KURSUS COORDINATED CADASTRAL SYSTEM (CCS)
INSTITUT TANAH & UKUR NEGARA
BEHRANG, PERAK

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

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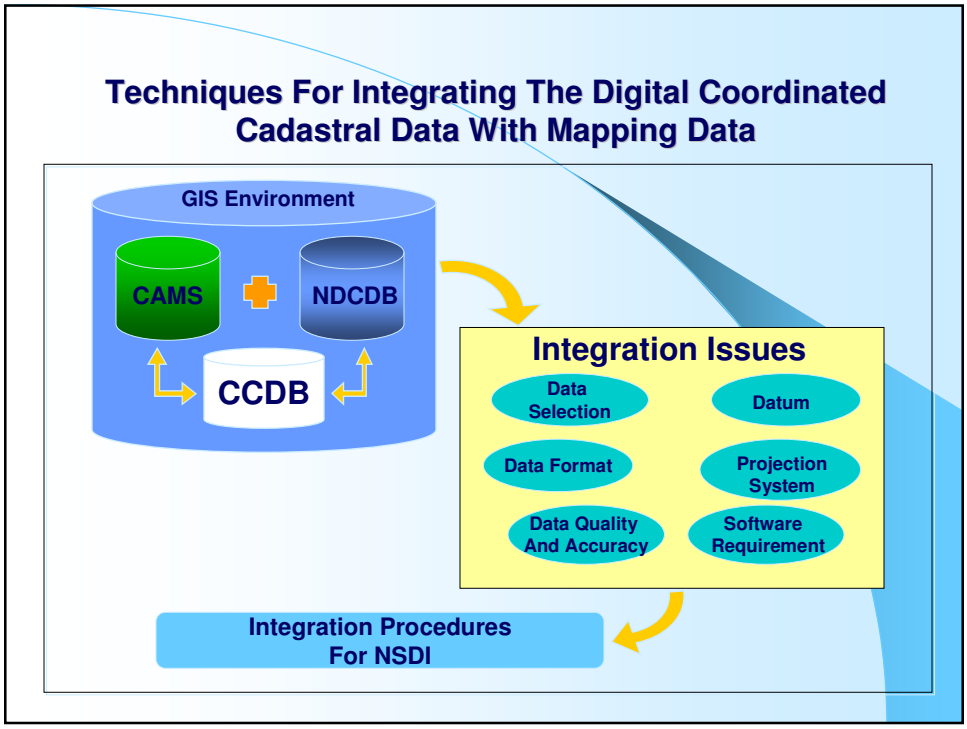
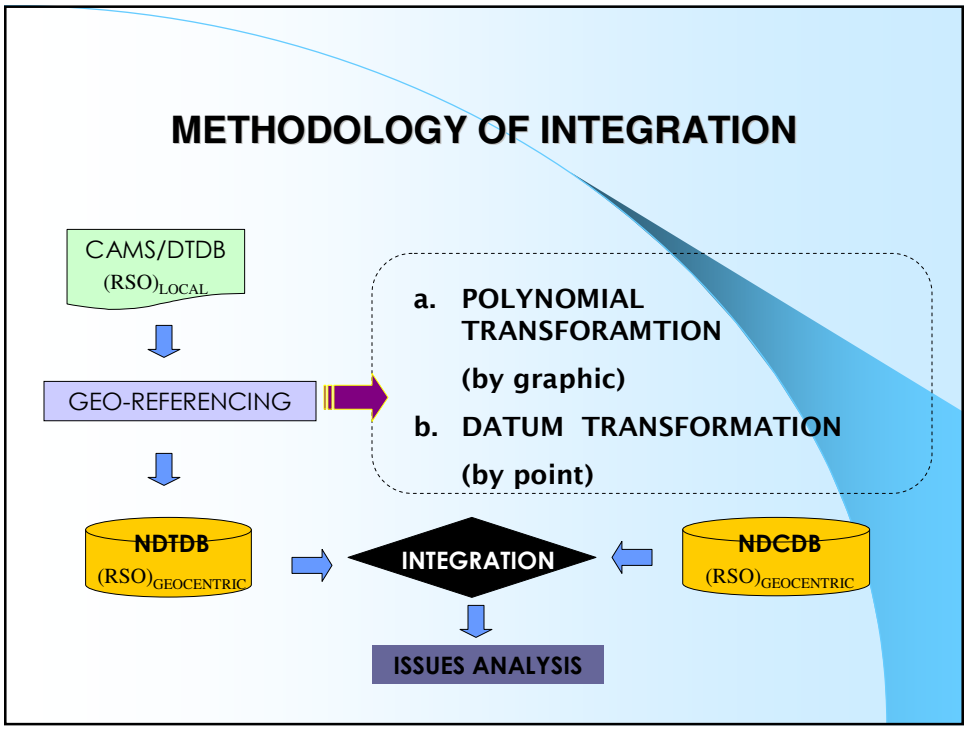
## OBJECTIVES

- To Design several experiments employing various techniques related to integration issues that can assure the quality and integrity of GIS output
- To propose techniques of integrating DCDB and CAMS data in the GIS environments so that users of the data sets can obtain output for their applications.


Techniques For Integrating The Digital Coordinated Cadastral Data With Mapping Data
GIS Environment
CAMS
NDCDB
CCDB
Integration Issues
Data Selection
Datum
Data Format
Projection System
Data Quality And Accuracy
Software Requirement
Integration Procedures For NSDI


METHODOLOGY OF INTEGRATION
CAMS/DTDB
(RSO)LOCAL
GEO-REFERENCING
a. POLYNOMIAL TRANSFORAMTION
(by graphic)
b. DATUM TRANSFORMATION
(by point)
NDTDB
(RSO)GEOCENTRIC
INTEGRATION
NDCDB
(RSO)GEOCENTRIC
ISSUES ANALYSIS

## GEO-REFERENCING

- Geo-referencing is the fundamental process to line up data sets which have different reference systems.
- Main purpose is to transform $RSO_{local}$ into $RSO_{geocentric}$.
- 2 methods :
  I. Polynomial Transformation [ by graphic ]
  II. Datum Transformation [ by point ]

## Summary of Polynomial Transformation Test Result

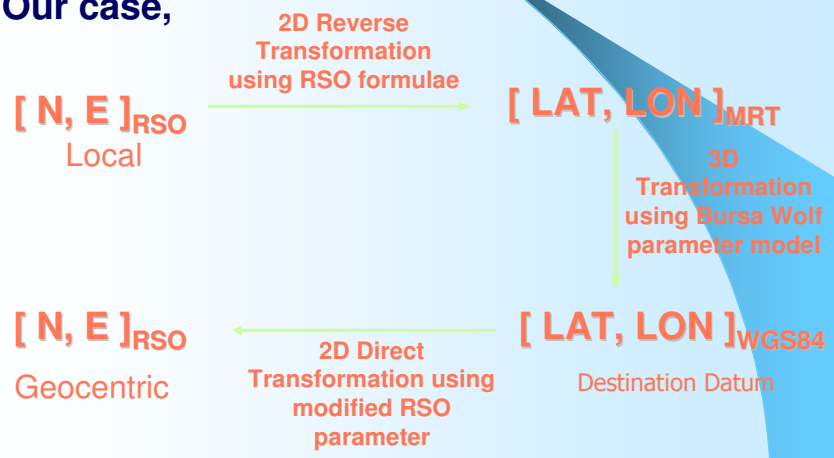
- Accuracy of transformation is influenced by the control point accuracy.
- Large area should be subdivided into smaller blocks.
- $2^{nd}$ order polynomial and the block size of 5km x 5km are optimum.
- Mismatching at block border.
- The NorderTransform software is only capable in doing $2^{nd}$ and $3^{rd}$ order transformation.

## Comparison Between Polynomial and Datum Transformation

| | *Advantages* | *Disadvantages* |
|---|---|---|
| **Polynomial** | 1. Transformation of graphic can be done on the fly. | 1. Need GPS control to be established<br>2. Limited to block size and order of polynomial.<br>3. Graphic mismatch at block size border. |
| **Datum** | 1. Transformation of point can be done on the fly.<br>2. No limited in block size.<br>3. No mismatch problem | |

## Review on Datum Transformation Procedure

- **Our case,**



## GEOCENTRIC RSO PROJECTION

- RSO projection (Geodetic to RSO) parameters have been modified for datum change from local to geocentric.
- The concept of modification is adapted from Australian experience.

## RSO Parameters

- Categories of RSO projection parameters

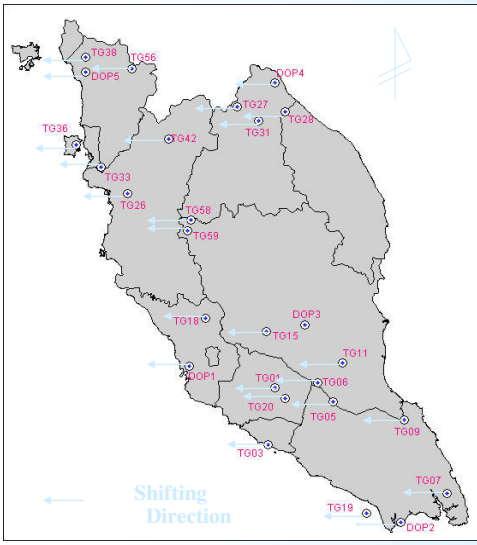
| | | |
|---|---|---|
| Category I | Defined parameters | Origin projection, Azimuth, Scale factor, False Origin (N,E) |
| Category II | Parameters related to ellipsoid change | A, B, C and Basic longitude |

## The New Geocentric RSO Projection Parameters for Peninsular and East Malaysia

| | Peninsular Malaysia RSO | East Malaysia Borneo RSO | Remark |
|---|---|---|---|
| **Ellipsoid Parameters** | | | |
| Ellipsoid | GRS 80 | GRS 80 | |
| Major axis, a | 6378137.000 Meters | 6378137.000 Meters | |
| Flattening, 1/f | 298.2572221 | 298.2572221 | |
| **Category I – Defined Parameters.** | | | |
| Latitude of Origin, $\phi_o$ | 4° 00' 00" N | 4° 00' 00" N | |
| Longitude of Origin, $\lambda_o$ | 102° 15' 00" E | 115° 00' 00" E | |
| Azimuth, $\alpha_c$ | $-\sin^{-1}(0.6)$ | $-\sin^{-1}(0.6)$ | |
| Scale factor, k | 0.99984 | 0.99984 | |
| False Origin (Easting) | 804,671 Meters E | Nil | |
| False Origin (Northing) | Nil | Nil | |
| **Category II - Parameter that related to ellipsoid change** | | | |
| Parameter A | 6378137.502 Meters | 6378137.502 Meters | $R(\rho_o \nu_o)^{1/2}$ |
| Parameter B | 1.003331484644 | 1.003331484644 | $(1+k^2 \cos^4 \varphi_o)^{1/2}$ |
| Parameter C | 0.000003016721 | 0.000003013554 | $\cosh(A/b_o) - B\psi_o$ |
| Basic Longitude, $\omega_o$ | 105° 14' 10.587" | 109°41' 08.948" | $\sin\beta(\omega_o-\omega) = 0.75 \sinh(B\psi + C)$ |

*Note: Formulae for Basic longitude for Borneo RSO is = 0.75 Sin ( $\beta$ (115°-$\omega_o$)) = Sinh ($B\psi$ + C)

## 27 common points have been selected both in MRT and WGS 84 system. The shifting of $RSO_{local}$ to $RSO_{geocentric}$ is computed.



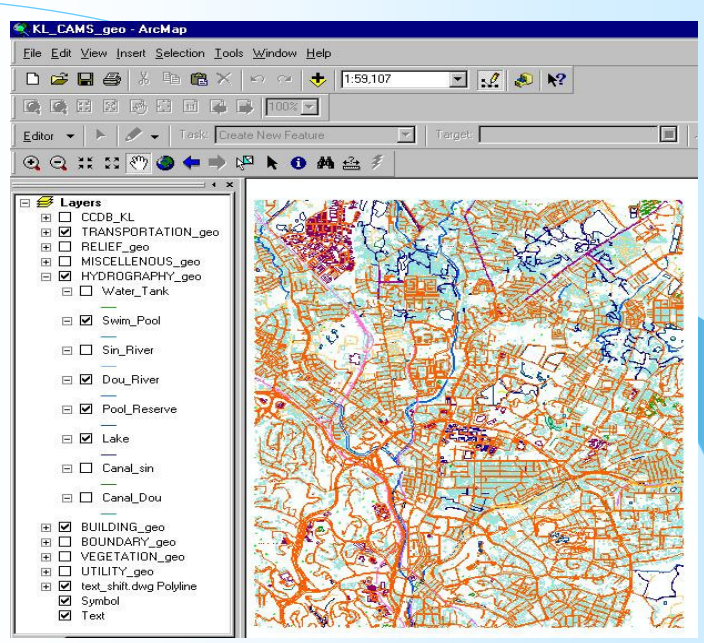

**The differences between $RSO_{local}$ and $RSO_{geocentric}$**

| | Δ E (m) | Δ N (m) |
|---|---|---|
| Min | -193.75 | 6.09 |
| Standard Deviation, σ | 0.73 | 0.47 |
| RMS | 0.72 | 0.47 |

Direction = 271° 31' 25"
Magnitude = 193.82 m

## ANALYSIS OF CAMS DATA AFTER GEO-REFERENCING.

- The geometry is maintained. Only the coordinate values changed.
- Coordinate value shifted about 195m in west direction due to the datum changed.
- Data format changed to shape file and sorted by layer name.
- A map presentation can be done in ArcMap.




KL NDTDB$_{geocentric}$ presented in ArcMap

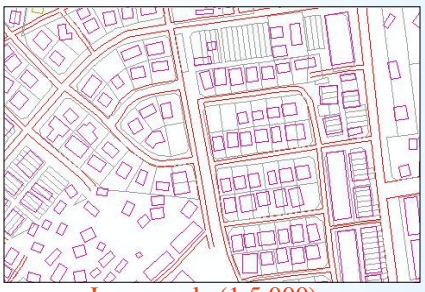
# INTEGRATION ISSUES ANALYSIS

## DATA STRUCTURE
### Data Format

- CAMS or DTDB
  - CAD format need to be converted in to GIS format for integration purpose.
  - Each layer will be represented by a SHP file.
  - Disadvantages of CAD format in GIS purpose:
    - No topology or relationship
    - No attribute table
    - No analysis function
- NDCDB
  - in GIS format.
  -3 shp file - boundary, lot and stone
  - have attributes.

## DATA STRUCTURE
## Map Scale

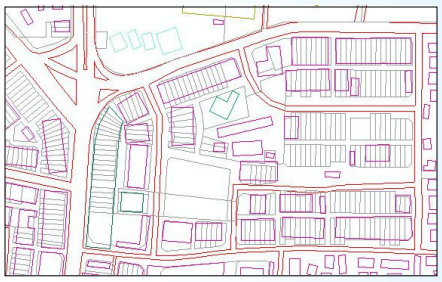
- Large scale map (1:8,000, 1:5,000) give higher geometric accuracy compared to small scale (1:25,000 and 1:50,000):
  1. Small scale experienced higher level generalization



Large scale (1:5,000)


Small scale (1:25,000)

2. Better integration between NDCDB and NDTDB for equivalent scale.



NDCDB = 1:8,000

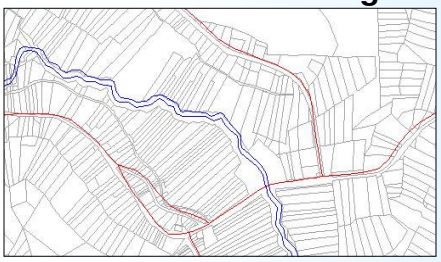
NDTDB = 1:5,000

NDCDB = 1:8,000

NDTDB = 1:25,000

## REFERENCE SYSTEM

- **Final Integration will be in: RSO**
- **2 datum have been tested:**
  - Local Geodetic based integration
    - WGS84 to MRT to RSO
  - Geocentric based integration
    - WGS84 to RSO
- **Almost similar integration results**



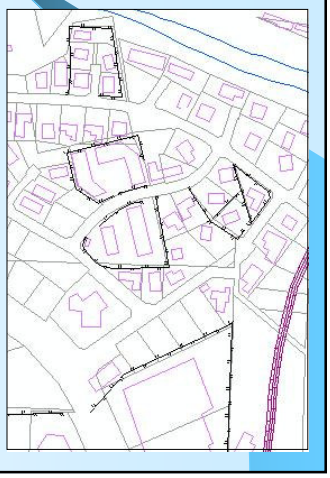
Integration in $RSO_{local}$

Integration in $RSO_{geocentric}$

## Input Data Accuracy/Quality – Geometrical Accuracy

### i. Absolute accuracy

- Absolute accuracy of CAMS data depends on scale and the degree of generalisation.
- Urban map scale 1:5,000
  (photo 1:20,000)
  Rural map scale 1:25,000
  (photo 1:40,000)

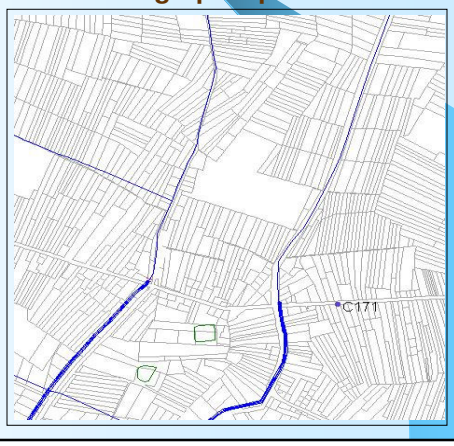


**Urban area show better absolute accuracy, eg. fences features are accurately sit on the boundary line around the building.**

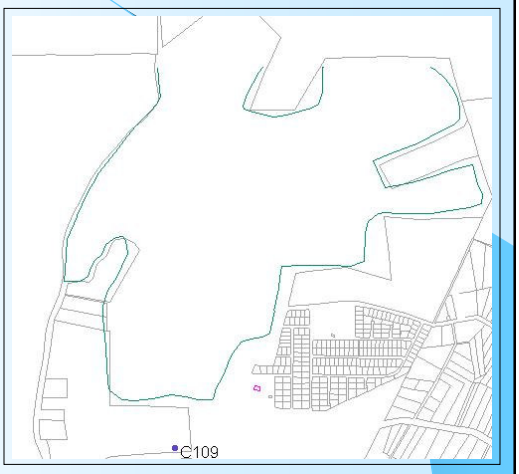
## ii. Relative accuracy

- **Subject to graphic presentation and cartographic process.**

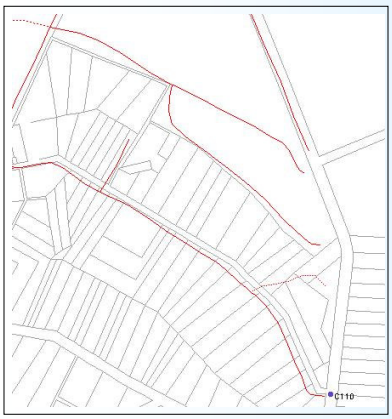
- Graphical Presentation
  - Data conversion from original CAD format to GIS format will giving wrong topology




- Cartographic Process
  - Constraint by map scale
  - Relative accuracy effected by generalization and simplification



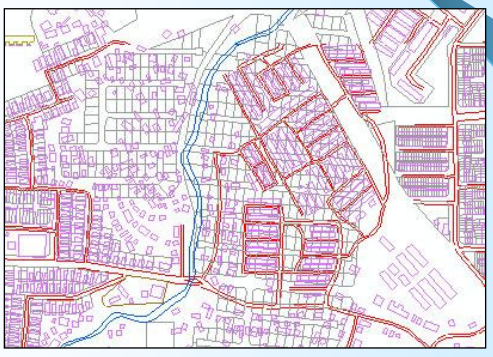
– **Different cartographic level for urban and rural areas mapping process.**




Rural area at Malacca


Urban area at Malacca

## iii. Update Information



**NDCDB is updated from time to time with the land use changes.**

## GIS ENVIRONMENT

- Software Requirements
  - ARCINFO (Data Base Management System and Map Presentation)
  - ARCVIEW (Geo-referencing)
- GIS Format
  - CAMS needs to be restructured to clean the geometry, add topology and common attributes.
  - Fully GIS format for NDCDB

## CONCLUSION

- The geocentric RSO parameter has been modified for geo-referencing purposes.
- For NDTDB , apparent shift in coordinate between $RSO_{local}$ and $RSO_{geocentric}$ is about 195 m to the west.
- Datum transformation is an effective method for geo-referencing.
- Integration issues have been experimented and addressed.

# RECOMMENDATIONS

- Single coordinate system should be adopted for both cadastral and topographic mapping purposes.
- Geocentric RSO should be adopted as a coordinate system for the integration of both digital datasets.
- Such coordinate system is based upon the newly established National Geocentric Reference Frame which has been realized through high precision GPS measurements.
- The existing CAMS dataset should be converted into geocentric RSO coordinate system.
- The conversion of the dataset coordinates is to be done using *datum transformation* technique of georeferencing.
- A systematic and well-planned conversion of the CAMS dataset is necessary for future development of a National Digital Topographical Database (NDTDB).
- A new digital CAMS dataset for semi-urban and rural area should be produced at a reasonable map scale.
- A compatible map scale for both cadastral and mapping datasets is needed for more meaningful integration.
- The existing map scale for the State digital cadastral dataset is at 1: 8000. The production of CAMS dataset at a comparable map scale may be done using orthophoto mapping technique