# CURRENT TREND IN GEOINFORMATION TECHNOLOGY

## *STUDIES TOWARD THE DEVELOPMENT OF IMPLEMENTATION PLAN OF COORDINATED CADASTRAL SYSTEM FOR MALAYSIA*

Abd. Majid A. Kadir, Shahrum Ses, Ghazali Desa, Kamalludin Omar,
Abdullah Hisham Omar, Chen Kah Eng, Wong Yeak Kuan
*Universiti Teknologi Malaysia*
*81310 UTM, Skudai, Johor*

Abd. Kadir Taib, Samad Abu, Teng Chee Boo, Teng Chee Hwa, David Chang,
Wan Zainuddin, Samad Bahari
*Jabatan Ukur Dan Pemetaan Malaysia*

Email: majid@fksg.utm.my

**February 2001**

## INTRODUCTION

A collaborative study between the Department of Survey and Mapping Malaysia (DSMM), the Universiti Teknologi Malaysia (UTM), the University College London (UCL), and the University of New South Wales (UNSW) on the feasibility of implementing CCS in Malaysia has been completed in 1999. Outcomes from the feasibility study call for further research regarding the development of the implementation plan for CCS in Malaysia.

Cont...

## Development of Implementation Plan of CCS for Malaysia: Research Objectives

The main objective of this study is:

i. **To develop and realize a geocentric based Cadastral Control Data Base**
ii. **To establish methodology for the Development of National Digital Cadastral Data Base**
iii. **To develop techniques for integrating the digital Cadastral Data with Mapping Data**
iv. **To address the Institutional Issues on the Implementation of CCS.**

## DEFICIENCIES IN THE PRESENT CADASTRAL SYSTEM

General – problems associated with cadastral survey system:

- General Deficiencies in the Cadastral Survey System
  - "Whole to the Part" concept not utilized.
  - Survey errors – not properly distributed and adjusted.
  - Use of running traverses.
  - Some earlier surveys – uncoordinated.
  - Use of natural feature boundaries.
- Difficulties in Using Different Projection Systems
  - Problems of data integration.
  - Complications when survey crosses from one State to another.

Cont…

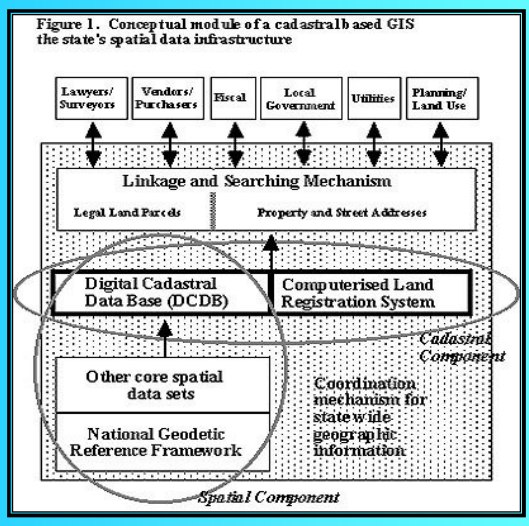
- Incompatibility with Current Technologies
  - Systems provided by new technologies – increasingly coordinate based.
  - Cadastral survey system based on parcel dimensions and relative locations. Therefore, not in a position to take advantage of new technologies.
- Inadequacy of the DCDB
  - Cadastral parcels – one of the core data sets for Malaysian LIS/GIS.
  - DCDB – the most sought after information source. Unfortunately, has flaws propagated through deficiencies of the cadastral survey system.
- Obsolete Rules and Regulations
  - Increasing number of provisions superseded by advances and changes in technology.

## CONCEPT OF COORDINATED CADASTRE

*Adapted from Williamson (1996)*

i) **First Version** of a coordinated cadastre is where the complete cadastral framework is based on coordinates determined by ground survey that is referred to a coordinate system. The said survey is used to define, describe, and re-define parcel boundaries, and its outcome shown graphically on a cadastral map, which in its digital form would form the Digital Cadastral Data Base (DCDB). The conduct of ground surveys and related processes usually result in an accurate cadastral map or DCDB and towards that fulfillment, requires sufficient density of control.

ii) **Second Version** is largely similar with the above description, the only difference being that the coordinates as determined are given legal significance. In this case the coordinates take precedence over boundary marks in the redefinition of boundaries.




Conceptual Module of A Cadastral Based Spatial Data Infrastructure

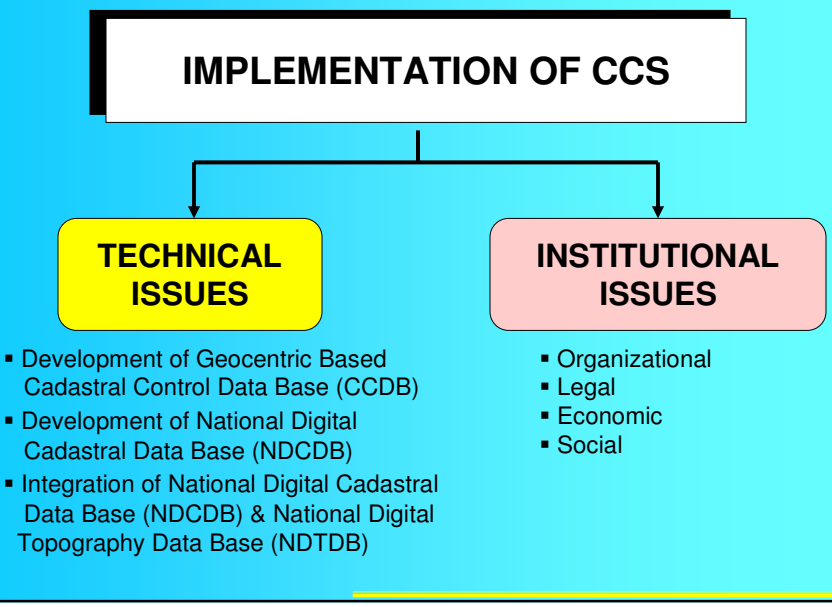
## COORDINATED CADASTRAL SYSTEM (CCS) STATEMENT FOR MALAYSIA

- The coordinate-based cadastral system simply means that coordinates are given greater emphasis. Bearings and distances are, therefore, only a means by which the final adjusted coordinates are derived.
- This concept allows: (i) the availability of abundance of survey control stations whose coordinates are given with respect to a geocentric datum; (ii) the adoption of a single coordinate projection system for the whole country; and (iii) the application of a rigorous network adjustment technique on survey accurate data so that a unique pair of coordinates and their respective accuracy information can be defined for every cadastral boundary marks.

## THE IMPORTANCE OF THE STUDY

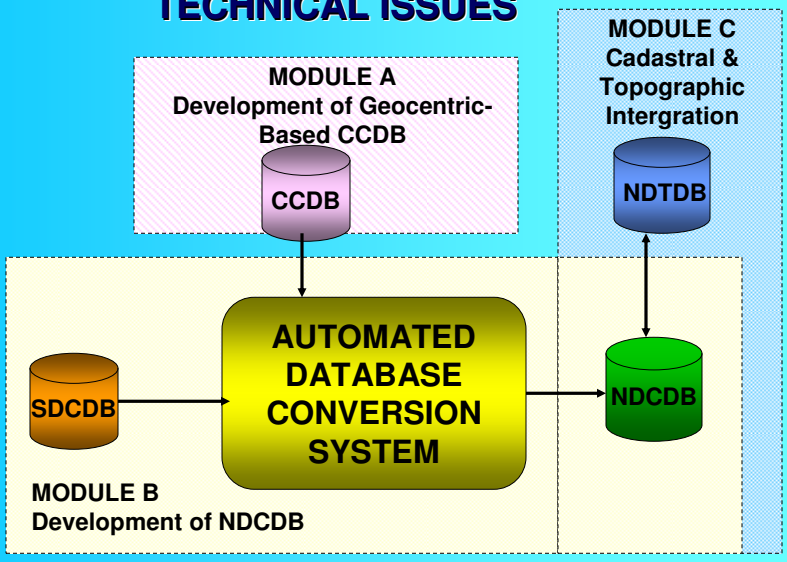
- Coordinated Cadastral System (CCS) – a cadastral reform programme to improve the cadastral survey system. Implementation of CCS – *feasible*, according to results of feasibility study.
- Long term benefits to be accrued from CCS implementation:
  - Utilizing "Whole to the Part" methodology.
  - Facilitate use of rapid data acquisition, storage, processing & management techniques.
  - Improvement of the cadastral survey system.
  - Provides common reference system.
  - Facilitate data integration.
  - CCS – basis for / underpins a good LIS.
  - Others

## STUDY FRAMEWORK



*Implementation of CCS*

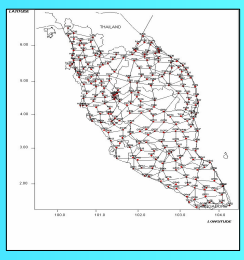
## TECHNICAL ISSUES




SDCDB - State Digital Cadastral Data Base
NDCDB - National Digital Cadastral Data Base
CCDB - Cadastral Control Data Base
NDTDB - National Digital Topographic Data Base

## MODULE A: Development of A Geocentric-Based Cadastral Control Database


Zero Order Geodetic GPS Network (MASS Stations)



First Order Geodetic GPS Network (30km Network)

**Cadastral Control Infrastructure**
- 5km, 2.5km,0.5km
- Ties to Cadastral Network

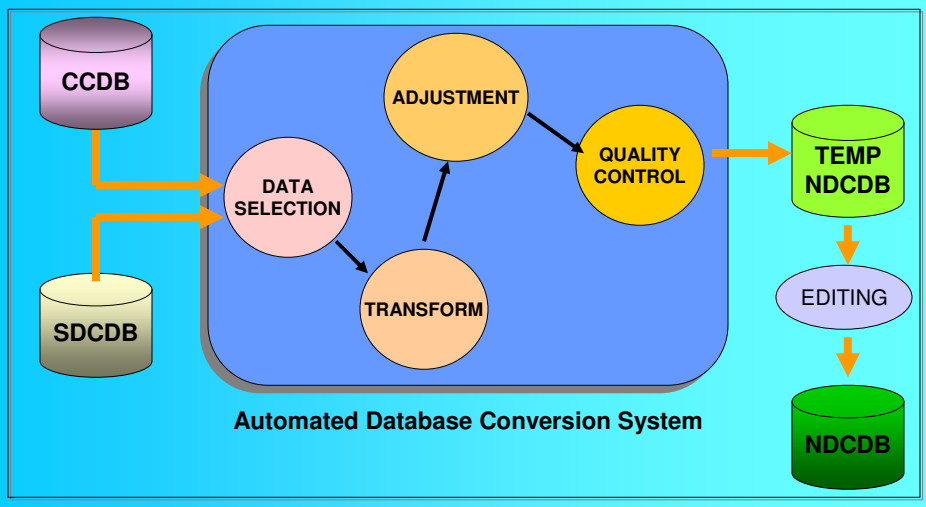
**Computation of Geocentric RSO Coordinates**

**Design & Analysis Of CCDB**

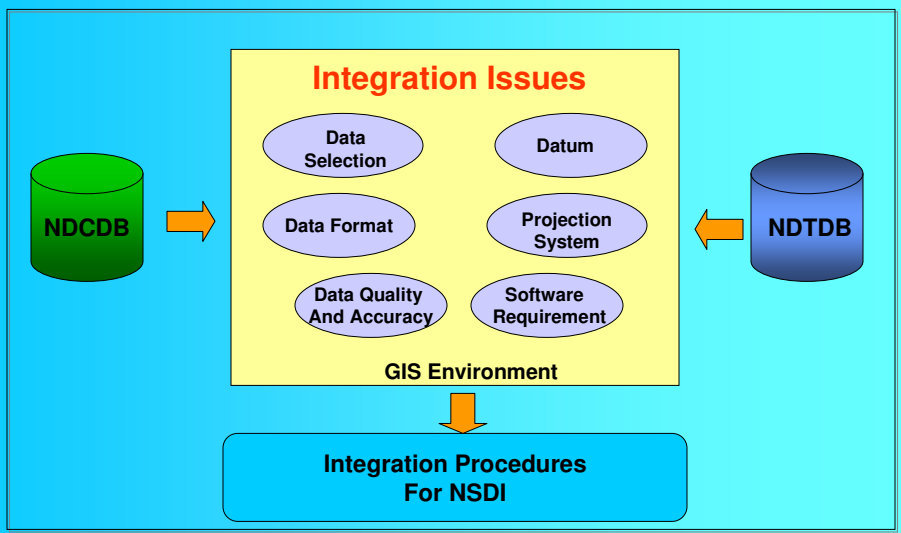
**Cadastral Control Database**

**CCDB**

## MODULE B: Development of A National Digital Cadastral Database

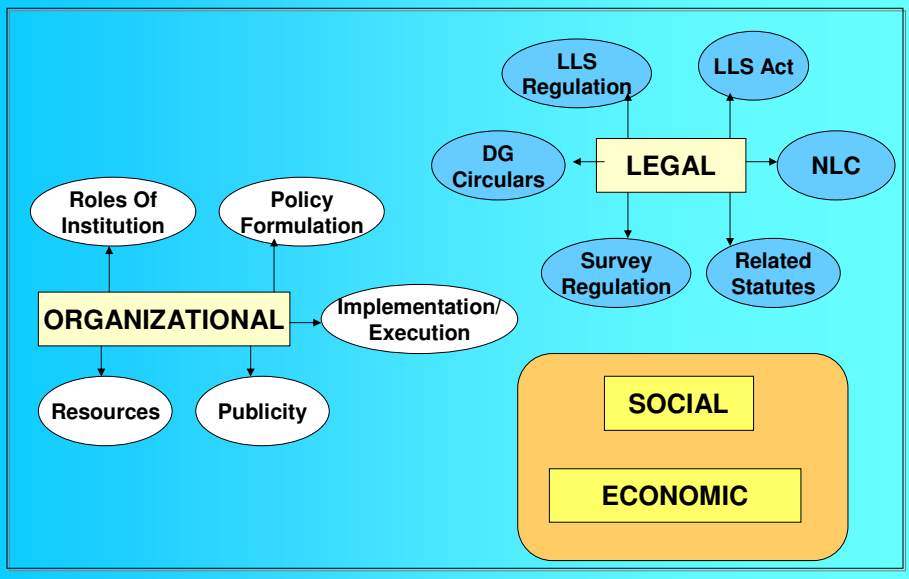



## MODULE C : Techniques For Integrating The Digital Coordinated Cadastral Data With Mapping Data

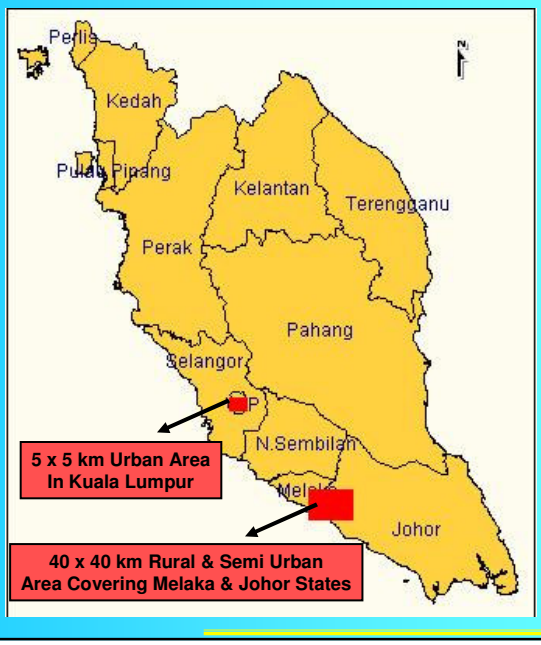


*IMPLEMENTATION OF CCS*

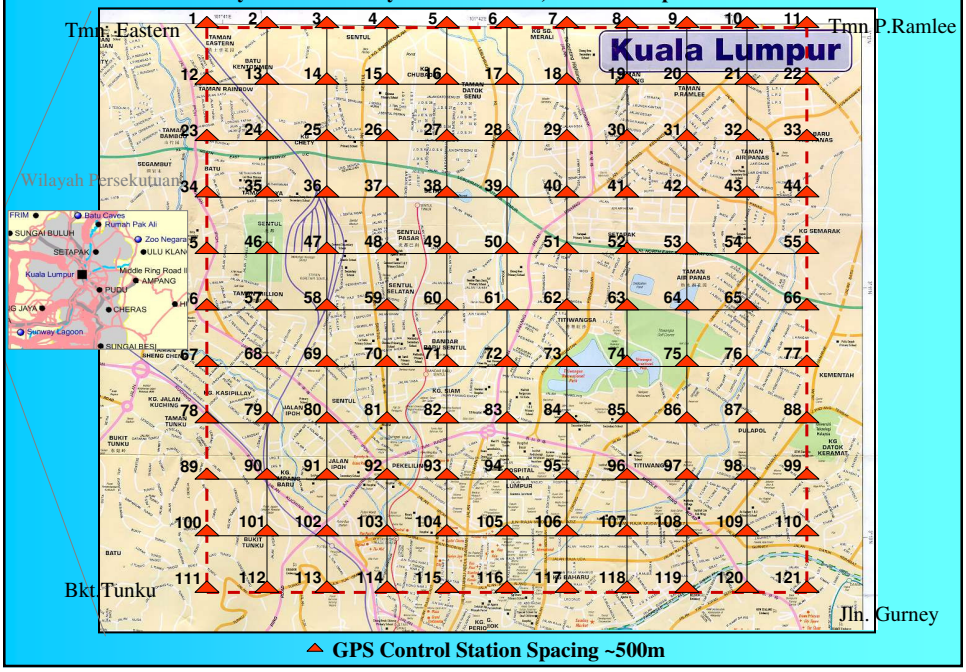
## Institutional Issues ( Module D)




## STUDY AREA

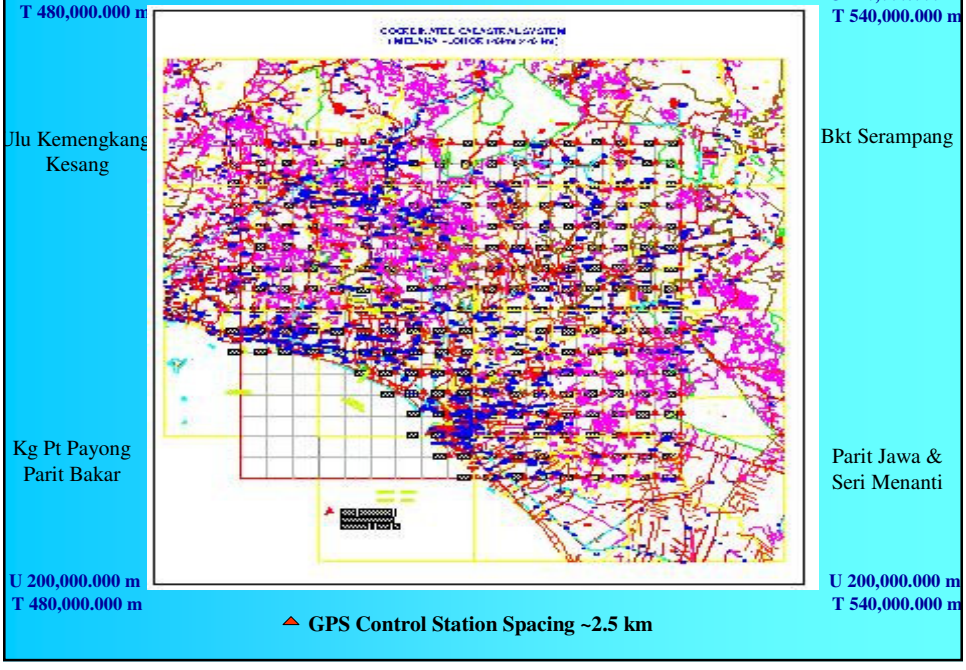


**COORDINATED CADASTRAL SYSTEM PROJECT**
**Study Area #1: Wilayah Persekutuan, Kuala Lumpur 5 X 5 km**




▲ GPS Control Station Spacing ~500m

**COORDINATED CADASTRAL SYSTEM PROJECT**
**Study Area #2: Melaka – Johor 40 X 40 km**




▲ GPS Control Station Spacing ~2.5 km

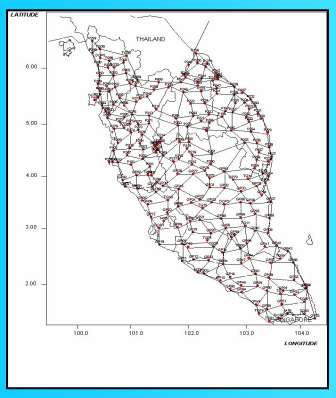
# DEVELOPMENT OF A GEOCENTRIC-BASED CADASTRAL CONTROL DATABASE (MODULE A)

***PROGRESS***

## Processing of Primary GPS Network (PGGN): 238 Stations

- Use GEOLAB to compute ITRF97 @00.0 coordinates of all PGGN stations. Input will consists of :
  - ITRF97 @00.0 vectors from original PGGN
  - coordinates of DOP1-DOP5
  - ITRF97 @00.0 coordinates of 25 links stations
- Allow original PGGN vectors to rotate
  - Solve for overall rotation between WGS84 of early 1990s and ITRF97 @00.0 in Malaysia.
- Use appropriate stochastic models for all data types
  - Use free network analysis to assess vector quality
  - Use Least-squares error propagation techniques to analyze compatibility of data
- Undertake QC at 5 pairs of stations
  - for both coordinates and quality measures
  - reprocess using checks as additional links if OK
  - observe and compute more link stations if not

## THE NEW GEODETIC INFRASTRUCTURE




- **Network adjustment** to include 25 link stations, check stations and DOP1-DOP5 to form First Order geodetic Control Network
- **The new geodetic infrastucture**;
  - Zero Order (MASS stations)
  - First Order
  - Second order ( old PGGN)
  - Cadastral Control (0.5 km - 2.5 km)

## METHODOLOGY FOR THE DEVELOPMENT OF NATIONAL DIGITAL CADASTRAL DATABASE (NDCDB)

## (MODULE B)

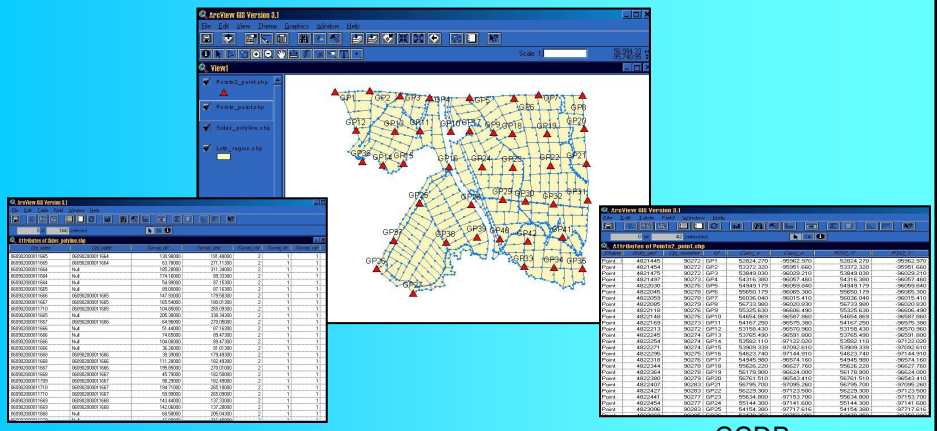
***PROGRESS***

## *Automated Database Conversion System*

## DATA SELECTION

**PROGRESS:**

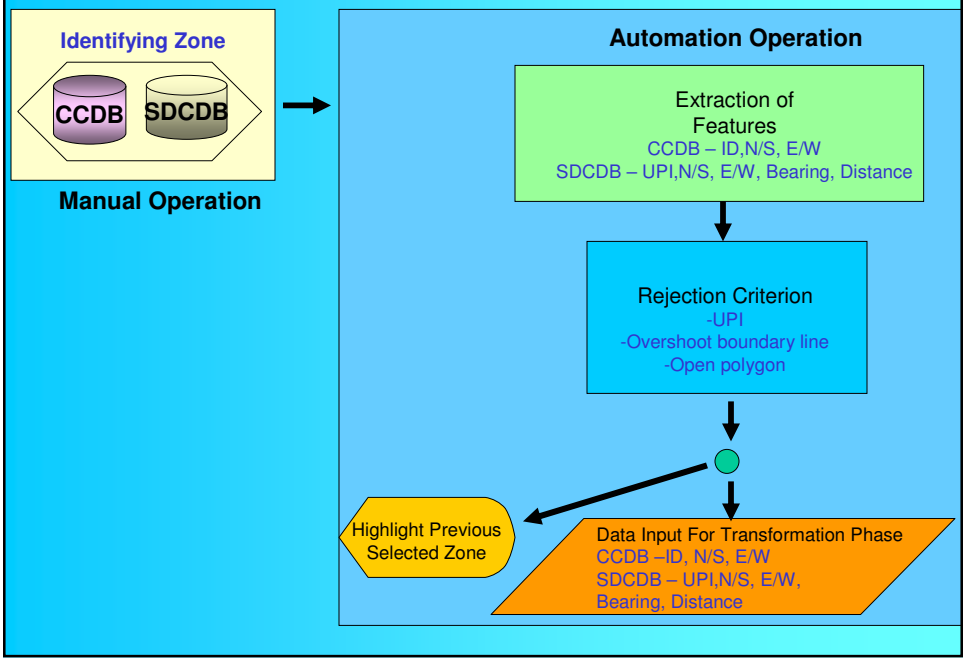
- Design and development of simulation database



SDCDB

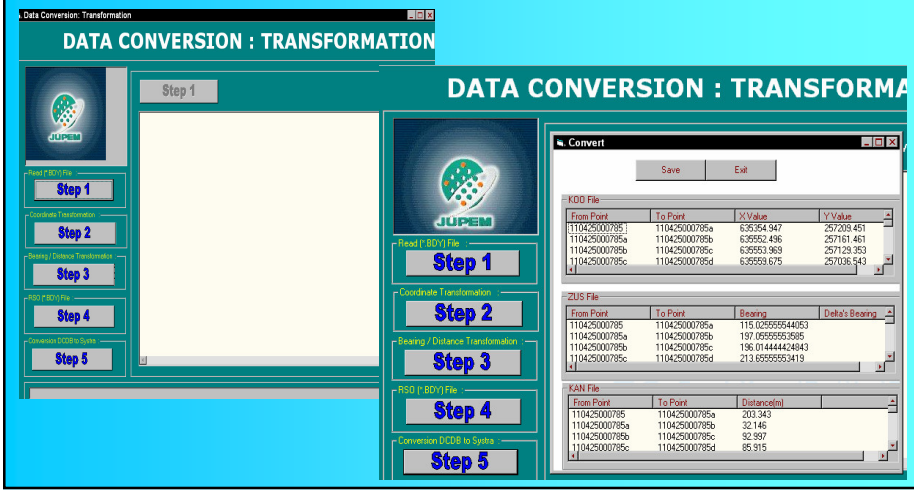
CCDB

## *Data Selection Methodology*



## TRANSFORMATION

Window-based Transformation Software: Cassini to RSO system

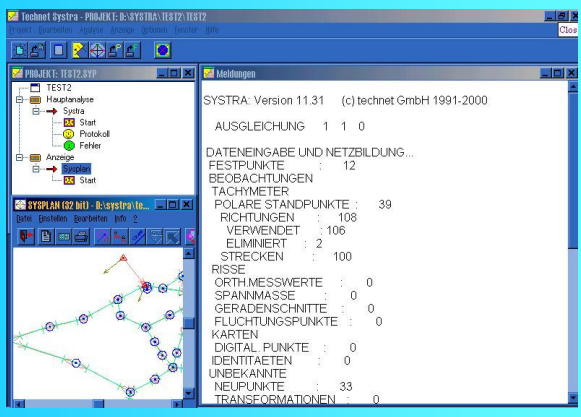



*Automated Database Conversion System*

## ADJUSTMENT

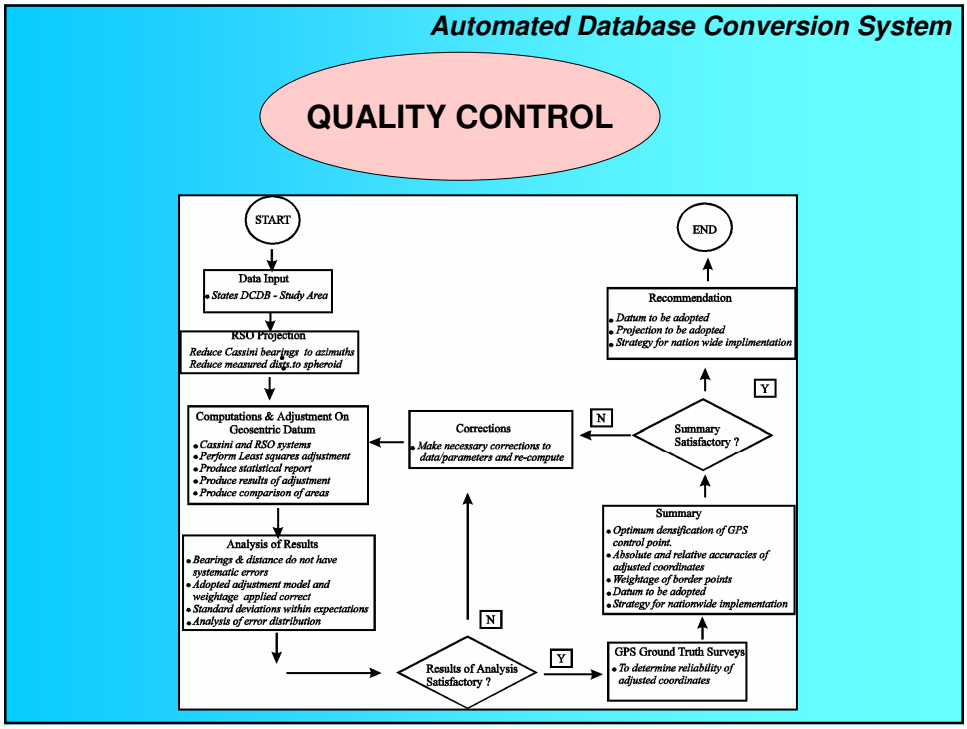
### PROGRESS:

- Test-run Systra using previous data (10 x10 km Melaka-Johor)




Rigorous Cadastral Network Adjustment Software : SYSTRA

*Automated Database Conversion System*

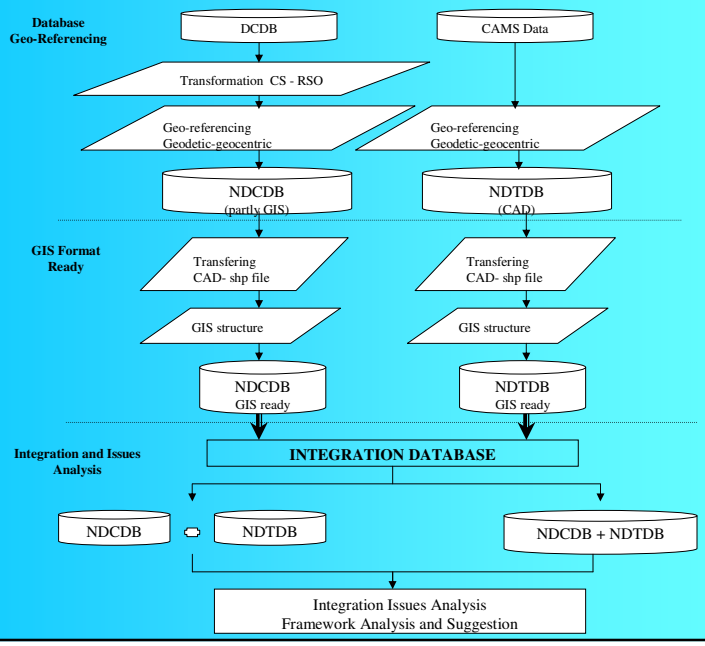



# TECHNIQUES FOR INTEGRATING THE DIGITAL COORDINATED CADASTRAL DATA WITH MAPPING (CAMS) DATA

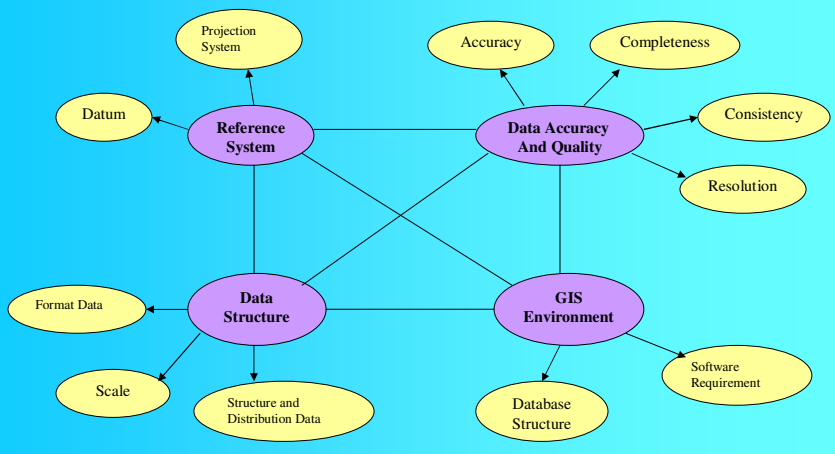
## (MODULE C)

***PROGRESS***

# INTEGRATION METHODOLOGY



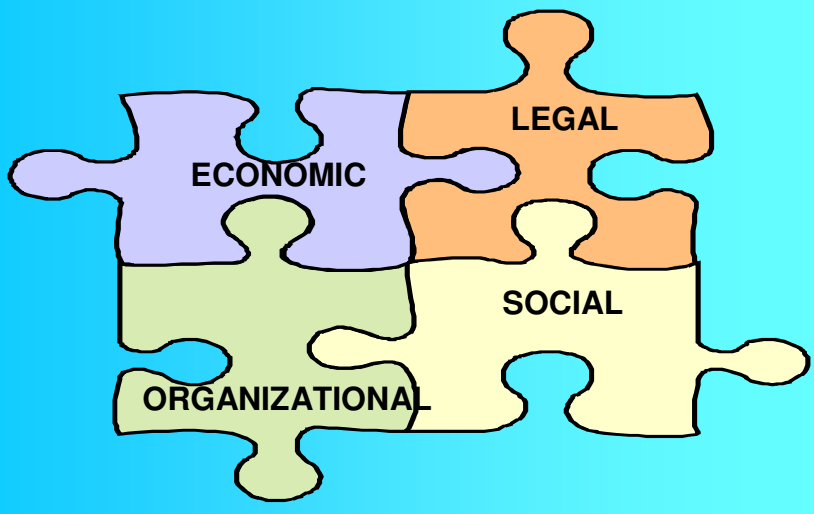

# PROJECT REVIEW: DATABASES INTEGRATION ISSUES

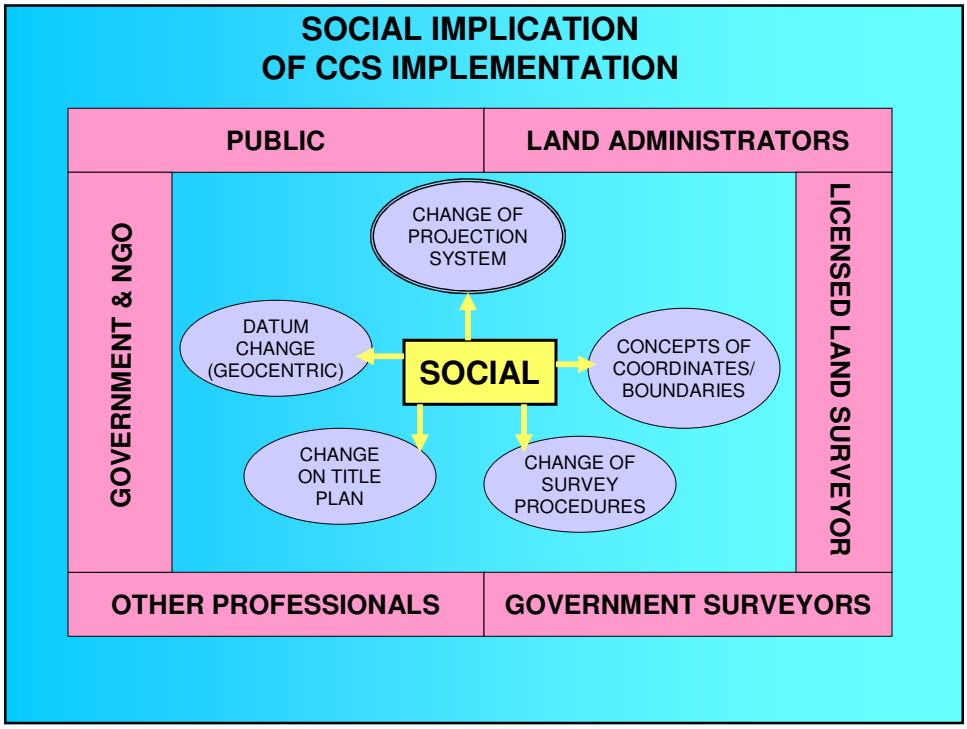


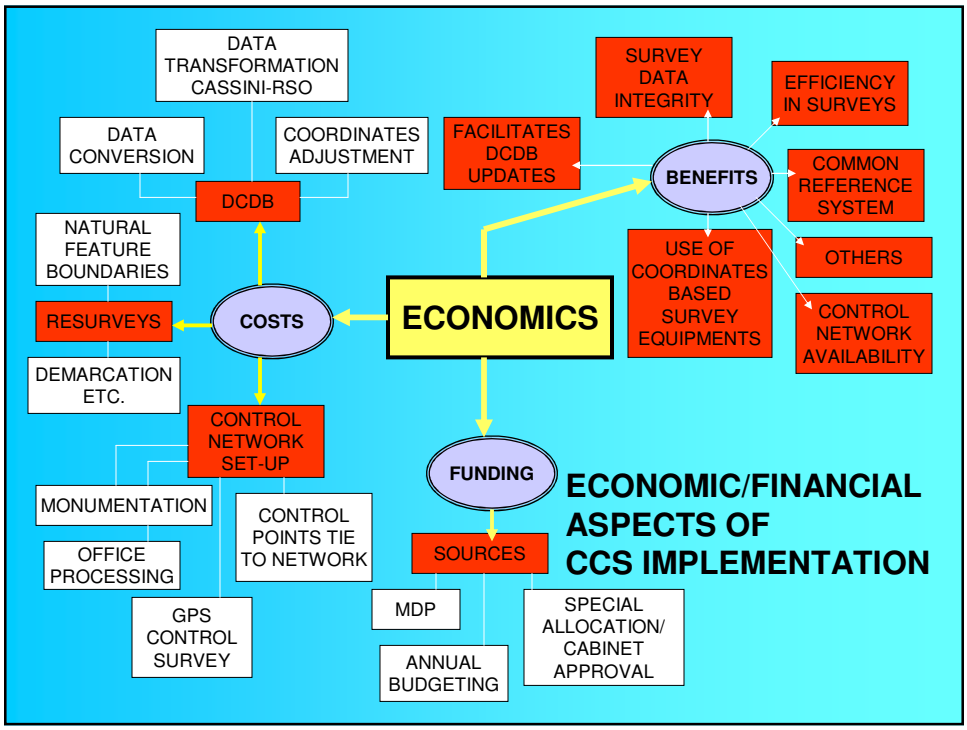
**INSTITUTIONAL ISSUES ON THE IMPLEMENTATION OF COORDINATED CADASTRAL SYSTEM (MODULE D)**

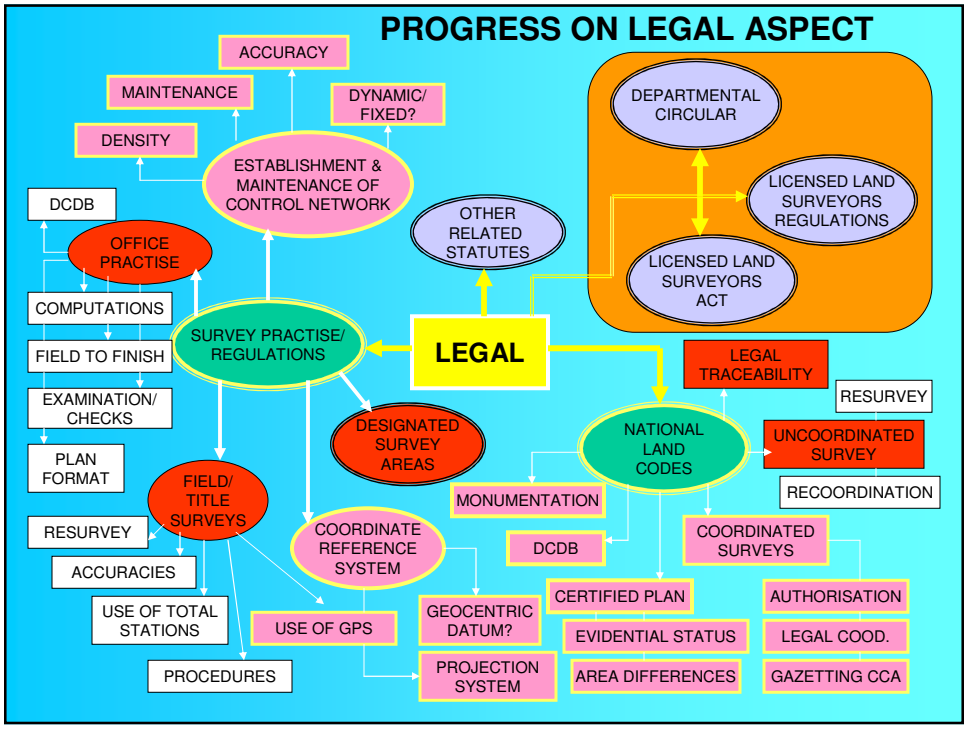
***PROGRESS REPORT***

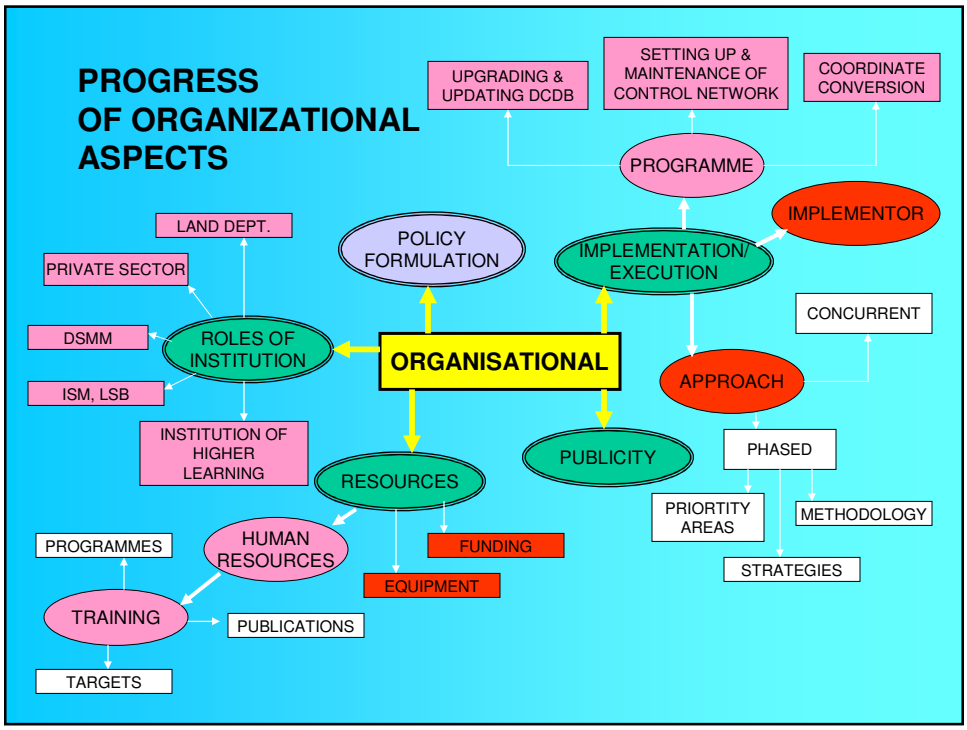
**COMPONENTS OF INSTITUTIONAL ISSUES**




SOCIAL IMPLICATION
OF CCS IMPLEMENTATION
PUBLIC
LAND ADMINISTRATORS
GOVERNMENT & NGO
LICENSED LAND SURVEYOR
CHANGE OF PROJECTION SYSTEM
DATUM CHANGE (GEOCENTRIC)
SOCIAL
CONCEPTS OF COORDINATES/ BOUNDARIES
CHANGE ON TITLE PLAN
CHANGE OF SURVEY PROCEDURES
OTHER PROFESSIONALS
GOVERNMENT SURVEYORS


DATA TRANSFORMATION CASSINI-RSO
DATA CONVERSION
COORDINATES ADJUSTMENT
DCDB
NATURAL FEATURE BOUNDARIES
RESURVEYS
DEMARCATION ETC.
COSTS
ECONOMICS
CONTROL NETWORK SET-UP
MONUMENTATION
OFFICE PROCESSING
GPS CONTROL SURVEY
CONTROL POINTS TIE TO NETWORK
FUNDING
SOURCES
MDP
ANNUAL BUDGETING
SPECIAL ALLOCATION/ CABINET APPROVAL
FACILITATES DCDB UPDATES
SURVEY DATA INTEGRITY
EFFICIENCY IN SURVEYS
BENEFITS
COMMON REFERENCE SYSTEM
OTHERS
USE OF COORDINATES BASED SURVEY EQUIPMENTS
CONTROL NETWORK AVAILABILITY
ECONOMIC/FINANCIAL ASPECTS OF CCS IMPLEMENTATION


PROGRESS ON LEGAL ASPECT
ACCURACY
MAINTENANCE
DYNAMIC/ FIXED?
DENSITY
ESTABLISHMENT & MAINTENANCE OF CONTROL NETWORK
DCDB
OFFICE PRACTISE
COMPUTATIONS
FIELD TO FINISH
EXAMINATION/ CHECKS
PLAN FORMAT
RESURVEY
ACCURACIES
USE OF TOTAL STATIONS
PROCEDURES
FIELD/ TITLE SURVEYS
SURVEY PRACTISE/ REGULATIONS
OTHER RELATED STATUTES
DEPARTMENTAL CIRCULAR
LICENSED LAND SURVEYORS REGULATIONS
LICENSED LAND SURVEYORS ACT
LEGAL
LEGAL TRACEABILITY
RESURVEY
DESIGNATED SURVEY AREAS
NATIONAL LAND CODES
UNCOORDINATED SURVEY
RECOORDINATION
MONUMENTATION
DCDB
COORDINATED SURVEYS
COORDINATE REFERENCE SYSTEM
USE OF GPS
GEOCENTRIC DATUM?
PROJECTION SYSTEM
CERTIFIED PLAN
EVIDENTIAL STATUS
AREA DIFFERENCES
AUTHORISATION
LEGAL COOD.
GAZETTING CCA


PROGRESS OF ORGANIZATIONAL ASPECTS
UPGRADING & UPDATING DCDB
SETTING UP & MAINTENANCE OF CONTROL NETWORK
COORDINATE CONVERSION
PROGRAMME
IMPLEMENTOR
LAND DEPT.
POLICY FORMULATION
IMPLEMENTATION/ EXECUTION
PRIVATE SECTOR
DSMM
ROLES OF INSTITUTION
ORGANISATIONAL
CONCURRENT
ISM, LSB
APPROACH
INSTITUTION OF HIGHER LEARNING
RESOURCES
PUBLICITY
PHASED
PRIORITY AREAS
METHODOLOGY
PROGRAMMES
HUMAN RESOURCES
FUNDING
EQUIPMENT
STRATEGIES
TRAINING
PUBLICATIONS
TARGETS

## CONCLUSION

The collaborative pilot and feasibility studies that have been undertaken by Department of Survey and Mapping Malaysia and the Universiti Teknologi Malaysia (1996 – 1999) indicates that Coordinated Cadastral System (CCS) has a vast potential and it is feasible for Malaysia. However, for its full implementation, a detailed study on a number of aspects need an immediate attention. It is hoped that outcomes from the this study provide a guidelines for the DSMM in embarking on CCS .