Managing Land Registration Spatio Temporal Aspects in National Land Information System

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Key words: SIMTANAS, Spatio Temporal, LADM

SUMMARY

Until now, in order to store, manage and represent spatial and textual information including the changing of its textual information, the National Land Agency of Republic of Indonesia (Badan Pertanahan Nasional RI/BPN RI) has developed and used National Land Information System (NLIS/SIMTANAS). Due to the dynamic of land registration system, especially its spatial information, SIMTANAS is not yet able to represent information related to spatial changing in case of development of land parcels until their changing into new land parcels. Therefore, it is necessary to develop SIMTANAS that could manage the spatial temporal aspects of land registration to represent the spatial information at any point in time.Land Administration Domain Model (LADM) as the international standard model in establishing land administration system can be utilized as a reference to generate a spatial temporal database. It is because of Object Version in LADM that has ability to model time in form of event based modeling and state based modeling.

The physical design of spatial temporal database refers to the Government Regulation No. 24/1997 concerning Land Registration in Indonesia. Furthermore, this design is performed in the platform of Oracle database with Oracle Spatial extension. Land registration data used are cadastral maps, map plans and land books.

By defining spatial elements of land parcels either the valid time of land parcels (start date and end date) or the origin of a land parcel including its attributes, a spatial temporal analysis could be performed. This analysis consists of a given time analysis, a certain period analysis including its spatial changing, hierarchy of land parcels/chain parcel, analysis the condition of a certain land parcel and analysis of attribute/textual changing. Based on analysis above, proved that in qualitatively, spatial temporal database is built based on LADM able to manage the spatial temporal aspects of land registration in Indonesia.

SUMMARY (inBahasa Indonesia)

Hingga saat ini, Badan Pertanahan Nasional Republik Indonesia (BPN-RI) telah mengembangkan dan menggunakan Sistem Informasi Pertanahan Nasional (SIMTANAS) yang dapat menyimpan, mengelola dan menampilkan informasi spasial, tekstual/yuridis beserta perubahan-perubahan tekstualnya. Untuk menangani data pendaftaran tanah yang bersifat dinamis, terutama informasi spasial, SIMTANAS belum dapat menyajikan informasi mengenai kronologis spasial yang dimulai dari pembentukan bidang tanah hingga perubahan menjadi bidang tanah baru. Oleh karena itu diperlukan pengembangan SIMTANAS terutama basis data spasial sehingga dapat mengelola aspek spasial temporal pendaftaran tanah yang mampu menyajikan informasi spasial pada setiap titik waktu.

Land Administration Domain Model (*LADM*) yang merupakan model standar internasional dalam pembentukan administrasi pertanahan dijadikan acuan dalam pembentukan basis data spasial temporal karena melibatkan object version yang mampu memodelkan waktu dalam bentuk pemodelan berbasis kejadian (*event based modelling*) dan pemodelan berbasis keadaan (*state based modelling*).

Perancangan fisik basis data spasial temporal mengacu pada LADM terutama *country profile* Indonesia dan Peraturan Pemerintah Nomor 24 Tahun 1997. Pembangunan fisik basis data spasial temporal dilakukan diatas platform basis data *Oracle* dengan ekstensi *Oracle Spatial*. Data yang digunakan untuk pengujian rancangan berasal dari Peta Pendaftaran, Surat Ukur dan Buku Tanah atas bidang tanah perumahan yang terletak di Kelurahan Antapani Tengah, Kecamatan Antapani, Kota Bandung.

Dengan mendefinisikan geometri bidang tanah, waktu validitas bidang tanah (tanggal mulai dan tanggal akhir validitas) serta induk/asal bidang tanah beserta atribut lainnya dalam *Structured Query Language* (*SQL*), basis data spasial temporal mampu menampilkan informasi berkenaan dengan analisis waktu tertentu, periode tertentu termasuk analisis perubahan spasial, hirarki bidang tanah, analisis kondisi bidang tanah tertentu serta analisis perubahan atribut bidang tanah. Berdasar analisis yang dilakukan, terbukti bahwa secara kualitatif basis data spasial temporal yang dibangun berdasarkan *LADM* mampu mengelola aspek spasial temporal pendaftaran tanah di Indonesia.

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1. INTRODUCTION

Land registration data is dynamic; it is always changing due to economic activities and human needs. Economic activities such as area development cause changing in the shape of a land parcel, changing in the ownership and changing in the use of a land parcel. Human needs on settlements could also be the source of changing of a land parcel related to its shape, its total number and its ownership due to land transaction (Ning, 2006). Changing in land parcels effects changing in land registration data where it could be categorized into two types: spatial changing (physical data) and attribute changing (juridical data) of a land parcel (Zevenbergen, 2002).

Up to now, in order to store, manage, and represent spatial information (cadastral maps) and juridical information (textual/attribute) including changing of its textual information, the National Land Agency of Republic of Indonesia (Badan Pertanahan Nasional RI/BPN-RI) has developed and used National Land Information System (Sistem Informasi Pertanahan Nasional/SIMTANAS) (Rukhyat, 2008). With regard to the dynamic of land registration system which explains three main things of land registration: (1) first land registration, (2) transfer of land rights (the whole land parcels) and parcel mutation/splitting due to partial transfer of land rights (Zevenbergen, 2002), the existing land information system is not proficient anymore to manage spatial changing of land parcels however it only can show the last spatial information. Consequently, there is a need of land information system that is capable to store, manage and represent information of land registration including its changing either spatially or textually. The information related to spatial temporal aspects of land registration is the changing concerning geometry of land parcels including their attributes changing in every time being (Heo, Hyun Kim, Kang, 2006).

Spatial information with its historical changing is required not only because of land registration function itself but also to streamline the sustainability of land administration function especially for sustainable development. This historical changing is also used to investigate the history of land parcels and the development of areas as well for land dispute resolution (PP. 24/1997 and Sucaya, 2009).

1.1 Hypothesis

A data model for land registration which is able to manage data simultaneously in terms of its geometry, its attribute and its time in one single database is required to streamline the function of land information system. Therefore it is expected that the spatial temporal elements of land registration could be managed properly. As stated by Sucaya (2009), LADM (Land Administration Domain Model) could be used to model land registration process in Indonesia by involving party, RRR (Rights, Responsibilities, and Restrictions), land parcel, and also its

spatial representation. By adding dimension of time, its start date and end date, for every line of data which requires investigation of its history, the line of data for a certain time could be acquired (Van Oosterom and Lemmen, 2001).

1.2 Literature Review

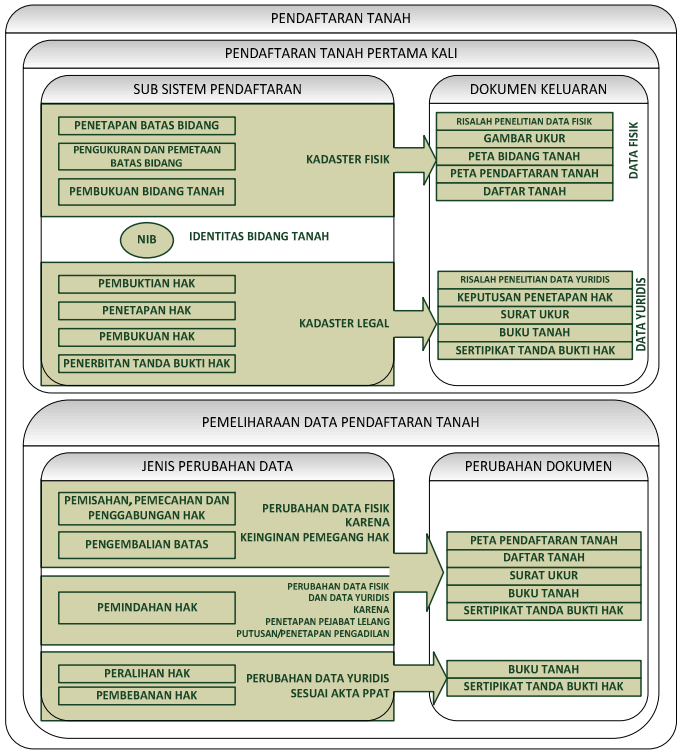


Figure 1. The scope of land registration regarding PMNA No.3/1997

Physical data of land parcels might be changed because of splitting and amalgamation as well boundaries reconstruction of land parcels. Splitting of land parcels is conducted if there is a need to transfer a part of right on lands. Amalgamation of land parcels is conducted if there is a need to transfer land rights upon several land parcels in one deed.

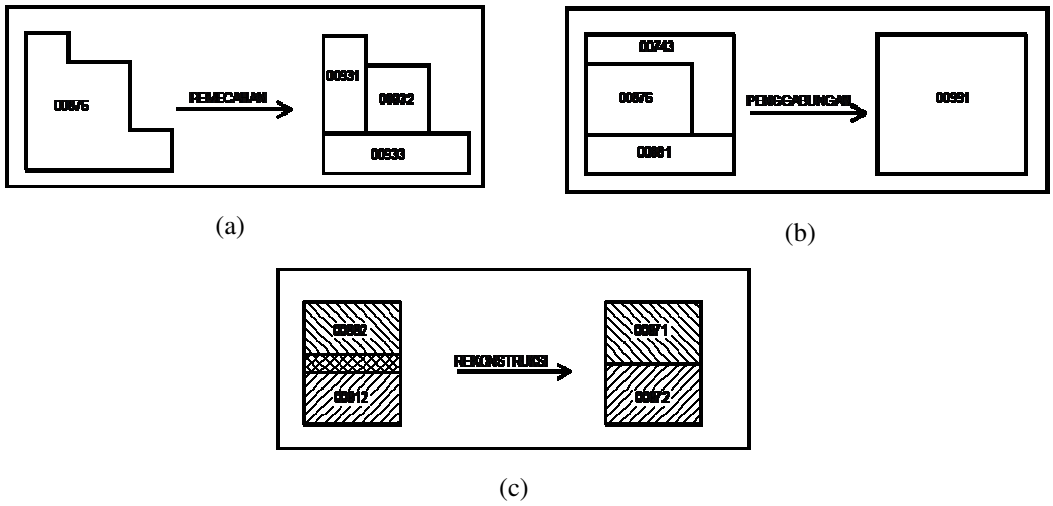


Figure 2. The spatial changing of land parcels in land registration (a) splitting, (c) amalgamation and (d) boundaries reconstruction.

Physical data provides information related to location, boundaries, and area of a land parcel also apartment units including information about the presence of buildings on it. Physical data of land registration is a spatial object of land parcels stored and depicted in field sketches (Gambar Ukur/GU), map plans (Surat Ukur/SU), parcel maps (Peta Bidang Tanah/PBT), cadastral maps (Peta Pendaftaran). Field sketches is a document depicting a parcel or more parcels and its surroundings (neighbor boundaries) and recorded data from field survey such as distance, angle, and azimuth. Map plan is a document depicting a land parcel by citing information from cadastral maps or in other words it depicts land parcels accordance with data from field survey. Cadastral map is document created to obtain information related to the shape, boundaries, location, and parcel identifiers of each land parcel (PMNA No. 3/1997).

Physical data changing of land parcels consists of splitting, amalgamation, and boundaries reconstruction stored and represented in field sketches, map plan and cadastral maps. This process is conducted throughout field survey and mapping activities. If the changing involves a certificate of land right as evidence, it must be stated in a new map plan and it must be a substitute of its certificate. This changing is also defined in cadastral maps. The changing due to splitting and amalgamation of land parcels is done by scratching its land boundaries and parcel numbers. On the other hand, if the changing is caused by boundaries reconstruction, the process is done by scratching the old boundaries and then drawing the new ones (PMNA No.3/1997).

LADM has capability to provide an abstract description and conceptual schema concerning land administration components such as parties (person and organization), basic administrative units and RRR in case of ownership, spatial unit (parcels, (buildings, and networks), spatial source (measurement) and spatial representation (geometry and topology). LADM also gives terminology for land administration based on either national or international system that is developed as simple as possible for practical purposes.

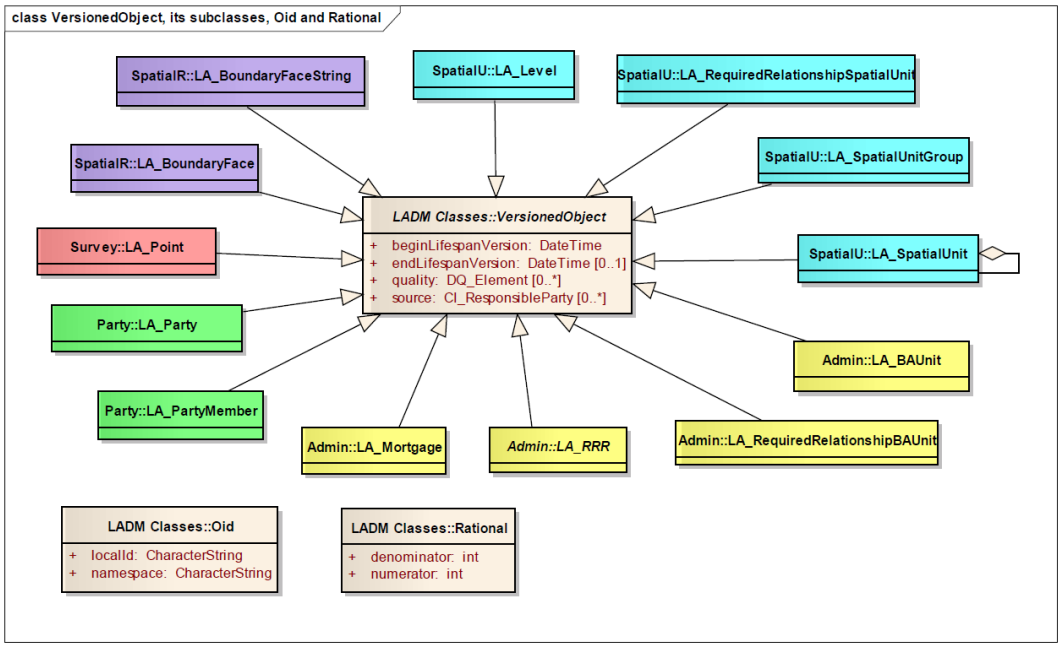


Figure 3. The representation of spatial temporal elements using LADM.

In addition LADMN has a special class called Object Version to model event based modeling and state based modeling where it plays important role in forming spatial temporal database. This modeling is performed by defining the validity of time for each class.

2. METHODS

This research is conducted in the Land Office of Bandung city with a case study in a residence on Cikajang Raya Street, Antapani Tengah, Antapani, Bandung. It considers on the dynamic development of an area in which it causes the spatial changing of land parcels in case of their shape.

Figure 4. A study case in Antapani Tengah, Antapani, Bandung (google earth, 2010: satellite imagery 2007).

There are three documents of land registration data utilized for designing and modeling a database as following:

1. Cadastral map; is a map depicting boundaries of land parcels for land administration purposes. Spatial data of land parcels that have been mapped and recorded are depicted in this map.
2. Map plan; is a document that contains the physical data of a parcel where it is shown as a map and its description.
3. Land book; is a document in the form of lists comprising juridical and physical data of land registration objects in which they already have a land right that attach on them. This document is to obtain juridical data (e.g. ownerships and type of land rights) of land parcels depicted in cadastral maps and map plans.

From physical design of a database as shown in Figure 5, the development of physical database are performed using Oracle software version 11g with its Oracle Spatial extension. To simplify and to execute the script, Oracle SQL Developer is used. Script is an SQL which contains the definition of tables, attributes and types of data, and also the relationship definitions of each table.

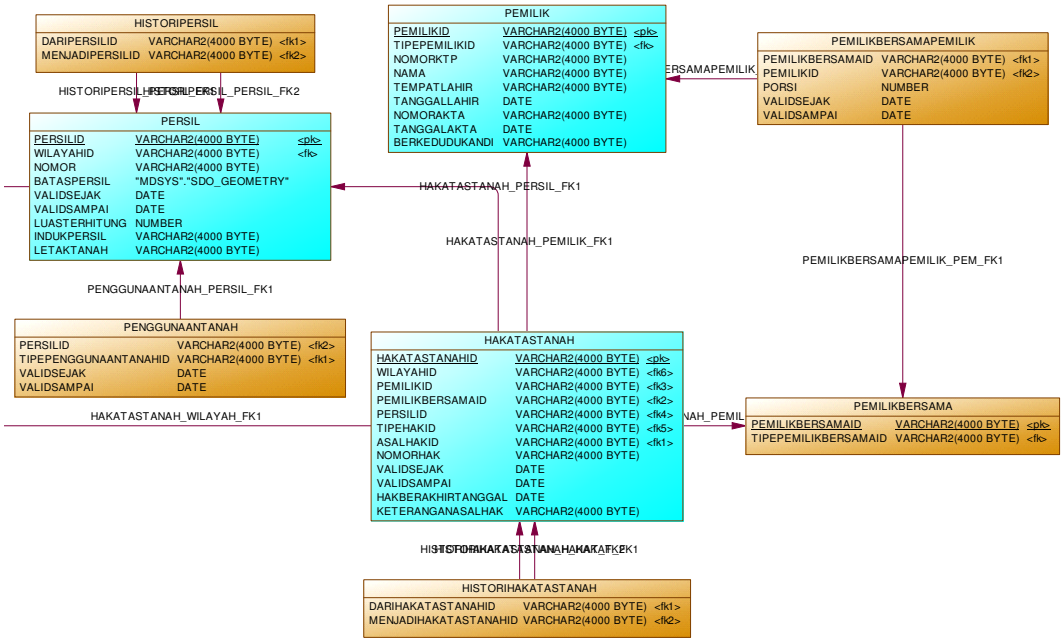


Figure 5. Core structure of database system.

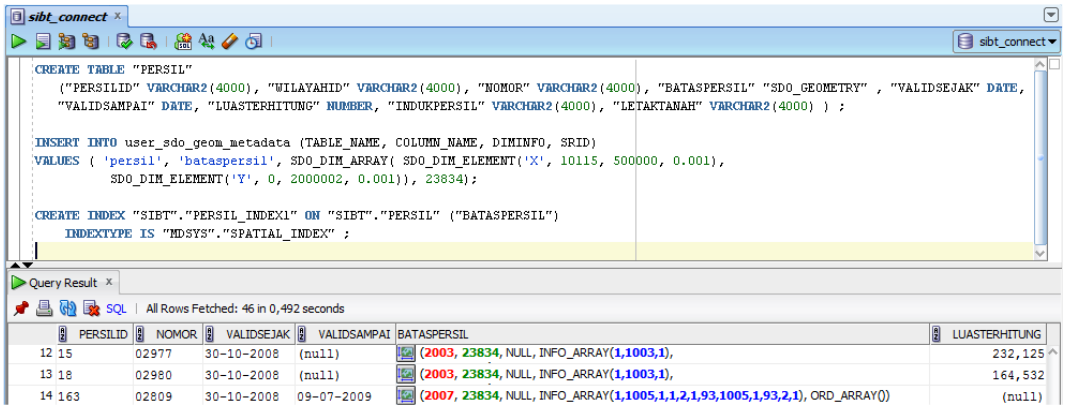


Figure 6. The development of a table of parcels in Oracle database.

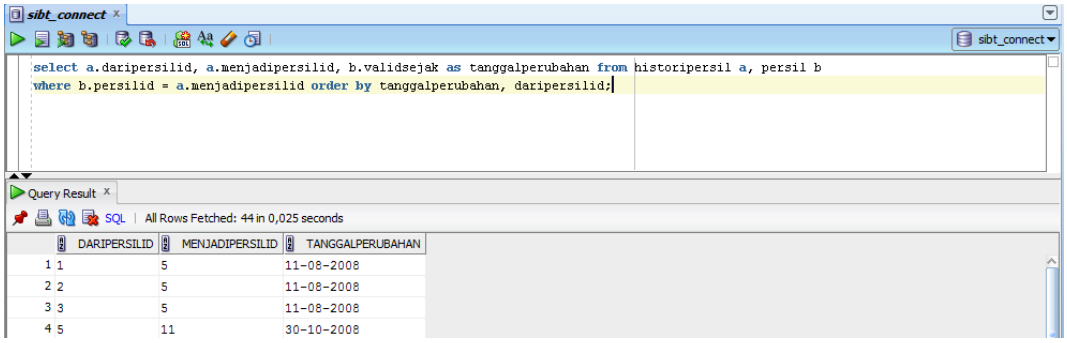
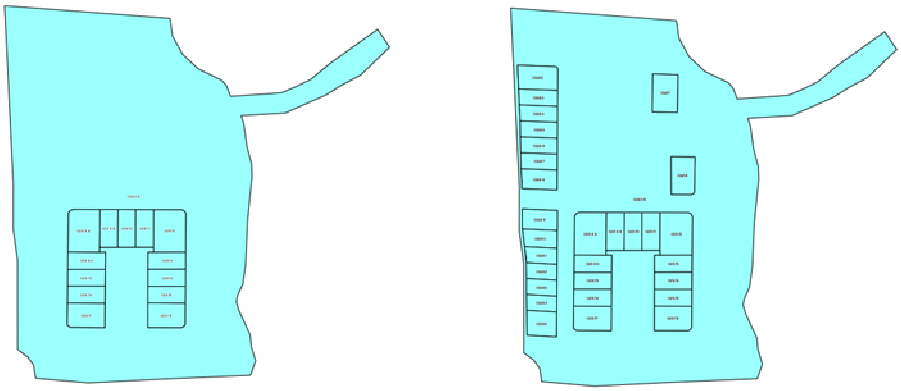


Figure 7. Table of the parcel history which contains the hierarchy changing of land parcels.

2.1 Database Analysis and Visualization

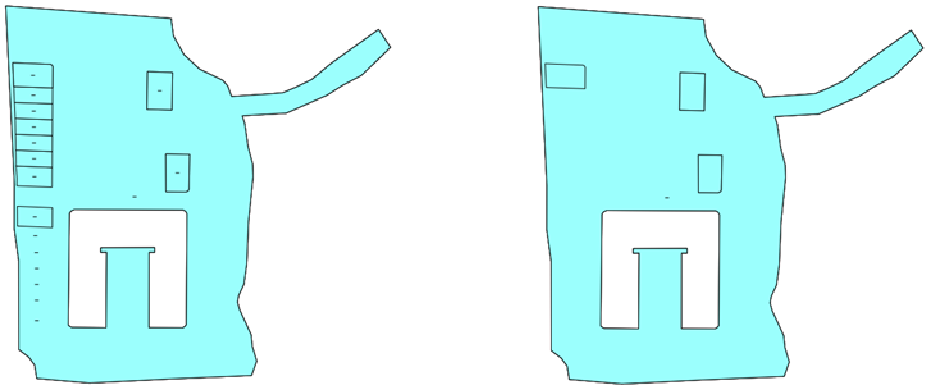
A database analysis is conducted to identify the capability of a database to present spatial temporal information of land registration. The spatial temporal analysis consists of a spatial temporal analysis in a given time, a spatial temporal analysis in a certain period, a hierarchy analysis of a land parcel, a spatial temporal analysis related to the condition of a certain area and spatial temporal analysis of a certain attribute.
A spatial temporal analysis in a given time is intended to identify the condition of an area in a particular date. It is done by defining one specific date thus a valid land parcel could be presented on that date.



(a) (b)

Figure 8: The condition of an area on December 31, 2008 (a), and on December 31, 2009 (b).

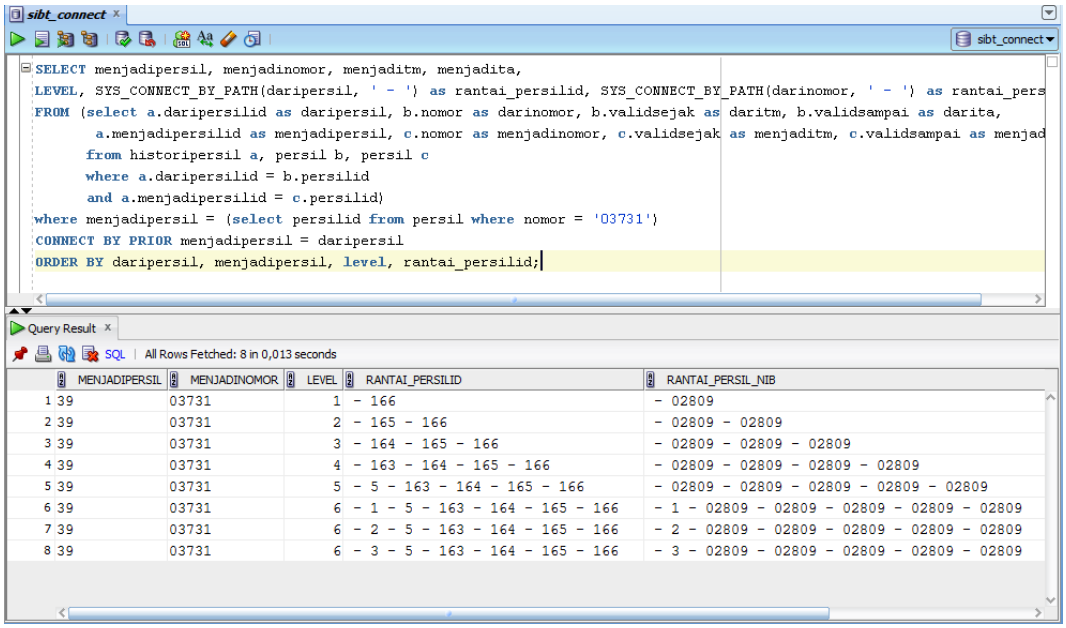
A spatial temporal analysis in a certain period is aimed to identify the condition of an area in a range of time by defining its condition in the early and late period including all changes on that range of time.



(a) (b)

Figure 8. The changing condition of an area on December 31, 2008 to December 31, 2009. The formed land parcel (a), the deleted land parcel (b).

A hierarchy analysis of a land parcel is intended to obtain the hierarchy of land parcel changing where this is the history of land registration of land parcels. This analysis causes spatial temporal database able to illustrate the stages of land parcel changing.

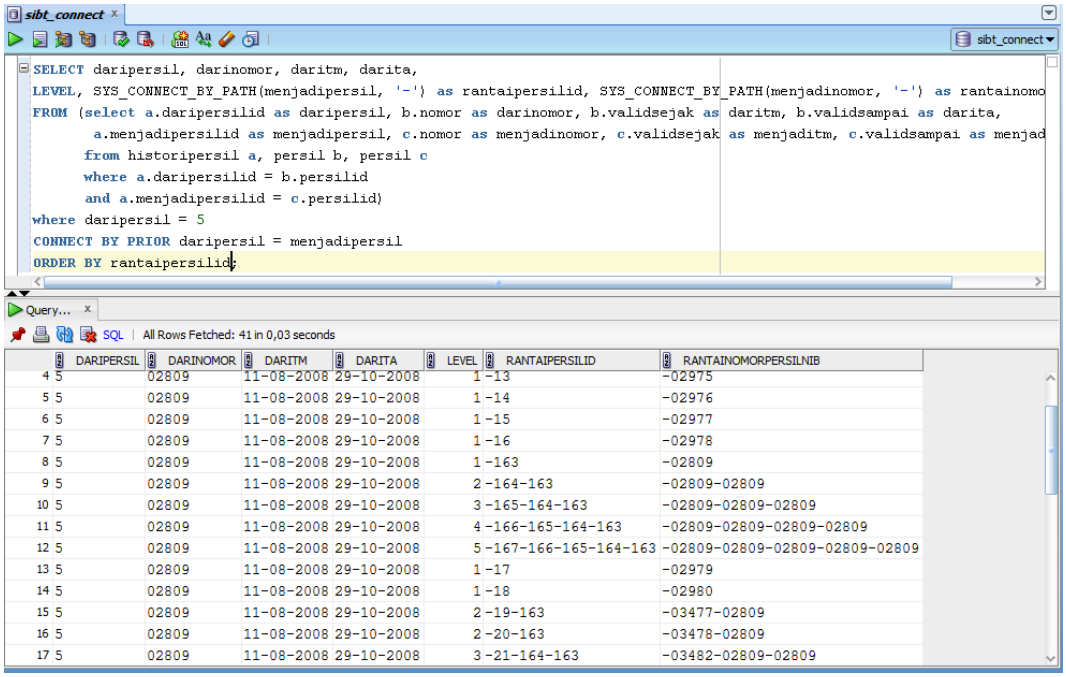


```
SELECT menjadipersil, menjadinomor, menjaditm, menjadita,
LEVEL, SYS_CONNECT_BY_PATH(daripersil, ' - ') as rantai_persilid, SYS_CONNECT_BY_PATH(darinomor, ' - ') as rantai_pers
FROM (select a.daripersilid as daripersil, b.nomor as darinomor, b.validsejak as daritm, b.validsampai as darita,
       a.menjadipersilid as menjadipersil, c.nomor as menjadinomor, c.validsejak as menjaditm, c.validsampai as menjad
      from historipersil a, persil b, persil c
      where a.daripersilid = b.persilid
      and a.menjadipersilid = c.persilid)
where menjadipersil = (select persilid from persil where nomor = '03731')
CONNECT BY PRIOR menjadipersil = daripersil
ORDER BY daripersil, menjadipersil, level, rantai_persilid;
```

Query Result — All Rows Fetched: 8 in 0,013 seconds

	MENJADIPERSIL	MENJADINOMOR	LEVEL	RANTAI_PERSILID	RANTAI_PERSIL_NIB
1	39	03731	1	- 166	- 02809
2	39	03731	2	- 165 - 166	- 02809 - 02809
3	39	03731	3	- 164 - 165 - 166	- 02809 - 02809 - 02809
4	39	03731	4	- 163 - 164 - 165 - 166	- 02809 - 02809 - 02809 - 02809
5	39	03731	5	- 5 - 163 - 164 - 165 - 166	- 02809 - 02809 - 02809 - 02809 - 02809
6	39	03731	6	- 1 - 5 - 163 - 164 - 165 - 166	- 1 - 02809 - 02809 - 02809 - 02809 - 02809
7	39	03731	6	- 2 - 5 - 163 - 164 - 165 - 166	- 2 - 02809 - 02809 - 02809 - 02809 - 02809
8	39	03731	6	- 3 - 5 - 163 - 164 - 165 - 166	- 3 - 02809 - 02809 - 02809 - 02809 - 02809

Figure 9. The hierarchy information of a land parcel upon its previous land parcel.



```
SELECT daripersil, darinomor, daritm, darita,
LEVEL, SYS_CONNECT_BY_PATH(menjadipersil, '-') as rantaipersilid, SYS_CONNECT_BY_PATH(menjadinomor, '-') as rantainomo
FROM (select a.daripersilid as daripersil, b.nomor as darinomor, b.validsejak as daritm, b.validsampai as darita,
       a.menjadipersilid as menjadipersil, c.nomor as menjadinomor, c.validsejak as menjaditm, c.validsampai as menjad
      from historipersil a, persil b, persil c
      where a.daripersilid = b.persilid
      and a.menjadipersilid = c.persilid)
where daripersil = 5
CONNECT BY PRIOR daripersil = menjadipersil
ORDER BY rantaipersilid;
```

Query... — All Rows Fetched: 41 in 0,03 seconds

	DARIPERSIL	DARINOMOR	DARITM	DARITA	LEVEL	RANTAIPERSILID	RANTAINOMORPERSILNIB
4	5	02809	11-08-2008	29-10-2008	1	-13	-02975
5	5	02809	11-08-2008	29-10-2008	1	-14	-02976
6	5	02809	11-08-2008	29-10-2008	1	-15	-02977
7	5	02809	11-08-2008	29-10-2008	1	-16	-02978
8	5	02809	11-08-2008	29-10-2008	1	-163	-02809
9	5	02809	11-08-2008	29-10-2008	2	-164-163	-02809-02809
10	5	02809	11-08-2008	29-10-2008	3	-165-164-163	-02809-02809-02809
11	5	02809	11-08-2008	29-10-2008	4	-166-165-164-163	-02809-02809-02809-02809
12	5	02809	11-08-2008	29-10-2008	5	-167-166-165-164-163	-02809-02809-02809-02809-02809
13	5	02809	11-08-2008	29-10-2008	1	-17	-02979
14	5	02809	11-08-2008	29-10-2008	1	-18	-02980
15	5	02809	11-08-2008	29-10-2008	2	-19-163	-03477-02809
16	5	02809	11-08-2008	29-10-2008	2	-20-163	-03478-02809
17	5	02809	11-08-2008	29-10-2008	3	-21-164-163	-03482-02809-02809

Figure 10. The hierarchy information of a land parcel upon its following land parcel.

A spatial temporal analysis related to the condition of a certain area is aimed to identify the spatial relationship of land parcels in the past, such as to obtain the information of land parcels that are overlapped with other land parcels.

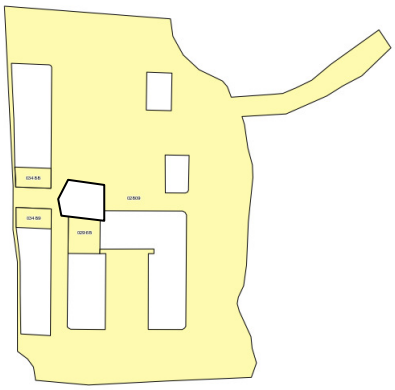


Figure 11. The information of land parcels that are overlapped with other land parcels on December 15, 2009.

A spatial temporal analysis of a certain attribute is intended to identify the condition of an area based on attributes of land registration in a given time an its changing in a certain period.

3. CONCLUSION

Based upon the previous descriptions, a database that integrates spatial elements (land parcels), attribute elements of land registration, and validity elements related to time of spatial and attribute of land parcels, is required in order to manage spatial temporal elements of land registration. As in LADM, spatial temporal databases are formed by defining the geometry of land parcels together with its creation date and its removal date, the hierarchy of land parcels including the attributes that attach on them which are presented in cadastral maps, map plans and land books. These have been proven by performing a spatial temporal analysis in a given time, a spatial temporal analysis in a certain period, a hierarchy analysis of a land parcel, a spatial temporal analysis related to the condition of a certain area and spatial temporal analysis of a certain attribute using Oracle with its spatial extension.

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BIOGRAPHICAL NOTES

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