a new theme for NDCDB. The first programme is known as '*creating polyline'* (pl_ndcdb.txt) to read the boundary line database (ndcdb_bdy.dbf) and boundary mark database (ndcdb_sto.dbf) files. The second programme is known as '*polyline to polygon converter'* (cvtplply.txt) to convert polyline to polygon (Figure 4.33 and Figure 4.34). Polygon feature is needed in GIS environment for land parcel.

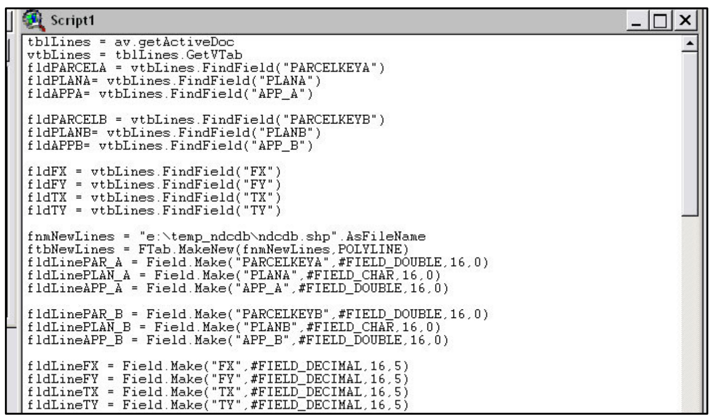


Figure 4.33: Avenue programme of pl_ndcdb.txt for creating polyline

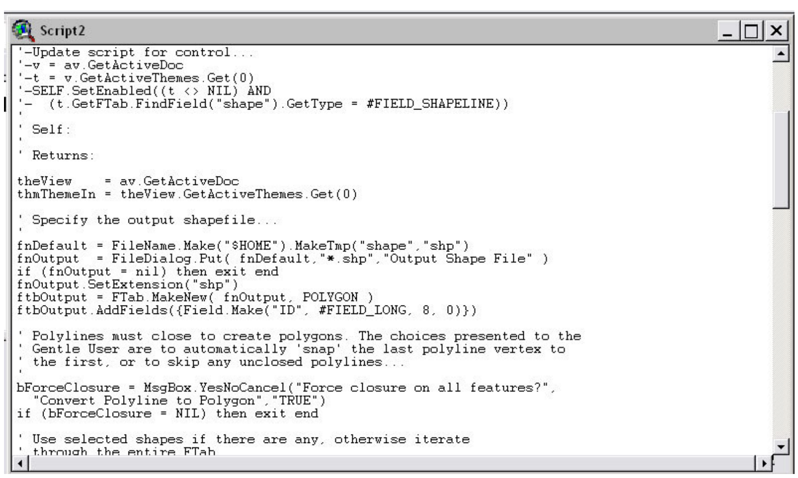


Figure 4.34: Avenue programme of cvtplply.txt for converting polyline to polygon

CHAPTER 5

ANALYSIS

5.1 Introduction

Analyses were carried out in term of accuracy of the input data and graphic visualization (spatial and attribute). Data analysis is part of data manipulation approach using developed prototype

Adjusted cadatral nework was analyzed in order to get survey accurate information. These information were used during the development of National Cadastral Database. Least sqaures adjustment output that contain related information such as adjusted observations and adjusted coordinates for each boundary marks also been analyzed

The development of window-based Cadastral Database Selection and Visualization (CDSV) will ease and smooth the NDCDB development process. The users can interact without any need to have the knowledge on the codes and instructions that usually needed when using the DOS interface. Application of Visual Basic programming and developer tools (Map Object) were found to be very effective. The result from the NDCDB generated show that the prototype was functioning very well. A series of test and analysis was conducted to see the effectiveness and the suitability of the development of cadastral database selection application to support modern cadastral and Malaysian spatial data infrastructure.

5.2 Data Quality

Data quality is the main issue in the DCDB development because it will influence the accuracy of the information. The quality of data in the DCDB is mostly related to the methods of data acquisition and data presentation. Four factors that determine the quality of the data:

i) Cleanliness of data
ii) Data accuracy
iii) Data maintenance
iv) Data transfer and format conversion

5.2.1 Cleanliness of data

Usually keyboard-entry method will not cause that much problem. Problems such as undershoots, overshoots, and slivers used to occurs into digitizing data entry method. Using the keyboard-entry method, all the information in CP will be entered manually.

5.2..2 Data Accuracy

The accuracy of the data in DCDB developed by DSMM using keyboard-entry can be influenced by two factors; observation and data entry.

i) Observation

Data observation in the field is directly related to data quality. This is because the observation or the measurement on the field will be entered into CP. All data in the DCDB that being developed by DSMM is depending solely on the CP whereby each CP will have it own Class of Survey. Class of survey is determined by misclosure that have been fixed. KPUP 1/97 Circular has stated that for 1st

class survey the misclosure must be not less than 1/8000 while for the second class the misclosure is in the range of 1/4000 to 1/8000.

ii) Data entry

The second factor that can influence the quality of data is the data entry. The development of DCDB comes from two different sources i.e:

a) License land surveyor (out-sourcing)
b) DSMM (in-house)

License surveyors will present the outsource work to DSMM that consist of three files of *.BDY, *.LOT, and *.NOT together with CP copies, CP graphic, and report. Data from the out-sourced mode will go through the inspection and certification process to make sure that the data confirms to the standard and the criteria that being fixed by DSMM. The inspection and certification process is conducted by Sistem Pengesahan Kualiti (SPEK). Assessment process on lot will be conducted based on the following criteria:

i) The difference on area provided with the calculated system must not exceed 0.5%. For area less than 100 m square, the difference must not exceed 1.0%.

ii) The difference on coordinate provided with the calculated system must not exceed 0.5%.

iii) The misclosure difference for 1^{st} class must be above 1:8000 while the 2^{nd} class is within 1:4000 to 1:8000 and the 3^{rd} class must not less than 1:2000.

If the difference exceeds the stated rules, the data reassessment process must be repeated. All the data that have been inspected must be error free before being sent to the server for the updating purposes.

5.3 Cadastral Database Selection and Visualization Prototype

Based on the Data Selection process that have been conducted shown that it will take time to produce cadastral lots that have unique boundary marks, no hanging line, no outliers, and closed lot. The longer time consumed is because there are multiple of algorithms need to be entered in order to produce one perfect output. Processing time depend on the cleanliness of the data sets and the specifications of the computer.

The analysis is a process to present the data to a new form either in form of graphic or table. In this study the result is a new theme encircles a new shape file and a new database known as NDCDB.

ndcdb_bdy.dbf

Parcelkeya	Plana	App_a	Parcelkeyb	Planb	App_b
402180003513	PA20238	207381	402180003512	PA20238	207423
402180003514	PA20238	207362	402180003513	PA20238	207381
402180004122	PA29244	207344	402180003514	PA20238	207358
402180003514	PA20238	207358	402180003514	PA20238	207362
402180003799	PA23173	207308	402180003799	PA23173	207304
402180003799	PA23173	207304	402180003799	PA23173	207301
402180003799	PA23173	207301	402180003799	PA23173	207288
402180003799	PA23173	207288	402180003799	PA23173	207275
402180003799	PA23173	207275	402180003799	PA23173	207274
402180003799	PA23173	207274	402180003799	PA23173	207272
402180003799	PA23173	207272	402180003799	PA23173	207309

Figure 5.1 (a): The adjusted boundary line (ndcdb_bdy.dbf) file input in ArcView

F_node	T_node	Fx	Fy	Tx	Ty
51658582073805	51658692074233	63945.79410	-63430.29090	63946.82300	-63387.48200
51658542073624	51658582073805	63945.35690	-63448.43080	63945.79410	-63430.29090
51658602073438	51658532073579	63946.03460	-63467.04940	63945.24760	-63452.95970
51658532073579	51658542073624	63945.24760	-63452.95970	63945.35690	-63448.43080
51638062073077	51648032073035	63740.67420	-63503.41190	63840.36880	-63507.45120
51648032073035	51658832073014	63840.36880	-63507.45120	63948.39620	-63509.46910
51658832073014	51658912072876	63948.39620	-63509.46910	63949.16440	-63523.20410
51658912072876	51658962072747	63949.16440	-63523.20410	63949.73880	-63536.09770
51658962072747	51646762072737	63949.73880	-63536.09770	63827.68560	-63537.29770
51646762072737	51626902072721	63827.68560	-63537.29770	63629.12610	-63539.24240
51626902072721	51627192073088	63629.12610	-63539.24240	63631.94140	-63502.53590

Figure 5.1 (b): The adjusted boundary line (ndcdb_bdy.dbf) file input in ArcView

ndcdb_sto.dbf

Id	E_cas	N_cas	E_rso	N_rso	Parcelkey	App	Plan	Entry
51658692074233	63946.8230	-63387.4820	516586.9917	207423.3951	402180003512	19740209	PA20238	
51648752074269	63847.3697	-63384.1102	516487.5457	207426.9173	402180002049	19370116	PA1399	
51658582073805	63945.7941	-63430.2909	516585.8980	207380.5910	402180003513	19740209	PA20238	
51658542073624	63945.3569	-63448.4308	516585.4333	207362.4529	402180003514	19740209	PA20238	
51658602073438	63946.0346	-63467.0494	516586.0831	207343.8347	402180004122	20040206	PA29244	
51658532073579	63945.2476	-63452.9597	516585.3173	207357.9245	402180003514	19740209	PA20238	
51627192073088	63631.9414	-63502.5359	516271.9429	207308.8257	402180003799	19901206	PA23173	
51638062073077	63740.6742	-63503.4119	516380.6721	207307.7855	402180003799	19901206	PA23173	
51648032073035	63840.3688	-63507.4512	516480.3585	207303.5955	402180003799	19901206	PA23173	
51658832073014	63948.3962	-63509.4691	516588.3805	207301.4146	402180003799	19901206	PA23173	
51658912072876	63949.1644	-63523.2041	516589.1279	207287.6792	402180003799	19901206	PA23173	

Figure 5.1 (c): The adjusted boundary mark (ndcdb_sto.bdy) file input in ArcView

Based on Figure 5.1(a), Figure 5.1 (b) and Figure 5.1 (c), the Avenue programme (pl_ndcdb.txt and cvtplply.txt) will read from the dBASE file to create a new theme. The programmes create a connection between ParcelkeyA to ParcelkeyB within its component. The result will be a new theme namely NDCDB view (Figure 5.2) and attributes (Figure 5.3).

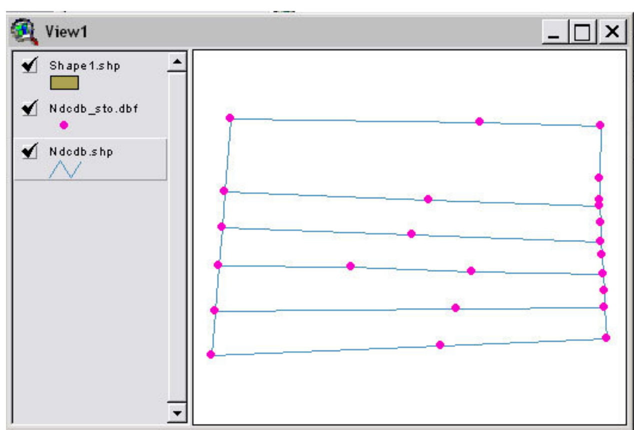
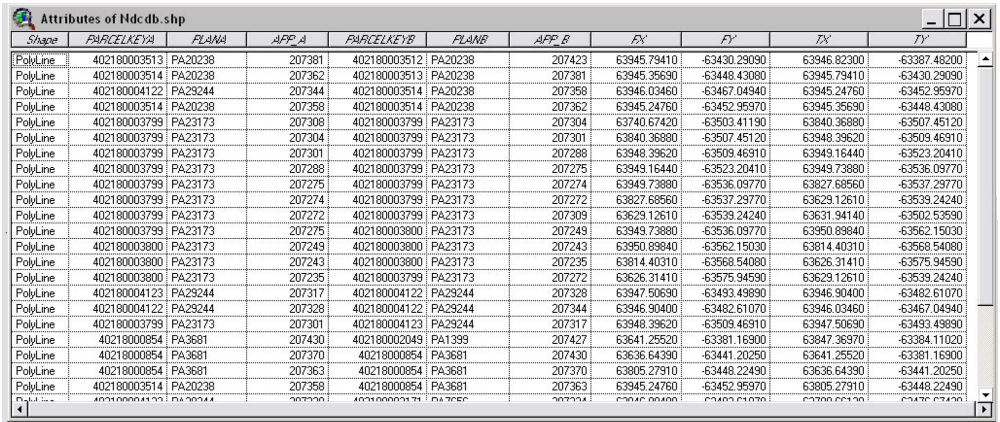


Figure 5.2: View of a new Theme based on boundary line database (ndcdb_bdy.dbf) and boundary mark database (ndcdb_sto.dbf) files.



Attributes of Ndcdb.shp

Shape	PARCELKEYA	PLANA	APP_A	PARCELKEYB	PLANB	APP_B	FX	FY	TX	TY
PolyLine	402180003513	PA20238	207381	402180003512	PA20238	207423	63945.79410	-63430.29090	63946.82300	-63387.48200
PolyLine	402180003514	PA20238	207362	402180003513	PA20238	207381	63945.35690	-63448.43080	63945.79410	-63430.29090
PolyLine	402180004122	PA29244	207344	402180003514	PA20238	207358	63946.03460	-63467.04940	63945.24760	-63452.95970
PolyLine	402180003514	PA20238	207358	402180003514	PA20238	207362	63945.24760	-63452.95970	63945.35690	-63448.43080
PolyLine	402180003799	PA23173	207308	402180003799	PA23173	207304	63740.67420	-63503.41190	63840.36880	-63507.45120
PolyLine	402180003799	PA23173	207304	402180003799	PA23173	207301	63840.36880	-63507.45120	63948.39620	-63509.46910
PolyLine	402180003799	PA23173	207301	402180003799	PA23173	207288	63948.39620	-63509.46910	63949.16440	-63523.20410
PolyLine	402180003799	PA23173	207288	402180003799	PA23173	207275	63949.16440	-63523.20410	63949.73880	-63536.09770
PolyLine	402180003799	PA23173	207275	402180003799	PA23173	207274	63949.73880	-63536.09770	63827.68560	-63537.29770
PolyLine	402180003799	PA23173	207274	402180003799	PA23173	207272	63827.68560	-63537.29770	63629.12610	-63539.24240
PolyLine	402180003799	PA23173	207272	402180003799	PA23173	207309	63629.12610	-63539.24240	63631.94140	-63502.53590
PolyLine	402180003799	PA23173	207275	402180003800	PA23173	207249	63949.73880	-63536.09770	63950.89840	-63562.15030
PolyLine	402180003800	PA23173	207249	402180003800	PA23173	207243	63950.89840	-63562.15030	63814.40310	-63568.54080
PolyLine	402180003800	PA23173	207243	402180003800	PA23173	207235	63814.40310	-63568.54080	63626.31410	-63575.94590
PolyLine	402180003800	PA23173	207235	402180003799	PA23173	207272	63626.31410	-63575.94590	63629.12610	-63539.24240
PolyLine	402180004123	PA29244	207317	402180004122	PA29244	207328	63947.50690	-63493.49890	63946.90400	-63482.61070
PolyLine	402180004122	PA29244	207328	402180004122	PA29244	207344	63946.90400	-63482.61070	63946.03460	-63467.04940
PolyLine	402180003799	PA23173	207301	402180004123	PA29244	207317	63948.39620	-63509.46910	63947.50690	-63493.49890
PolyLine	40218000854	PA3681	207430	402180002049	PA1399	207427	63641.25520	-63381.16900	63847.36970	-63384.11020
PolyLine	40218000854	PA3681	207370	40218000854	PA3681	207430	63636.64390	-63441.20250	63641.25520	-63381.16900
PolyLine	40218000854	PA3681	207363	40218000854	PA3681	207370	63805.27910	-63448.22490	63636.64390	-63441.20250
PolyLine	402180003514	PA20238	207358	40218000854	PA3681	207363	63945.24760	-63452.95970	63805.27910	-63448.22490

Figure 5.3: Attributes of the GIS DCDB

Using ArcView 3.1 windows interface, identifying the attributes can be made. By using the Identify button, clicking on the theme (for an example shown in Figure Figure 5.4 and Figure 5.5) a result will be shown.

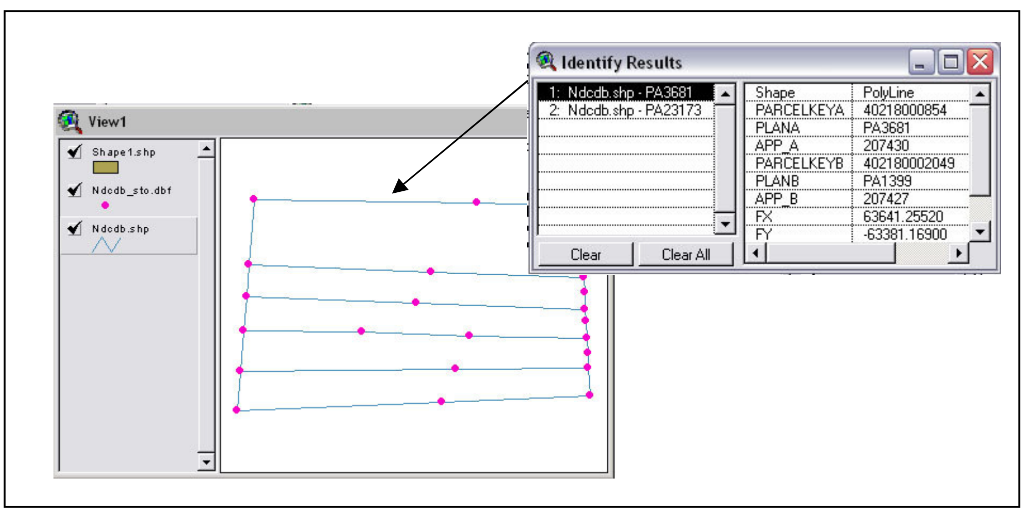


Figure 5.4: Identifying the attributes.

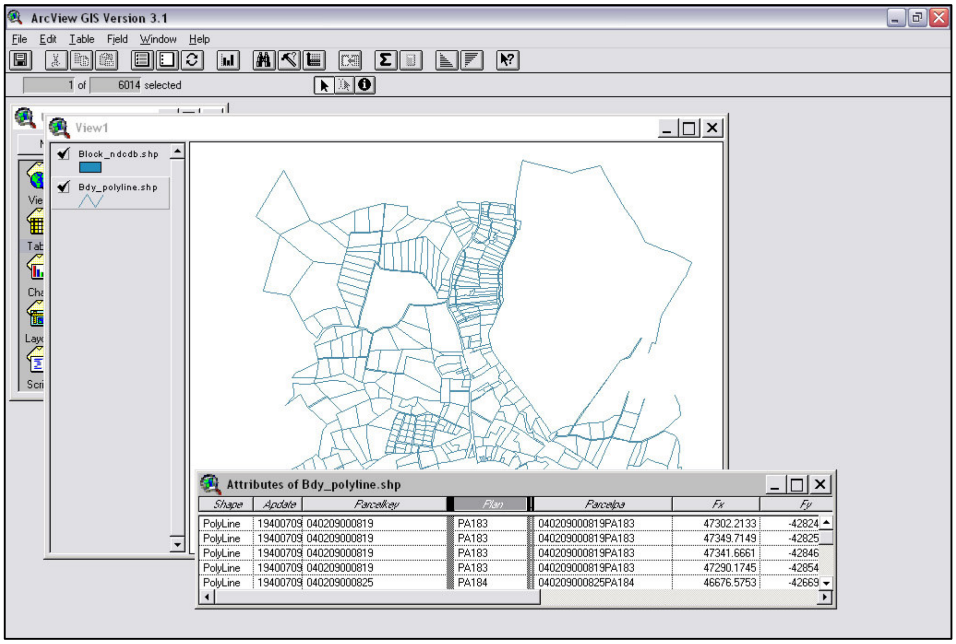


Figure 5.5: N DCDB for large cadastral network generated using CDSV

5.4 Analysis of Data Input: Adjusted Cadastral Network

Cadastral networks in study area have been adjusted using StarNet™ least squares software. Table 5.1 tabulates an example of the summary of the input data in the study area.

Table 5.1 : Example of Observation Statistic

Summary	***Total***
Cadastral Control	*4*
Number of Distance Observations	*3094*
Number of Bearing Observations	*3094*
Number of Stations	*1781*
Number of Observations	*6150*
Number of Unknowns	*3554*
Number of Redundant Observation	*2596*

.

Table 5.2 : Summary of Adjustment Result

Adjustment Statistical Summary	
Total Error Factor	1.020
Total iteration converged	4
Chi Square Test	5.00% *Level Passed*

Adjusted Observations and Residuals				
	Residuals		Station Coordinate Standard Deviations	
	Bearing	Distance	E (m)	N (m)
Max	2'40"	0.063	0.041	0.036
Min	0.01"	-0.085	0.001	0.005

Table 5.2 shows the adjustment statistic that reflect the quality of the input data that need to be used in the CDSV prototype. From the result (Figure 5.6), is shows that the input data is having a good quality and can be used as input in the CDSV. The RMS (s) for northing and easting components are less than 5 cm, repectively.

coor.xls

	A	B	C	D	E	F	G	H	I	J
1	473024282	0.014195	0.014621	0.000201	0.000214		E		N	
2	473494282	0.01405	0.014611	0.000197	0.000213		Max	0.041	Max	0.036
3	473414284	0.014175	0.014935	0.000201	0.000223		Min	0.001	Min	0.005
4	472904285	0.01431	0.014873	0.000205	0.000221		rms	0.022442		0.022536
5	466764266	0.013184	0.013547	0.000174	0.000184					
6	467954274	0.013105	0.013034	0.000172	0.00017					
7	467914279	0.013013	0.012927	0.000169	0.000167					
8	467244277	0.013487	0.013336	0.000182	0.000178					
9	466694277	0.013003	0.013102	0.000169	0.000172					
10	466674271	0.013303	0.013707	0.000177	0.000188					
11	465874279	0.012639	0.012504	0.00016	0.000156					
12	465364269	0.013405	0.012992	0.00018	0.000169					
13	465264263	0.013489	0.01303	0.000182	0.00017					
14	465844263	0.013834	0.013747	0.000191	0.000189					
15	466364262	0.013447	0.013627	0.000181	0.000186					

Figure 5.6 : Adjusted Coordinates for Boundary Mark

Figure 5.7 visualize the overlapping area between existing DCDB and NDCDB created by CDSV ptototype. Based on this figure, its indicates that the geometry of the new NDCDB and attribute information is similar to the existing DCDB. NDCDB that created using survey accurate information is more accurate than existing.

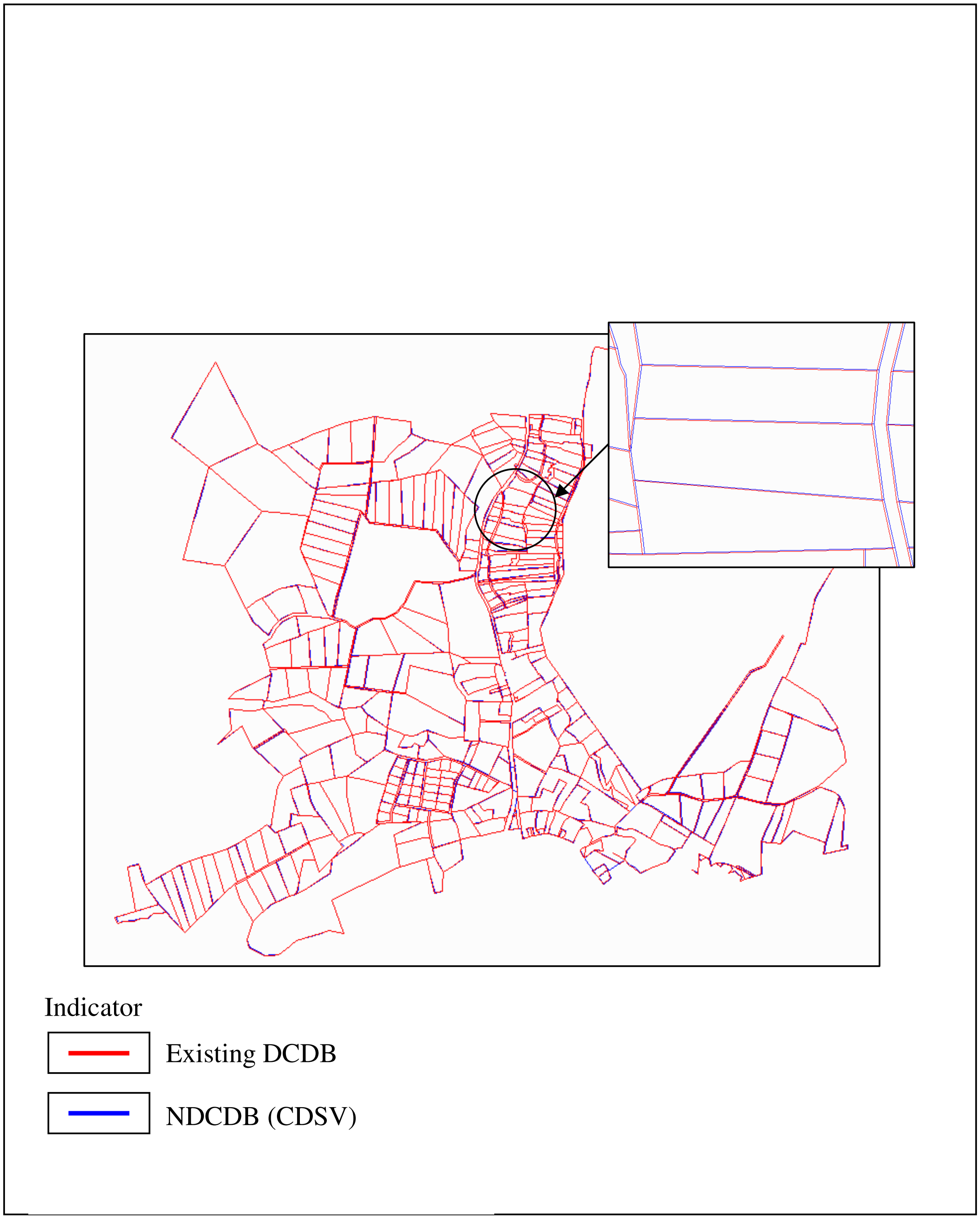


Figure 5.7 : Overlay Analysis Between Existing DCDB and NDCDB Created by CDSV Prototype.

CHAPTER 6

CONCLUSION AND RECOMMENDATIONS

6.1 Introduction

The study has been carried out to investigate the use of DCDB for developing the NDCDB. It has been shown that the use of DCDB as the main input for CCS is the most efficient and economical approach. A few aspects with regards to DCDB management need to be taken into consideration such as issue related to Data Integrity and DCDB Maintenance. In addition, the development of the Cadastral Database Selection and Visualization based on the object-oriented technology and GIS was found to be well functioning and can interact with DCDB effectively.

6.2 Details Findings

6.2.1 State Digital Cadastral Database

i) Data Quality

Data quality in the DCDB is nearly related to the methods of data acquisition and data presentation. Mode of data entry used in DCDB populating process is keyboard-entry. The said method is the best method available.

Using keyboard-entry method, data cleanliness problem will not exist. This is because with keyboard-entry method, problems such as undershoots, overshoots, and slivers will not exist compared to digitizing data entry method. All the information in CP will be entered manually, while the graphic information produce is depending solely on the entered information.

Data accuracy in DCDB developed by DSMM using keyboard-entry can be influence by two factors that is observation and data entry. Data observation in the field is important in gathering quality data. This is because the observation or the measurement on the field will be entered into CP. All the data in the DCDB that being developed by DSMM is depending solely on the CP, where each CP will have it own Class of Survey. Class of survey is determining by misclosure that have been fixed.

Data from the out-source will go through the inspection and certification process to make sure the data are following the standard and the criteria that being fixed by DSMM. All of the inspection and certification process is conducted under Sistem Pengesahan Kualiti (SPEK).

License surveyor will present the out-sourced work. These data will be reassessing to make sure it is free from mistake (random error). Assessment process on lot will be conducted based on the following criteria:

a) The difference on wide provided with the calculated system must not exceed 0.5%. For area less than 100m2, the allowed difference will not exceed 1.0%.

b) The difference on coordinate provided with the calculated system must not exceed 0.5%.

c) The misclose difference for 1st CLASS must be above 1:8000 while the 2nd CLASS is between 1:4000 to 1:8000 and the 3rd CLASS must not less than 1:2000.

If the difference stated above exceeding the stated rules, so the data reassessment must be done again. All the data that have been inspected must free from error before being sent to server for the updating process.

iii) Data Maintenance

Data Maintenance is needed if there are changes in the DCDB such as resurveying lot and updating boundary information, boundary marks, and lot. In the DCDB, if there are cases of resurveying then the original CP for the current lot will become *history*. *History* lot and current lot are identified by using *approved date* information.

6.2.2 Cadastral Database Selection Application

The development of the Intelligence Based Cadastral Database Selection and Visualization System will ease the NDCDB development process. Data screening and cleaning is essential since outliers exist in the data input. Intelligence and automated self-correction mechanisms will execute during the data input screening and filtering process and it will minimize manual editing process. The application will handle the incomplete spatial features and solve the outliers in the DCDB. Execution time for data selection, screening, and filtering depend on several factors, as follows:

i) Outliers
ii) Algorithm
ii) Block size
iii) Number of boundary mark
vi) Density of the cadastral lot

The result form the adjustment and new survey accurate NDCDB show that the Intelligence Based Cadastral Database Selection and Visualization prototype was functioning well and having a good reliability and integrity. The result form the adjustment show that the CDSA was functioning very well if the input data collect from DCDB is having a good integrity.

Based on the Data Selection process that have been conducted shown that it will take time to produce cadastral lots that have unique boundary marks, no hanging line, no outliers, and closed lot. The longer time consumed is because there are multiple of algorithms need to be entered in order to produce one perfect output. Processing time depend on the cleanliness of the data sets and the specifications of the computer.

There are definite trends occurring in the technology and management of cadastral systems. Establishing digital cadastral data based on adjusted coordinated will impact on the development of modern cadastres in each state and territory.

The study has attempted to describe the vision for modern cadastres and associated coordinated cadastres which are evolving in Peninsular Malaysia through CCS approach. It is hoped that a better understanding of the development of GIS DCDB based on adjusted coordinated will produce a systematic, efficient and effective database as a reference for GIS application and can be a model for implementation of e-cadastre in Malaysia.

Results show that GIS DCDB can be as a model for large scale implementation for survey authority. This DCDB will facilitate many GIS applications that required survey accurate information.

6.3 Recommendations

Recommendations for further study are as follows:

i) Web based Cadastral Database Selection and Visualization system
ii) Dynamic selection algorithms
iii) Incorporated advanced mathematical algorithms
iv) Develop dynamic least squares adjustment software in same prototype
v) Automation and simulation approach

REFERENCES

Abd Majid A Kadir, Kamaluddin Hj Omar, Kamaluddin Hj Talib and Mohd Nor Kamaruddin (1986). *Map projection Used for the National Mapping of Peninsular Malaysia*. Dept.of. Geod. Sci & Surv. The Ohio State University, Columbus, USA.: Term Paper,

Abd Majid A Kadir, Tan Say Kee, Chia Wee Tong and Teng Chee Boo (1996). *Report on the Feasibility Study of the Coordinated Cadastral System for Malaysia*. Department of Survey and Mapping, Malaysia.

Abdul Majid Mohamed, Chia Wee Tong and Chan Hun Seok (1998). *Cadastral Reforms in Malaysia*. FIG XXI Congree Proceeding, Commission 7. Brighton.

Abd Majid A.Kadir, Shahrum Ses, Cross, P., Rizos, C. (1999(a)). *Executive Summary Report on Contract Research for Feasibility Study on a Coordinated Cadastral System for Malaysia*. Department of Survey and Mapping, Malaysia.

Abd Majid A. Kadir and Shahrum Ses (1999(b)). *Report on Contract Research for Feasibility Study on a Coordinated Cadastral System for Malaysia: The Adjustment of Large Cadastral Network with Reference to RSO Coordinate System*. Department of Survey and Mapping, Malaysia.

Abdul Majid Kadir, Shahrum Ses, Chia Wee Tong and Teng Chee Boo (2000). *Towards the Implimentation of Coordinated Cadastral System in Malaysia: Large Cadastral Network Adjustments*. Deakin: The Institute of Surveyor Australia.

Abd Majid A. Kadir and Kamaluddin Hj Omar (2001). *Report on Definition And Realisation of A Geocentric Datum For Peninsular Malaysia*. Department of Survey and Mapping, Malaysia.

Abd Majid Kadir, Ghazali Desa and Abdullah Hisham Omar (2000). *Sistem Maklumat Tanah: Prinsip dan Amala*n. Fakulti Kejuruteraan & Sains Geoinformasi, Universiti Teknologi Malaysia : Monograph.

Abd Majid Kadir and Ghazali Desa (2002). *Report On The Institutional Issues On The Implementation of Coordinated Cadastral System*. Department of Survey and Mapping, Malaysia.

Abd Majid Kadir, Shahrum Ses and Abdullah Hisam Omar (2002). *Methodology For The Development of National Digital Coordinated Cadastral Database*, report submitted to the Licensed Land Surveyors Board of Peninsular Malaysia.

Ahmad Fauzi Nordin (2002). *Institutional Issues On The Implementation of The Coordinated cadastral System For Peninsular Malaysia: A Study on the legal and Organisational Aspects*. Universiti Teknologi Malaysia, Skudai : Masters Degree Thesis.

Dale, P.F and Mclaughlin, J.D. (1989). *Land Information Management : An Introduction With Special Reference To Cadastral problems In Third World Countries*. Oxford: Clarendon Press.

Demers, M.N (1997). *Fundamentals of Geographic Information Systems*. New York: John Wiley & Sons.

DOL (1986). *Feasibility Study into a Coordinated Cadastre for South Australia*. Department of Lands (South Australia).

DOLA. (1995). *Technical Report: Digital Cadastral Database In Australia*. Deakin: The Institute of Surveyor Australia : The Australian Surveyor. Vol 40, No.3.

DSMM (1999). *Anugerah Teknologi Maklumat Sistem Pengurusan Data Kadaster*. Department of Survey and Mapping Malaysia, Kuala umpur.

DSMM (2001). *Malaysia DCDB Out-Sourced Format*. Department of Survey and Mapping Malaysia, Kuala Lumpur

Elmasri, R. and Navathe, S.B. (1994). *Fundamentals of Database Systems*. California : The Benjamin/Cummings Publishing Company.

Environmental System research Institute (2001). *ArcInfo 8*. http://www.esri.com

Featherstone, W. (1994). *An Update Explanation of The Geocentric Datum of Australia (GDA) and it Effects Upon Future Mapping Cartography*. http://www.intergraph.com/au/aic/level/11_gda94.htm

Featherstone, W. (1998). *The Geocentric Datum of Australia (GDA94)*. School of Spatial Sciences, Curtin University of Technology.

Hessen, J.L.G (1995). *Digital Cadastral Database In Australia*. Deakin :, The Institute of Surveyor Australia : The Australian Surveyor. Vol 40, No.3, pp 235-244.

Huber, B (2000). *Reprojecting Geographic Features*. Direction Magazine. http://www.Directionsmag.com

Kanun Tanah Negara (1996). Kuala Lumpur: Percetakan Nasional Malaysia

KPUP (1999). *KPUP Circular 6/1999*._Department of Survey and Mapping, Malaysia.

Larsson, G. (1991). *Land Registration And Cadastral Systems – Tool For Land Information And Management*. Essex: Longman Group UK Limited.

Lodwick, G. (1999). *Land Information System*. School of Spatial Sciences, Curtin University of Technology, Curtin.

Mc Laughlin, J.D. (1988). *Land Information Management*. 1st Ed. Oxford: Oxford University Press.

NRC (2004). *Geomatics CofP – Real Property: Cadastral Systems Trends and Benchmarking*. Natural Resources Canada, Canada.

Richardus, P. and Adler R.K. (1974). *Map Projections*. Netherland: North Holland Publishing Company.

Rizos,C. and Abd Majid A. Kadir (1997). *Preliminary Report: Feasibility Study On Coordinated Cadastre System in Malaysia. Legal Traceability Issues, Standards & Specifications for GPS Cadastral Surveys*. Kuala Lumpur, Department of Survey and Mapping, Malaysia.

Rosly Abdul Kadir. (1982). *Computer Assisted Mapping Requirements In Support of A Multipurpose Cadastre*. A Technical Paper Presented to the Department of Geodetic Science and Surveying, Ohio State University, Ohio.

Samad Abu (1998). *Status of Existing Geodetic Networks and Future GPS Activities In Malaysia*. *The Surveyor*. 33 (3). 12-20.

Samad Abu (2001). *Definition and Realisation of A Geocentric Datum For Peninsular Malaysia*. Universiti Teknologi Malaysia : Doctor of Philosophy Thesis.

Suon, S. and Lor, D. (2001). *Reforming Land Registration in Cambodia*. Ministry of Land Management Urban Planning and Construction of the Kingdom of Cambodia, Cambodia.

Spatial-Online (2001), *nOrderTransform*. Integration World System (IWS). http://www.spatial-online.com.

STARPLUS (2002). *StarNet : Least Squares Survey Adjustment Program*. Oakland: Starplus Software, Inc.

Tang, C (2002). *Cadastral Survey System Enhancement in The Hong Kong Special Administrative Region of The People's Republic of China: A Study of Survey Law Reform in Hong Kong*. The Hong Kong Polytechnic University: Doctor of Philosophy Thesis

Tien Yin Chou (2005). *e-Taiwan with Cadastral Information Database*. GIS Development Magazine. 9(3): 18-20.

Tan, Say Kee. (1997). *Pelarasan Jaringan Kadastra Bersaiz Besar Untuk Menyokong Sistem Kadastra Berkoordinat*. Universiti Teknologi Malaysia : Tesis Sarjana.

Taher Buyong. (1990). *Model Konsep Sistem Maklumat Tanah Berdasarkan Kepada Ukuran*. The Surveyor. 3rd Quaterly '90.

UN/ECE/WPLA. (2001). *Inventory of land administration systems in Europe and North America*. London

Van der Molen, P. (2003). *The Future Cadastres – Cadastres after 2014*. Proceedings of the FIG Working Week 2003. April 13-17. Paris, France.

Wan Abdul Aziz et al. (2002). *Cadastral reform in Malaysia : a vision to the 2000s*. Universiti Teknologi Malaysia: Research Paper

Williamson,I and Hunter,G. (1996a). *The Establishment of a Coordinated Cadastre For Victoria*. Department of Geomatics, University of Melbourne, Melbourne: A Report for the Office of Surveyor General and the Office of Geographic Data Coordination Department of Treasury and Finance.

Williamson, I. (1996b). *Coordinated Cadastre: A Key To Building Future GIS*. Information System For Success, Melbourne : Proceedings of the Regional Conference On Managing Geographic, pp 60-69.

Williamson, I. (1996c). *Establishing Coordinated Cadastre - Australian Experiences*. Presented to the International Conference on Cadastral Reform, Korea.

Williamson, I. (1990). *Why Cadastral Reform?*. Proceeding of National Conference on Cadastral Reform. Melbourne, Australia

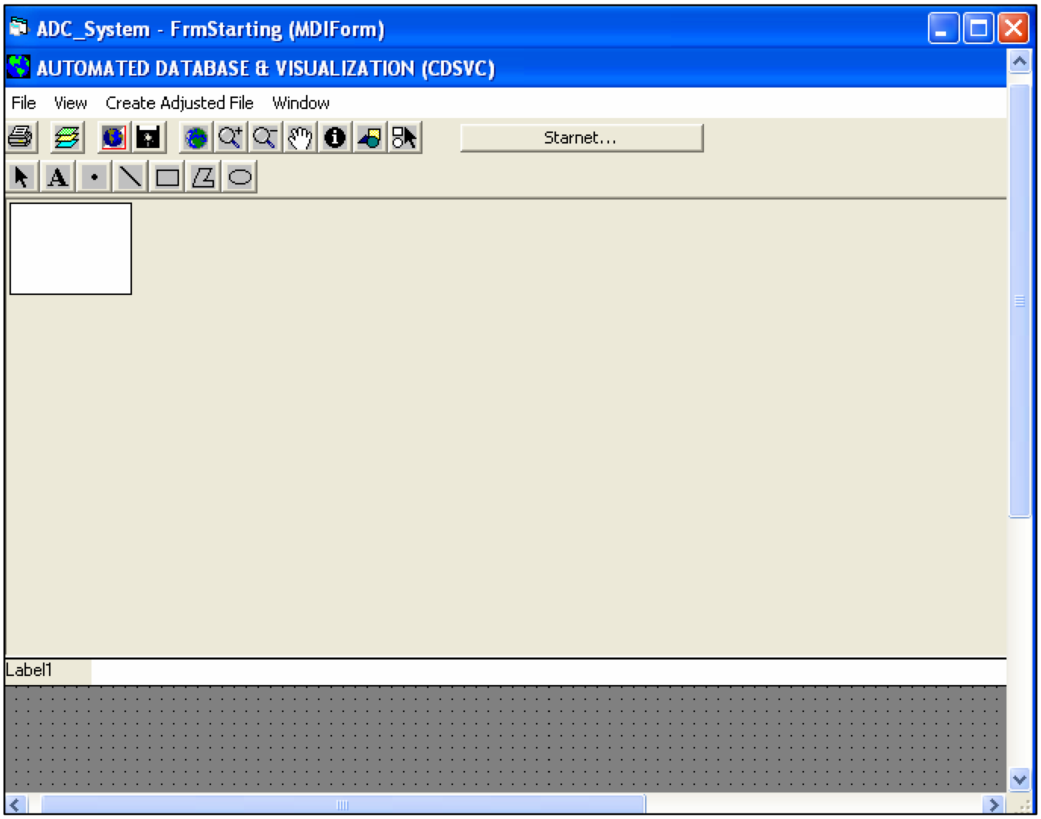
Williamson, I. (1998). *Strategic Management of Cadastral Reform*. FIG Commission 7 Symposium on Cadastral Systems in Developing Countries. Penang, Malaysia.

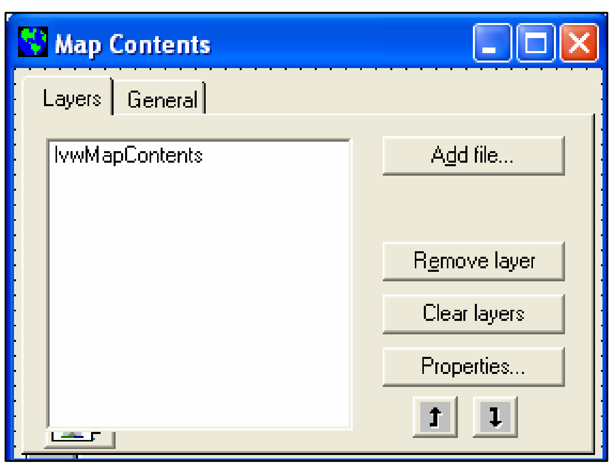
Williamson, I. (2002). *The Cadastral "Tool Box" – A Framework for Reform*. Proceedings of the FIG XXII International Congress. April 19-26. Washington, USA.

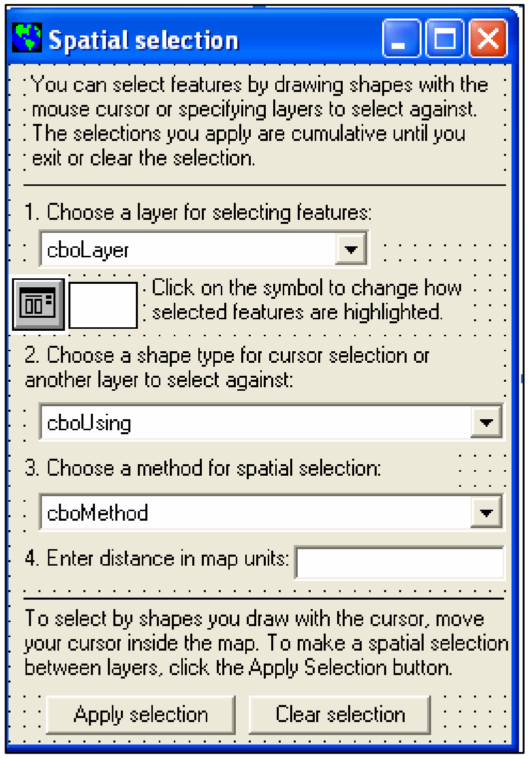
Wong Kok Siong. (1999). *Kearah Perlaksanaan Sistem Koordinat Kadaster Homogen Untuk Semenanjung Malaysia*. Fakulti Kejuruteraan dan Sains Geoinformasi. Universiti Teknologi Malaysia. Skudai : Tesis Ijazah Sarjana Sains (Ukur Tanah).

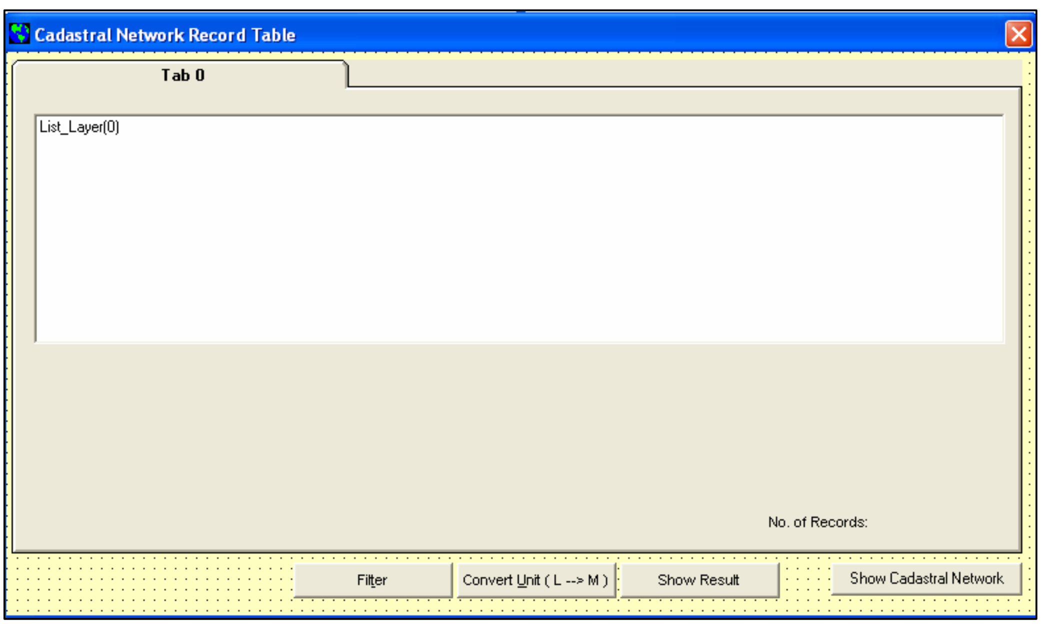
APPENDIX A

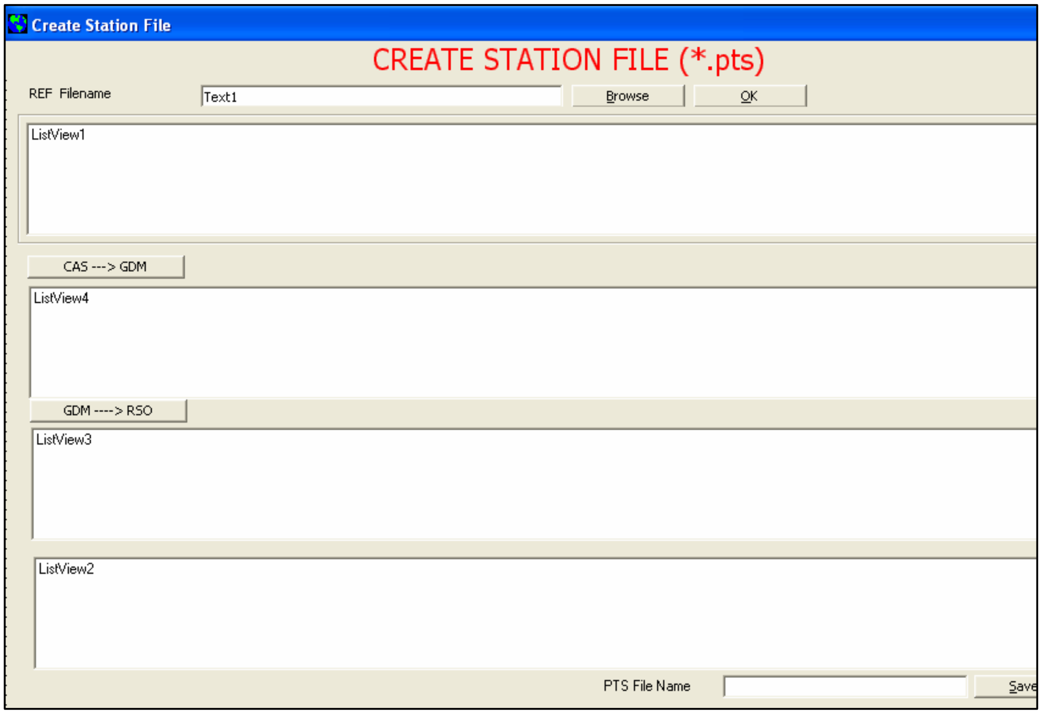
Intelligence Cadastral Database Selection and Visualization System

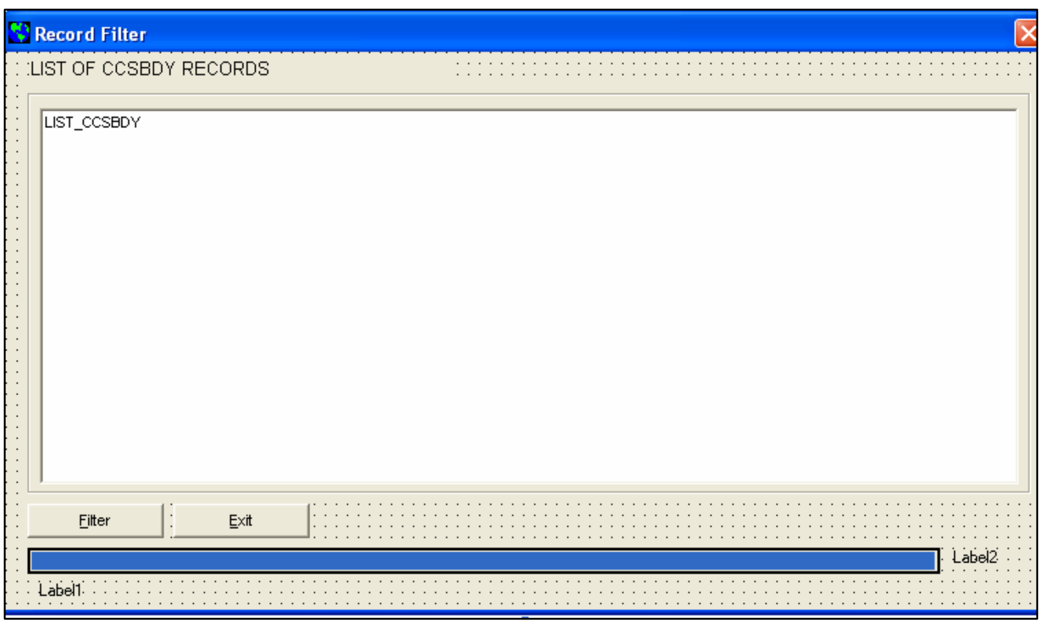





Spatial selection
You can select features by drawing shapes with the mouse cursor or specifying layers to select against. The selections you apply are cumulative until you exit or clear the selection.
1. Choose a layer for selecting features:
cboLayer
Click on the symbol to change how selected features are highlighted.
2. Choose a shape type for cursor selection or another layer to select against:
cboUsing
3. Choose a method for spatial selection:
cboMethod
4. Enter distance in map units:
To select by shapes you draw with the cursor, move your cursor inside the map. To make a spatial selection between layers, click the Apply Selection button.
Apply selection
Clear selection


Cadastral Network Record Table
Tab 0
List_Layer(0)
No. of Records:
Filter
Convert Unit (L --> M)
Show Result
Show Cadastral Network


Create Station File
CREATE STATION FILE (*.pts)
REF Filename
Text1
Browse
OK
ListView1
CAS ---> GDM
ListView4
GDM ----> RSO
ListView3
ListView2
PTS File Name
Save


Record Filter
LIST OF CCSBDY RECORDS
LIST_CCSBDY
Filter
Exit
Label2
Label1

CDSV CODING

```
Dim g_EditLayer As New clsEditLayer

Dim m_mapTip As New clsMapTip

Dim dropValid As Boolean
Public Sub CSRSO(NCS, ECS, A1, A2, A3, A4, A5, B1, B2, B3, B4, B5, NOCS, _
            EOCS, NORSO, EORSO, R1, R2, MNRSO, MERSO)
    x = NCS - NOCS
    y = ECS - EOCS
    TESTA = 0#
    TESTB = 0#
    A = x
    B = y
    Call MALAR(A, B, A1, A2, A3, A4, A5, B1, B2, B3, B4, B5, R1, R2, MALAR1, MALAR2)
    TEST1 = x + MALAR1
    TEST2 = y + MALAR2
    NRSO = NORSO + TEST1
    ERSO = EORSO + TEST2
    MNCS = NCS * 20.11678249
    MECS = ECS * 20.11678249
    MNRSO = NRSO * 20.11678249
    MERSO = ERSO * 20.11678249


End Sub
Public Sub UNITO(x, y)
    x = x / 20.11678249
    y = y / 20.11678249
End Sub


Public Sub MALAR(x, y, A1, A2, A3, A4, A5, B1, B2, B3, B4, B5, R1, R2, MALAR1, MALAR2)
    XX = x / 10000#
    yy = y / 10000#
    XXYY = XX * yy
    XX2 = XX ^ 2
    yy2 = yy ^ 2
    MALAR1 = R1 + (XX * A1) + (yy * A2) + (XXYY * A3) + (XX2 * A4) + (yy2 * A5)
    MALAR2 = R2 + (XX * B1) + (yy * B2) + (XXYY * B3) + (XX2 * B4) + (yy2 * B5)
End Sub


Public Sub loadlist(bil_lay As Integer)

  On Error Resume Next
   Dim i As Integer
   If frm_table.Tab_Layer.Tabs = bil_lay Then Exit Sub
   frm_table.Tab_Layer.Tabs = bil_lay
   For i = 1 To frm_table.Tab_Layer.Tabs - 1
      frm_table.Tab_Layer.Tab = i
      Load frm_table.List_Layer(i)


      Set frm_table.List_Layer(i).Container = frm_table.Tab_Layer

      Load frm_table.lbl_norec(i)
      Set frm_table.lbl_norec(i).Container = frm_table.Tab_Layer
      frm_table.lbl_norec(i).Top = 5280
      frm_table.lbl_norec(i).Left = 8340
      frm_table.lbl_norec(i).Visible = True

      frm_table.List_Layer(i).Top = frm_table.Tab_Layer.Top + 400
      frm_table.List_Layer(i).Left = frm_table.Tab_Layer.Left + 400
      frm_table.List_Layer(i).Visible = True

      frm_table.List_Layer(i).Width = frm_table.Tab_Layer.Width * 0.95
      frm_table.List_Layer(i).Height = frm_table.Tab_Layer.Height * 0.7
      frm_table.List_Layer(i).Left = ((frm_table.Tab_Layer.Width - frm_table.List_Layer(i).Width) / 2) * 0.9 ' Center
form horizontally.
```

```
    Next i
    frm_table.Tab_Layer.Tab = 0
    frm_table.List_Layer(0).Top = frm_table.Tab_Layer.Top + 400
    frm_table.List_Layer(0).Left = frm_table.Tab_Layer.Left + 400

    frm_table.List_Layer(0).Width = frm_table.Tab_Layer.Width * 0.95
    frm_table.List_Layer(0).Height = frm_table.Tab_Layer.Height * 0.7
    frm_table.List_Layer(0).Left = ((frm_table.Tab_Layer.Width - frm_table.List_Layer(0).Width) / 2) * 0.9 ' Center
form horizontally.
    frm_table.Show
End Sub
Public Sub resizeform()
   Map1.Width = Me.Width * 0.95
   Map1.Height = Me.Height * 0.8


   Map1.Left = ((Me.Width - Map1.Width) / 2) * 0.9
   Map1.Top = Me.Top + 800
   ProgressBar1.Width = Map1.Width - 800
   ProgressBar1.Top = Me.Height - 700
   ProgressBar1.Left = Map1.Left
   lblbar1.Top = ProgressBar1.Top
   lblbar1.Left = ProgressBar1.Width + 300
   lblbar3.Top = ProgressBar1.Top - 300

End Sub

Private Sub Export_Shapes()
  Dim outputName As String
  Screen.MousePointer = 11

  CommonDialog1.Filter = "ESRI Shapefiles (*.shp)|*.shp"
  CommonDialog1.DefaultExt = ".shp"
  CommonDialog1.ShowSave

  If Len(CommonDialog1.filename) = 0 Then Exit Sub

  g_EditLayer.ExportToShapefile CommonDialog1.filename
  Screen.MousePointer = 0
End Sub

Private Sub barDisplay_ButtonClick(ByVal Button As Button)

  Dim bKey As String
  bKey = Button.Key
  Call doTask(bKey)

End Sub

Private Sub cboTipField_Click()
  If cboTipField.text <> "" Then
    m_mapTip.SetLayer FrmStarting.mapDisp.Layers(cboTipLayer.text), cboTipField.text
  End If
End Sub

Private Sub cboTipLayer_Click()
  updateTipField
End Sub

Private Sub chkTipLayer_Click()
  If mapDisp.Layers.Count = 0 Then
    chkTipLayer.Value = 0

  ElseIf chkTipLayer.Value = 1 Then
    frmMapContents.refreshMapTips

  ElseIf chkTipLayer.Value = 0 Then
    cboTipLayer.Clear
    cboTipField.Clear

  End If
End Sub

Private Sub Command1_Click()
    showkan = 1
```

```
    mapDisp.TrackingLayer.Refresh True
    Exit Sub
End Sub

Private Sub Command2_Click()
   Command1_Click
End Sub

Private Sub Command3_Click()
On Error GoTo salah:
 Shell "C:\Program Files\StarPlus\StarNet\StarNet.exe", vbMaximizedFocus
Exit Sub
salah:
MsgBox "File not found : C:\Program Files\StarPlus\StarNet\StarNet.exe"
End Sub

Private Sub Command4_Click()
showkan = 0
End Sub

Private Sub mdiForm_Load()
On Error Resume Next '

  Dim topCorner As Integer
  Dim leftCorner As Integer

  If FrmStarting.WindowState <> 0 Then Exit Sub

  topCorner = (Screen.Height - FrmStarting.Height) \ 2
  leftCorner = (Screen.Width - FrmStarting.Width) \ 2
  FrmStarting.Move leftCorner, topCorner

  barGraphics.Visible = False
  g_EditLayer.Initialize mapDisp


  m_mapTip.Initialize mapDisp, tmrMapTip, picMapTip, lblMapTip
  mapDisp.Top = Picture2.Top
  mapDisp.Left = Picture2.Left
  mapDisp.Width = Picture2.Width
  mapDisp.Height = Picture2.Height
  mapDisp.Refresh

End Sub

Private Sub MDIForm_Resize()
  Dim border As Double, sideBorder As Double
  Dim topBorder As Double, statusbarHeight As Double

  border = 30
  topBorder = 480
  sideBorder = 480

  statusbarHeight = 400

  mapDisp.Top = Picture2.Top

  mapDisp.Left = Picture2.Left

  If ScaleHeight > topBorder + border + statusbarHeight Then
   Picture2.Height = Screen.Height - topBorder - border - statusbarHeight - Picture1
    mapDisp.Height = Picture2.Height
  End If
  If ScaleWidth > (border * 2) + sideBorder Then
    mapDisp.Width = Picture2.Width
  End If

  Dim h As Long, w As Long
  h = FrmStarting.Height
  w = FrmStarting.Width
End Sub

Private Sub mdiForm_Unload(Cancel As Integer)
    End
End Sub
```

```
Private Sub mapDisp_AfterTrackingLayerDraw(ByVal hDC As Stdole.OLE_HANDLE)

If ActionCode = 2 Then

   Dim recs As MapObjects.Recordset
   Dim fld As MapObjects.Field
   Dim sym As New MapObjects.symbol

   '============================================================================
   If showkan = 1 Then
     On Error Resume Next
     For i = 0 To frm_table.Tab_Layer.Tabs - 1
         frm_table.Tab_Layer.Tab = i
         Set recs = mmorstSelectedFeatures(i)
         If Not recs Is Nothing Then
            Dim fld2 As MapObjects.Field, fld1 As MapObjects.Field, fld3 As MapObjects.Field
            sym.color = moYellow
            If style = moTransparentFill Then sym.OutlineColor = moYellow
            sym.style = moTransparentFill

            Set fld = recs("shape")
            If recs.Count = 0 Then GoTo yy
            recs.MoveFirst     ' reset the cursor
            Do While Not recs.EOF ' loop through the records
              Select Case UCase(frm_table.Tab_Layer.Caption)
                 Case "CCSBDY":    'ccsbdy file
                       PP = frm_table.List_Layer(i).ListItems.Count
                       For p = 1 To PP
                              Set fld22 = recs("FX")
                              Set fld222 = recs("FY")
                              Set fld33 = recs("TX")
                              Set fld333 = recs("TY")
                              If ((frm_table.List_Layer(i).ListItems.Item(p).SubItems(17) = fld22.Value And _
                                   frm_table.List_Layer(i).ListItems.Item(p).SubItems(18) = fld222.Value) _
                                   And _
                                  (frm_table.List_Layer(i).ListItems.Item(p).SubItems(19) = fld33.Value And _
                                   frm_table.List_Layer(i).ListItems.Item(p).SubItems(20) = fld333.Value)) _
                                   Or _
                                   ((frm_table.List_Layer(i).ListItems.Item(p).SubItems(19) = fld22.Value And _
                                   frm_table.List_Layer(i).ListItems.Item(p).SubItems(20) = fld222.Value) _
                                   And _
                                  (frm_table.List_Layer(i).ListItems.Item(p).SubItems(17) = fld33.Value And _
                                   frm_table.List_Layer(i).ListItems.Item(p).SubItems(18) = fld333.Value)) _
                                   Then
                                     mapDisp.DrawShape fld.Value, sym
                                     TEE = TEE + 1
                              End If

                       Next p
                    End Select

                    recs.MoveNext
                 Loop
         End If
yy:
      Next i
      showkan = 0

      'On Error GoTo 0
      Exit Sub
   End If

   '==========================================================
   'this function used to draw the selection rectangle
   If Not mmorectSearchBounds Is Nothing Then
         sym.SymbolType = moFillSymbol
         sym.style = moDiagonalCrossFill
         sym.color = moBlue
         mapDisp.DrawShape mmorectSearchBounds, sym
   End If
   '====================================================
cobaah:
   For i = 0 To billayer - 1
      Set recs = mmorstSelectedFeatures(i)
      If Not recs Is Nothing Then
         sym.color = moYellow
```

```
            If style = moTransparentFill Then sym.OutlineColor = moYellow
            sym.style = moTransparentFill
            Set fld = recs("shape")

            If recs.Count = 0 Then GoTo rr
            recs.MoveFirst     ' reset the cursor

            Do While Not recs.EOF ' loop through the records
              mapDisp.DrawShape fld.Value, sym
               recs.MoveNext
            Loop
rr:
        End If
    Next i
End If

  g_EditLayer.Draw  ' draw the edit layer
  frmSpatial.DrawSelectedFeatures (hDC)

End Sub

Private Sub mapdisp_BeforeLayerDraw(ByVal Index As Integer, ByVal hDC As Stdole.OLE_HANDLE)
  updateScale
End Sub

Private Sub mapDisp_DragFiles(ByVal fileNames As Object, ByVal x As Single, ByVal y As Single, ByVal STATE As
Integer, dropValid As Boolean)
  If fileNames.Count > 0 Then
    dropValid = True
  End If
End Sub

Private Sub mapDisp_DropFiles(ByVal fileNames As Object, ByVal x As Single, ByVal y As Single)
  Dim dcx As New MapObjects.DataConnection
  Dim shpfile As Variant
  Dim i As Integer
  Dim ml As MapObjects.MapLayer
  shpfile = (Dir(fileNames.Item(0), vbDirectory))
  shpfile = CStr(Left(shpfile, Len(shpfile) - 4))

  dcx.Database = Left(fileNames.Item(0), Len(fileNames.Item(0)) - Len(shpfile) - 5)
  If dcx.Connect Then
    For i = 0 To fileNames.Count - 1
      Set ml = New MapObjects.MapLayer
      shpfile = Dir(fileNames.Item(i), vbDirectory)
      shpfile = CStr(Left(shpfile, Len(shpfile) - 4))
      ml.GeoDataset = dcx.FindGeoDataset(shpfile)
      mapDisp.Layers.Add ml
    Next i

    'prepare collections to sort layers
    Dim ptcoll As New Collection
    Dim linecoll As New Collection
    Dim polycoll As New Collection
    Dim imagecoll As New Collection

    For i = 0 To mapDisp.Layers.Count - 1
      If mapDisp.Layers(i).LayerType = moImageLayer Then
          imagecoll.Add mapDisp.Layers(i)
      ElseIf mapDisp.Layers(i).LayerType = moMapLayer Then
        Select Case mapDisp.Layers(i).shapeType
          Case 21 'point features
            ptcoll.Add mapDisp.Layers(i)
          Case 22 'line features
            linecoll.Add mapDisp.Layers(i)
          Case 23 'polygon features
            polycoll.Add mapDisp.Layers(i)
        End Select
      End If
    Next i
    mapDisp.Layers.Clear

    'add all the layers back in sorted by type
    Dim p As MapObjects.MapLayer
    For Each p In polycoll
      mapDisp.Layers.Add p
```

```
   Next p

   Dim l As MapObjects.MapLayer
   For Each l In linecoll
     mapDisp.Layers.Add l
   Next l

   For Each p In ptcoll
     mapDisp.Layers.Add p
   Next p

   Dim im As MapObjects.ImageLayer
   For Each im In imagecoll
     mapDisp.Layers.Add im
   Next im

  End If
  mapDisp.Extent = mapDisp.FullExtent
  mapDisp.Refresh

  'This refreshes the Map Contents list view
  Call frmMapContents.rebuildListView

End Sub

Private Sub mapDisp_MouseDown(Button As Integer, Shift As Integer, x As Single, y As Single)
    On Error Resume Next
    showkan = 0

If ActionCode = 2 Then
Dim l As MapObjects.MapLayer
   Dim rowlayer As Integer
   Dim bilcol As Integer, jumcol As Integer
   Dim fname As String
   Open App.path + "\BDY_OLD.TXT" For Output As #100
   If zoomin = True Then
       DoZoom Shift, Button
   Else
       Set mmorectSearchBounds = mapDisp.TrackRectangle
       billayer = 0

       loadlist (mapDisp.Layers.Count) 'CALL FUNCTION LOADLIST

       For Each l In mapDisp.Layers 'LOOP FOR EACH LAYERS
       frm_table.List_Layer(billayer).ListItems.Clear
       frm_table.List_Layer(billayer).ColumnHeaders.Clear
       Set mmorstSelectedFeatures(billayer) = _
                 l.SearchShape(mmorectSearchBounds, moAreaIntersect, "")
         '==============================================================
         frm_table.Tab_Layer.Tab = billayer
         frm_table.Tab_Layer.Caption = UCase(Trim(l.Name))

         jumcol = mmorstSelectedFeatures(billayer).TableDesc.FieldCount + 6
         jumtemp = mmorstSelectedFeatures(billayer).TableDesc.FieldCount
         If UCase(l.Name) = "GPS" Then jumcol = jumcol - 3
         For bilcol = 1 To jumcol

             If bilcol > jumtemp Then
                 frm_table.List_Layer(billayer).ColumnHeaders.Add
                 Select Case bilcol - jumtemp
                    Case 1:
                       frm_table.List_Layer(billayer).ColumnHeaders.Item(bilcol).text = "RSO_FNODE"
                    Case 2:
                       frm_table.List_Layer(billayer).ColumnHeaders.Item(bilcol).text = "RSO_Fx"
                    Case 3:
                       frm_table.List_Layer(billayer).ColumnHeaders.Item(bilcol).text = "RSO_Fy"
                    Case 4:
                       frm_table.List_Layer(billayer).ColumnHeaders.Item(bilcol).text = "RSO_TNODE"
                    Case 5:
                       frm_table.List_Layer(billayer).ColumnHeaders.Item(bilcol).text = "RSO_Tx"
                    Case 6:
                       frm_table.List_Layer(billayer).ColumnHeaders.Item(bilcol).text = "RSO_Ty"
                 End Select

             Else
                 frm_table.List_Layer(billayer).ColumnHeaders.Add
```

```
            frm_table.List_Layer(billayer).ColumnHeaders.Item(bilcol).text = _
                  mmorstSelectedFeatures(billayer).TableDesc.fieldName(bilcol - 1)
          End If
        Next bilcol
''''''''''''        '=====================================================
''''''''''''        'SPECIAL FUNCTION TO SORT COLUMN FOR CCSTO & CCSBDY
''''''''''''         Select Case UCase(Trim(l.name))
''''''''''''           Case "CCSBDY"
''''''''''''''            temp = frm_table.List_Layer(billayer).ColumnHeaders.Item(2).Text
''''''''''''''            frm_table.List_Layer(billayer).ColumnHeaders.Item(2).Text = _
''''''''''''''                 frm_table.List_Layer(billayer).ColumnHeaders.Item(1).Text
''''''''''''''            frm_table.List_Layer(billayer).ColumnHeaders.Item(1).Text = temp
''''''''''''         End Select
''''''''''''         'END SPECIAL COLUMN SORTING
''''''''''''         '=========================================================================
        'END CODE
        '=================================
        countervalue = mmorstSelectedFeatures(billayer).Count
        frm_table.lbl_norec(billayer).Caption = "No. of Records :" & countervalue
        lblbar3.Caption = "Loading " & UCase(l.Name) & " file. Please Wait..."
        ProgressBar1.Min = 0
        ProgressBar1.Value = 0

        If countervalue = 0 Then countervalue = 1
        pbarvalue = Format(ProgressBar1.Max / countervalue, "###.00")
        lblbar1.Caption = Format(ProgressBar1.Value, "###") & "%"
        lblbar1.Refresh


        mmorstSelectedFeatures(billayer).MoveFirst
        'LOOP FOR EACH ROW IN EACH LAYER
        rowlayer = 1

        While Not mmorstSelectedFeatures(billayer).EOF
          frm_table.List_Layer(billayer).ListItems.Add
          fname = mmorstSelectedFeatures(billayer).TableDesc.fieldName(0)
          frm_table.List_Layer(billayer).ListItems(rowlayer).text = _
            mmorstSelectedFeatures(billayer).Fields(fname).Value
          jumcol = mmorstSelectedFeatures(billayer).TableDesc.FieldCount
          TEMPBDY = frm_table.List_Layer(billayer).ListItems(rowlayer).text & ","

          For bilcol = 1 To jumcol - 1
              fname = mmorstSelectedFeatures(billayer).TableDesc.fieldName(bilcol)
              frm_table.List_Layer(billayer).ListItems(rowlayer).SubItems(bilcol) = _
                 mmorstSelectedFeatures(billayer).Fields(fname).Value
          Next bilcol


          For bilcol = 1 To jumcol - 1
               TEMPBDY = TEMPBDY + frm_table.List_Layer(billayer).ListItems(rowlayer).SubItems(bilcol) + ","

          Next bilcol
          Print #100, TEMPBDY


'=====================================================================================
          ' ADDED BY AMRAN:
          ' DATE 03/04/2005 : TO CONVERT CASSINI TO RSO COORDINATE

          Select Case UCase(Trim(l.Name))
                Case "CCSBDY":
                     NCS = frm_table.List_Layer(billayer).ListItems(rowlayer).SubItems(18)
                     NCS = Format(NCS, "0.00")
                     ECS = frm_table.List_Layer(billayer).ListItems(rowlayer).SubItems(17)
                     ECS = Format(ECS, "0.00")
                     Call UNITO(NCS, ECS)
                     Call CSRSO(NCS, ECS, 0.04887, -19.7519, -5.29544, -1.48678, _
                             1.39966, 19.88167, -0.08787, -3.60882, 2.40011, _
                             -1.63052, -47.152, -12.03, 14918.998, 21786.154, _
                             -0.0132, -0.011, MNRSO, MERSO)
                     frm_table.List_Layer(billayer).ListItems(rowlayer).SubItems(25) = MNRSO
                     frm_table.List_Layer(billayer).ListItems(rowlayer).SubItems(24) = MERSO

'
                     'ADDED BY AMRAN ON 1 MAY 2005
                     MYPOS = InStr(1, MNRSO, ".")
```

```
        NODE_id1A = Abs(Mid(MNRSO, 1, MYPOS))
        NODE_id2B = Abs(Mid(MNRSO, MYPOS + 1, 1))
        NODE_id1 = Trim(str(NODE_id1A)) & NODE_id2B


        MYPOS = InStr(1, MERSO, ".")
        NODE_id1A = Abs(Mid(MERSO, 1, MYPOS))
        NODE_id2B = Abs(Mid(MERSO, MYPOS + 1, 1))
        NODE_id2 = Trim(str(NODE_id1A)) & NODE_id2B

        POINTKEY = NODE_id1 & NODE_id2
        frm_table.List_Layer(billayer).ListItems(rowlayer).SubItems(23) = POINTKEY



        NCS = frm_table.List_Layer(billayer).ListItems(rowlayer).SubItems(20)
        NCS = Format(NCS, "0.00")
        ECS = frm_table.List_Layer(billayer).ListItems(rowlayer).SubItems(19)
        ECS = Format(ECS, "0.00")
        Call UNITO(NCS, ECS)
        Call CSRSO(NCS, ECS, 0.04887, -19.7519, -5.29544, -1.48678, _
            1.39966, 19.88167, -0.08787, -3.60882, 2.40011, _
            -1.63052, -47.152, -12.03, 14918.998, 21786.154, _
            -0.0132, -0.011, MNRSO, MERSO)
        frm_table.List_Layer(billayer).ListItems(rowlayer).SubItems(28) = MNRSO
        frm_table.List_Layer(billayer).ListItems(rowlayer).SubItems(27) = MERSO

        MYPOS = InStr(1, MNRSO, ".")
        NODE_id1A = Abs(Mid(MNRSO, 1, MYPOS))
        NODE_id2B = Abs(Mid(MNRSO, MYPOS + 1, 1))
        NODE_id1 = Trim(str(NODE_id1A)) & NODE_id2B


        MYPOS = InStr(1, MERSO, ".")
        NODE_id1A = Abs(Mid(MERSO, 1, MYPOS))
        NODE_id2B = Abs(Mid(MERSO, MYPOS + 1, 1))
        NODE_id2 = Trim(str(NODE_id1A)) & NODE_id2B

        POINTKEY = NODE_id1 & NODE_id2
        frm_table.List_Layer(billayer).ListItems(rowlayer).SubItems(26) = POINTKEY

    Case "CONNECTION":

        NCS = frm_table.List_Layer(billayer).ListItems(rowlayer).SubItems(7)
        ECS = frm_table.List_Layer(billayer).ListItems(rowlayer).SubItems(6)
        Call UNITO(NCS, ECS)
        Call CSRSO(NCS, ECS, 0.04887, -19.7519, -5.29544, -1.48678, _
            1.39966, 19.88167, -0.08787, -3.60882, 2.40011, _
            -1.63052, -47.152, -12.03, 14918.998, 21786.154, _
            -0.0132, -0.011, MNRSO, MERSO)
        frm_table.List_Layer(billayer).ListItems(rowlayer).SubItems(15) = MNRSO
        frm_table.List_Layer(billayer).ListItems(rowlayer).SubItems(14) = MERSO

         MYPOS = InStr(1, MNRSO, ".")
        NODE_id1A = Abs(Mid(MNRSO, 1, MYPOS))
        NODE_id2B = Abs(Mid(MNRSO, MYPOS + 1, 1))
        NODE_id1 = Trim(str(NODE_id1A)) & NODE_id2B


        MYPOS = InStr(1, MERSO, ".")
        NODE_id1A = Abs(Mid(MERSO, 1, MYPOS))
        NODE_id2B = Abs(Mid(MERSO, MYPOS + 1, 1))
        NODE_id2 = Trim(str(NODE_id1A)) & NODE_id2B

        POINTKEY = NODE_id1 & NODE_id2
        frm_table.List_Layer(billayer).ListItems(rowlayer).SubItems(13) = POINTKEY



        NCS = frm_table.List_Layer(billayer).ListItems(rowlayer).SubItems(9)
        ECS = frm_table.List_Layer(billayer).ListItems(rowlayer).SubItems(8)
        Call UNITO(NCS, ECS)
        Call CSRSO(NCS, ECS, 0.04887, -19.7519, -5.29544, -1.48678, _
            1.39966, 19.88167, -0.08787, -3.60882, 2.40011, _
            -1.63052, -47.152, -12.03, 14918.998, 21786.154, _
            -0.0132, -0.011, MNRSO, MERSO)
```

```
                frm_table.List_Layer(billayer).ListItems(rowlayer).SubItems(15) = MNRSO
                frm_table.List_Layer(billayer).ListItems(rowlayer).SubItems(14) = MERSO
                 MYPOS = InStr(1, MNRSO, ".")
                NODE_id1A = Abs(Mid(MNRSO, 1, MYPOS))
                NODE_id2B = Abs(Mid(MNRSO, MYPOS + 1, 1))
                NODE_id1 = Trim(str(NODE_id1A)) & NODE_id2B


                MYPOS = InStr(1, MERSO, ".")
                NODE_id1A = Abs(Mid(MERSO, 1, MYPOS))
                NODE_id2B = Abs(Mid(MERSO, MYPOS + 1, 1))
                NODE_id2 = Trim(str(NODE_id1A)) & NODE_id2B

                POINTKEY = NODE_id1 & NODE_id2
                frm_table.List_Layer(billayer).ListItems(rowlayer).SubItems(16) = POINTKEY
          Case "GPS":
                NCS = frm_table.List_Layer(billayer).ListItems(rowlayer).SubItems(8)
                NCS = Format(NCS, "0.00")
                ECS = frm_table.List_Layer(billayer).ListItems(rowlayer).SubItems(7)
                ECS = Format(ECS, "0.00")
                Call UNITO(NCS, ECS)
                Call CSRSO(NCS, ECS, 0.04887, -19.7519, -5.29544, -1.48678, _
                      1.39966, 19.88167, -0.08787, -3.60882, 2.40011, _
                      -1.63052, -47.152, -12.03, 14918.998, 21786.154, _
                      -0.0132, -0.011, MNRSO, MERSO)
                frm_table.List_Layer(billayer).ListItems(rowlayer).SubItems(11) = MNRSO
                frm_table.List_Layer(billayer).ListItems(rowlayer).SubItems(10) = MERSO

                 MYPOS = InStr(1, MNRSO, ".")
                NODE_id1A = Abs(Mid(MNRSO, 1, MYPOS))
                NODE_id2B = Abs(Mid(MNRSO, MYPOS + 1, 1))
                NODE_id1 = Trim(str(NODE_id1A)) & NODE_id2B


                MYPOS = InStr(1, MERSO, ".")
                NODE_id1A = Abs(Mid(MERSO, 1, MYPOS))
                NODE_id2B = Abs(Mid(MERSO, MYPOS + 1, 1))
                NODE_id2 = Trim(str(NODE_id1A)) & NODE_id2B

                POINTKEY = NODE_id1 & NODE_id2

                frm_table.List_Layer(billayer).ListItems(rowlayer).SubItems(9) = POINTKEY


        End Select

'==========================================================================================



        '=======================================================
        'SPECIAL FUNCTION TO SORT COLUMN FOR CCSTO

''''''''''        Select Case UCase(Trim(l.name))
''''''''''
''''''''''          Case "CCSBDY":
''''''''''            temp = frm_table.List_Layer(billayer).ListItems(rowlayer).SubItems(1)
''''''''''            frm_table.List_Layer(billayer).ListItems(rowlayer).SubItems(1) = _
''''''''''              frm_table.List_Layer(billayer).ListItems(rowlayer).SubItems(10)
''''''''''            frm_table.List_Layer(billayer).ListItems(rowlayer).SubItems(10) = temp
''''''''''
''''''''''        End Select

        'END SPECIAL COLUMN SORTING
        '=======================================================

        If ProgressBar1.Value + pbarvalue > 100 Then
          ProgressBar1.Value = 100
        Else
          ProgressBar1.Value = ProgressBar1.Value + pbarvalue
        End If
        If ProgressBar1.Value Mod 2 = 0 Then
          lblbar3.ForeColor = vbBlue
        Else
          lblbar3.ForeColor = vbRed
        End If
```

```
            lblbar1.Caption = Format(ProgressBar1.Value, "###") & "%"
            lblbar1.Refresh

            rowlayer = rowlayer + 1
            mmorstSelectedFeatures(billayer).MoveNext
          Wend
          billayer = billayer + 1
      Next l
      ProgressBar1.Value = 100
      lblbar1.Caption = Format(ProgressBar1.Value, "###") & "%"
      lblbar1.Refresh
      lblbar3.Caption = "OK"
      lblbar3.Refresh
      mapDisp.TrackingLayer.Refresh True
  End If
  frm_table.Hide
  Close #100
  End If
'This procedure invokes the active map tool; zoom in, zoom out, pan, or other.
Dim curRectangle As Rectangle

'Zoom in button was pushed
If barDisplay.Buttons("Zoom in").Value = 1 Then
  Set curRectangle = mapDisp.TrackRectangle
  Set mapDisp.Extent = curRectangle

'Zoom out button was pushed
ElseIf barDisplay.Buttons("Zoom out").Value = 1 Then
  Dim Loc As New Point
  Set Loc = mapDisp.ToMapPoint(x, y)
  'We calculate the full width and height. Adding and substracting
  'the full values from Loc has the effect of zooming out by a factor of 2.
  Dim mapWidth As Double, mapHeight As Double
  Set curRectangle = mapDisp.Extent
  mapWidth = mapDisp.Extent.Width
  mapHeight = mapDisp.Extent.Height
  curRectangle.Right = Loc.x + mapWidth
  curRectangle.Left = Loc.x - mapWidth
  curRectangle.Top = Loc.y + mapHeight
  curRectangle.Bottom = Loc.y - mapHeight
  Set mapDisp.Extent = curRectangle

'Pan button
ElseIf barDisplay.Buttons("Pan").Value = 1 Then
  mapDisp.Pan

'Identify button
ElseIf barDisplay.Buttons("Identify").Value = 1 Then
  Call frmIdentify.Identify(x, y)

'Spatial selection of features
ElseIf barDisplay.Buttons("Spatial select").Value = 1 Then
  Call frmSpatial.SelectFeatures(Button, Shift, x, y)

End If

'Add and select shape features
If barGraphics.Visible Then
  If barGraphics.Buttons("Select graphic").Value = 1 Then
    If Button = 1 Then
      g_EditLayer.SelectShape
    Else
      g_EditLayer.DeleteSelection
    End If
  ElseIf barGraphics.Buttons("Add text").Value = 1 Then
    g_EditLayer.AddText x, y
  ElseIf barGraphics.Buttons("Add point").Value = 1 Then
    g_EditLayer.AddPoint x, y
  ElseIf barGraphics.Buttons("Add line").Value = 1 Then
    g_EditLayer.AddLine
  ElseIf barGraphics.Buttons("Add rectangle").Value = 1 Then
    g_EditLayer.AddRectangle
  ElseIf barGraphics.Buttons("Add polygon").Value = 1 Then
    g_EditLayer.AddPolygon
  ElseIf barGraphics.Buttons("Add ellipse").Value = 1 Then
    g_EditLayer.AddEllipse
```

```
    End If
  End If

End Sub

Private Sub updateScale()
  'This procedure updates the scale dislay in the status bar.
  Dim mapScreenWidth As Double
  Dim mapExtentWidth As Double
  Dim mapScale As Double

  'Get width of screen and convert twips to inches.
  mapScreenWidth = mapDisp.Width / 1440
  'Get map width
  mapExtentWidth = mapDisp.Extent.Width
  'Calculate scale and update text of status bar
  mapScale = Int(mapExtentWidth / mapScreenWidth)
  sbrStatus.Panels(1).text = "Scale 1"":" & mapScale
End Sub

Private Sub mapDisp_MouseMove(Button As Integer, Shift As Integer, x As Single, y As Single)
  'This procedure updates the coordinate display in the status bar.
  Dim curPoint As Point
  Dim curX As Double
  Dim curY As Double
  'Convert screen coordinates to map coordinates
  Set curPoint = mapDisp.ToMapPoint(x, y)
  curX = curPoint.x
  curY = curPoint.y
  'If map coordinates are large, suppress digits to right of decimal place.
  Dim cX As String, cy As String
  cX = curX
  cy = curY
  cX = Left(cX, InStr(cX, ".") + 2)
  cy = Left(cy, InStr(cy, ".") + 2)
  sbrStatus.Panels(2).text = "X:" & cX & " Y:" & cy

  'Now trigger the MapTip's mousemove...
  If chkTipLayer.Value = 1 Then m_mapTip.MouseMove x, y

End Sub

Public Sub doTask(buttonKey As String)
'Gotta clean up some forms first...
Dim i
ActionCode = 2

      Unload frmIdentify
      Unload frmSpatial
      Unload frmMapContents
'*****************************************************************************
Select Case buttonKey
    '---------------------------------------------------------------------------
    Case "Print"
       mapDisp.PrintMap "myMap", "", True
    '---------------------------------------------------------------------------
    Case "Map contents"
       For i = 9 To 14
          barDisplay.Buttons(i).Value = 0
       Next
       barDisplay.Buttons(6).Value = 0

       If barGraphics.Visible = True Then barGraphics.Visible = False
       frmMapContents.Show
       mapDisp.MousePointer = moArrow
    '---------------------------------------------------------------------------
    Case "Cadastral Network"
      '  MsgBox ActionCode

       ActionCode = 2
       'MsgBox ActionCode & "The Cadastral Network form is not enabled."
       For i = 9 To 14
          barDisplay.Buttons(i).Value = 0
       Next
       If barGraphics.Visible = True Then barGraphics.Visible = False
      mapDisp.MousePointer = moCross
```

```
  '  MsgBox ActionCode
    'frmMapContents.Show
   '-----------------------------------------------------------------------------
   Case "Simpan"
If barDisplay.Buttons(6).Value = 1 Then
     Call write_fail
Else

MsgBox "No Spacial selected .."
End If
    '-----------------------------------------------------------------------------


   Case "Full extent"
       For i = 9 To 14
       barDisplay.Buttons(i).Value = 0
     Next
     barDisplay.Buttons(6).Value = 0
     If barGraphics.Visible = True Then barGraphics.Visible = False

     mapDisp.Extent = mapDisp.FullExtent
         mapDisp.MousePointer = moArrow
         ActionCode = 2
    zoomin = False

   '-----------------------------------------------------------------------------
   Case "Graphics"
     barDisplay.Buttons(6).Value = 0
    barGraphics.Visible = True
   ' barGraphics.Height = 2400
'    barGraphics.Width = 375
   barGraphics.Refresh
    mapDisp.MousePointer = moCross
   '-----------------------------------------------------------------------------
   Case "Spatial select"
     barDisplay.Buttons(6).Value = 0
    If FrmStarting.mapDisp.Layers.Count > 0 Then
     Unload frmSpatial  'Do unload to make sure it runs through load procedure
     frmSpatial.Show
     mapDisp.MousePointer = moArrow
    End If
    If barGraphics.Visible = True Then barGraphics.Visible = False
   '-----------------------------------------------------------------------------
   Case "Zoom in"
     barDisplay.Buttons(6).Value = 0
    If barGraphics.Visible = True Then barGraphics.Visible = False
    mapDisp.MousePointer = moZoomIn
    zoomin = True
   '-----------------------------------------------------------------------------
   Case "Zoom out"
     barDisplay.Buttons(6).Value = 0
    If barGraphics.Visible = True Then barGraphics.Visible = False
     mapDisp.MousePointer = moZoomOut
   '-----------------------------------------------------------------------------
   Case "Pan"
     barDisplay.Buttons(6).Value = 0
    If barGraphics.Visible = True Then barGraphics.Visible = False
     mapDisp.MousePointer = moPan
   '-----------------------------------------------------------------------------
   Case "Identify"
     'MsgBox ActionCode

     barDisplay.Buttons(6).Value = 0
    If barGraphics.Visible = True Then barGraphics.Visible = False
    mapDisp.MousePointer = moIdentify
   '-----------------------------------------------------------------------------
   Case "About"
    'frmIntro.Show

   End Select

End Sub

Private Sub mnuEdit_Find_Click()

 Call doTask("Find")
```

```
End Sub

Private Sub mnuFile_Exit_Click()

  End

End Sub

Private Sub mnuFile_MapContents_Click()

  Call doTask("Map contents")

End Sub

Private Sub mnuFile_Print_Click()

  Call doTask("Print")

End Sub

Private Sub mnuHelp_About_Click()

  Call doTask("About")

End Sub

Private Sub mnuHelp_Summary_Click()

  Call doTask("Summary")

End Sub

Private Sub mnuView_FullExtent_Click()

  Call doTask("Full extent")

End Sub

Private Sub mnuView_Graphics_Click()

  barDisplay.Buttons("Graphics").Value = 1
  Call doTask("Graphics")

End Sub

Private Sub mnuView_Identify_Click()

  barDisplay.Buttons("Identify").Value = 1
  Call doTask("Identify")

End Sub

Private Sub mnuView_Pan_Click()

  barDisplay.Buttons("Pan").Value = 1
  Call doTask("Pan")

End Sub

Private Sub mnuView_SpatialSelect_Click()

  barDisplay.Buttons("Spatial select").Value = 1
  Call doTask("Spatial select")

End Sub

Private Sub mnuView_ZoomIn_Click()

  barDisplay.Buttons("Zoom in").Value = 1
  Call doTask("Zoom in")

End Sub

Private Sub mnuView_ZoomOut_Click()
```

```
  barDisplay.Buttons("Zoom out").Value = 1
  Call doTask("Zoom out")

End Sub

Private Sub MnuCascade_Click()
   Me.Arrange (0)
End Sub

Private Sub MnuCreateInputFile_Click()
   Frm_InpFile.Show
End Sub

Private Sub MnuCreateNDCDBtextfile_Click()
   Frm_LstRef.Show
End Sub

Private Sub MnuCreateStationFile_Click()
   Frm_StnFile.Show
End Sub

Private Sub MnuExit_Click()
End
End Sub

Private Sub MnuFullExtend_Click()

  Call doTask("Full extent")
End Sub

Private Sub MnuGraphics_Click()

  barDisplay.Buttons("Graphics").Value = 1
  Call doTask("Graphics")
End Sub

Private Sub MnuHorizontal_Click()
Me.Arrange (1)
End Sub

Private Sub MnuIdentify_Click()

  barDisplay.Buttons("Identify").Value = 1
  Call doTask("Identify")

End Sub

Private Sub MnuMap_Click()
  Call doTask("Map contents")

End Sub

Private Sub MnuPan_Click()

  barDisplay.Buttons("Pan").Value = 1
  Call doTask("Pan")
End Sub

Private Sub MnuSpatialSelec_Click()

  barDisplay.Buttons("Spatial select").Value = 1
  Call doTask("Spatial select")

End Sub

Private Sub MnuTable_Click()
  frm_table.Show
  frm_table.ZOrder 0
End Sub

Private Sub MnuVertical_Click()
Me.Arrange (2)
End Sub

Private Sub MnuViewMap_Click()
```

```
    frm_table.cmd_exit.Value = True

End Sub

Private Sub MnuZoomIn_Click()

  barDisplay.Buttons("Zoom in").Value = 1
  Call doTask("Zoom in")

End Sub

Private Sub MnuZoomOut_Click()

  barDisplay.Buttons("Zoom out").Value = 1
  Call doTask("Zoom out")

End Sub

Private Sub tmrMapTip_Timer()
  m_mapTip.Timer
End Sub

Public Sub updateMapTipLayer()
    m_mapTip.SetLayer mapDisp.Layers(cboTipLayer.text), _
                cboTipField.text

End Sub

Public Sub updateTipField()

  cboTipField.Clear

  'If we've selected tips on an image layer, set check box to false cuz we can't display
  'tips for images.
  If FrmStarting.cboTipLayer = "" Then
    chkTipLayer.Value = 0
    Exit Sub
  End If

  'Now populate the listbox for the selected field
  Dim tb As MapObjects.TableDesc
  Set tb = FrmStarting.mapDisp.Layers(FrmStarting.cboTipLayer.text).Records.TableDesc
  Dim fType As String, itemToSet As String
  Dim numFields As Integer
  numFields = tb.FieldCount
  Dim firstString As Boolean
  firstString = True

  Dim i As Integer
  For i = 0 To numFields - 1
    fType = tb.FieldType(i)
    If fType = moString Or fType = moLong Or fType = moDouble Then
      FrmStarting.cboTipField.AddItem tb.fieldName(i)
      If firstString = True And fType = moString Then
        firstString = False
        itemToSet = tb.fieldName(i)
      End If
    End If
  Next i

  'Make the first string field the default field
  If itemToSet <> "" Then
    FrmStarting.cboTipField.text = itemToSet
  Else
    FrmStarting.cboTipField.text = FrmStarting.cboTipField.List(0)
  End If

  'Update the layer and field in MapTip class
  m_mapTip.SetLayer FrmStarting.mapDisp.Layers(cboTipLayer.text), cboTipField.text

End Sub


Sub DoZoom(Shift As Integer, Button As Integer)
   Dim Rect As MapObjects.Rectangle
```

```
If Shift = 0 Then
  If Button = 1 Then
    Set Rect = mapDisp.Extent

    Rect.ScaleRectangle (0.25)
    mapDisp.Extent = mapDisp.TrackRectangle
  Else
    Shift = 1

    Set r = mapDisp.Extent

    r.ScaleRectangle (2000000000)
    mapDisp.Extent = r
  End If
 Else
  Set r = mapDisp.Extent
  r.ScaleRectangle (1.5)
  mapDisp.Extent = r
 End If
End Sub

Public Sub write_fail()

  Dim j As Integer
  Dim BEARING
  Dim DIS
  For j = 0 To frm_table.Tab_Layer.Tabs - 1
    frm_table.Tab_Layer.Tab = j
    If frm_table.Tab_Layer.Caption = "CCSBDY" Then BDY = j
    If frm_table.Tab_Layer.Caption = "GPS" Then gps = j
    If frm_table.Tab_Layer.Caption = "CONNECTION" Then cnt = j
  Next j


  CommonDialog1.CancelError = True
  CommonDialog1.InitDir = App.path
  CommonDialog1.Filter = "DAT format(*.DAT)|*.dat"

  'On Error Resume Next
  CommonDialog1.ShowSave
  If Err.Number = 32755 Then
      Exit Sub
  End If

  If CommonDialog1.filename = "" Then 'if cancel
        MsgBox "Sila berikan nama fail", vbOKOnly, "Data Selection"
        Exit Sub
  End If

  outfile = CommonDialog1.filename
  Open outfile For Output As #1

  CommonDialog1.CancelError = True
  CommonDialog1.InitDir = App.path
  CommonDialog1.Filter = "LOG format(*.LOG)|*.log"

  On Error Resume Next
  CommonDialog1.ShowSave
  If Err.Number = 32755 Then
      Exit Sub
  End If

  If CommonDialog1.filename = "" Then 'if cancel
        MsgBox "Sila berikan nama fail", vbOKOnly, "Data Selection"
        Exit Sub
  End If

  logfile = CommonDialog1.filename
  Open logfile For Output As #3



  On Error GoTo 0

'###########################################################################################
```

```
'11111111111111111111111111111111111111111111111111111111111111111111111111111111111
'###################################################################################
'MODULE 1: PRINT THE GPS DATA
Print #3,
Print #3, "###########################################################################"
Print #3, "                              GPS DATA                              "
Print #3, "###########################################################################"
Print #3, "NEW ID", "OLD ID"
For i = 1 To frm_table.List_Layer(gps).ListItems.Count

   POINTKEY_OLD = frm_table.List_Layer(gps).ListItems.Item(i).text
   rso_E = frm_table.List_Layer(gps).ListItems.Item(i).SubItems(1)
   rso_N = frm_table.List_Layer(gps).ListItems.Item(i).SubItems(2)
   NODEX = frm_table.List_Layer(gps).ListItems.Item(i).SubItems(10)
   NODEY = frm_table.List_Layer(gps).ListItems.Item(i).SubItems(11)
   POINTKEY = frm_table.List_Layer(gps).ListItems.Item(i).SubItems(9)


   Print #3, POINTKEY, POINTKEY_OLD
   Print #1, "C", POINTKEY, rso_E, rso_N, "!", "!"

Next i
Print #1,

'END OF MODULE 2
'###################################################################################
'11111111111111111111111111111111111111111111111111111111111111111111111111111111111
'###################################################################################


'###################################################################################
'22222222222222222222222222222222222222222222222222222222222222222222222222222222222
'###################################################################################
'MODULE 2:  TO PRINT FILE BDY

Print #3,
Print #3, "###########################################################################"
Print #3, "                          BOUNDARY DATA                              "
Print #3, "###########################################################################"
Print #3, "NEW ID", "OLD ID"

For i = 1 To frm_table.List_Layer(BDY).ListItems.Count
      FNODE_OLD = frm_table.List_Layer(BDY).ListItems.Item(i).SubItems(10)

      FNODEX = frm_table.List_Layer(BDY).ListItems.Item(i).SubItems(17)
      FNODEY = frm_table.List_Layer(BDY).ListItems.Item(i).SubItems(18)
      TNODE_OLD = frm_table.List_Layer(BDY).ListItems.Item(i).SubItems(11)
      TNODEX = frm_table.List_Layer(BDY).ListItems.Item(i).SubItems(19)
      TNODEY = frm_table.List_Layer(BDY).ListItems.Item(i).SubItems(20)

      BEARING = frm_table.List_Layer(BDY).ListItems.Item(i).SubItems(2)
      DISTANCE = frm_table.List_Layer(BDY).ListItems.Item(i).SubItems(3)
      kelas = frm_table.List_Layer(BDY).ListItems.Item(i).SubItems(5)

      FNODE = frm_table.List_Layer(BDY).ListItems.Item(i).SubItems(23)
      TNODE = frm_table.List_Layer(BDY).ListItems.Item(i).SubItems(26)
      PARCEL = frm_table.List_Layer(BDY).ListItems.Item(i).SubItems(1)
      APDATE = frm_table.List_Layer(BDY).ListItems.Item(i).text
      PLAN = frm_table.List_Layer(BDY).ListItems.Item(i).SubItems(9)
      ENTRYMODE = frm_table.List_Layer(BDY).ListItems.Item(i).SubItems(8)
      If BEARING = "" Or BEARING = 0.0001 Then
            BHOUR = "00"
            bmin = "00"
            bsec = "00"
      'modified by amran on june 2005
      ' if bearing = 0.0001 or no reading..... make it to 00-00-00
'           DN = TNODEY - FNODEY
'           DE = TNODEX - FNODEX
'
'           Call BEARINGGG(DN, DE, BRG)
'           Call JARAK(DN, DE, DIS)
'           B = BRG * 206264.806247
'           DEG = Int(B / 3600#)
'           MINIT = Int((B - DEG * 3600#) / 60#)
'           SEC = Int(B - (DEG * 3600#) - (MINIT * 60#))
'
```

```
'           DEG = Abs(DEG)
'           MINIT = Abs(MINIT)
'           SEC = Abs(SEC)
'
'           BHOUR = DEG
'           bmin = Format(MINIT, "00")
'           bsec = Format(SEC, "00")
          ' If Abs(DISTANCE - DIS) > 0.99 Then DISTANCE = DIS
    Else
            MYPOS = InStr(1, BEARING, ".")
            If MYPOS = 0 Then
               BHOUR = BEARING
               bmin = "00"
               bsec = "00"
            Else
               If Mid(BEARING, 1, 1) = "-" Then
                  BHOUR = Mid(BEARING, 2, MYPOS - 2)
               Else
                  BHOUR = Mid(BEARING, 1, MYPOS - 1)
                  Select Case Len(Mid(BEARING, MYPOS + 1, Len(BEARING) - MYPOS))
                     Case 4: bmin = Mid(BEARING, MYPOS + 1, 2)
                     Case 3: bmin = Mid(BEARING, MYPOS + 1, 2)
                     Case 2: bmin = Mid(BEARING, MYPOS + 1, 2)
                     Case 1: bmin = Mid(BEARING, MYPOS + 1, 2) & "0"
                  End Select
                  Select Case Len(Mid(BEARING, MYPOS + 1, Len(BEARING) - MYPOS))
                     Case 4: bsec = Mid(BEARING, MYPOS + 3, 2)
                     Case 3: bsec = Mid(BEARING, MYPOS + 3, 1) & "0"
                     Case 2: bsec = "00"
                     Case 1: bsec = "00"
                  End Select
               End If
            End If
    End If

    Select Case Val(kelas)
       Case 1: bearing1 = 10: distance1 = 0.001
       Case 2: bearing1 = 30: distance1 = 0.01
    End Select


    Print #3, FNODE & "-" & TNODE, FNODE_OLD & "-" & TNODE_OLD
    Print #1, "B", FNODE & "-" & TNODE, BHOUR & "-" & bmin & "-" & bsec, Format(bearing1, "0.00"), """ &
PARCEL & "," & APDATE & "," & PLAN & "," & ENTRYMODE

    Print #1, "D", FNODE & "-" & TNODE, DISTANCE, Format(distance1, "0.000"), """ & PARCEL & "," &
APDATE & "," & PLAN & "," & ENTRYMODE
  Next i

' END OF MODULE 2
'2222222222222222222222222222222222222222222222222222222222222222222222222222222222222
'#####################################################################################

'#####################################################################################
'3333333333333333333333333333333333333333333333333333333333333333333333333333333333333
'#####################################################################################
'MODULE 2:  TO PRINT FILE CONNECTION

  Print #3,
  Print #3, "###########################################################################"
  Print #3, "                       CONNECTION DATA                              "
  Print #3, "###########################################################################"
  Print #3, "NEW ID", "OLD ID"

  Print #1, "#PERMULAAN CONNECTION"

  For i = 1 To frm_table.List_Layer(cnt).ListItems.Count
    If UCase(frm_table.List_Layer(cnt).ColumnHeaders.Item(12).text) = "F_NODE" Then
       FNODE_OLD = frm_table.List_Layer(cnt).ListItems.Item(i).SubItems(11)
    Else
       FNODE_OLD = ""
    End If
    FNODEX = frm_table.List_Layer(cnt).ListItems.Item(i).SubItems(6)
    FNODEY = frm_table.List_Layer(cnt).ListItems.Item(i).SubItems(7)

    If UCase(frm_table.List_Layer(cnt).ColumnHeaders.Item(13).text) = "T_NODE" Then
```

```
    TNODE_OLD = frm_table.List_Layer(cnt).ListItems.Item(i).SubItems(12)
Else
    TNODE_OLD = ""
End If
TNODEX = frm_table.List_Layer(cnt).ListItems.Item(i).SubItems(8)
TNODEY = frm_table.List_Layer(cnt).ListItems.Item(i).SubItems(9)
BEARING = frm_table.List_Layer(cnt).ListItems.Item(i).text
DISTANCE = frm_table.List_Layer(cnt).ListItems.Item(i).SubItems(1)
kelas = frm_table.List_Layer(cnt).ListItems.Item(i).SubItems(5)
FNODE = frm_table.List_Layer(cnt).ListItems.Item(i).SubItems(13)
TNODE = frm_table.List_Layer(cnt).ListItems.Item(i).SubItems(16)

Select Case Val(kelas)
    Case 1: bearing1 = 10: distance1 = 0.001
    Case 2: bearing1 = 30: distance1 = 0.01
End Select

If BEARING = "" Or BEARING = 0.0001 Then
        BHOUR = "00"
        bmin = "00"
        bsec = "00"
'modified by amran on june 2005
' if bearing = 0.0001 or no reading..... make it to 00-00-00
''          DN = TNODEY - FNODEY
''          DE = TNODEX - FNODEX
''
''          Call BEARINGGG(DN, DE, BRG)
''          Call JARAK(DN, DE, DIS)
''          B = BRG * 206264.806247
''          DEG = Int(B / 3600#)
''          MINIT = Int((B - DEG * 3600#) / 60#)
''          SEC = Int(B - (DEG * 3600#) - (MINIT * 60#))
''
''          DEG = Abs(DEG)
''          MINIT = Abs(MINIT)
''          SEC = Abs(SEC)
''
''          BHOUR = DEG
''          bmin = Format(MINIT, "00")
''          bsec = Format(SEC, "00")
''          If Abs(DISTANCE - DIS) > 0.99 Then DISTANCE = DIS
Else
        MYPOS = InStr(1, BEARING, ".")
        If MYPOS = 0 Then
            BHOUR = BEARING
            bmin = "00"
            bsec = "00"
          Else
            If Mid(BEARING, 1, 1) = "-" Then
                BHOUR = Mid(BEARING, 2, MYPOS - 2)
            Else
                BHOUR = Mid(BEARING, 1, MYPOS - 1)
                Select Case Len(Mid(BEARING, MYPOS + 1, Len(BEARING) - MYPOS))
                    Case 4: bmin = Mid(BEARING, MYPOS + 1, 2)
                    Case 3: bmin = Mid(BEARING, MYPOS + 1, 2)
                    Case 2: bmin = Mid(BEARING, MYPOS + 1, 2)
                    Case 1: bmin = Mid(BEARING, MYPOS + 1, 2) & "0"
                End Select
                Select Case Len(Mid(BEARING, MYPOS + 1, Len(BEARING) - MYPOS))
                    Case 4: bsec = Mid(BEARING, MYPOS + 3, 2)
                    Case 3: bsec = Mid(BEARING, MYPOS + 3, 1) & "0"
                    Case 2: bsec = "00"
                    Case 1: bsec = "00"
                End Select
            End If
          End If
''          If Mid(BEARING, 1, 1) = "-" Then
'''             BHOUR = Mid(BEARING, 2, MYPOS - 2)
'''          Else
'''              BHOUR = Mid(BEARING, 1, MYPOS - 1)
'''              Select Case Len(Mid(BEARING, MYPOS + 1, Len(BEARING) - MYPOS))
'''
'''              Case 4: bmin = Mid(BEARING, MYPOS + 1, 2)
'''                  Case 3: bmin = Mid(BEARING, MYPOS + 1, 2)
'''                  Case 2: bmin = Mid(BEARING, MYPOS + 1, 2)
'''                  Case 1: bmin = Mid(BEARING, MYPOS + 1, 2) & "0"
```

```
'''
'''                End Select
'''                   Select Case Len(Mid(BEARING, MYPOS + 1, Len(BEARING) - MYPOS))
'''                   Case 4: bsec = Mid(BEARING, MYPOS + 3, 2)
'''                      Case 3: bsec = Mid(BEARING, MYPOS + 3, 1) & "0"
'''                      Case 2: bsec = "00"
'''                      Case 1: bsec = "00"
'''                      End Select
'''
'''             End If
      End If



      Print #3, FNODE & "-" & TNODE, FNODE_OLD & "-" & TNODE_OLD
      Print #1, "B", FNODE & "-" & TNODE, BHOUR & "-" & bmin & "-" & bsec, Format(bearing1, "0.00")
      Print #1, "D", FNODE & "-" & TNODE, DISTANCE, Format(distance1, "0.000")

   Next i

'   Print #1, "#DUPLICATE"
'   Open App.Path + "\TEMP.LOG" For Input As #4
'   While Not EOF(4)
'      Input #4, LBL
'      Print #1, LBL
'   Wend
'   Dim FN_TN As String, FN_TNOLD As String
'   Print #3,
'   Print #3, "###########################################################################"
'   Print #3, "                     DUPLICATE DATA                         "
'   Print #3, "###########################################################################"
'   Print #3, "NEW ID", "OLD ID"
'   Open App.Path + "\TEMP2.LOG" For Input As #5
'   While Not EOF(5)
'      Input #5, FN_TN
'      Print #3, FN_TN
'   Wend

   Close #1
   Close #2
   Close #3
 ' Close #4
 ' Close #5

   Exit Sub

norecord:
   MsgBox "No data selected in GPS and CCSBDY file", vbOKOnly, "Data Selection"

End Sub
```

APPENDIX B

Avenue Coding For Creating Cadastral Polygon

```
tblLines = av.getActiveDoc
vtbLines = tblLines.GetVTab
fldPARCELA = vtbLines.FindField("PARCELKEYA")
fldPLANA= vtbLines.FindField("PLANA")
fldAPPA= vtbLines.FindField("APP_A")

fldPARCELB = vtbLines.FindField("PARCELKEYB")
fldPLANB= vtbLines.FindField("PLANB")
fldAPPB= vtbLines.FindField("APP_B")

fldFX = vtbLines.FindField("FX")
fldFY = vtbLines.FindField("FY")
fldTX = vtbLines.FindField("TX")
fldTY = vtbLines.FindField("TY")

fnmNewLines = "d:\test_ndcdb\newlines.shp".AsFileName
ftbNewLines = FTab.MakeNew(fnmNewLines,POLYLINE)
fldLinePAR_A = Field.Make("PARCELKEYA",#FIELD_DOUBLE,16,0)
fldLinePLAN_A = Field.Make("PLANA",#FIELD_CHAR,16,0)
fldLineAPP_A = Field.Make("APP_A",#FIELD_DOUBLE,16,0)

fldLinePAR_B = Field.Make("PARCELKEYB",#FIELD_DOUBLE,16,0)
fldLinePLAN_B = Field.Make("PLANB",#FIELD_CHAR,16,0)
fldLineAPP_B = Field.Make("APP_B",#FIELD_DOUBLE,16,0)

fldLineFX = Field.Make("FX",#FIELD_DECIMAL,16,5)
fldLineFY = Field.Make("FY",#FIELD_DECIMAL,16,5)
fldLineTX = Field.Make("TX",#FIELD_DECIMAL,16,5)
fldLineTY = Field.Make("TY",#FIELD_DECIMAL,16,5)


ftbNewLines.AddFields({fldLinePAR_A})
ftbNewLines.AddFields({fldLinePLAN_A})
ftbNewLines.AddFields({fldLineAPP_A})
ftbNewLines.AddFields({fldLinePAR_B})
ftbNewLines.AddFields({fldLinePLAN_B})
ftbNewLines.AddFields({fldLineAPP_B})
ftbNewLines.AddFields({fldLineFX})
ftbNewLines.AddFields({fldLineFY})
ftbNewLines.AddFields({fldLineTX})
ftbNewLines.AddFields({fldLineTY})


fldShape = ftbNewLines.FindField("Shape")

for each rec in vtbLines
  pntFrom =
point.Make(vtbLines.ReturnValue(fldFX,rec),vtbLines.ReturnValue(fldFY,rec))
  pntTo =
point.Make(vtbLines.ReturnValue(fldTX,rec),vtbLines.ReturnValue(fldTY,rec))

  newRec = ftbNewLines.AddRecord

ftbnewLines.SetValue(fldShape,newRec,PolyLine.Make({{pntFrom,pntTo}}))


ftbNewLines.SetValue(fldLinePAR_A,newRec,vtbLines.ReturnValue(fldPARCELA,rec))

ftbNewLines.SetValue(fldLinePLAN_A,newRec,vtbLines.ReturnValue(fldPLANA,rec))

ftbNewLines.SetValue(fldLineAPP_A,newRec,vtbLines.ReturnValue(fldAPPA,rec))
                                        .
                                        .
                                        .
```

```
                              :
                              :
ftbNewLines.SetValue(fldLinePAR_B,newRec,vtbLines.ReturnValue(fldPARCELB,rec))

ftbNewLines.SetValue(fldLinePLAN_B,newRec,vtbLines.ReturnValue(fldPLANB,rec))

ftbNewLines.SetValue(fldLineAPP_B,newRec,vtbLines.ReturnValue(fldAPPB,rec))


ftbNewLines.SetValue(fldLineFX,newRec,vtbLines.ReturnValue(fldFX,rec))

ftbNewLines.SetValue(fldLineFY,newRec,vtbLines.ReturnValue(fldFY,rec))

ftbNewLines.SetValue(fldLineTX,newRec,vtbLines.ReturnValue(fldTX,rec))

ftbNewLines.SetValue(fldLineTY,newRec,vtbLines.ReturnValue(fldTY,rec))


end
ftbNewLines.SetEditable(FALSE)
vwNew = view.Make
vwNew.AddTheme(FTheme.Make(ftbNewLines))
vwNew.GetWin.Open
```

```
' Name:  View.ConvertPolylineToPolygon
'
' Title:  Converts polylines in the active theme to polygons
'
' Topics:  GeoData
'
' Description:  Converts selected polylines to polygons to create a new
' shapefile.  If no features are currently selected all polylines will
' be processed.
'
' If the polylines are not closed, i.e. the first and last points are
' not identical, the user may choose to automatically close all
' polylines. This option will move the last point to the first point.
'
' Multi part shapes are not currently supported.
'
' Requires:  a View must be the active document, a polyline theme must
' be the active theme. Use the following as an update script:
'
'-Update script for control...
'-v = av.GetActiveDoc
'-t = v.GetActiveThemes.Get(0)
'-SELF.SetEnabled((t <> NIL) AND
'-  (t.GetFTab.FindField("shape").GetType = #FIELD_SHAPELINE))
'
' Self:
'
' Returns:

theView    = av.GetActiveDoc
thmThemeIn = theView.GetActiveThemes.Get(0)

' Specify the output shapefile...
'
fnDefault = FileName.Make("$HOME").MakeTmp("shape","shp")
fnOutput  = FileDialog.Put( fnDefault,"*.shp","Output Shape File" )
if (fnOutput = nil) then exit end
fnOutput.SetExtension("shp")
ftbOutput = FTab.MakeNew( fnOutput, POLYGON )
ftbOutput.AddFields({Field.Make("ID", #FIELD_LONG, 8, 0)})

' Polylines must close to create polygons. The choices presented to the
' Gentle User are to automatically 'snap' the last polyline vertex to
' the first, or to skip any unclosed polylines...
'
bForceClosure = MsgBox.YesNoCancel("Force closure on all features?",
  "Convert Polyline to Polygon","TRUE")
if (bForceClosure = NIL) then exit end

' Use selected shapes if there are any, otherwise iterate
' through the entire FTab...
'
if (thmThemeIn.GetFTab.GetSelection.Count > 0) then
  colToProcess = thmThemeIn.GetFTab.GetSelection
  nRecs = colToProcess.Count
else
  colToProcess = thmThemeIn.GetFTab
  nRecs = colToProcess.GetNumRecords
end
```

```
nCount = 0
nRecAdded = 0
fldShapeIn  = thmThemeIn.GetFTab.FindField("shape")
fldShapeOut = ftbOutput.FindField("shape")
fldIDOut    = ftbOutput.FindField("id")
for each r in colToProcess
  nCount = nCount + 1
  av.SetStatus((nCount / nRecs) * 100)
  shpIn = thmThemeIn.GetFTab.ReturnValue(fldShapeIn,r)

  if (shpIn.AsList.Count > 1) then
    MsgBox.Warning("Unable to convert multi-part shape at record"++
      nCount.AsString,"Convert Polyline to Polygon")
    continue
  end


lstPoints = shpIn.AsList.Get(0)
  ptStart = lstPoints.Get(0)
  ptEnd   = lstPoints.Get((lstPoints.Count - 1))
  if (ptStart <> ptEnd) then
    if (bForceClosure) then  ' Force the close...
      ptEnd.SetX(ptStart.GetX.Clone)
      ptEnd.SetY(ptStart.GetY.Clone)
    else
      continue
    end
  end

  shpNew = Polygon.Make({lstPoints})
  shpNew.Clean

  nRecNew = ftbOutput.AddRecord
  ftbOutput.SetValue(fldShapeOut,nRecNew,shpNew)
  ftbOutput.SetValue(fldIDOut,nRecNew,nCount)
  nRecAdded = nRecAdded + 1
end

av.SetStatus(100)

if (nRecAdded = 0) then
  MsgBox.Info("No closed polylines found. Unable to convert"++
    "polylines to polygons.", "Convert Polyline to Polygon")
  exit
else
  MsgBox.Info(nRecAdded.AsString++"shapes converted.",
    "Convert Polyline to Polygon")
end

if (MsgBox.YesNo("Add shapefile as theme to a view?",
  "Convert Polyline to Polygon", true).Not) then
  exit
end

' Create a list of views and allow the user to choose which view to
' add the new theme to...
lstViews = {}
for each d in av.GetProject.GetDocs
  if (d.Is(View)) then
    lstViews.Add( d )
  end
end
lstViews.Add("<New View>")

vweAddTo = MsgBox.ListAsString( lstViews,"Add Theme to:",
  "Convert Polyline to Polygon" )

' Get the specified view, make the theme, and add it...
if (vweAddTo <> nil) then
  if (vweAddTo = "<New View>") then
    vweAddTo = View.Make
    vweAddTo.GetWin.Open
  end
  thmNew = FTheme.Make( ftbOutput )
  vweAddTo.AddTheme( thmNew )
  vweAddTo.GetWin.Activate
end
```