

New Cadastral System Towards Planning and Construction Sustainability

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Abstract– The urban population in Asia has increased by 550 million people during 1960-1990 and is expected to increase by 1,286 million people by year 2020 [5]. Since late 1990s, the population of Malaysia has increased from approximately 21.80 million to 27.73 million in 2008 [3] and it is predicted to reach 31 million by 2020. Cities in State of Penang, Selangor, Kuala Lumpur and Johore have so far absorbed their growing numbers in settlements with a varying quality of living and the complexities of the extreme modern buildings are expected to be designed and built in the near future. Unfortunately, the existing Malaysian Cadastral System and legislation for 2D parcel is unsuitable for representing the land rights in 3D situations for those rapid increases for development and technical purposes. Hence, an efficient 3D land use in real estate property especially for multilayer objects is directly linked to the socio-economic and environmental development in Malaysia.

This paper describes the overview of Malaysian Cadastral System for 3D purpose and the situation in Malaysia. We explain the current practice of cadastral registration in Malaysia and the Malaysian Cadastral Data Model are elaborates also. The Malaysian Digital Cadastral Database (DCDB), Computerised Land Registration System (CLRS) and Cadastral Data Management System (CDMS), the development of 3D Cadastre registration and the integration of CLRS and CDMS are illustrates respectively.

Throughout the paper it is hope that this new approach can bring to planning and construction sustainability in Malaysia.

1. INTRODUCTION

A systematic record of lands matters involving registration of the details of transaction such as transfer of land and interest, lease, charge, releasing of easement and change of condition of land is very important in the land administration, planning and development of land. As stated in [17], land administration consists of Cadastral Survey and Mapping Registration System, and Land Registration System. Both systems contain different sets of records about land. These two systems are very important

for the formation of a good cadastral system. A cadastral system is an information system consisting of a series of maps or plans showing the size and location of all land parcels together with text records that describe the attributes of the land. This 2D Cadastre system is adopted by many countries in the world including Malaysia because the system provides essential information about land and property such as ownership of the lot and land parcel for the country.

One of the important issues with regards to land is the adequacy of vacant land for development. There are many countries from all over the world including Malaysia who do have not enough vacant land on the ground surface to cater for the rapid development, particularly in big cities. In densely developed area and crowded cities, many of the real estate developments are either above or below the ground surface such as apartments and business complexes and engineering constructions which could be underground car parks, skywalks and buildings above road reserve. It is anticipated that for future urban developments, the alternatives to the land surface would be the space above and below the ground surface and the shallow underwater areas along the seashore which involves marine cadastral. Both, the above and below ground surface developments as well as marine development have increased in recent years. However, expensive and high costs of construction and the lack of legal and organisational aspects of right to property have always intimidated and made potential investors cautious.

2. OBJECTIVES

In view of the Malaysian Cadastral System that is based on the 2D cadastre, the main task of this research is to propose the changes to be made in the legislation of cadastral survey and mapping as well as registration of a 3D property objects. The objectives of the research are to review literature associated with the execution and application on

the legal status of the various 3D property objects in Malaysia and other countries, and on the research of 3D cadastre, strata title, 3D property rights and etc; to establish the fundamental principles in the field of 3D property legislation by analyse the existing legislation of 3D property cadastral objects in Sweden, Norway, Denmark and the Netherlands that was matched the need of Malaysian Land Law; and to investigate and make recommendations for changes, if necessary of the Strata Title Act 1985 (Act 318) and National Land Code 1965 (Act 56) that would facilitate the Malaysian Cadastral System practices and can be implemented under the existing environment in Malaysia.

3. 3D CADASTRE & 3D PROPERTY

At present, there is a lot of development taking place that is not covered in the 2D Cadastre system as there is a lot of interest in utilising land and space above and below the ground surface. Thus, there is a necessity to find a suitable cadastre solution for multilayer constructions. Therefore, the proposed 3D Cadastre system should be able to represent the actual real world situation and not the surface parcel. The traditional cadastral system and land registry based on 2D have not been prepared to register this utilisation of land in a 3D situation. The implication of these new ways of land use due to a high demand for ground space means that, there must be changes made to the 2D paradigm in law and legal aspects.

An earlier paper by [14] did describe that today's property situations often occur whereby the third dimension play a significant role in determining the legal status of such property, especially in areas with multilayer use of space. Examples of such property unit can be found in the following situations, (a) above surface constructions, such as apartments, constructions on top of each other, overhead infrastructure and utilities & Use of air space and (b) below surface constructions, such as underground constructions, infrastructure and utilities, region of polluted area & geological activities

3.1 3D Property Cases in Malaysia

In Malaysia, public road i.e. state roads and municipal roads belong to state government while federal roads belong to federal government. When a private property is constructed above the public road, the cadastral system should recognise two or more different owners at the same time. An earlier example of some cases for 3D property above the ground surface of public road in Malaysia was presented by [15] and [16] determined it into three categories, i.e. private properties (building structure) over a public road, public properties (transportation network) over a public road and Overlapping private properties.

4. PROBLEMS AND CONSTRAINTS IN CURRENT MALAYSIAN CADASTRAL SYSTEM FOR 3D PROPERTY

The current 2D Malaysian Cadastral System is insufficient to meet the changes brought about by the booming yet complex high density developments in urban areas. Furthermore, there is a growing interest and need for using space above or below the ground surface for construction real estate property objects especially in metropolitan areas. In such developments, some of the buildings have been built on top of each other or crossing boundary edge [5]; [4]; [2] and [11], but the legal changes in the land registry has not been made in accordance with the complexity of the developments that are taking place. The growing request for changes mentioned earlier is bogged by constraints and difficulties to register the ownership of real estate properties created above or below ground surface. These problems need to be addressed and there is a need for a legal registration status of such property, so that one would be able to define and manage the juridical situation satisfactorily. Thus, information based on 3D is becoming absolutely necessary for land administration in Malaysia.

The Malaysia legal cadastral system and land law are still using 2D legal and law expression for land and property tenure, for example in Strata Title Act 1985 (Act 318) and National Land Code 1965 (Act 56). As there is a growing need for ground space, the 2D paradigm in law and legal should be changed. But, the question is how does one determine and define the current legal practices meant for complex development situations. There is also the issue that the traditional cadastral maps, survey regulation and land registry which are still in 2D are no longer technically, legally and organisationally adequate to cater for these 3D situations.

The current legal registration process for 3D property in Malaysia is very slow. This is due to the problems associated with the legal registration process for 3D property. There is a possibility that they can be solved by adopting the approaches presented in [9], where he underlined the organisational, technical, data, legal and different working procedures and practices issues associated with the integration of the various systems and organisations. Therefore, the comprehensive decision making usually is more difficult because there are multi authorities involved.

The increasing number of multi- storeys and underground properties as well as other types of constructions has led to the urgency of implementing a 3D Cadastre in Malaysia. Thus, this study on the institutional issue is urgently needed to be in tandem with the technical development issues. Furthermore, the implementation of a 3D Cadastre for 3D property is not easy due to the different database compiled by the different organisations involved. Besides that the legal, survey and mapping part is also governed by different laws which makes the implementation of a 3D Cadastre for 3D property much more complicated and this will be one of the aspects to discussed and debated further in this research.

5. MALAYSIA SITUATION

There is a need for a refined description of land because land is the most valuable resource for humans and it is the fundamental or base for all forms of human activities. Since the last 15 years, urbanisation of Malaysia in an amazing speed and millions of people migrate to the cities, especially in Georgetown, Ipoh, the city of Kuala Lumpur and Johor Bahru. The areas of the cities are expanding and at the same time, construction projects keeping running in the urban area. The skyscraper and transportation network constructions, which are for multiple uses are now seen in all major cities of Malaysia. These complex situations always happen in Malaysia where public road i.e. state roads and municipal roads belong to state government while federal roads belong to federal government. When a private property is constructed above the public road, the cadastre system should recognise two or more different owners at the same time. However, the experiences on registration, management, real estate market and legislation show that there are insufficient of such 3D property legislation.

The cadastral system is adopted worldwide and Malaysia is one of the countries who adopted the system for its land management. Malaysia land administration is traditionally based on the Malaysian land law and this provides a variety of rights that are dependent on the traditions of the country. In Malaysia, land use rights are often based on occupation of land over a long period and this is defined in the written law or set by traditions. As the context of land use is no longer confined to the conventional definitions, the application of Malaysian legalistic land law of Malaysian Cadastral System for property which consists of Land Registration System and Cadastral Survey and Mapping Registration System using 2D geometric in legal and law expression for land and property tenure is no longer adequate.

Furthermore, the utilisation of land for various purposes in Malaysia has not followed the process of the ideal Malaysian Cadastral System. It would be more practical if the Malaysian Cadastral System includes relevant information such as foundation of buildings, underground utilities, skywalks, using of air space, transportation services, and underground construction or whenever a situation arises for the need of exploiting a lot or land parcel for different activities.

5.1. Cadastral Map and Land Title

Cadastre is a technical term for a set of records showing the value and ownership of land parcel. It provides precise description and identification of particular pieces of land and its acts as a continuous record of rights in land. Meanwhile, a modern cadastre normally consists of series of large scale cadastral map and corresponding register.

Both the maps and registers may be stored in computers, such as Cadastral Database Management System (CDMS) and Computerised Land Registration System (CLRS) in Malaysian Cadastral System.

After final survey of an individual parcel of land or a number of lands, a cadastral map, so-called Certified Plan in Malaysia will be produced for those plot/plots of land. Certified plan is prepared following the format determined by the Department of Survey and Mapping Malaysia (DSMM). It shows the lot boundary in various scales with a given Certified Plan number. Information pertaining to the lot location, number, area, bearing and distance are also displayed. The digital certified Plan in the Certified plan image Library (CPIL) can be obtained in *.tiff format. Immediate after the approval of Certified Plan, the document of title, such as Registry Title and Land Office Title in Malaysia will be prepared, approved and issued to the owner. Registry Title means title evidenced by a grant or State lease or by any document of title registered in a registry under the provisions of any previous land law while Land Office Title means title evidenced by a Mukim grant or Mukim lease or by any document of title registered in a registry under the provisions of any previous land law. The digital Registry Title and Land Office Title can be obtained in B1.tiff format.

Unfortunately, these Certified Plan, Registry Title and Land Office Title mostly only represents the surface level of ground with individual land parcels by 2D boundaries, descriptions, rights, restrictions and responsibilities. These conventional 2D map and title display geographical data and is vital for revealing spatial relationships and patterns [6]. However, it has difficulties to record and display the multiple uses of lands with the construction above and below the ground surface.

5.2. Cadastre Registration System in Malaysia

The traditional cadastre registration system that is practiced in Malaysia are parcel bounded system with 2D nature and provide essential lands and properties information of the lots and land parcels [5]. Furthermore, [19] points to the fact that traditionally land has been described and registered into 2D and all cadastral systems of the world are in fact 2D nature. The existing traditional Malaysian Cadastral Survey and Mapping Registration System and Land Registration System deals with properties not only located on the surface level, but above the surface level and also below the surface level. Therefore, the rights, restrictions and responsibilities (RRR) of the proprietor of the surface parcel shall also apply to the proprietor of the above that is air space and underground land as well.

The current Malaysia Cadastral Registration System does not consist and includes 3D objects registration and 3D rights as well, but this current system is more similar to land administration system. As stated in [16], land

administration consists of Cadastral Survey and Mapping Registration System and Land Registration System where both of them contain a set of records about land. This type of 2D Cadastre system being practice in Malaysia for a period of one hundred years and it provides essential information about land and property like ownerships of the lots and land parcels for the country. In Malaysia, the cadastral system is managed by three main authorities namely Department of Survey and Mapping Malaysia (DSMM), State Land and Mines Office (PTG) and District Land Office (PTD). In general, cadastral survey and mapping is under the jurisdiction of DSMM where it responsible for carrying out land survey and mapping, then follow by registration of cadastral objects there are lots and land parcel boundaries while PTG and PTD are responsible for the land title registration (Registry Titles and Land Office Titles).

In Malaysian Cadastral System, there are two systems namely Cadastral Database Management System (CDMS) and Computerised Land Registration System (CLRS) which operated by DSMM and PTG as well as PTD. The CDMS database stored land attributes, spatial objects and other things while the CLRS database stored land ownerships, land tenures and so on, but these two systems works separately in each organisation with difference legal aspect and still in nature of 2D. This mean, there are no 3D object property rights as well as 3D cadastral rights. These two systems later on can be incorporated in the registration form with the present advance and modern technologies such as GIS, internet, web based and e-commerce applications. Figure 1 shows the current system with the proposed concept of legal aspect for 3D objects registration and visualisation rights as well as 3D property rights. For more discussion and detail on 3D property rights, see [12].

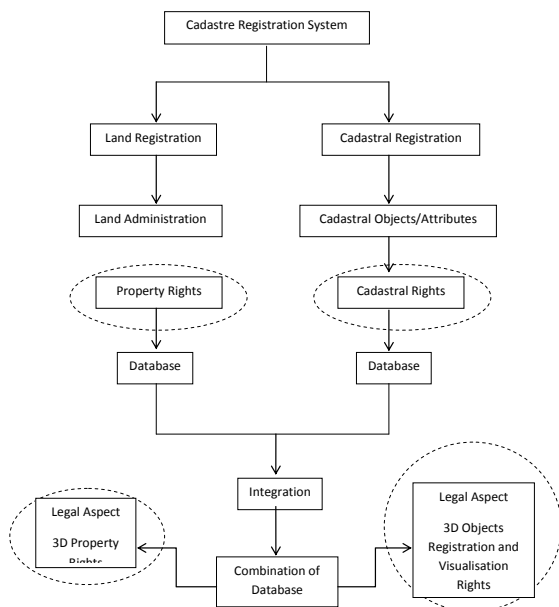


Figure 1: Current cadastral system with proposed concept of rights

5.3. Malaysian Cadastral Data Model

The CCDM which introduced in the current version of model [18] mentioned that this data model is the foundation of most land administration. Which means that, this foundation of core cadastral data model is designed for various land registration system and cadastral system all over the world and as a base for all cadastral registration, therefore, in other words, the relationship between the three core classes in the UML diagram as in Figure 2, there are Person (subject), RRR (right, restriction, responsibility) and Register Object (real property objects), can used to illustrate Malaysia Cadastral Data Model.

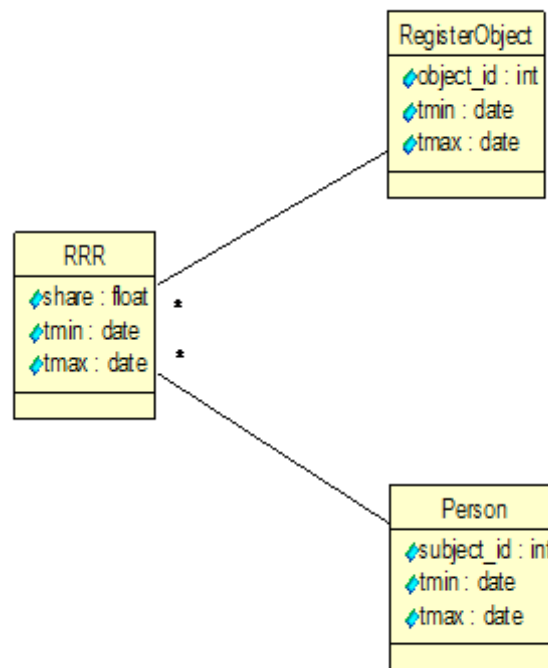


Figure 2: UML class diagram of CCDM: (Adapted from [13]; [18]; and [2])

5.4. Malaysia Cadastral Database

The arrival of computer and the rapid development of Information Communication Technology (ICT) has resulted widespread technological reforms in the field of cadastral system and in line with the government objective of providing efficient and quality land administration services to the public. Realising the importance and potential of this new technology, DSMM and PTG had initiated their computerisation programme in the early 1980's and 1990's respectively. The most significant change that ICT has brought about is that the shift from conventional analogue data to digital data and consequently the introduction of the concept of digital database which forms the base component of a Land Information System (LIS) which in turn has been identified as having an indispensable role in the process of

decision making in resource management and planning. For example, PTG has computerised two of its main operations in land administration named Computerised Land Registration System (CLRS) and Land Revenue Collection System (LRCS) to cater the land registration and revenue collection activities. On the other hand, DSMM has implemented a data collection and processing facility named Cadastral Data Management System (CDMS) for cadastral activity, the Computer Assisted Topographic Mapping (CATMAPS) for mapping activity and also the Automated District Survey Office System (ADSS) for district survey office activity, and then both CLRS and CDMS enabled the process of land registration and measurement of ownership to be accelerated [2].

The Cadastral Data Management System (CDMS) will provide a network for the survey department to access the DCDB and the digital image library from any personal computer within the network, with a single window and single point of access. DCDB holds digital cadastral base maps that are used for building up GIS and land related applications, while the image library holds scanned and indexed certified plans stored in the disk arrays at every state survey departments. CDMS is also capable of receiving orders from clients through remote access, e-mail, dial-up and other things as well as providing an automatic invoicing, billing and accounting system and it also cater for remote access to and from the District Survey offices (JUD). A system which forms part of the CDMS that is Quality Assurance System (SPEK) is a module to preserve the integrity, and accuracy of the DCDB.

With the implementation of the CLRS, a system to modernise and to facilitate the registration of land title and dealings, data are extracted from both the documents of title and other land related documents. Meanwhile, the information in the CLRS database are based on the records kept in the land registers and relevant files with include information on ownership (Person), land identification (Register Object), restriction (RRR) and record of dealings. As mentioned by [2], the register furnishes all information pertaining to the ownership (person), the land (object, through description of area and location and boundary limits from the Certified Plan and rights (details of encumbrance, expressed conditions, caveats and prohibitory orders and other things). However, not all restrictions are stated in the register, some are implied by law for example National Land Code 1965 (Act 56), planning control and so on.

5.5. 3D Cadastre Registration Development in Malaysia

The development of 3D Cadastre registration are more on technical part where researchers study on the process of adding 3D Cadastre objects in the current cadastre data model and information accessible among DSMM, PTG and PTD, unfortunately the two state database which are DCDB and CLRS database works separately in different authorities

and still in 2D situation. As mentioned in this research previously, Malaysia land administration are based on the Torrens system where Cadastral Map and legal document with spatial and textual information as a legal evident under the rules and regulations are needed in order to have fully institutional coordination. Therefore, a good institutional is very important, so as to achieve an excellent and wonderful cadastre registration system. However, due to too many historical constrains, it seems quite difficult to realise this unless with fully cooperation from various legislative agencies, technical agencies, organisations and other land related government and private sector as well. Recently, the 3D Cadastre proposed registration model focused on the combination of these two different databases mentioned above and these two cadastre registration databases namely the legal rights land attributes and the spatial objects geo-data. These three authorities, DSMM, PTG and PTD that are mentioned above are the main government agencies that responsible for the cadastre registration system where they will integrate and coordinate each other, in order to have an integrated and fully cadastral system in Malaysia using the 2D/3D hybrid cadastre approach [13].

The 3D Cadastre objects such as strata building, construction on, above and below the ground surface, i.e. underground tunnel, metro station, skywalk and other things is a real property object that being built on the 2D land parcel, which are the responsible by PTG, PTD and DSMM on the ownership registration and object registration respectively. Apart from this 2D land parcel, there is also a 3D land parcel, which is similar to 3D physical object based on the hybrid solution by [13], together form from the Register Object, where the 2D land parcel is represented as a 2D geometry while 3D land parcel is form with 2D geometry and 3D information. Furthermore, the 2D land parcel is inherited from the current registration system that is the cadastral lot that consists of boundary lines and boundary marks. On the other hand, 3D land parcel is projected with the 3D bounded space that consists of face, node and vertex with list of coordinates that form flat faces and forming of 3D objects which so-called 3D Cadastre object later.

To sum up, 3D Cadastre registration is a combination of land registration with 2D and 3D land parcel of cadastral registration. There are combination of legal rights of land attributes, 2D cadastral objects and 3D information. The combination of this concept data model can be shown in Figure 3.

between PTG and DSMM.

With the vast changing in the ICT, such as GIS, internet and web based application and together with the initiative of Malaysian Geospatial Data Infrastructure (MyGDI) National Spatial Data Infrastructure (NSDI), e-Tanah of Ministry of Natural Resources and Environment (NRE) and e-Cadastre, Electronic Strata Module of DSMM, CLRS and CDMS database could be integrated electronically. In order to achieve the goal of comprehensive Land Information System from district level up to state and eventually at the national level, the integration of spatial CDMS database with the textual CLRS database play a preliminary requirement of all these. Moreover, [8] introduced a mechanism to integrate these two standalone databases. Coordination among DSMM, PTG and PTD can be provided by the installation of centralised server or distributed server at each of their office which act as the transporters and bridges in exchanging data between CLRS and CDMS. Figure 4 illustrates the conceptual integration of cadastral survey and title registration databases. Although there are a lot of benefits from an integrated textual title registration database and the graphic as well as spatial cadastral database, but there are still many hurdles to solve at this stage.

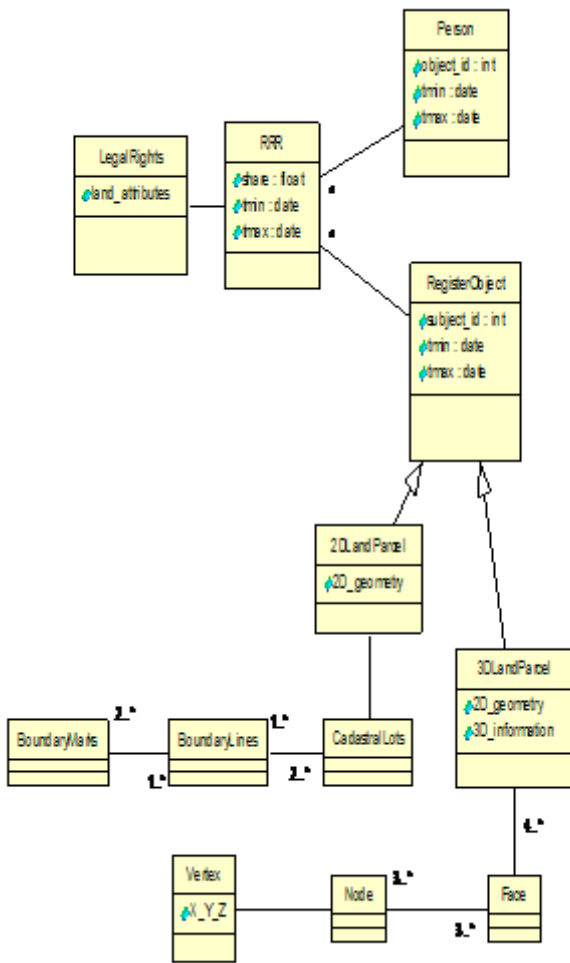


Figure 3: UML class diagram of 3D cadastre registration concept data model (Adapted from [1])

5.6. Integration of Computerised Land Registration System (CLRS) and Cadastral Data Management System CDMS)

There could be extensive benefits if these two systems, which are CLRS of PTG and CDMS of DSMM, are linked together. For that reason, a pilot project being started in Kuala Lumpur in 1st April 1995 to electronically connect and integrate the CLRS with the CDMS for the whole Kuala Lumpur then to develop the operational systems that can subsequently be implemented throughout the country in Peninsular Malaysia. Therefore, with the integration of attribute data from CLRS and spatial data from CDMS and through identified application, efficiency of land administration can be greatly improved. [9] stated that the envisaged applications include on-line registration for survey and preparation of title, extending DCDB enquiry module to the land administrators and on the hand, linking the Qualified Title (QT) information to the DCDB. Although conceptually tenable, the eventual implementation would need substantial negotiation and compromising in

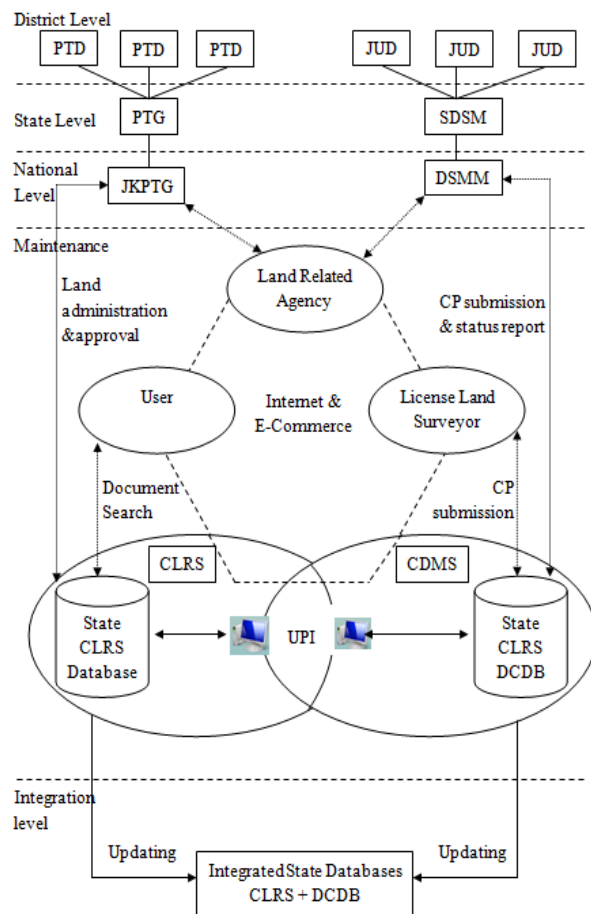


Figure 4: Conceptual model to integrate CLRS and DCDB (Partly adapted from [9])

6. CONCLUSIONS

In Malaysia, the main thing that hinders the progress has been the national legal system because there are no provisions and there is a lack of proper Malaysia cadastre law to cater for the registration of legal and organisational aspects for 3D property in full 3D Cadastre as described by [13]. Therefore, the legal profession is always very conservative because they are attached to the old and traditional land registry law and legal changes generally take quite a long time to change.

Malaysia adopts a title registration system where the register contain information about the proprietor, encumbrances, express conditions, implied conditions, restrictions in interest, caveats and prohibited orders if any. However, not all imposed conditions and restrictions are stated clearly in the register as there are some that are provided by law and have to be complied by the proprietor. Meanwhile, the land register can be considered as the pillar of the record machinery in the Malaysian Registration System. The hardcopy land registry is now replaced by computerised land registry which enables the proprietor to transfer, lease and change the land or grant rights of easement.

The rights associated with this registration would be clear in the registry titles issued as well as that provided for under legislation. For example, Strata Title Act 1985 (Act 318) [8] allows land to be subdivided into parcels or land parcels based on the area occupied. Besides that in National Land Code 1965 (Act 56) [7], air space is permitted up to a maximum of 21 years only, and there are still a lot of arguments about the surface under different categories of land use, subdivision, partition, amalgamation as well, because all these are still in 2D nature. However, these arguments would clearly be different if they are used in the case of 3D property alienation, although the mode of registration being quite similar. It is important to note the fact that there is provision of volumetric parcel alienation, in particular for underground land alienation under the said legislation.

Different government department and agencies under different authorities are involving for the cadastral system and land registration in Malaysia and there is a need of effective institutional arrangement for the registration of 3D real estate properties and improvement of the legal and organisational arrangement.

Research on 3D cadastre have been carried out in several countries like in the Netherlands, Norway, Sweden, Denmark, Finland, Canada, Australia, Israel, Turkey and Greece, even some of these countries such as the Netherlands, Sweden and Norway had implemented law for 3D cadastre but most of these works are still not operational and still needs a lot of research efforts (Hassan, Abdul-Rahman and Stoter, 2006) in legal and organisational

aspects before it could be fully implemented and realized in Malaysian law of cadastre.

This paper is part of the research on developing Malaysian 3D Cadastral System. As mentioned earlier, besides this technical aspect, legal and organisational aspects also play an essential role and cannot be ignore or separated from the 3D cadastre main body, therefore, all of these aspects should work together and concurrently. In short, this paper can be an initial start for research on the legal and organisational aspects for developing Malaysian 3D Cadastral System.

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