IMPROVING ORGANIZATIONAL WORK PROCESS OF LAND REGISTRATION BASED ON 3D CADASTRE AND CADASTRE 2014 CONCEPTS (Case Study Apartment Unit Registration)

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Intisari: Kebutuhan akan tanah yang semakin meningkat sementara ketersediaan tanah yang tetap telah memaksa masyarakat untuk menggunakan tanah secara lebih intensif. Sehubungan dengan hal tersebut penggunaaan konsep-konsep kadaster tradisional yang masih menggunakan konsep 2 dimensi tidaklah cukup untuk memenuhi kebutuhan akan informasi kadaster yang lengkap. Dengan pengalaman-pengalaman penerapan pendaftaran tanah berbasis 2 dimensi dan pengetahuan mengenai konsep-konsep kadaster 2014 dan konsep-konsep kadaster 3 dimensi, pengembangan proses kerja organisasi yang sedang berjalan pada saat ini sangatlah diperlukan. Tulisan ini akan menjelaskan bagaimana melakukan desain proses kerja pendaftaran tanah dalam rangka penerapan konsep-konsep kadaster 3 dimensi dan kadaster 2014 dengan menggunakan proses modelling. Hasil dari proses tersebut adalah diagram alir pekerjaan yang baru serta hal-hal yang diperlukan untuk dilakukan perubahan di dalam maupun diluar organisasi untuk mengadopsi proses kerja yang baru tersebut. Namun dikarenakan kadaster 3D merupakan sebuah konsep yang komplek, dalam tulisan ini akan membahas khusus mengenai pendaftaran unit-unit apartemen di Indonesia.
Katakunci: kadaster 3D, kadaster 2014, pemodelan.

Abstract: The need for land always increases but the area of land never increases. This makes people to use the land effectively. The use of traditional cadastre; the use of 2 dimensional cadastral concept, is no longer able to fulfill the complete cadastral needs. Having experiments on applying the 2 dimensional land registration, knowledge on 2014 cadastral concepts and 3 dimensional cadastral concepts, the development of the ongoing organization's work process is badly required. The paper is aimed at explaining how to design the process of land registration in applying the 3 D cadastral and 2014 cadastral concepts using a modeling process. The result of the process is the new diagram showing the change of the organization; both inside and outside. However, due to the complexity of the 3 D cadastral concept, the discussion is limited to the apartment units in Indonesia.
Keywords: 3D cadastre, 2014 cadastre, modeling.

A. Introduction

Land is the main property for human being and has important meaning for human's life. Land can be used as production factor, consumption factor or a place where humans do their activities. There is an increase of land requirement since the growth of population and the characteristic of land which is not extendable. It has pushed human to utilize space for the land that lay below and top of the ground. This reason is a clue that gives a glance of understanding about the needs for 3D cadastre research in Indonesia.

BPN is Government Institution that has responsibility in managing Land Registration. It builds partnerships with other stakeholders to perform increased land related services to the clients by installing the concepts of e-government, e-commerce and e-payment in the near

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future. Amongst the partnerships, there are two, which are continuously built, related to the cadastral survey and mapping and to the conveyancing and mortgages activities. The first is built with Licensed Surveyors and the second with public officer called PPAT stands for Pejabat Pembuat Akta Tanah. PPAT is a public officer who specializes in issuing deeds related to land transactions. In order to continue the building of partnerships with stakeholders and in considering the significant growth of socio-economic development in Jakarta, BPN attempts to improve extensively public services related to land by performing Land Office Computerization (LOC) project. LOC is one of the projects to accelerate land registration process using Land Information System technology toward the development of a Spatial Data Infrastructure in Indonesia.

Regarding to 3D properties management, strata tile is a concept, which is often used for defining 3D property and giving the right for 3D cadastral object. Based on the Indonesia legal framework, strata title concept is used to give title not only for apartment unit but also for the ownership of building unit for business purposes. As explained by Hendriatiningsih et al. (2007), In Indonesian legal cadastre framework, the building property is not often considered as the registration object, except for the strata title ownership of apartment known as Right of Ownership of Apartment Unit (Hak Milik Atas Satuan Rumah Susun/HMASRS). Even though the HMASRS has been stipulated since 1985, the strata title ownership concept is not fully understood up to now. Thus, further consideration on HMASRS should be initiated, particularly on the apartment unit and HMASRS itself. The consideration on apartment unit should include the basic law and regulation, definition, type, requirement, part, separation and boundary of apartment unit. On the other hand, the consideration on HMASRS should comprise the definition of, holder of and proof of ownership recognized by HMASRS.[1]

Figure 1. Example of Strata Title Property, Integrated Apartment and Stores Building (Suhattanto, 2009:2)

According to Hendriatiningsih et al. (2007) the need of 3D cadastre in Indonesia based on the reason which is to provide boundary certainty of 3D cadastre object, particularly regarding HMASRS. The current cadastre system could not provide the boundary certainty on 3D property as it has been represented by 2D data[2].

Based on the main aim of cadastral registration that provides appropriate information related to land and property ownership, redesigning the existing cadastre system is important since it can warrant legal security in real estate. Improving cadastral system based on 3D concept hopefully will help customer to get proper 3D property information and improves legal security of their property.

B. Statements of Cadastre 2014

Cadastre 2014 is a publication of the 7th commission of FIG (International Federation of the survey) working group. The working group has

[1] Hendriatiningsih, I. Soemarto, et al. (2007). "Identification of 3-Dimensional Cadastre Model for Indonesian Purpose". FIG Working Week. Hongkong, China, page 3.

[2] Hendriatiningsih, I. Soemarto, et al. (2007). "Identification of 3-Dimensional Cadastre Model for Indonesian Purpose". FIG Working Week. Hongkong, China, Page 5.

discussed the theme of Cadastre 2014 from 1994 to 1998 and presented at the FIG congress in July 1998. This publication is expected to be a measure of success (benchmarks) of the countries around the world in order to measure the development of its cadastre system. Indonesia, with BPN as main actor in Land Registration, should also use the cadastre 2014 in assessing and evaluating the development of its cadastral system. Cadastre 2014 generally produces 6 famous statements about the vision of the world cadastre in 2014. In general, the sixth mission statement includes organizational, technical development, privatization, and cost recovery (cost recovery) of a cadastral system[3]. The sixth statements of cadastre 2014 can be explained below:

1. The first statement: Cadastre 2014 will show the complete legal situation of land, including public rights and restriction.
   From the first statement on cadastre 2014, we can explain that the cadastre system in 2014 will expand its scope of simply presenting the land rights data as presented in the traditional cadastral. The limited amount of land while the needs of land is increasing day by day has been forcing people to use land more intensively such as prefer of using space, above and under ground, rather than land surface. In this matters, The using of traditional cadastre concepts which are still 2 dimension based is not enough to fulfill the legal certainity and the needs of complete cadastre information. Based on those facts, in order to provide legal certainty on the land and space, all the facts relating to the land or property law should be clearly presented in a cadastral system by the use of 3 Dimension (3D) cadastre concepts.
2. The second statement: "The separation between map and registers will be abolished".
   Previously, Cadastral maps and land registration book separately administered. This happens due to the limitations of technology in the past which was still using paper and pen. In the modern cadastre, separation between the maps (spatial data) and data related to Subject, Object, and Rights will not exist anymore because everything would be managed in a computer-based database system.
3. The third statement "The cadastral mapping will be dead, Long live modelling"
   In the future, the map will not be a place to store information. The spatial data, data Position in space, will be stored in the database. Cadastral mapping will not be managed manually, the data modeling, integration between textual and spatial data managed by database, will be used so it will be easier to search and manipulate data. 3D cadastre uses 3D modelling that is more complect than 2D modeling thus the past methode which still use paper as media for keeping data is not sufficient anymore to model 3D property.
4. The fourth statement: "Paper and pencil-cadastre will have gone"
   Paper, a pen or pencil that are use to record data will not be used anymore because the technology associated with survey and mapping instrument and the computer and software for storage and informing the data has been highly developed.
5. The fifth statement: Cadastre 2014 will be highly privatized, public and private sectors are working closely together.
   Trend has been happening in this modern life, shows that many units of government transferred to the private sector, so it can work more flexibly and meet customer demands. Similarly in the cadastre and land registration activity, measurements can be carried out

[3]FIG.(1998). "FIG statement on the cadastre." From http://www.sli.unimelb.edu.au/fig7/cadastre/statement_on_cadastre.html

by the private sector (in BPN we are familiar with the licensed surveyor). In the future work and maintenance of cadastral data can be done by private parties. However, the government still must ensure the legal security of land administration systems. The government also still responsibles to monitor and control the cadastral system. This paper will describe how BPN makes strategic cooperation with private sector especially Private surveyors and PPAT to handle 3D property surveying and mapping.

6. The sixth statement: Cadastre 2014 will be Cost Recovering

   Cadastral 2014 will be more emphasis on cost recovery by minimizing the costs to be paid by the public and customers. In the future land registration data also contains all other information related to the land (land values, land use, land use, etc.). With the high demand for such information, the fees charged for obtaining information to recover the costs of development and maintenance of the cadastre itself. It is already presented in the structure of BPN budgeting scheme through State Revenue (tax revenues) would in future be expected to undertake self-financing BPN using the funds in non-tax revenues to fund operating expenses in carrying out the Land Registration.

C. The concepts of 3D Cadastre

3D cadastre is a concept to overcome the problems related to how to give better insight for registering the uses of space, which have been happening in the recent time. Basically the terms regarding to 3D cadastre in this thesis follow the definition that is given by Stoter and Van Oosterom (2006). Based on this literature, it explains that 3D cadastre is a cadastre that registers and gives insight into rights and restrictions not only on parcels but also on 3D property units. A 3D property unit, also abbreviated as 3D property is that (bounded) amount of space to which a person is entitled by means of real rights. 3D property situations or 3D situations refer to situations in which different property units are located on top of each other or constructed in even more complex structures i.e. interlocking one another[4].

In principle, 3D cadastre is needed if there are multiuse and multi-ownership of land exist, it is stated by Van Der Molen (2001), In situation where separation of ownership is present, the legal object should be represented on the cadastral map. If the legal object coincidences with the real object, the representation of the legal object includes the real object. If not, the orientation function of the cadastral map makes representation of the real object recommendable[5].

a. Types of Cadastral Registration of 3D situation

3D cadastre cannot be separated from legal point of view. According to Stoter and Van Oosterom (2006) The existing right, which should be taken into account in registering 3D property situation, will be explained as follow.

1. Right of ownership

   Basically, a legal boundary of land ownership is an infinitesimally thin surface extending from the centre of the Earth to the infinite in the sky and is essentially an abstract concept. In the case of strata titles, such as in high-rise buildings, the boundary surface may be horizontal.

   In the 3D situation when multi-use of land exists, the ownership of land always has 3D components. Each restriction attached to the

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[4] Stoter, J. and P. Van Oosterom (2006). *3D cadastre in an international context legal, organizational, and technological aspect*. Boca Raton, Taylor & Francis, page 5.

[5] Van Der Molen, P. (2001). *Institutional aspects of 3D cadastres*. International workshop on 3D cadastre, Delft, International Federation of Surveyors, page 392.

right always has correlation with how much space that can be used by the parcel owner. The restriction to limit how far or how much the use of parcel is needed when multi use to a parcel exists. If there are no regulation in public law and private law regulate the restriction regarding the ownership of land in space, it is possible can lead land dispute. For example, in case underground construction will be built through several parcel, if the construction will disturb or damage the existing construction on the surface, this becomes obviously make dispute.

2. Accession
   Accession is a legal term, to determine the ownership of certain buildings or constructions that are built above or below the surface. There are two types of accession, vertical accession and horizontal accession. Vertical accession is that buildings and other constructions that are permanently fixed to the land are considered part of that land. Consequently, constructions below or above the surface that are permanently fixed to the surface are owned by the owner of the land unless other rights or restrictions have been established on the surface parcel. Horizontal accession can be implemented if there are the constructions which are part of another property. The owner of the main construction is the owner of parts of the construction that encroach another parcel.
3. Right of superficies
   In contrast with principle of accession, right of superficies give chance to differentiate the owner of the parcel and the owner of the construction built in, on, or above it. The right of superficies is a real right to own or to acquire buildings, works, or vegetation in, on, or above an immovable thing owned by another.
4. Right of easement
   An easement is a charge imposed on a parcel (the serving parcel) in favour of another parcel (the dominant parcel).
5. Apartement right and strata title
   Apartment is one of example the common 3D property. The concept of strata title is used to register the ownership of apartment. In strata title concept basically, There are two part of areas of apartment, communal area where is held in co-ownership and full ownership of a part of building where is held by person. The owner of the apartment units are joint owners of the entire building and the ground below.

b. The needs for registering property in 3D

The question has been raised why we should register property in 3D way. Based in the literature, the needs on registering property in 3D can be explained as below:

- Stoter and Van Oosterom (2006) have been mentioned no cadastral registration exists that reflect the 3D characteristics of these 3D property units as part of the cadastral geographical data set (cadastral map). Consequently, current cadastral registrations are not able to provide 3D insight into the real situation, even though real rights always have entitled person to volume and not to flat parcels. 3D cadastre also gives opportunity to have good accessibility to the legal status of stratified property including 3D spatial information as well as to public law restrictions.
- As representation of 3D legal objects meet the requirement of specialty the existing system of real rights tend to be appropriate. However, without such representation, real rights should verbally specify the 3D legal object (a 3D description) which seems to be almost impossible, (Van Der Molen, 2001).
- The future cadastre will be digital, it is stated in the statement of cadastre 2014. The modeling will replace analogue map. Cadastre

based on digital database will replace analogue archives, (Kaufmann, 1998). As all 3D mapping will also be digital, preliminary adjustment of the 2D cadastre to 3D cadastre is essential, (Grinstein, 2001).

D. The existing 3D Property Registration in Indonesia

The registration of apartment unit in strata is the only 3D property registration in existing Indonesian cadastral system. The high-rise building with several rooms, that each room is individually used has been known for long time in the big city in Indonesia. The ownership of the building is the same with the ownership of land, so the use of individual room is contracted by rent agreement. The apartment unit Act no 16 year 1985 has been giving the new ownership title concept related to 3D property right.

The definition of apartment is a high-rise building that is functionally structured in horizontal and vertical direction, divided into units, which have clear boundaries, size, and area. It can be separately owned and occupied. Apartment has common part, common things, and common parcel where the building is erected on it, (Government of Indonesia, 1985). Common parcel cannot be individually owned because of its nature and function that should be used together.

The apartment unit can be defined as the part of apartment that have primary function for living and occupancy area, and separately used from the other part of the building. It should have access to the public road.

The ownership of apartment right is given for two purposes, dwelling place and business place. The apartment unit for dwelling place should be built above land surface, nevertheless for business purpose, it can be built below the land surface.

Strata title always has the concept of co-ownership. The definition about co-ownership based on the Indonesian land law can be summarized as below:

- Common parcel is parcel that is used, as based for co-ownership right, and for erecting apartment building. The apartment only can be built on the land owned by the right of ownership, the right of building, the right of use of state land, and the right of management. In the case a person or legal body does not have the right of ownership or the right of building, based on law, nobody could entitle the related apartment unit. For the apartment that will be built on the land entitled by the right of use of state land , the land law guarantee the right of use will be granted in the enough period of time. The right of management only can be granted for the legal bodies owned by government, In the case the apartment will be built on the land entitled by the right of management, the developer should make agreement with the holder of the right of management to grant the right of building on this land.
- Common part is part of apartment, which is owned for collective uses in the integral function of the apartment unit. The collective part cannot be separately entitled and used by the owner of apartment unit. It should be collective link. Moreover, it cannot be separated from the ownership of apartment. The examples of collective part are roof, corridor, stair, public room, substructure of building, etc.
- Common things are the things, which are not part of apartment, collective owned by the occupants, in order to be used for collective purposes. The examples of collective part are water system, electricity system, gas system, escalator, sport and recreation Park, etc.

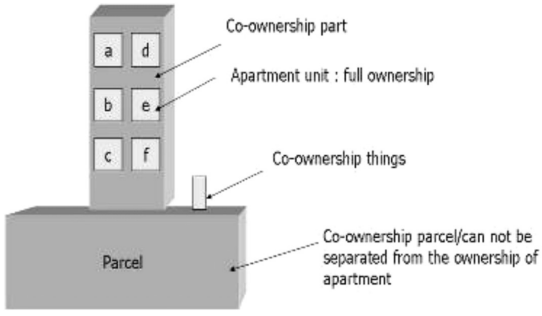

Figure 2. Types of ownership in strata title registration (Suhattanto, 2009:36)

According to the co-ownership concept above, it should be a tool to determine the right and the obligatory of apartment unit owner. The qualitative tools used, is called proportional value. Proportional value is a number show the shares each unit owner has in the collective properties. It is counted based on the ratio between the area of each unit apartment and total area of whole unit apartment.

$$PV\ Au = \frac{L\ Au}{T\ Au} * 100\ \%$$

Equation 1. Equation to calculate Proportional Value

Note :

PV Au: Proportional value of unit apartement

Au = Apartment Unit

L Au = Area of each unit apartment

T Au = Total area of whole unit apartment.

The proportional value is still calculated based on the area, ignoring height and volume, although in fact the right of apartment unit highly related with strata, which is 3D component.

According to the law, the co-ownership things have to be managed and used in common. The corporation of the occupant has to be formed who has responsibilities to manage them. The corporation is the legal entrusted body that is formed by the title holder of the right of ownership of apartment in order to formulate the management of co-ownership things. The member of corporation is the title holder itself. As the legal body, it should have rights and obligatory that are ruled in the organizational statue, therefore it can take the legal action on behalf of the occupant.

a. Procedure to register strata title

According to the Law No 16 year 1985 concerning apartment article 18, apartment unit can be sold after the suitable occupancy permit has been issued from the municipal, and the certificate of ownership of apartment right has been issued from BPN.

There are two things that should be fulfilled by developer to develop an apartment, those are:

- Technical requirement, which consist of plan about room, building structure, apartment supporting tools, the unit of apartment, the co ownership section, and the density and site of building. The technical requirements are usually provided in digital format mainly for floor plan and division plan beside paper format.
- Administrative requirement, which consist of building permit, the ratification from municipal of division plan, the certificate of land title, advice land use planning, division plan, architecture of building plan. Structure of building plan, the utilities plan.

To give insight about the whole system of apartment related to right and obligatory of the apartment unit owner, the developer should make the division plan. The division plan contains the description, in map and text form, which give clear insight about the boundaries of each unit of apartment. It shows horizontal boundaries, vertical boundaries, collective part, collective things, collective parcel, and the list of proportional ratio value of each apartment units.

For issuing ownership of apartment right cer-

tificate, firstly, issued on behalf of the developer, after certificate has been issued, the developer has the right to transfer its right to the buyer of apartment unit. The deed notary is needed to prove the property transaction. The signed deed is an evidence to prove that ownership of apartment right has been transferred from the developer to the occupant including the right of co ownership things that cannot be separated from the apartment. The certificate of ownership of apartment right consist of

- The copy of ground book and letter measurement of co ownership parcel
- The division plan
- Division deed
- Suitable occupancy permit

The procedure for issuing ownership of apartment right certificate can be seen in the diagram below:

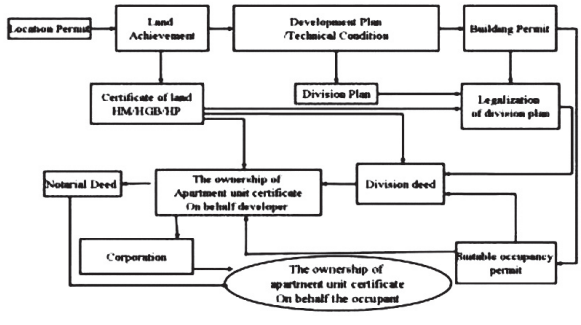

Figure 3. Procedure to register apartment unit (Hutagalung, 2007: page 4)

It should be noted here, that the cadastral surveying is not involved yet to register the strata title properties. The surveying and mapping just concentrate on registering parcel on which the apartment building erected. The unit of apartment itself as the object of strata title registration is not handled by cadastral surveying process. The division plan, provided by developer, is the only spatial data show relative position of apartment unit that will be legal evidence, and then will be kept in register.

b. Cadastral system in handling 3D property

BPN office has been equipped with GIS software for conducting cadastral functions. Some of land region offices especially in the urban area already had Land Office Computerization System. Small-word is used to manage spatial data. Small word Application has been able to manage apartment Information, even though, the 3D information is considered to be 2D information by keeping the floor plan as scanned file that is linked to the primary database (3D tags). The visualization of the existing cadastral system in order to inform the apartment unit can be seen in the below picture.

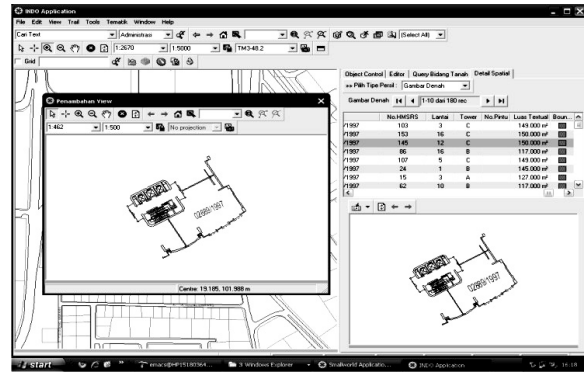

Figure 4. Visualization of apartment unit in Land Office Computerization System (Suhattanto, 2009:36)

The weaknesses of the existing system in order to register 3D property can be summarized as follow:

1. The legal part does not provide yet sufficient regulation for all types of 3D situations
2. No integration between cadastral map and spatial information of unit apartment
3. Cadastral registration cannot provide 3D information on how properties are located in the building complex itself, it because there is separation between cadastre map which contain the whole parcels and the division plan which contain spatial information relate to the unit of property ownership, thus ca-

dastral map merely describe the position of parcel where the building erect on.

4. No height information in strata plan/drawing plan because cadastral surveying is not executed for apartment unit.
5. It is not possible to view 3D property unit interactively, which is helpful to get insight into complex 3D property
6. Limited accessibility of data exchange because analogue achieves is still used.

E. Modelling Land Registration Process

Based on Stoter and Salzmann (2003), the solution to register 3D properties can be achieved with 3 ways

1. Full 3D cadastre, in which persons can explicitly be entitled to volumes, in this solution the registration object is fully bounded by 3D volumes so the parcel is not considered as a basis for land registration anymore.
2. Hybrid cadastre, this solution provides opportunities to combine existing 2D registration for traditional parcel and 3D registration for 3D property situation. There are two alternatives of hybrid solutions:
   a. Alternative 1: registration of 2D parcels in all cases of real property registration, and additional registration of 3D legal space in the case of 3D property units within one parcel, using a bottom and top height level of the space to which rights apply.
   b. Alternative 2: registration of 2D parcels in all cases of real property registration and additional registration of the legal space of physical objects in 3D space.
3. 3D administrative tags or files linked to parcels that exist in the current cadastral registration[6].

[6] Stoter, J. and M. Salzmann (2003). "Towards a 3D cadastre: where do cadastral needs and technical possibilities meet?" Computers, Environment and Urban Systems 27, page 398

Figure below show the model how those solution will maintain subject, object and right of cadastral system.

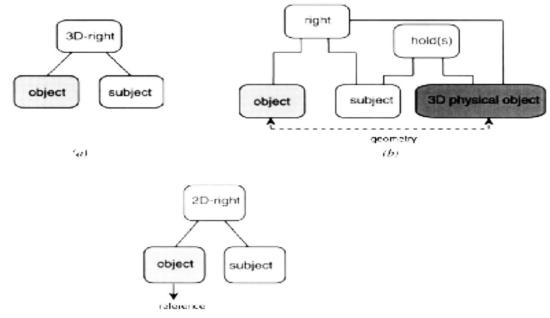

Figure 5. Models of 3D cadastre solution (Stoter and Salzmann, 2003:398)

Basically , the current cadastral system in Indonesia adopts the third solution of 3D property registration that use tags or external file to give spatial information of apartment unit. The system use scanned drawing plan to illustrate the shape of registered apartment unit.

F. Redesigning 3D property Registration in Indonesia based on 3D cadastre concepts

This chapter discusses about how to redesign the existing work process based on 3D and cadastre 2014 concepts. The case will be modelled is apartment unit registration. Apartment unit is the only 3D property that is considered as object in the existing land registration in Indonesia. The modelling technique is used to design possible mechanism to register apartment unit in 3D way.

a. The Existing Mechanism of Apartement Unit Registration

In the existing system, the relationship between parcel and person follows the common model of traditional relationship between person, right and parcel with additional 3D information from scanned plan. Based on Stoter and Van Oosterom (2006) this model is known as 2D cadastre with tags to 3D situation.

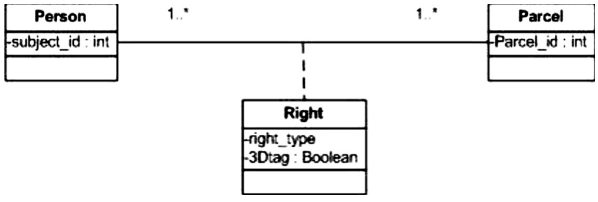

Figure 6. Class diagram of existing strata tile registration. (Stoter and Van Oosterom, 2006:26)

In Indonesian cadastral system, horizontal division is implemented in case of right of apartment unit ownership. Thus, the main object of apartment unit registration is common parcel where the apartment buildings erect on. The common parcel is limited by the parcels that are titled by ownership right, use right or building right. Apartment unit rights contain two types of right, the private right, which is the right for each apartment unit, and common right, which is the right for common parcel.

The process of Registration of apartment unit involves two components, stakeholders of BPN and BPN. The sections of BPN that highly involved in registering apartment unit are:

- Survey and mapping section
- Land titling and land registering section

Whereas, external stakeholders who have important role and directly involved in the strata title registration are:

- Apartment unit Owners (subject in the apartment unit registration who holds the right of apartment unit ownership)
- PPAT (PPAT is a private sector who make deed as evidence document for the executed legal transaction)
- Municipality (Giving the permit for building construction)
- Real Estate Developer (Constructing building, providing floor plan and division plan, appealing certificate)

The rest of stakeholders are parties who can take benefits from strata title registration by using cadastral information to assist their business. For example: Tax service office (Using property registration for land and property taxation) and Bank (Using cadastral information for property valuation in order mortgaging purposes),

The workflow process below show how the apartment unit has been registered in the existing land registration system of BPN. The workflow focuses only in BPN system, so the other process such as achieving building permit from municipality is not involved in the workflow.

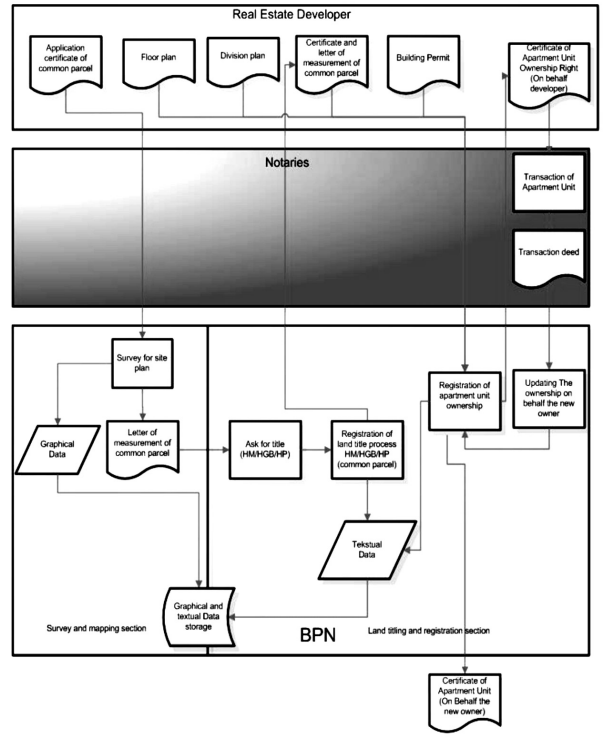

Figure 7. Workflow of existing Apartment Unit Registration (Suhattanto, 2009:71)

In the current land registration system, surveying and mapping activities are conducted only to survey co-ownership parcel, thus the spatial information related to apartment unit are obtained from floor plan and division plan which are provided by developer.

b. The Proposed Mechanism

Hybrid solution with physical object registration is a proper solution to register apartment unit in land registration system. The motivation

of using this solution is because the existing system has been managing 2D parcel in 2D spatial data management for long time. The availability of strata plan to depict the physical building (even tough in 2D) can also help the data acquisition to model the 3D object.

The proposed mechanism to register apartment unit in the cadastral system based on the hybrid solution with physical object registration can be illustrated by class diagram below:

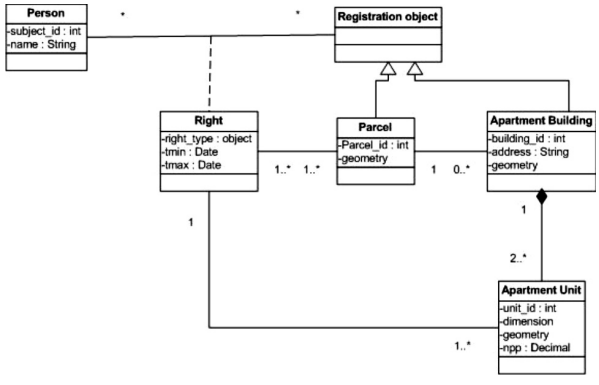

Figure 8. Proposed Class Diagram to register Apartment Unit (Suhattanto,2009:72)

In the proposed mechanism, the registration object is not only parcel but also apartment building. The relationship between parcel and apartment building is illustrated with the generalization in UML class diagram. Apartment building consist of at least 2 or many apartment units, the relationship between apartment unit and apartment building is shown with composition that means the apartment unit exist only if apartment building is in the system.

According to The regulation of BPN chairman No 4 year 189, the attributes are involved in the case of apartment unit registration are:

- Identification number of right of apartment unit ownership.
- Address of apartment building
- Identification number of right of common parcel
- The date of the right of common parcel is issued, and the date of the right of common parcel will end.
- Name of owner of apartment unit
- Proportional ratio value for each apartment unit (npp).
- Another attributes that are needed.

All of the attributes above are involved in the proposed mechanism to register apartment unit in Indonesian land registration system.

Based on the statement 5th of cadastral 2014 that states private sectore should be involved in Land Registration process, the use case diagram is developed to show the parties who are involved in the proposed mechanism to register apartment unit. The following actors with their role in the system can be seen in the use case diagram below:

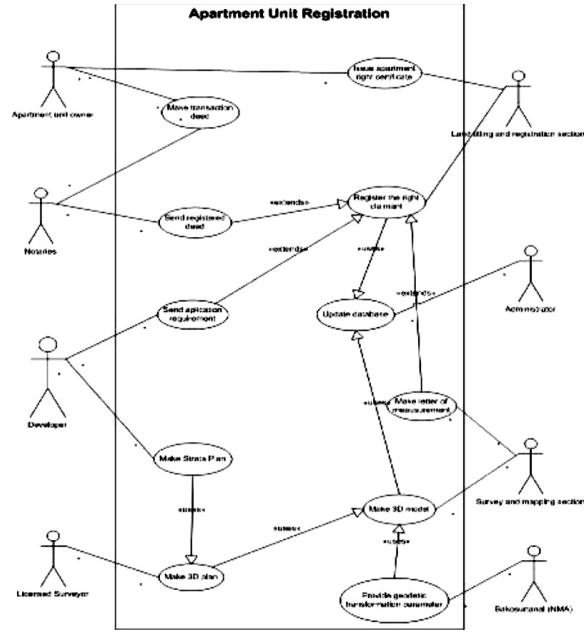

Figure 9. Use Case Diagram of Proposed Solution (Suhattanto,2009:73)

The proposed working process adopts the user requirement of the 3D cadastral registration, mainly in the involvement of private sector in the system and reduces the work flow process in order to accelerate the registration process.

The specific role of involved stakeholder can be explained below:

- Apartment Unit Owner: Apartment owner is

a subject of the registration. The apartment unit owner is not highly involved because the developer of apartment building should take active role to register the properties in BPN, especially to submit the application in the certification process.

- Developer: Developer takes the important part of the process because it has responsibility to register the property before the transaction of each apartment unit. The requirement application for apartment unit registration process should be completely done by developer.
- Private Surveyor/Licensed surveyor: Private surveyors are not new party in the cadastral registration process in Indonesia, They are also involved in the cadastral survey and mapping but in the case of strata title registration, but they don't have important role. To get the license from BPN to conduct cadastral survey, the private surveyor should have sufficient knowledge about Geodetic and cadastral survey and mapping. So the proposed workflow take consideration to involve them to prepare the 3D plan as an additional application that should be completed by the developer.
- Land Titling and registration Section: The Land titling and registration section is the section in the regional land office that has responsibility to register the right and the owner of right in the existing land registration process and to examine the authenticity of land possession evidence in order to issue certificate.
- IT Administrator: There are two types of administrator, graphical administrator who has responsibility to update graphical data in the database, and textual administrator who has responsibility to update attribute information in the land office database. The database administrators are employed in the regional land office that has been equipped with Land Office Computerization (LOC).
- Survey and Mapping Section: In the existing mechanism survey and mapping section has active role to make survey and mapping activities with help from private surveyor. In the new proposed workflow the survey and mapping section of regional land office has a role as supervision for spatial data collection that has been done by private surveyor. Besides that, it has responsibility to convert the 3D plan into 3D model thus integrate it into the cadastral database.
- Bakosurtanal/NMA: Bakosurtanal is a government institution that has responsibility as survey and mapping coordinator. It also provides Geodetic reference points for Geodetic survey (Planimetric and vertical reference).

Based on the involved actors, the proposed workflow is built with eight swimlanes in the activities diagram as follow:

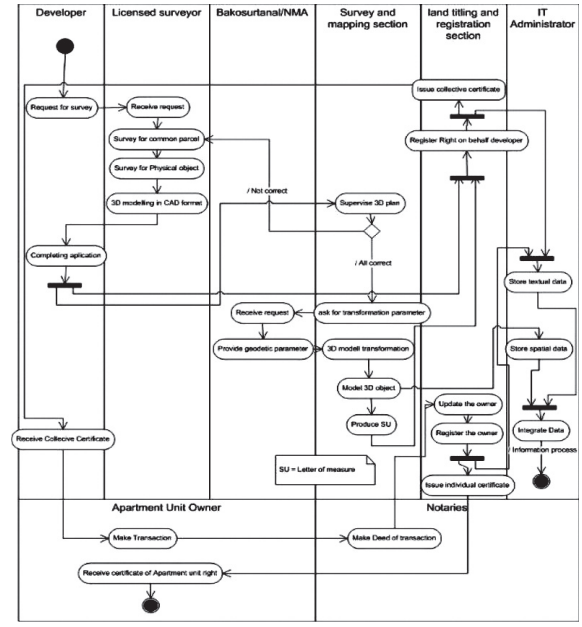

Figure 10. Activity Diagram of Proposed Workflow (Suhattanto,2009:75)

The workflow of the proposed work process can be explained more detail as follow:

Step 1: Submitting Application

The Real estate developer has full responsibility for this step. The proposed workflow gives other responsibilities for real estate developer, with the

cooperation of private surveyor, to provide 3D plan of the property, besides of the other administrative and technical requirement. It should be noted here that the existing strata/floor plan had already in the digital archive but merely depicted in 2D situation (vertical and horizontal section). The example of floor plan can be seen in the following figure.

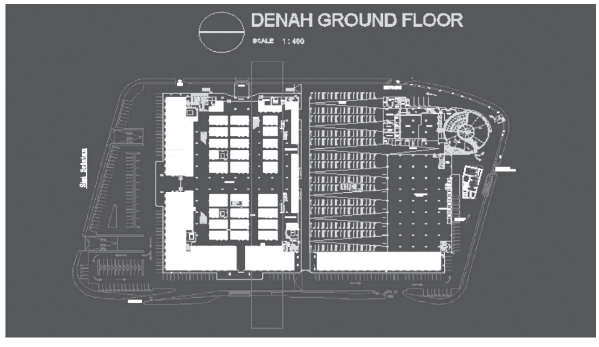

Figure 11. Example of Floor Plan (horizontal perspective) in CAD Format. (Suhattanto, 2009:76)

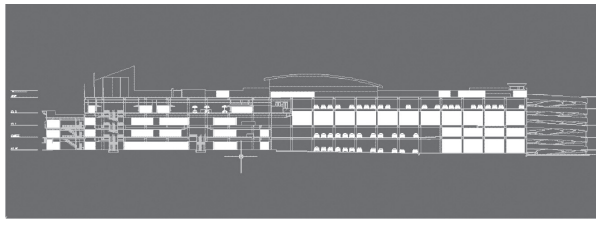

Figure 12. Example of Floor plan (Vertical Perspective) in CAD Format. (Suhattanto, 2009:76)

The existing plan could be improved to be 3D model by conducting survey and mapping for the building that will be discussed in the next step.

Step 2: Survey and mapping of common parcel and physical building

The real estate developer needs to involve the private surveyor in order to develop 3D plan. The regulation to involve private surveyor for cadastral survey and mapping activities has been ruled in the regulation of BPN chair-man no 2 year 1998 that give opportunity for private sector to assist the cadastral process in Indonesia. The private surveyor has to have sufficient knowledge to survey and mapping the 3D properties. There are two benefits in the development of 3D plan. First, the AutoCAD software is commonly used by surveyor in Indonesia to develop the map and plan in digital file. Second, the availability of Geodetic Engineer in the private surveyor company who has sufficient knowledge about survey procedure for horizontal and vertical dimension. The 3D plan should be built in line with technical reference that is provided by BPN later on. The simplification of existing process occurs when submission of application is conducted only once, thus the survey and mapping can be executed for both object, that are common parcel and building.

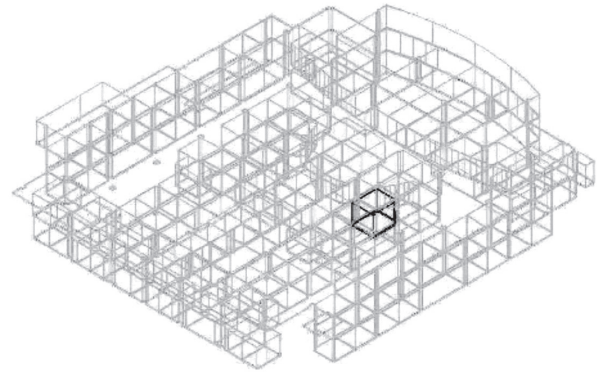

Figure 13. Example of 3D plan in CAD format (Hendriatiningsih, I. Soemarto, et al, 2007:7).

Step 3: 3D model creation

The survey and mapping section take part for modelling 3D object then integrate it into the cadastral database. Based on Stoter (2006) for the design and building process, 3D CAD models are generated from the designs for visualization purposes. Also those models cannot directly be used for the 3D cadastre. Since CAD models contain much more details than it's needed in the 3D cadastre[7]. It has to be studied what selections and generalizations are needed to obtain

[7] Stoter, J. and P. Van Oosterom (2006). *3D cadastre in an international context legal, organizational, and technological aspect*. Boca Raton, Taylor & Francis

the relevant information such as the outer boundary of objects. So the step that should be followed to integrate 3D CAD model into database can be explained as follow:

- Simplification or generalization of 3D plan from too much detail information to obtain relevance information for cadastral information purposes
- Transformation from the local coordinate to the National reference coordinate by using GPS measurement and geodetic parameter that is provided by NMA specially to assign height information to the model.
- Model the properties using the graphical software in the land office and integrating it in the cadastral database.

Step 4: Textual data registration

Textual in this case related to the registration of attribute the ownership of apartment unit. The land titling and registration is the section that has responsibility on it. The registration part in the workflow is divided into two sub-processes; first process is to register the apartment unit on behalf the developer and second process is to register the apartment unit on behalf the apartment unit.

Step 5: Graphical and textual data storage

Database plays the important part in order to give information for the customer. The IT administrators have responsibilities to manage spatial and textual data in the cadastral system, therefore the information can be obtained by customer easily. The development of system to deliver cadastral information is still on going in Indonesia, the project, namely SIMTANAS, is a project to integrate the data from all of land office in Indonesia by using database concept, therefore the data can be share and change for various stakeholder. The information can be accessible via GIS front end software in each land regional office and via BPN portal in internet.

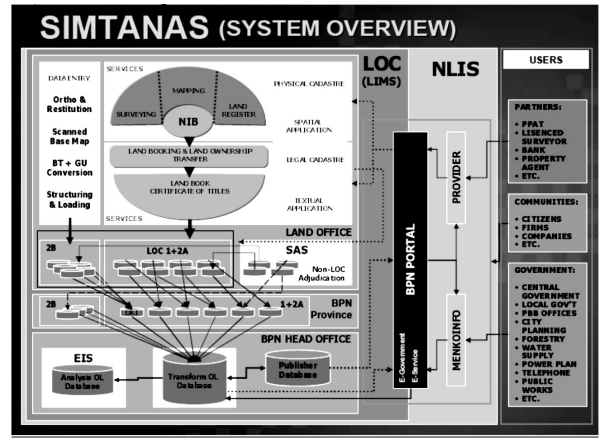

Figure 14. SIMTANAS, Data Sharing in Indonesian Cadastral System (Suhattanto,2009:78)

c. Organizational change requirement

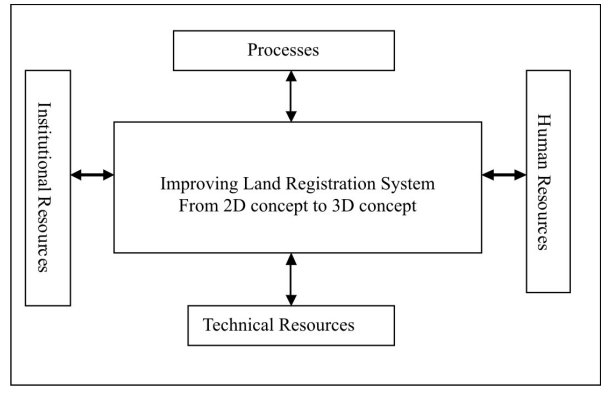

Figure 15. The Aspects of Internal Organization that is Influenced by Proposed New System (Suhattanto, 2009:79)

There are some organizational change should be considered to implement the proposed workflow. The involved stakeholders have been added to the cadastral function influence the role of the section in BPN. There are no needs to change the structure of organization to conducting 3D properties registration. The sections that highly interrelated with Strata title registration in 3D are survey and mapping section and ICT department. The changes of organization in registering strata title with 3D concept will be explained as follow:

1. Technical Resources

BPN uses a unified system to integrate all of cadastral data, namely Transfer Mercator 3°. This

Coordinate system based on Universal Transverse Mercator (UTM) that usually used in Geodetic Survey and mapping. All of cadastral survey and mapping activities has use horizontal position reference that is provided in TM 3 coordinate. TM 3° projection system divides a zone of UTM, which has width 6° for each zone, into two subzones that has width 3°. Therefore, in one zone of UTM consists of two zone of TM 3°. This division aims to increase the accuration of cadastral object.

For conducting survey in 2D parcel, the surveyor usually uses Total station and meter band to measure the horizontal dimension of parcel. Then, the local coordinate has to transform into TM 3 projection system by using geodetic reference network that are spread in the whole area of the country.

Recently, GPS is an instrument that is commonly used by surveyor to conduct cadastral survey. In the case of 3D model construction, height measurements take important part in cadastral survey. As it has been done in the research by Tzur and Jarroush (2001) linking the boundaries of the building to horizontal control network can be realized by using GPS with Real Time Kinematic Method (RTK). The method to link the boundary of object into vertical control network can use transformation of RTK height data into vertical national reference[8]. The transformation is needed because RTK provide ellipsoidal height, which height measured with respect to reference Ellipsoid (WGS 1984), meanwhile vertical national reference use orthometric heights, which height measured with respect to Geoid reference. Thus, this transformation needs undulation model in each area.

From the explanation above, the use of GPS is necessary to give the height elements for cadastral object. The other solution can be used for example conducting levelling measurement to link the height of cadastral object to vertical national reference but it is not efficient. The proposed solution will take advantage of the development of GPS technology to assist 3D modelling for strata title registration purposes.

2. Process

The proposed workflow needs the changes of process in the property registration. The changes are caused by the object of registration is not only parcel but also in building or construction as an additional object in land registration system. The changes of process mainly happen in the data acquisition part and data maintenance.

Spatial Data acquisition is the responsibility of survey and mapping section. The role of survey and mapping section in the daily job is to conduct cadastral survey and mapping source for spatial data in the land registration system. The new workflow does not change the basic responsibilities of this section but the role of this section to survey land and the properties will be given into private surveyor. Therefore, the responsibility of this section is to conduct supervision of 3D plan that is provided by developer and private surveyor. The new workflow create the addition job for this section because he 3D plan can not directly be used for the cadastral system, this plan should be integrated to the system through some process in order to create 3D model of the apartment unit. The process involve of geodetic transformation and 3D map cartographic process. Based on Stoter and Van Oosterom (2006) The process can be summarized as follow:

- Adding height information into spatial data (z coordinate).

[8] Tzur, G. E. and J. Jarroush (2001). *Reinstating and marking spatial parcel boundaries as a base for 3D digital cadastre by means of real time kinematic GPS*. Registration of properties in strata International workshop on 3D cadastre, Delft, International Federation of Surveyor, page 216.

Considering fixed boundary approach is used in Indonesian cadastral survey, the absolute z coordinate will be proposed for the new workflow rather than relative coordinate. There is no need to survey whole area so the survey is executed for only the surrounding 3D object. The absolute coordinate of 3D object means the height coordinate component (z) to define the 3D position of the 3D object should refers to national reference system, in geodetic the z coordinate should refers to geoid surface. Whereas in the relative coordinate, the height coordinate component refers to land surface. To transform the model into national system, the geodetic transformation parameters are needed, such as undulation and measurement from GPS to obtain z values. However, this paper will not explore more about the technical way to add z component of 3D model, but the sources of this process is provided by Bakosurtanal/ NMA that gives data for geodetic survey and mapping such as Undulation map, Digital Elevation Model and topographic map. The most consideration should be taken here that BPN should make cooperation with Bakosurtanal related to 3D property registration.

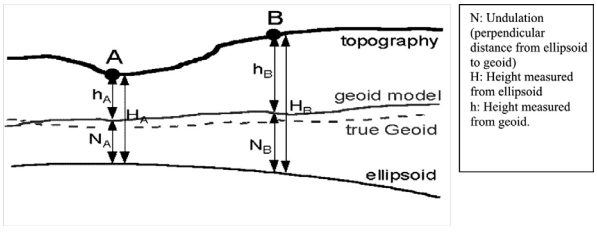

Figure 16. Example of Geodetic Vertical Reference (Suhattanto,2009:81)

- Generalization of 3D plan.
  It is because 3D spatial data in CAD files contain complex geometries and are sometimes parametrically described. At the moment these data cannot automatically be converted to the primitives that are available in the spatial DBMS, which is used for the 3D cadastre (point, lines, polygons, polyhedrons). Also once the 3D CAD object will be available as geometries in the DBMS, 3D generalization and simplification is needed to obtain the appropriate information. Building 3D model and integrating the model into database. The construction of 3D models can be approached from four ways.
  1. Bottom up: Using footprints from existing 2D maps and extruding the footprints with a given height using surveying, GPS or photogrammetric data.
  2. Top down: Using the roof obtained from aerial stereophotographs, airbone laserscan, and some height information from the ground.
  3. Detailed reconstructing of all detail: Using 3D point clouds obtained from laser data, it will be complex approach and need sophisticated software
  4. Combination of all approach [9]

  The availability of 3D data source now is still very limited in Indonesia. In strata title registration process, the main source of spatial data is 3D plan that can be obtained in CAD file. The strata plan and height information from survey can be used to build 3D model as explained in the bottom up approach, also if it is necessary the aerial photo from photogrammetric section can be used for additional data.

The department of BPN that has responsibility to provide and develop ICT functions takes the important part. The ICT department in this case is Pusat data dan informasi (The centre of cadastral information) that has responsibilities to extend the existing system in order to deal with 3D object registration. ICT department has to improve the availability of software and hard-

[9] Stoter, J. and P. Van Oosterom (2006). *3D cadastre in an international context legal, organizational, and technological aspect*. Boca Raton, Taylor & Francis, page 166.

ware to handle the registration of 3D property. The existing GIS software in land office computerization, Small-word, has to be improved to be able to creating, storing, analyzing, and informing 3D model, thus he information of Apartment unit in 3D is accessible in front end using the existing software or using BPN portal in the internet. The existing Web-based tool could be improved to visualize 3D object via internet.

3. Human Resources

The new workflow proposes the participation of external stakeholder to assist the 3D object registration. Specially, for survey and mapping activities for 3D object that is conducted by licensed surveyors. They can assist the spatial data acquisition for creation of 3D model. The existing system has been involving them to survey 2D parcel. The licensed surveyor is a company that have employee who has skill and ability to conduct geodetic survey and mapping, it becomes a benefit point for BPN to involve them in 3D cadastre. It is also in line with the future desire of BPN to highly involve private sector in surveying and mapping process. Thus in the strata title registration, BPN has a role as supervision part that supervise the properness of 3D plan provided by licensed surveyor.

The public sectors also involved in the new workflow. Bakosurtanal/NMA will be highly involved to assist 3D property registration specially to provide geodetic data in creation of 3D model. The existing cadastral system has been utilizing infrastructure provided by Bakosurtanal to conduct 2D parcel survey. Bakosurtanal has been supporting the accurate positions of control points for cadastral survey. For 3D cadastral registration case Bakosurtanal can supply the data for vertical positioning purposes such as DEM, undulation, vertical positions control points, and laser scanning data.

4. Institutional Resources

Institutional can be defined as the rule of the game that provides regulation in how the organization should conduct its activities. According to 3D cadastre, without sufficient regulation to regulate the task of land registration for registering 3D properties the concept of 3D cadastre cannot yet be implemented in Indonesia. It because the main purpose of land registration is to provide data and information that has legal affect. The land registration activities always have legal consequence, thus Law is the first priority to be built before to go to further step, the implementation of 3D cadastre itself. The consideration should be taken by Indonesian government as public decision maker to provide bundle of law in handling 3D property situation as a basis to execute 3D registration. BPN as an executor organization that has mandate to conduct land registration should prepare the legal and technical concepts that can be adopted in the development of land law in order to handle 3D property registration in accordance with the proposed solution.

G. Conclusion

The new work process for apartment unit registration based on 3D and cadastre 2014 concepts has been developed. The new work process needs additional task for organizational function because of the implementation of 3D model. This process mainly influences the surveying and mapping process and ICT management. 3D plan should be provided by developer to complete the requirement application of apartment unit registration. It gives the chance for private surveyor to be involved in the 3D property registration process. The availability of data for 3D model creation from other public sector such as Bakosurtanal, has been giving the opportunity to realize 3D property registration in Indonesia. Of course, the other consideration should be

taken by BPN before implementation of 3D cadastre registration such as providing sufficient regulation to give guidance for 3D registration and technical reference of 3D properties survey. In addition, the most important part is improving the GIS software that is used in order to manage 3D spatial data.

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