TRANSFORMATION OF TOPOGRAPHIC DATA VISUALIZATION FROM FREEHAND DRAWING TO CARTOGRAPHIC REPRESENTATION

(Transformasi Visualisasi Data Topografi dari Penggambaran "Freehand" ke Tampilan Kartografi)

Aji Putra Perdana[1], Eli Juniati[2] and Joni Hidayat[3]
[1,2,3] Geospatial Information Agency (BIG)
Jl. Raya Jakarta-Bogor Km. 46, Cibinong, Bogor, Indonesia
E-mail: aji.putra@big.go.id

Diterima (received): 17 September 2013; Direvisi (revised): 10 Oktober 2013; Disetujui dipublikasikan (accepted): 16 Oktober 2013

ABSTRACT

Topographic data visualization has been changed into geodatabase cartography. So far, freehand drawing has been used to visualize topographic data. Unfortunately, freehand drawing does not connect its graphical features with its database, meaning that the attributes data not exist in the freehand drawing. Meanwhile, the existing cartographic rules for map representations still based on the freehand drawing and this is become a great challenge to transform these rules into geodatabase cartographic data visualization. The geodatabase cartography and its representation should be defined first in order to follow the existing rules and analyze it. On the other hand, there is another challenge related to human resource capability to understand the transformation process from drawing method into geodatabase cartography. This paper explores the transformation of topographic map visualization and its geodatabase design.

***Keywords**: cartography, topographic map, geodatabase, cartographic representation*

ABSTRAK

Visualisasi data topografi dalam hal ini Peta Rupabumi mulai berubah dengan menggunakan *geodatabase* kartografi. Sejauh ini, penggambaran peta dengan *freehand* telah digunakan untuk mendesain tampilan peta topografi. Namun demikian, *freehand* tidak mempunyai kemampuan untuk menggabungkan data grafik dengan basis datanya, yang berakibat pada hilangnya atribut data. Sementara itu, aturan tampilan kartografi yang ada masih dibuat berdasarkan *software freehand*, dan hal ini menjadi tantangan besar untuk mentransformasikan ke dalam tampilan kartografi berdasarkan basis data geospasial (*geodatabase*). Untuk memenuhi aturan yang sudah ada, *geodatabase* kartografi dan tampilannya harus didefinisikan terlebih dahulu dan kemudian dianalisis. Di lain pihak, terdapat tantangan lain terkait dengan kemampuan sumberdaya manusia untuk memahami proses transformasi dari metode menggambar ke *geodatabase* kartografi. Makalah ini mengkaji proses transformasi dari visualisasi peta topografi dan desain *geodatabase*nya.

Kata Kunci: kartografi, peta rupabumi, *geodatabase*, tampilan kartografi

INTRODUCTION

Indonesian topographic map or known as *Peta Rupabumi Indonesia (RBI)* cartographically visualized using Freehand Drawing. Started this year (2013), topographic data visualization has been change into geodatabase cartography to reduce the steps of creating cartography visualization in topographic mapping activity (PPRT-BIG 2013a, 2013b). Visualization of topographic data usually utilized freehand drawing that is not connected to database. In the process, there are too many data format and data conversion should be done also there is scaling arrangement in freehand drawing to depict topographic data in proper map scale.

Printed topographic map is one of the famous products from BAKOSURTANAL or now BADAN INFORMASI GEOSPASIAL (BIG) as Indonesian Geospatial Information Agency and this is the reason freehand drawing is one of the best drawing applications. Because with freehand drawing topographic data can be scaled, visualized and printed at any resolution, without losing detail or clarity. Freehand drawing is a vector-based drawing application. Input data to be drawn in freehand is AutoCAD DXF (*.dxf) while AutoCAD is one of the application used in topographic mapping activities beside GIS Application which produce Shapefile format (*.shp) or recently Geodatabase format (*.gdb/*.mdb) (PPRT-BIG 2013a, 2013b).

The existing cartographic rules representations still based on freehand drawing and this is become a great challenge for us to transform these rules into geodatabase cartographic data visualization. The current standard of technical specification on visualization of topographic map developed based on cartographic rules representation of freehand drawing. This specification kept in style to depict point, line, polygon/area, and text from color in CMYK (cyan, magenta, yellow, and black), size defined in millimeters; but the naming of layers

drawn in freehand from one person to other person is different. Sometimes if there is some information should be change or fix, the process was done in freehand but not repairs the data source of database. It causes problem the differences between printed out topographic maps with topographic map database.

The development of GIS (Geographic Information System) software for geodatabase which include cartographic representation in the database to visualize features will reduce several steps such as scaling arrangement, data conversion, the differences between input and output due to data editing, and any problems cause by unconnected visualization and database. The use of geodatabase cartographic data visualization is not as simple as changing the color of feature. It needs the study on how the existing rules or style on freehand drawing can be drawn in cartographic representation, creating map templates to be used, and also capacity building for human resources of cartography. In this paper described the transformation of topographic map visualization and its geodatabase design.

METHODS

Materials in this research consist of existing standard of technical specification on visualization of topographic map as known *SNI* (Indonesian National Standard) on topographic map visualization 1:250.000, 1:50.000, 1:25.000 scale and *RSNI* topographic map visualization 1:10.000 scale (BSN, 2000a; 2000b; 2000c; 2000d), Existing Map and Template of Cartographic Freehand Drawing of Topographic Map, Topographic Dataset, Technical Specification of Cartography Indonesian Topographic Map.

Methods used by analyzing the documents and map templates of freehand drawing to describes each feature visualization in cartographic representation and creates map templates. There are three main activities: creating cartographic representative style, designing map templates includes grid and graticule layer, and designing geodatabase cartography to save representative symbology. The process of methods and its implementation of transformation from freehand drawing into cartographic geodatabase can be seen in **Figure 1.**

RESULTS AND DISCUSSION

Transformation from freehand drawing to cartographic geodatabase need an effort on drawing the symbol for each feature code to meet the specification as mentioned in the document standard and also freehand style. Those specifications are the existing rules that represent feature drawing on the topographic map.

The geodatabase cartography and its representation should be defined first in order to follow the existing rules and analyze it. In other hand, there is a new challenge related human resource capability to understand the transformation process from drawing method into geodatabase cartography. There are three main discussion related this transforming from freehand drawing to geodatabase cartography: requirements assessment, cartographic template design and testing, and implementation.

Requirements Assessment

To meet the requirements on the use of geodatabase cartography should be discussed data and its structure. Currently, AutoCAD and Shapefiles are two kind of data format produced by topographic mapping activities. Geodatabase only produced on seamless database activity. This condition should be considered in the future activity of topographic mapping as one production mapping activity with single data format.

Hardware, software and brainware (human resources) are three important things to meet the implementation of this transformation. Computer with specification meet the minimum requirement of GIS software is needed. In this case, ArcGIS 10.x as one of the products from ESRI has the ability in geodatabase cartography and more enhanced with Production Mapping extension. Familiarity in using GIS software such as ArcGIS need to improve cartography technician previously using freehand drawing in develop cartography design for topographic map.

Training, training and training should be done to introduce and enhance the capacity and increase data quality. The existence of geodatabase cartography will help the process of visualization but still operator or technician needs knowledge about cartography as science, technology and art in map production.

Cartographic Template Design

Creating cartography template design involves discussion with cartography technician/expert for topographic map. Even though, the documents or standard of specification topographic data visualization has been developed. At the first time, there was a discussion related CMYK color on freehand and ArcGIS due to the differences in screen color to display such as 100% cyan in GIS more bright than 100% cyan in freehand as can be seen in **Figure 2.**

Besides color of feature, the size of each design symbol also discussed to meet the requirements of topographic map specification. **Figure 3** displays design template for topographic map 1:10.000 scale with layer structure in table of contents.

Topographic data using feature code of current topographic dataset and stored in geodatabase cartography with representative symbology. Representative rules in **Figure 4,** stored in style as can be seen in and load into style manager of ArcGIS and this style can be used as standard style for cartographic representative in visualized topographic data.

Implementation

In this year, cartography of topographic map 1:50.000 scale and topographic map 1:10.000 scale using cartographic representation to depict feature symbol. This activity conducted by third party on supervision and quality control by cartography technician/expert from Center for Topographic Map and Toponym-*Badan Informasi Geospasial*.

There are 4 packages activities of cartography, 1 package topographic map 1:50.000 scale with 50 sheets Papua region and 3 packages topographic map 1:10.000 each 50 sheets Sumatera region. Human resources in each contractor play important roles in the development of creating cartography map production because they should understand geodatabase, topology rules, cartography representation, color separation, etc. Supervisor should have an extra attention because based on first step in creating grid and graticule and calculating declination have taken time. Cartography editing step need the understanding on how each feature visualize and how is the synchronization with other features.

In the future, if this cartography process will be direct part of topographic mapping activities as one line production there is a huge need to refine production workflow and enhance human resource of cartography.

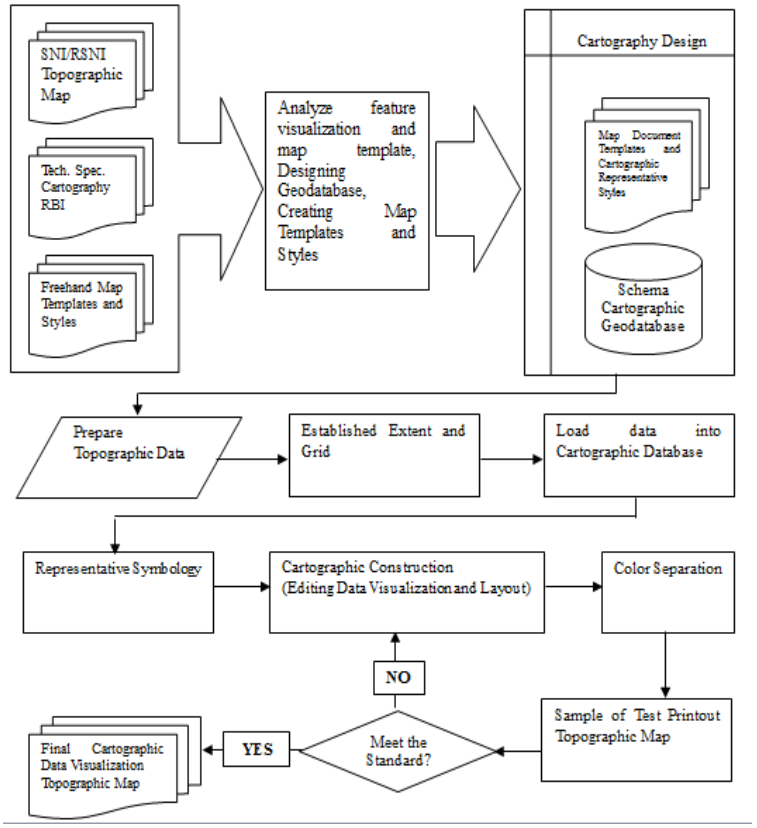

Figure 1. Methods and implementation of transformation of topographic data visualization.

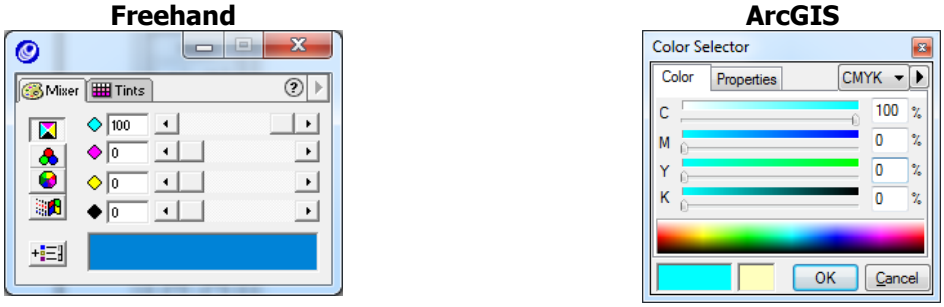

Figure 2. 100% Cyan in freehand and ArcGIS.

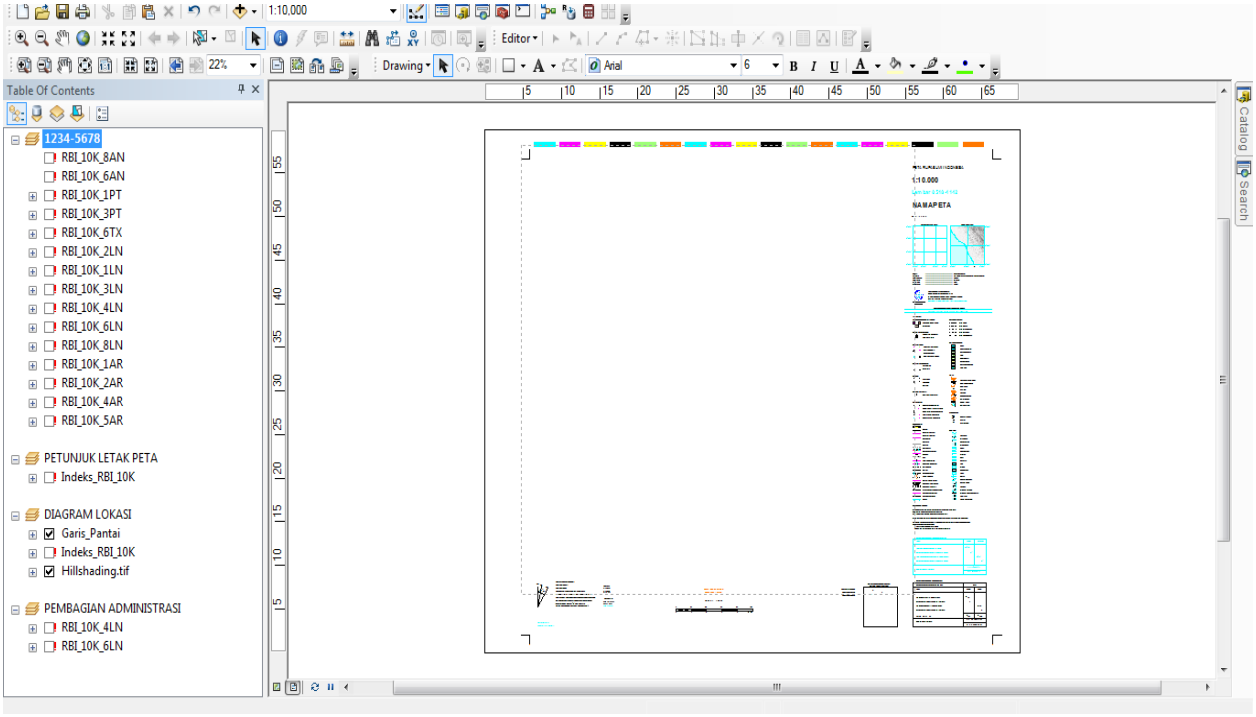

Figure 3. Cartographic map template.

SHAPE	RepresentationRule						
	10220, Kantor Gubernur		11932, Stasiun Kereta Api		30014, Timbunan		50306, Sawah
	10222, Kantor Walikota		11946, Pelabuhan Samudra		40002, Batas Negara		50308, Sawah Tadah Hujan
	10224, Kantor Bupati		11948, Pelabuhan Antar Pulau		40102, Batas Negara 2		50310, Tegalan / Ladang
	10226, Kantor Camat		11950, Pelabuhan Nelayan		40102, Batas Provinsi		50402, Air Laut
	10228, Kantor Desa		11966, Stasiun Pasang Surut		40102, Batas Provinsi 2		50404, Air Danau
	10230, Kantor Lurah		11968, Menara Suar		40202, Batas Kabupaten/Kota		50406, Air Waduk / Bendungan
	10404, Kantor Polisi		12002, Penahan Ombak		40202, Batas Kabupaten/Kota 2		50408, Air Tawar Sungai
	10502, Masjid		12006, Bendungan		40302, Batas Kecamatan		50412, Air Rawa
	10506, Gereja		12008, Tanggul		40302, Batas Kecamatan 2		50418, Air Penggaraman
	10510, Vihara		30104, Spot Height		40402, Batas Desa/Kelurahan		50420, Air Empang
	10514, Pura		30302, Titik GPS		40402, Batas Desa/Kelurahan 2	TPU	51102, TPU/Pemakaman Umum
	10600, Pendidikan/Penelitian		30304, TTG		60000, Garis Tepi Perairan		51104, Pemakaman Islam
	10700, Tempat Menarik		30306, Titik Gaya Berat		60102, Garis Tepi Pantai/Pulau		51106, Pemakaman Kristen
	10708, Tempat Bersejarah				60104, Garis Tepi danau/Situ		51108, Pemakaman Budha
	10718, Taman Sumber Air Panas		10000, Garis Tepi Bangunan		60108, Sungai Dua Garis		51110, Pemakaman Hindu
	10752, Menara		10908, Pipa saluran Air		60110, Sungai Satu Garis	TMP	51112, Pemakaman Pahlawan
	10800, Rumah Sakit Lainnya		11026, Transmisi Listrik		60112, Sungai Musiman		
	10816, Puskesmas		11110, Pipa Bahan Bakar Minyak		60130, Karang		
	10902, Sumber Air Minum		11122, Pipa Bahan Bakar Gas		60206, Saluran Irigasi/Drainase		
	10904, Bak/Tangki Penyimpan Air		11908, Jembatan Jalan Arteri dll		60212, Garis Tepi Air Empang		
	11004, PLTA		20102, Jalan Tol		80202, Gratikul		
	11006, PLTU		20110, Jalan Arteri Dua Jalur		80204, Grid		
	11008, PLTD		20110, Jalan Arteri Satu Jalur		80206, Tick Grid		
	11010, PLTN		20112, Jalan Kolektor				
	11106, Sumur Bahan Bakar Minyak		20114, Jalan Lokal		10002, Bangunan/Gedung		
	11112, Tangki Bahan Bakar Minyak		20116, Jalan Lain		10100, Hunian Lainnya		
	11114, Sumber Gas Alam		20120, Jalan Setapak		50102, Permukiman		
	11200, Pertambangan Lainnya		20204, Jalur Kereta Api Tunggal		50104, Tanah Kosong / Gundul		
	11504, Pasar		20212, jalan Lori		50106, Pasir Darat		
	11702, Kantor Telepon		20302, Landas Pacu Int/Domestik		50108, Pasir / Bukit Pasir Laut		
	11800, Kantor Pos/Paket Linnya		20306, Landas Pacu Perintis		50202, Hutan Rimba		
	11908, Jembatan Jalan Arteri		30002, Garis Kontur Index		50204, Padang Rumput		
	11918, Titian		30004, Garis Kontur		50206, Semak Belukar		
	11928, Tonggak/Pal Kilometer		30006, Kontur Bantu		50210, Hutan Rawa		
	11930, Terminal Bis		30014, Galian		50304, Perkebunan / Kebun		

Figure 4. Cartographic representative rules.

CONCLUSION

Based on the current progress of work on cartography representation, it can be seen transformation from using vector-drawing software into GIS software with cartography capability can maintain database structure and reduce data translation/conversion. Training, training, and training need to be done to increase the numbers of human resources with cartography expertise.

ACKNOWLEDGMENT

We would like to express our sincere thanks to The Head and colleagues of Center for Topographic Map and Toponym, BADAN INFORMASI GEOSPASIAL for supporting this research by providing basic geospatial information.

REFERENCES

BSN. (2000a). *SNI 19-6502.1-2000, Spesifikasi Teknis Peta Rupabumi Indonesia Skala 1:10.000.* Badan Standarisasi Nasional (BSN). Jakarta. Indonesia. Available online: http://big.go.id/assets/download/sni/SNI/SNI%2019-6502.1-2000_image.pdf [Accessed on 9th September 2013].

BSN. (2000b). *SNI 19-6502.2-2000, Spesifikasi Teknis Peta Rupabumi Indonesia Skala 1:25.000.* Badan Standarisasi Nasional (BSN). Jakarta, Indonesia. Available online: http://big.go.id/assets/download/sni/SNI/SNI%2019-6502.2-2000_image.pdf [Accessed on 9th September 2013].

BSN. (2000c). *SNI 19-6502.3-2000, Spesifikasi* Teknis Peta Rupabumi Indonesia Skala 1:50.000. Badan Standarisasi Nasional (BSN). Jakarta. Indonesia. Available online: http://big.go.id/assets/download/sni/SNI/SNI%2019_6502.3-2000_image.pdf [Accessed on 9th September 2013].

BSN. (2000d). *SNI 19-6502.4-2000, Spesifikasi Teknis Peta Rupabumi Indonesia Skala 1:250.000.* Badan Standarisasi Nasional (BSN).Jakarta, Indonesia. Available online: http://big.go.id/assets/download/sni/SNI/SNI%2019-6502.4-2000_image.pdf [Accessed on 9th September 2013].

PPRT-BIG. (2013a). *Kerangka Acuan Kerja Pekerjaan Kartografi Peta Rupabumi Indonesia Skala 1:10.000* (TOR Cartography Activity of Indonesian Topographic Map 1:10.000 scale). Pusat Pemetaan Rupabumi dan Toponim-Badan Informasi Geospasial. Bogor.

PPRT-BIG. (2013b). *Kerangka Acuan Kerja Pekerjaan Kartografi Peta Rupabumi Indonesia Skala 1:50.000* (TOR Cartography Activity of Indonesian Topographic Map 1:50.000 scale). Pusat Pemetaan Rupabumi dan Toponim-Badan Informasi Geospasial. Bogor.