A REVIEW OF FEATURE MANIPULATION ENGINE (FME)

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ABSTRACT

Coordinate conversion terms are crucial role in geospatial data management and preserve the existing data challenging. Using a specific ffunctions which is coordinate system feature offered by Feature Manipulation Engine (FME) and GIS database development process, able to identifying the characteristics of coordinate conversion preserving factor. Then all the factor being used to examine a precision coordinate conversion within the specific format data. Furthermore, using FME study on this paper focus on restructuring of the geospatial data extraction, transformation and loading (ETL) within a database circumstance. Perhaps, a review of coordinate conversion method using FME Server released in 2008, able to enhances a user's ability to distribute and deliver data in variety of formats by way of a variety of services such as WFS, WMS, SOAP, KML as well as basic streaming. Furthermore, FME Cloud (released in 2013) enables users to deploy FME Server in the cloud.

Keyword: Coordinate conversion, FME, Geospatial data, ETL.

1.Introduction

Changing through conversion formats and obsolescence of technology, untrained staff and human error, authenticity and reliability of material, standardization, copyright and cost issues and awareness are some issues in preserving factor during coordinate conversion process. Stephanie Routhier Perry (2014) also mention important to focus on the future, anticipating what challenges could arise, and devising solutions. This paper almost explains the issues and short list all the factors could arise while coordinate conversion process. But in detail about how to measure the accurateness and the precision of digital map after coordinate conversion done, supposedly to be clarify.

Further due to overcome all the above challengers of the coordinate conversion, researchers mention about changes conversion era. For example, as mention by article writer A.C

Seijmonsbergen (2013), map hardcopy conversion birds-eye views, three-dimensional display and animations, virtual globe visualizations, geospatial portable document format maps or access to geomorphological maps via web-based services are possible through remote servers. The visualization and publication of digital geomorphological information layers have drastically changed the end-user interactively controls the information that is on-screen displayed, analyzed, and distributed.

The study subject consists in three contemporaneous pre-geodetic maps (late 16th century) from the ancient Po river delta area (Italy), by means of which a geometrically correct representation also known as coordinate conversion of those parts of the landscape, not preserved today because of sea erosion, was tried by Gabriele Bitelli et al (2014). Starting from measurement of sighting angles and distances applied to a number of landmarks, a splitting of the old maps in sub-areas, probably corresponding to the set of original surveyed zones, was performed. Then, a new specific error index, be applied to maps lacking an explicit graphical scale, is proposed to evaluate the map truthfulness degree.

Yiyi Sulaeman et al (2013) approach about map conversion application which is known as GlobalSoilMap.net project. This paper prefers to provide soil legacy data management for supporting digital soil mapping and to develop a prototype soil observation database for global soil mapping in Indonesia. Using legacy data identification and collection, data selection, database development and population, data harmonization and display, and dataset integration. Historical soil survey reports and soil maps were collected, scanned, coordinate conversion and summarized. Database design development will be implement for soil profile observations and implemented it at two levels: spatial site data and horizon data. Spatial site data includes site geographical coordinates and attributes, while horizon data includes soil physical and chemical properties. The depths of soil profile database entries were standardized using the equal-area spline.

For all the changes and development of previous research, find solution as mention by Stephanie Routhier Perry (2014) to focus on the future, anticipating what challenges could arise, and devising solutions. But in term of find a better accurate and precise while doing coordinate conversion are not mention clearly. Hence, this study is to review a specific functions which is coordinate system feature offered by Feature Manipulation Engine (FME) and GIS database development. Its contain identifying the characteristics of coordinate conversion preserving factor. Also cover about the precision coordinate conversion within the specific format data examine. But in the same time restructuring of the geospatial data extraction, transformation and loading (ETL) within a database circumstance.

The study area concentrates on transformed datasets that were existed in different formats. ArcInfo's Coverage, ArcView's Shapefile and Autodesk's dxf/ dwg formats and also having different map projections. FME was utilized to convert all the given different datasets into a Geodatabase format. All the process including only on conversion itself and conversion into geodatabase. Database development to finally output both coordinate conversion and reconstructing the geodatabases.

Feature Manipulation Engine (FME) and ArcGIS 10.2 version software used for entire processing of coordinate conversion and reconstructing the geodatabases. The accuracy assessment of this study will be measured using MRSO, BRSO, WGS84, GDM2000 and MS1759 Standard Guidelines.

2. Methodology

2.1. Preliminary studies on the characteristics of coordinate conversion preserving factor.

The accuracy assessment of this study will be measured using MRSO, BRSO, WGS84, GDM2000 and MS1759 Standard Guidelines.

2.1.1 MRSO

From Kadir et al., (2003) sources, Malaysian Rectified Skew Orthomorphic (MRSO) use Kertau, Pahang (804671.29977,0.000) origin. Some projection spatial features including of it has a conformal shape which means by a local shapes are true. Area increases with distance from the center line. For direction features, local angles are correct and the distance is true along the chosen central line.

The rectified skew orthomorphic (RSO) map projection is an oblique Mercator projection developed by Hotine in 1947. This projection is orthomorphic (conformal) and cylindrical. All meridians and parallel are complex curves. Scale is approximately 21 true along a chosen central line (exactly true along a great circle in its spherical form). It is thus a suitable projection for an area like Switzerland, Italy, New Zealand, Madagascar and Malaysia as well. The RSO provides an optimum solution in the sense of minimizing distortion whilst remaining conformal for Malaysia.

2.1.2 BRSO

Rectified Skew Orthomorphic (RSO) Borneo map projection system used by the Department of Lands and Surveys, Sarawak has 2,000,000 m and 5,000,000 m defined as the False Easting and False Northing respectively in the projection parameters; otherwise the Easting and Northing coordinates enter into negative values in the western most region of Sarawak, i.e. somewhere beyond Sematan area of Lundu district. Negative coordinates values are less flavourable for the purpose of coordinates computation and cadastral mapping.

As such, the modified version of the RSO Borneo projection parameters using EPSG:9812 Hotine Oblique Mercator (Variant A) (where the final rotation applied is at the natural origin) should look like this:

Latitude of projection centre	4		sexagesimal DMS
Longitude of projection centre	115		sexagesimal DMS
Azimuth of initial line	53° 18' 56.9537"		sexagesimal DMS
Angle from Rectified to Skew Grid	53° 7' 48.3685"		sexagesimal DMS
Scale factor on initial line	0.99984		unity
False easting	2,000,000		metre
False northing	5,000,000		metre

Table 1. The modified version of the RSO Borneo projection parameters using EPSG:9812 Hotine Oblique Mercator (Variant A).

2.1.3 WGS84 and GDM2000

The World Geodetic System 1984 (WGS84) is the datum used by the Global Positioning System (GPS). The datum is defined and maintained by the United States National Geospatial-Intelligence Agency (NGA). Coordinates computed from GPS receivers are likely to be provided in terms of the WGS84 datum and the heights in terms of the WGS84 ellipsoid.
WGS 84 / UTM zone 48N is a projected CRS and is suitable for use in between 102Â°E and 108Â°E, northern hemisphere between equator and 84Â°N, onshore and offshore. Used by Cambodia, China, Indonesia, Laos and Malaysia including West Malaysia, Mongolia and Russian Federation, Singapore and Thailand. While WGS 84 / UTM zone 48N uses the WGS 84 geographic 2D CRS as its base CRS and the UTM zone 48N (Transverse Mercator) as its projection. WGS 84 / UTM zone 48N is a CRS for large and medium scale topographic mapping and Engineering Survey.

Specifically in Malaysia, WGS84/ UTM zone 47N will use for Perlis, Kedah, Penang, Perak, Selangor, Pahang, Negeri Sembilan and Malacca. WGS84/ UTM zone 48N used by Kelantan, Terengganu, Pahang, Negeri Sembilan, Malacca and Johor. While WGS84/ UTM zone 49N using for Sarawak and WGS84/ UTM zone 50N for both Sabah and Sarawak.

GDM2000

Recently, Malaysia used the GRS80 ellipsoid used for GDM2000, instead of the WGS84 ellipsoid. This is because of the two ellipsoids can be considered identical. When the WGS84 system was developed it was based on the GRS80 ellipsoid, but computational techniques resulted in a small difference in the flattening. When used to express earth-centred Cartesian positions (X, Y, Z) as latitude, longitude and ellipsoidal height, these two ellipsoids result in a difference of less than 1 millimeter.

a) Semi major axis (a)
   6378137 m WGS84
   6378137 m GRS80

b) flattening (1/f)
   298.257223563 WGS84
   298.257222101 GRS80

This is the latest and up to date datum that is being used in Malaysia. It opens door to the possibility of having survey data presented in one unified datum for the whole country hence promoting efficient survey data management. GDM stands for the Geocentric Datum of Malaysia. It forms the new earth-centred coordinate datum for Malaysia that will 'gradually' replace the regional datums of Kertau 1948 in Peninsular Malaysia and Timbalai 1948 in Sabah and Sarawak. GDM2000 is basically realized using Global Positioning System (GPS) to connect the national Zero Order Network (i.e. the Malaysia Active GPS System stations) with some of the global permanent GPS network (i.e. the International GPS Service stations). GDM2000 was officially launched on 26th of August 2003. The main advantage is that GDM2000 coordinates are immediately compatible with global coordinates obtained from GPS and with other coordinate systems adopted in many parts of the world. It will also allow an efficient exchange of data and linking of products from various information systems.

2.1.4 MS1759 Standard Guidelines

This Malaysian Standard is intended for use by all businesses that produce, distribute or utilise geospatial data, either alone or in conjunction with non-geospatial data. These range from geographic information systems, decision support systems, data mining, data warehousing, to modelling and simulations. Application areas include but not limited to resource planning and management, automated mapping, geo-engineering, construction, communication, transportation and utilities.

It provides a system for feature and attribute coding by which producers and users of geographic information may use in structuring their digital spatial data. This standard facilitates sharing and exchanging between both data producers and users. This Standard represents a major improvement over MS 1074:1992 and contains some 2000 additional features and organised into twelve main categories such as aeronautical, geology, soil, utility and special use.

2.2. Examine a precision coordinate conversion within the specific format data.

ArcInfo's Coverage, ArcView's Shapefile and Autodesk's dxf/ dwg formats are several specific format data that have been used to cater of its precision.

1. Converting Esri Shapefile to Geodatabase

a) Inspecting the Data

Dragged sg. sekudai.shp file into the FME Data Inspector and clicked OK.

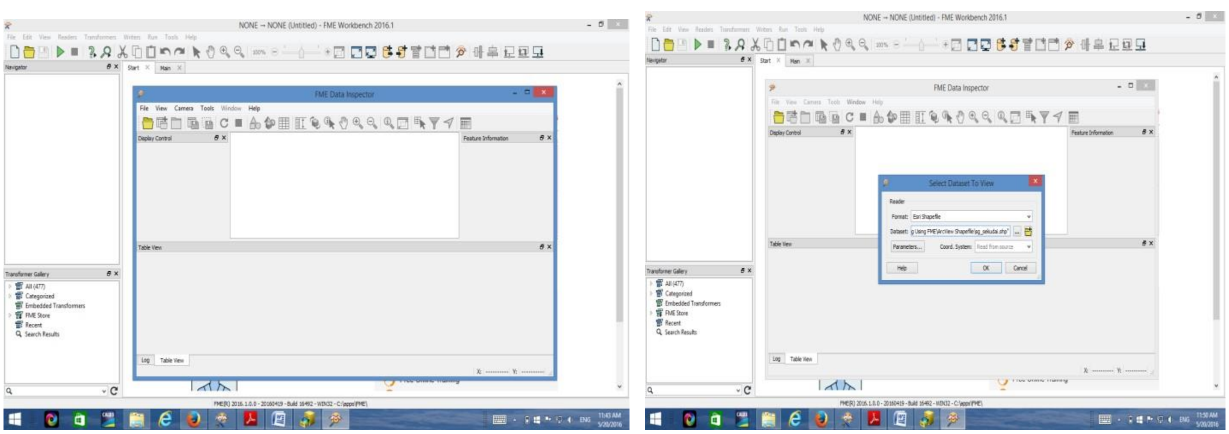
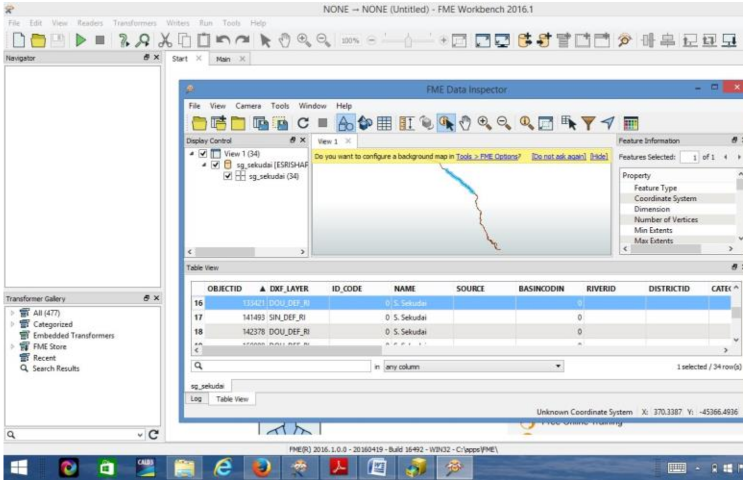


Figure 1. Dragged sg.sekudai file into FME Data Inspector and OK.



In data inspector window, there are many features that elaborate the data; feature information shows the properties of the selected river segment, and table view also shows the attributes of the data, moreover, display control demonstrates the names of the data that is under inspection.

Figure 2. Data Inspector Window.

b) Select Generate Workspace

This is found on the Create Workspace section of the FME Workbench interface. Creating workspace consists of three sections: Reader, Writer and Workflow options.

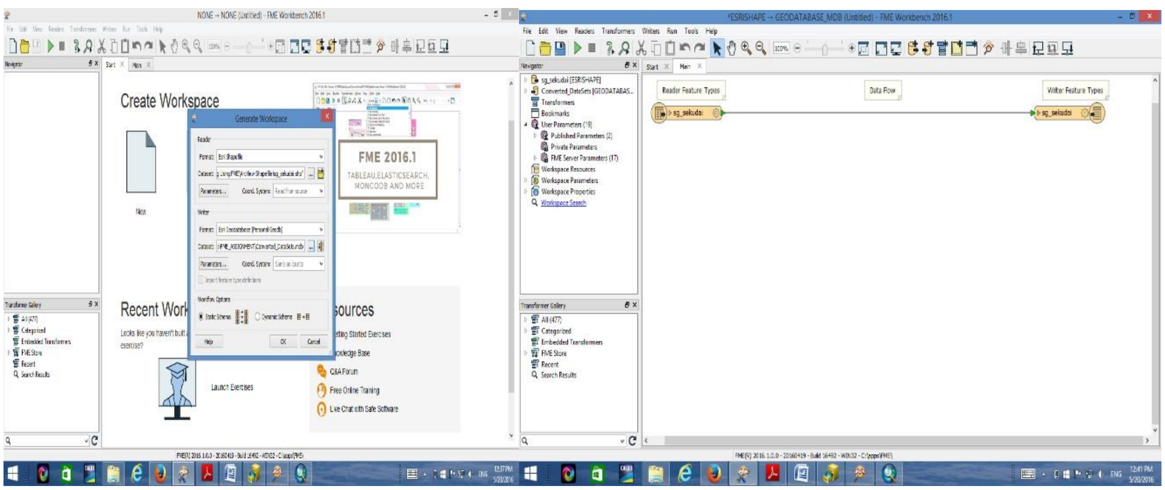


Figure 3. Reader, Writer and Workflow options for create workspace.

c) Browsing to and selecting the source (Reader) dataset

ESRI Shape file (*.shp) was selected for the reader and navigated to the sg_sekudai.shp file and it was selected.

d) Setting the output (Writer) format to ESRI Geodatabase

For the Writer format, ESRI Geodatabase (Personal Geodatabase) format was selected.

e) Setting the output (Writer) dataset location

For the dataset location, already exited Geodatabase was selected to create the workspace.

f) Modifying output (Writer) Feature Type Properties

By default, the translation creates a new Feature Class within the Geodatabase. However, no modification was performed for the output feature type properties.

g) Running translation by clicking run button on the toolbar

Running the workspace by clicking on the green play button, Thus, this carries out the translation.

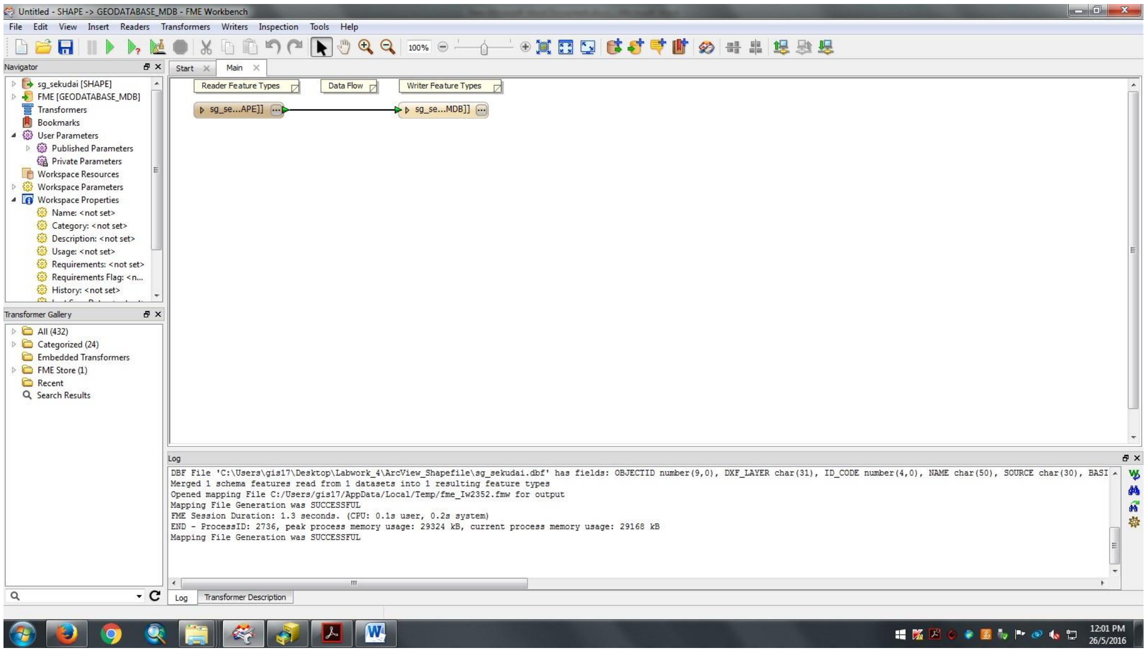


Figure 4. Running translation.

A below screenshot shows that translation was carried out successfully.

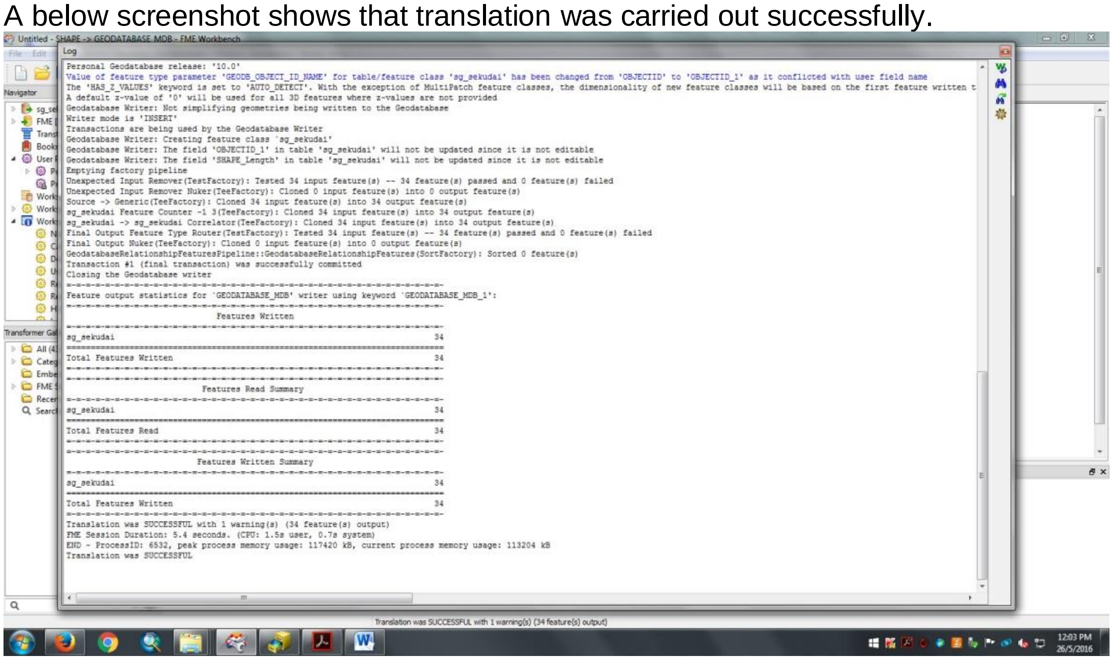


Figure 5. Succes translation process.

h) Viewing the Feature Dataset & Feature Class in ArcMap

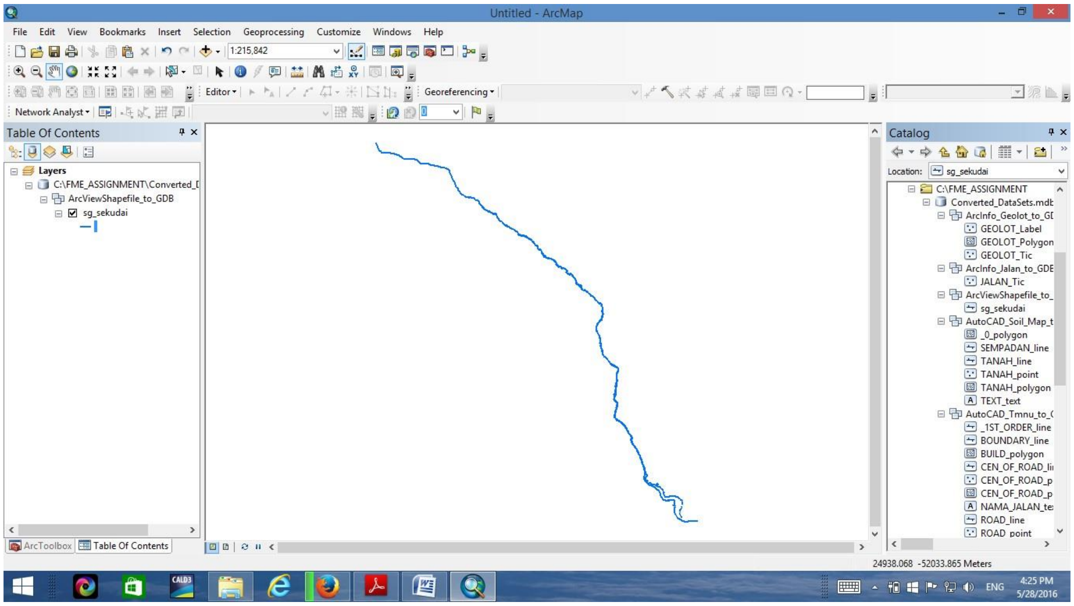


Figure 6. Feature dataset and Feature class view.

2. Conversion of Soil_Map_tr.dxf and tmnu.dwg AutoCAD formats into Geodatabase

The datasets were given in AutoCAD format and was attempted to be converted into Geodatabase (Personal gdb). The screenshots below display the datasets in AutoCAD drawings.

(i) Soil_Map_tr.dxf

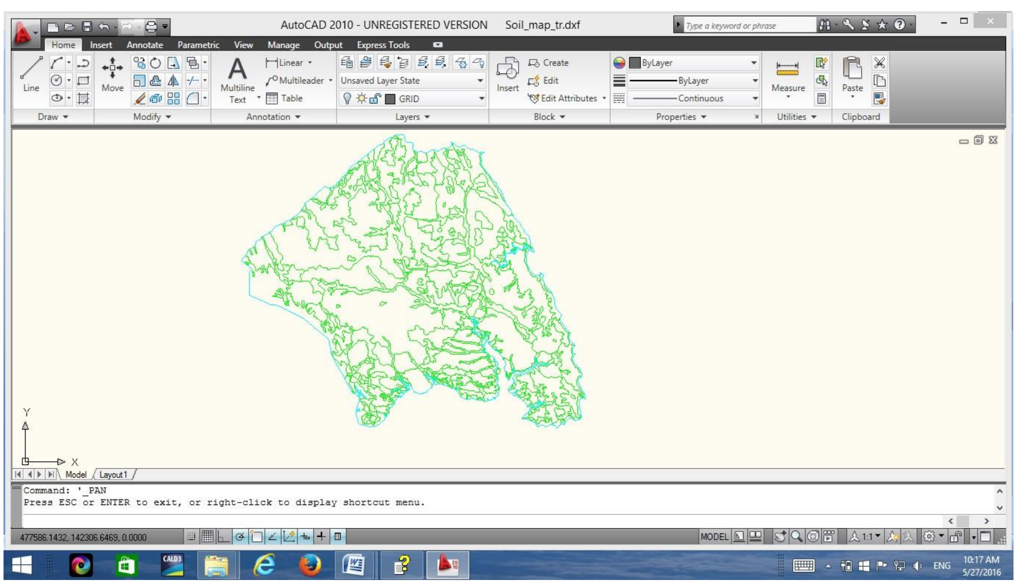


Figure 7. Datasets AutoCAD drawings (.dxf).

(ii) Tmnu.dwg

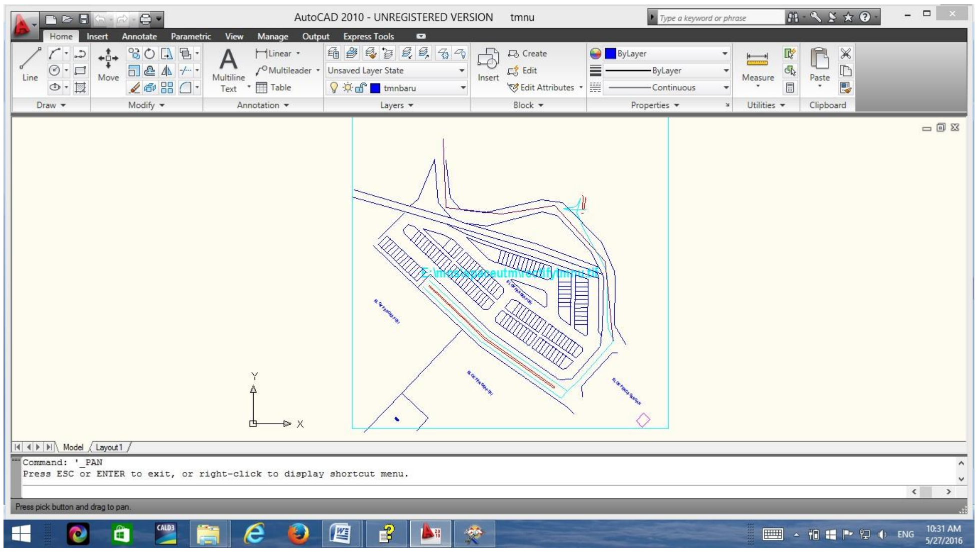


Figure 8. Datasets AutoCAD drawings (.dwg).

For conversion of AutoCAD into Geodatabase, the datasets were inspected by dragging into FME Data Inspector and selected Generate Workspace. Creating workspace usually consists of three sections: Reader, Writer and Workflow options. The reader dataset source was selected as AutoCAD dwg/dfx and browsed the datasets where the output was selected ESRI Personal Geodatabase and writer output location was set preexisted Geodatabase. No modification was performed in this conversion and the conversion was carried out as a FME default.

(i) Setting and running translation of Soil_Map_tr.dxf

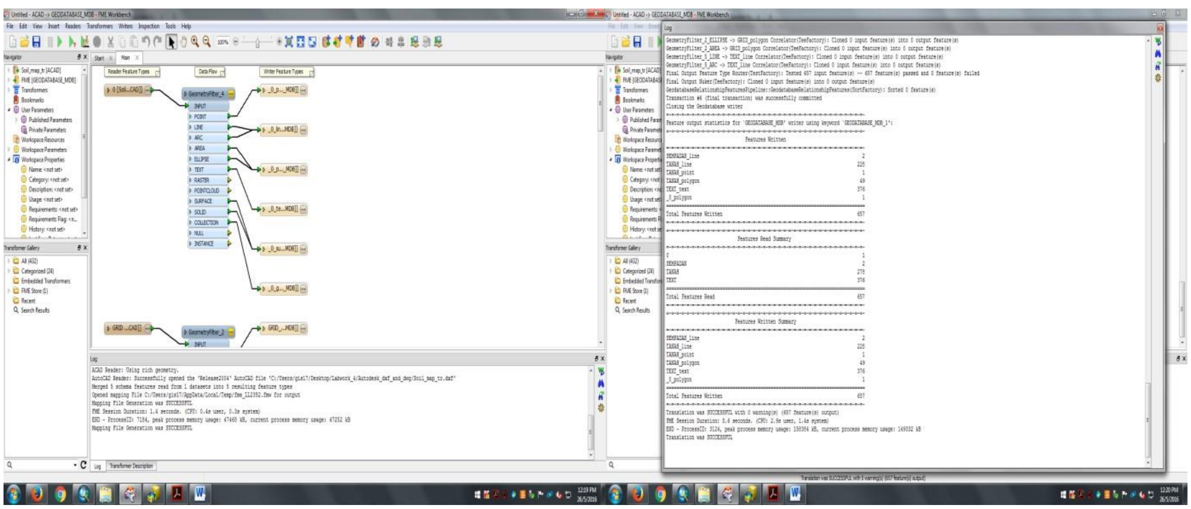


Figure 9. Set and run translation process (.dxf).

(ii) Viewing in ArcMap

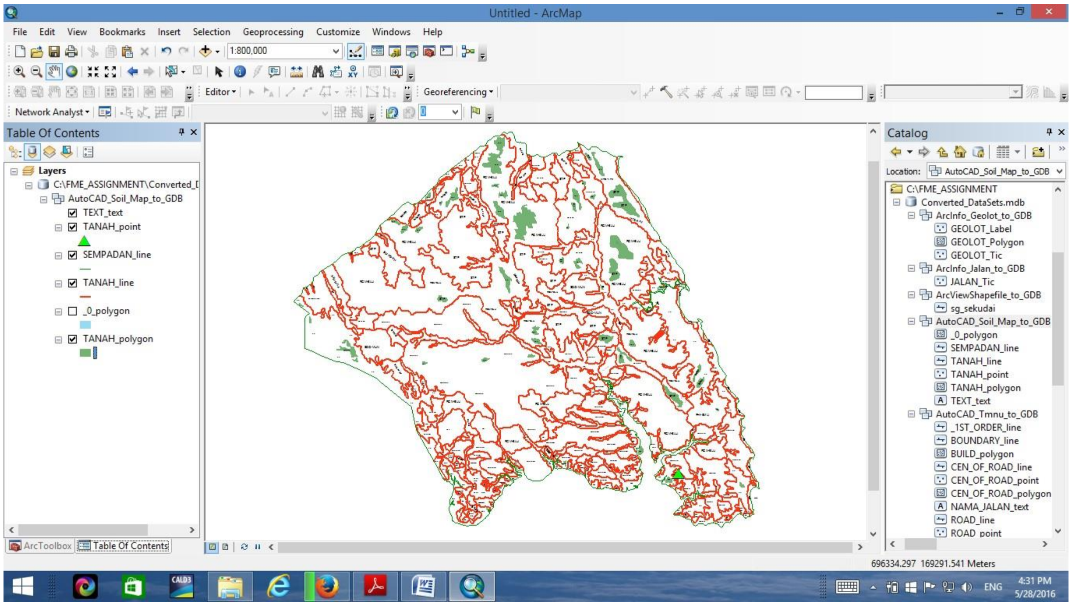


Figure 10. After translation process (change to ArcMap).

(iii) Setting and running translation of Tmnu.dwg

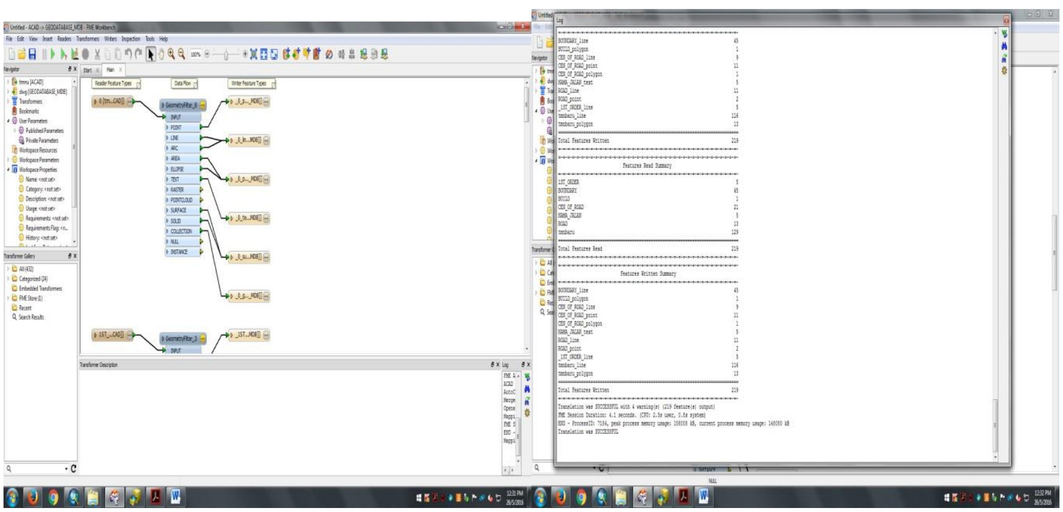


Figure 11. Set and run translation process (.dwg).

(iv) Viewing in ArcMap

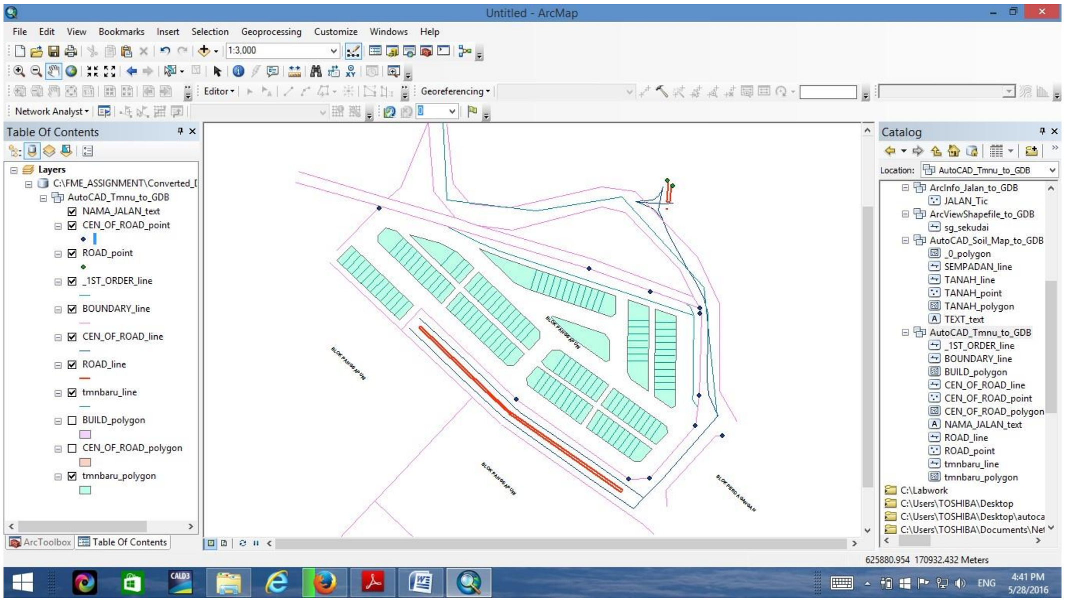


Figure 12. After translation process (change to ArcMap).

3. Conversion of ArcInfo Coverage into Geodatabase

The ArcInfo Coverage format is a data model that stores spatial data including geographic features and corresponding attribute information. However, ArcInfo Coverage datasets were given within two folders Geolot and Jalan datasets. These datasets were existed in DATAFILE and dBASE tables. Both the datasets were previewing in ArcCatalog.

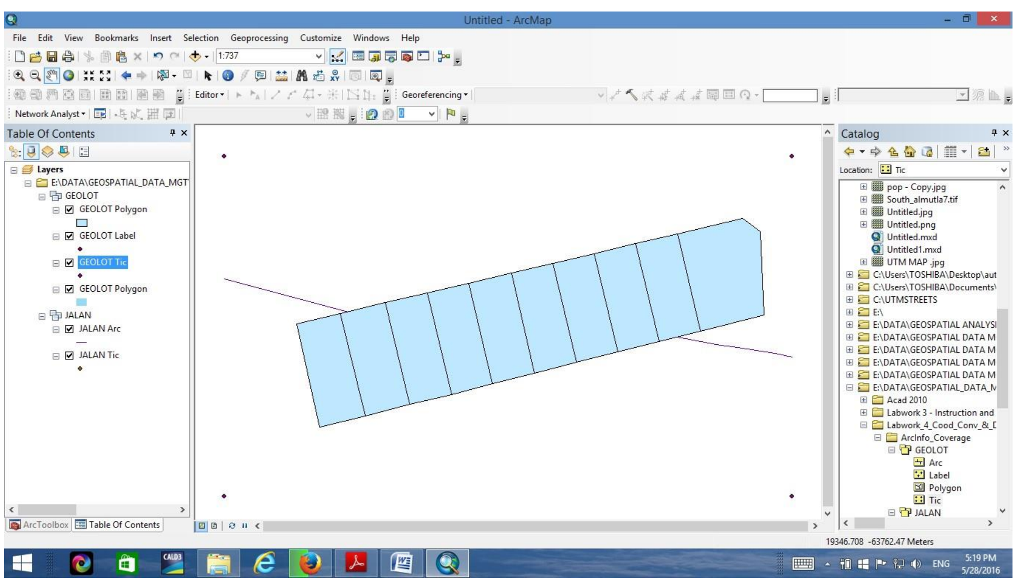


Figure 13. Arcinfo to Geodatabase conversion.

Workspace for conversion of ArcInfo Coverage into Geodatabase was created and the creation of workspace usually consists of three sections: Reader, Writer and Workflow options. The reader dataset source was selected as dBASE and Datafile formats consecutively and browsed the datasets where the output was selected ESRI Personal Geodatabase and writer output location was set the preexisted Personal Geodatabase.

(i) Geolot Files setting for translation and running translation

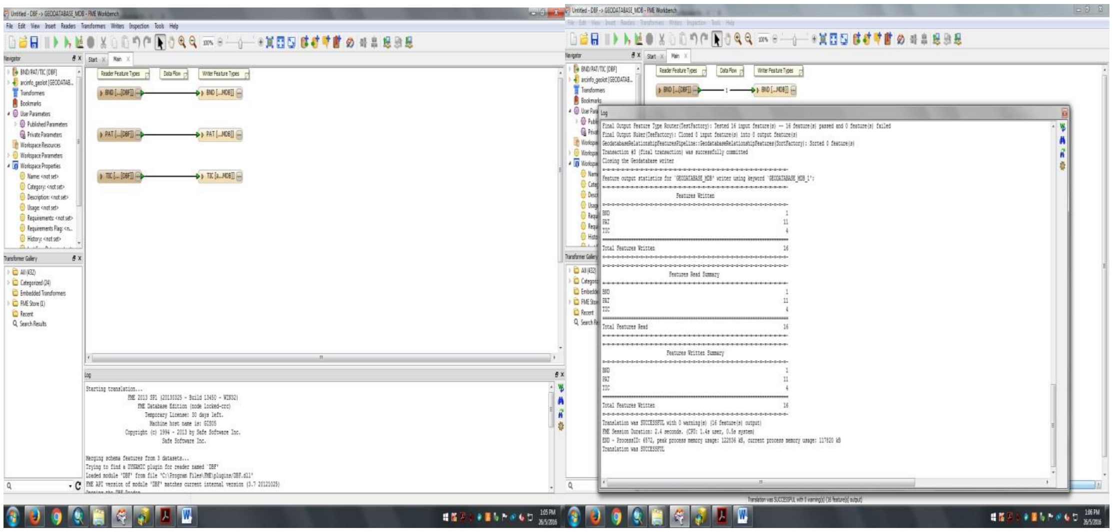


Figure 14. Translate and run translation files.

(ii) Viewing in ArcMap

The converted ArcInfo into Geodatabase can be viewed in ArcMap. Coverages usually have a set of feature classes to represent geographic features. Each feature class stores a set of points, lines (arcs), polygons, or annotation (text). Coverages can also show the relationships between features.

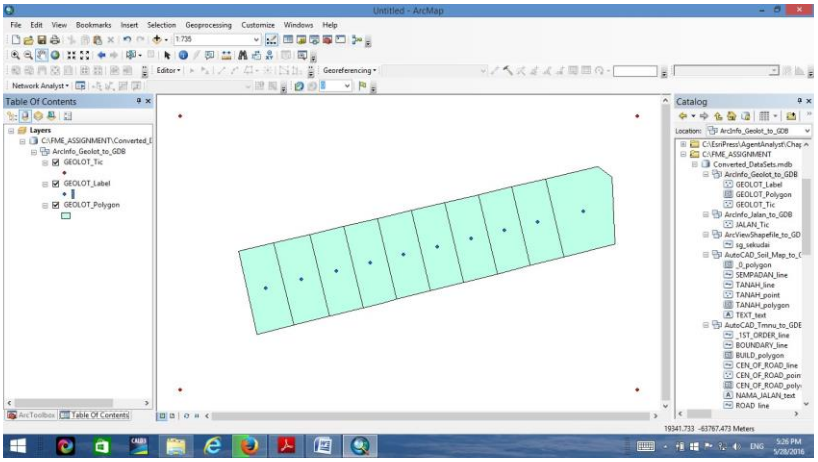


Figure 15. After translation process (change to ArcMap).

(iii) Jalan Files setting for translation into Geodatabase

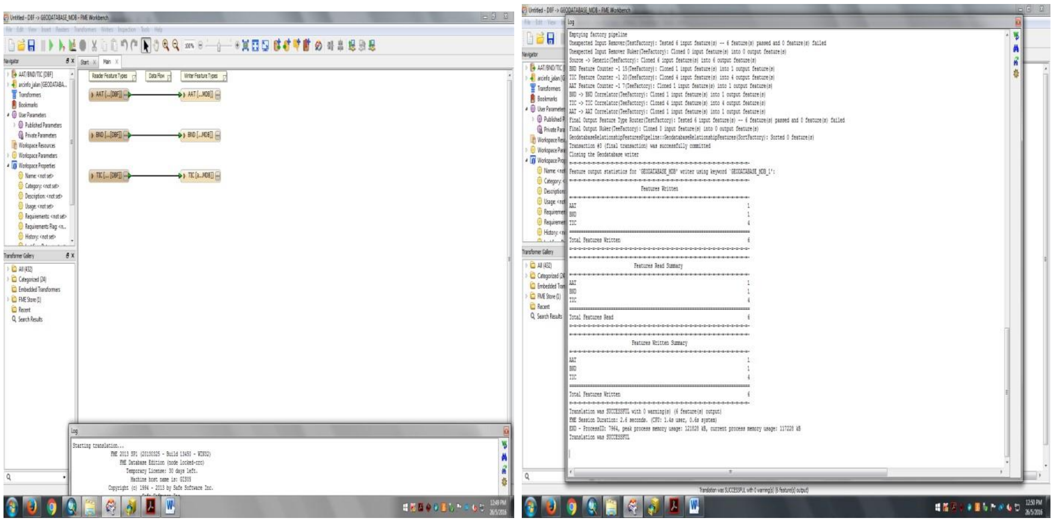


Figure 16. Geodatabase translation process.

(iv) Viewing the converted ArcInfo in ArcMap

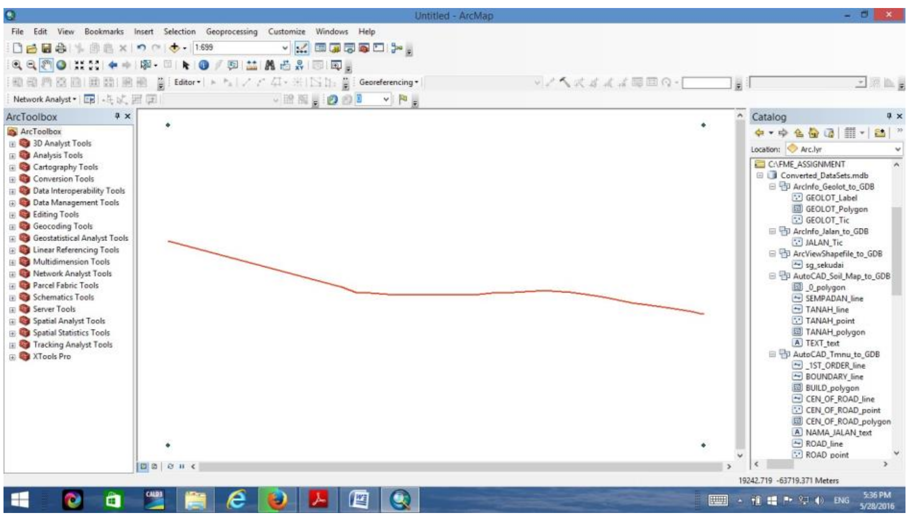


Figure 17. After translation process (change to ArcMap).

2.3. Restructuring of the geospatial data extraction, transformation and loading (ETL) within a database circumstance.

In this part, a Sg_sekudai.shp (from the ArcView Shapefile's folder) was given with many attributes. So, it is needed to be removed all the others attribute and create and retain only the following attributes:

(i) Riv_length (type=number, width=16; dec=2) [length of the river segment]

Riv_length was created and calculated the length of each river segment and characterized with its given properties.

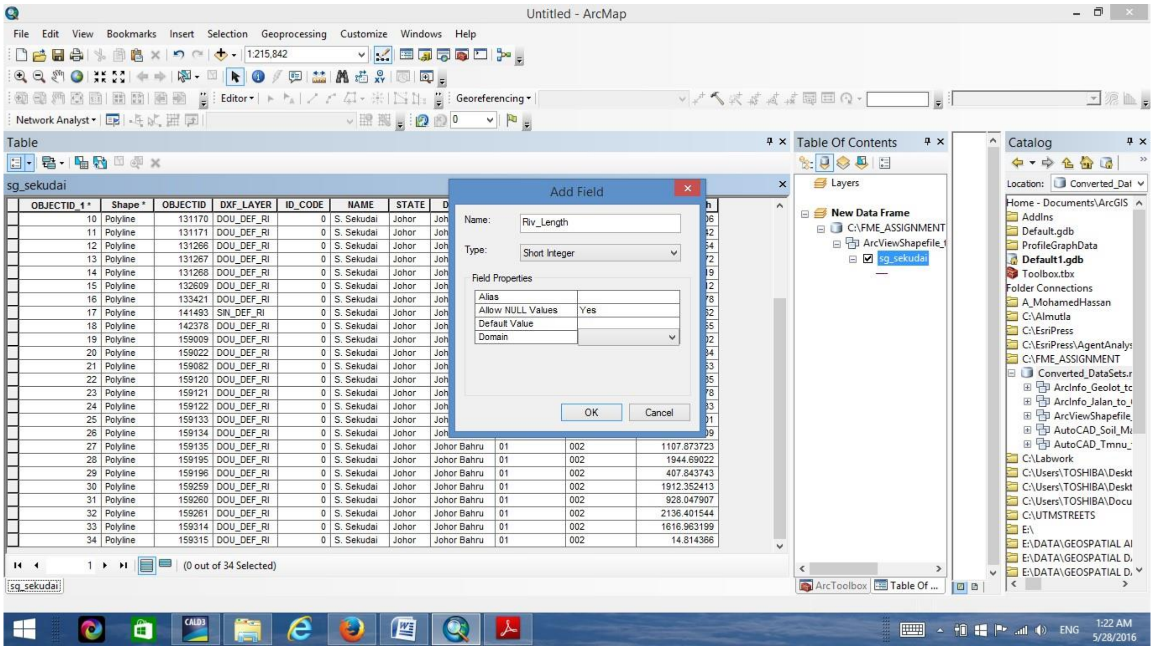


Figure 18. Length calculation and characterized process.

Riv_length type, width and decimal numbers were set as shown in a below screenshot

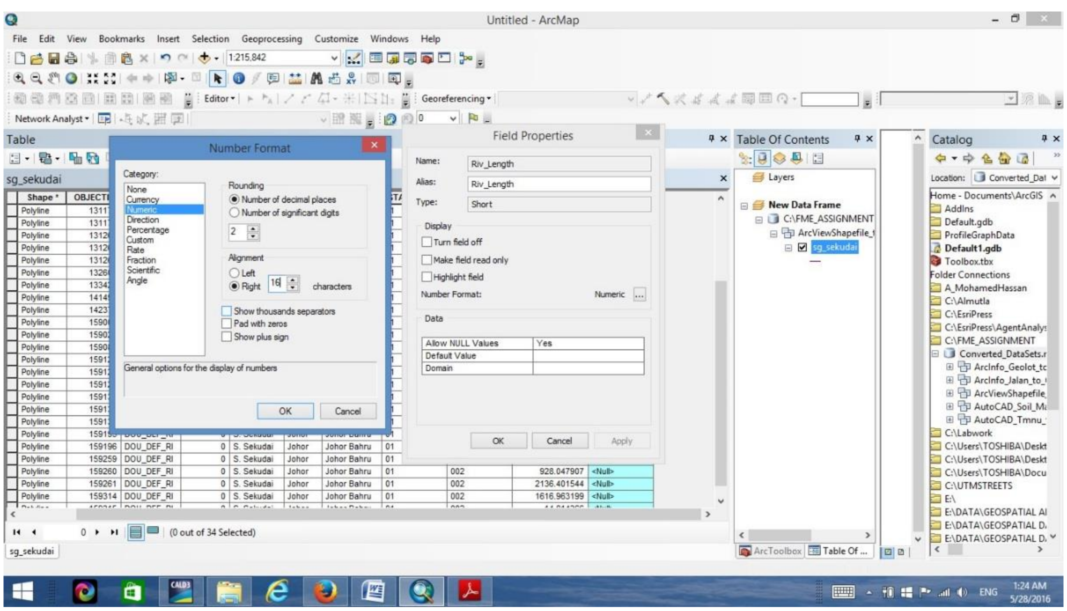


*Figure 19.*Width and decimal places.

(ii) Riv_name (type=string, width=25)

Riv_name was created in the attribute with the given properties as shown in this screenshot.

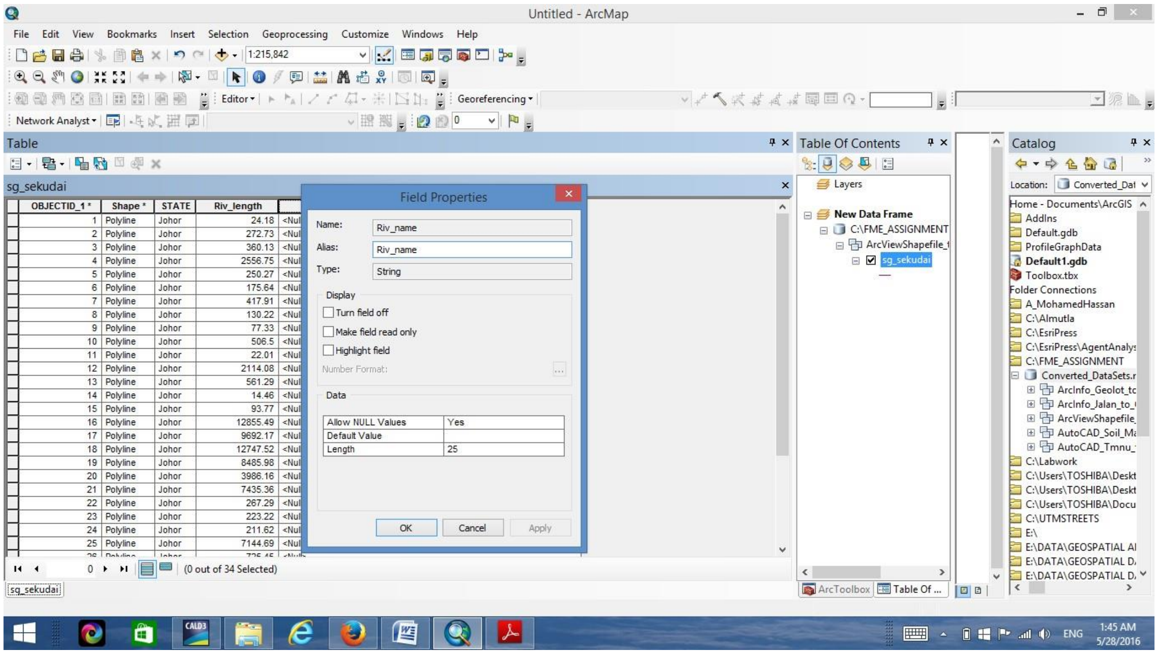


Figure 20. Attribute properties.

(iii) FCODE of the river

For setting the feature code of the river, **MS1759** was referred for naming an appropriate structure and code of the river, here are some descriptions of river as per Malaysian Standard1759:

Table1: HH Inland Water (River)

Feature Code	HH0040
Feature Name	River
Description	A relatively large natural stream of water
Feature Class	Line, Polygon
Possible Attribute	Name (NAM)

Table 2. Malaysian Standard1759:HH Inland Water (River)

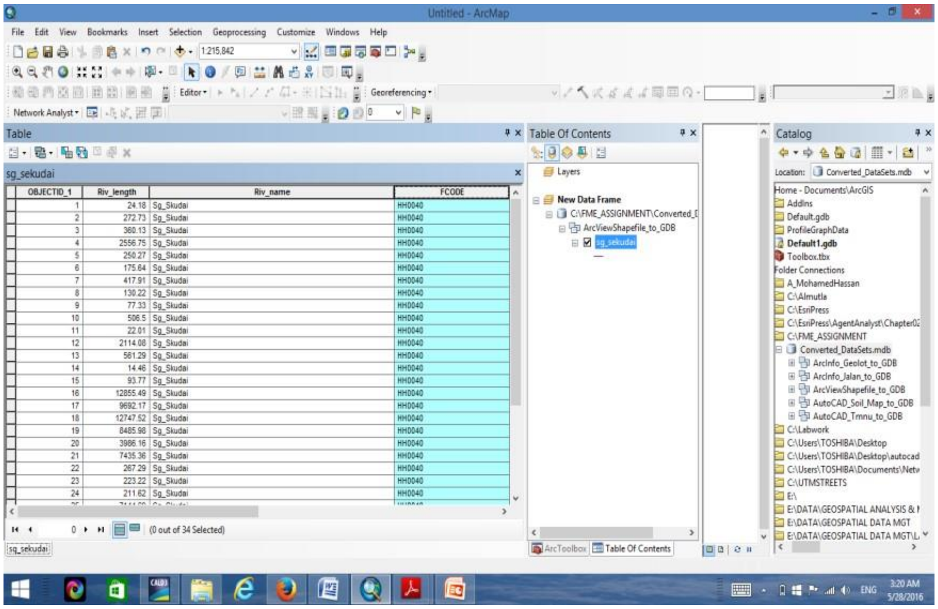


Figure 21. Feature river code setting.

(iv) Riv_cust (type=string, width=25)

The custodianship of Sg Skudai is considered as state level, thus Johor State is responsible for protecting and managing the river. The river attributes was managed as shown in a below screenshot.

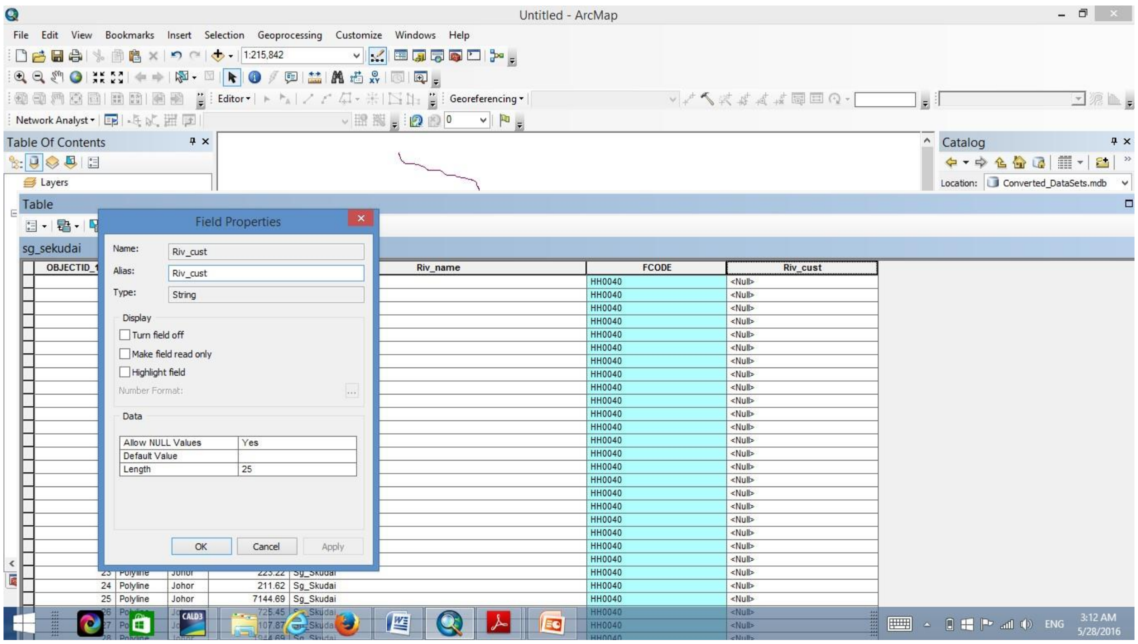
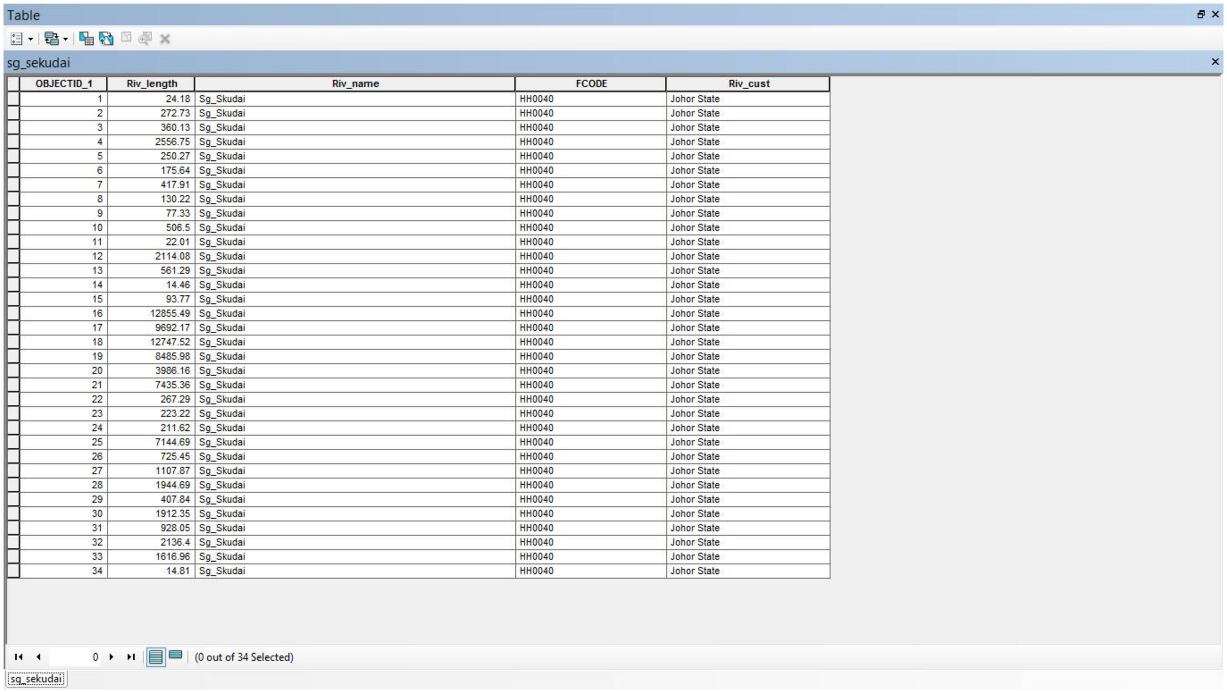


Figure 21. Attribute input of river.

The overall properties of the river were characterized as shown in a below screenshot



Table

sg_sekudai

OBJECTID_1	Riv_length	Riv_name	FCODE	Riv_cust
1	24.18	Sg_Skudai	HH0040	Johor State
2	272.73	Sg_Skudai	HH0040	Johor State
3	360.13	Sg_Skudai	HH0040	Johor State
4	2556.75	Sg_Skudai	HH0040	Johor State
5	250.27	Sg_Skudai	HH0040	Johor State
6	175.64	Sg_Skudai	HH0040	Johor State
7	417.91	Sg_Skudai	HH0040	Johor State
8	130.22	Sg_Skudai	HH0040	Johor State
9	77.33	Sg_Skudai	HH0040	Johor State
10	506.5	Sg_Skudai	HH0040	Johor State
11	22.01	Sg_Skudai	HH0040	Johor State
12	2114.08	Sg_Skudai	HH0040	Johor State
13	561.29	Sg_Skudai	HH0040	Johor State
14	14.46	Sg_Skudai	HH0040	Johor State
15	93.77	Sg_Skudai	HH0040	Johor State
16	12855.49	Sg_Skudai	HH0040	Johor State
17	9692.17	Sg_Skudai	HH0040	Johor State
18	12747.52	Sg_Skudai	HH0040	Johor State
19	8485.98	Sg_Skudai	HH0040	Johor State
20	3986.16	Sg_Skudai	HH0040	Johor State
21	7435.36	Sg_Skudai	HH0040	Johor State
22	267.29	Sg_Skudai	HH0040	Johor State
23	223.22	Sg_Skudai	HH0040	Johor State
24	211.62	Sg_Skudai	HH0040	Johor State
25	7144.69	Sg_Skudai	HH0040	Johor State
26	725.45	Sg_Skudai	HH0040	Johor State
27	1107.87	Sg_Skudai	HH0040	Johor State
28	1944.69	Sg_Skudai	HH0040	Johor State
29	407.84	Sg_Skudai	HH0040	Johor State
30	1912.35	Sg_Skudai	HH0040	Johor State
31	928.05	Sg_Skudai	HH0040	Johor State
32	2136.4	Sg_Skudai	HH0040	Johor State
33	1616.96	Sg_Skudai	HH0040	Johor State
34	14.81	Sg_Skudai	HH0040	Johor State

0 (0 out of 34 Selected)

sg_sekudai

Figure 22. Complete river file properties.

3. Limitation and solution

Limitations were encountered for converting different formats into Personal Geodatabase. Since, The FME *Esri Geodatabase* formats use the ArcGIS ArcObjects library which requires ArcGIS software to be installed and licensed on the same machine as FME. Moreover, the exception is the FME Format - *Esri Geodatabase (File Geodatabase API).* This File Geodatabase does not require any Esri software to be installed or any additional Esri license.

Format	**Required Safe Software Application**	**Required Esri Application**	**Operating System**	**Comments**
Personal Geodatabase	32 bit FME	Licensed ArcGIS for Desktop	Windows only	
File Geodatabase API (*FILEGDB*)	32 or 64 bit FME	none	32 or 64 bit Windows, Linux and Mac	Limited Geodatabase functionality support

Table 3. Esri Formats Supported by FME Version.

Solutions

All the different format datasets that were given converted successfully by using full licensed ArcGIS software in the lab GIS II or the conversions could be accomplished by setting File Geodatabase to be the output dataset location. A below screenshot shows that the converted datasets in ArcCatalog and also were burned into CD for submission.

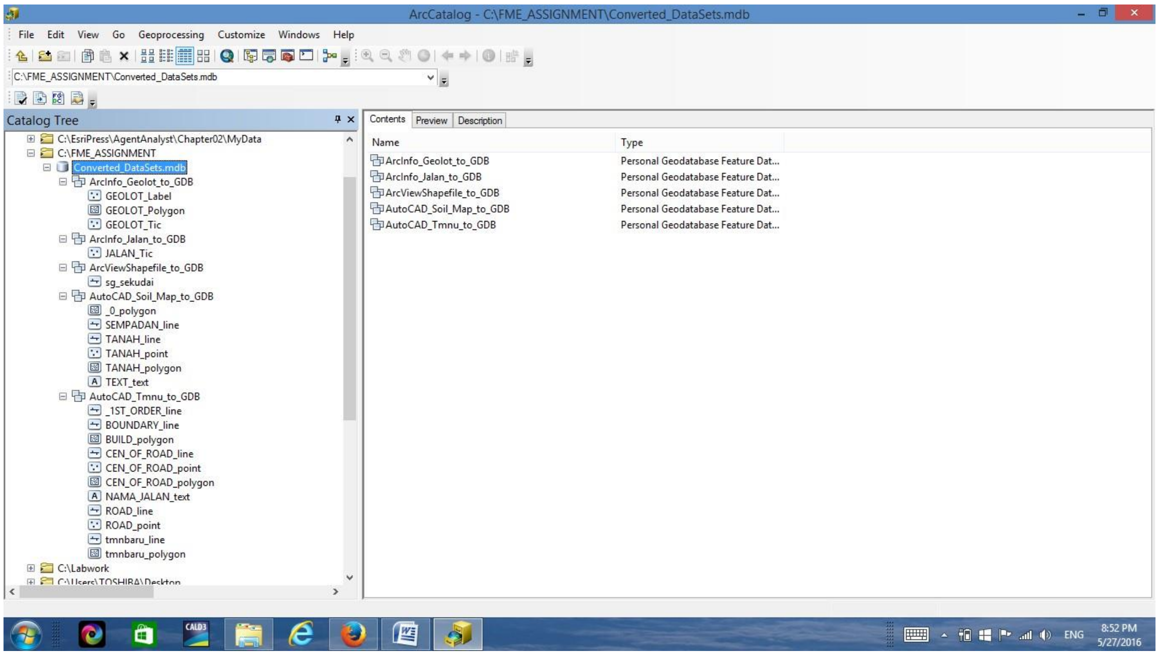


Figure 23. Complete river file properties.

4. Conclusion

Coordinate conversion method using FME Server released in 2008, able to enhances a user's ability to distribute and deliver data in variety of formats by way of a variety of services such as WFS, WMS, SOAP, KML as well as basic streaming. Furthermore, FME Cloud (released in 2013) enables users to deploy FME Server in the cloud. Even though various of recent software seems able to help users be more competitive and efficient, but certain time have some obstacle and limitations. For example, two datasets were given and the datasets were obtained from field surveys by using handheld Trimble GPS with having Trimble's native format (*.ssf). It is required SSF format to be converted into Geodatabase. Using FME, it was achieved conversions of format into required formats and also placing into their right projection and coordinate system. However, for the case of SSF conversion into Geodatabase, it was not succeeded on account of having no installed FME 2010 to 2013, furthermore, it was required to be installed and activated Trimble SSF and DDF Data Format Extensions For FME.

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