



Solutions for Vietnam Affordable Housing Database Management

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Abstract: Affordable housing database management has become a social concern that requires urgent actions in the context of rapid urbanization, particularly in urban areas. This discussion paper applies literature review, analysis and consolidation as well as modelling approach to identify outstanding issues in affordable housing management in Vietnam nowadays. Based on such findings, the document proposes a solution to collect and develop the sector database to facilitate future management. It suggests data categories, structure, model and procedures to update, manage and exploit Vietnam's affordable housing management database. The pilot software of the proposed model was formulated based on the application of web-based system technologies such as Web API, OSM (OpenStreetMap), REST (REpresentational State Transfer), SOAP (Simple Object Access Protocol).

Keywords: Affordable housing, database, management

1. Introduction

1.1 Background

Internet infrastructure and web-based IT system development are the way forward for socio-economic development of every country in the context of knowledge economy. Resolution No. 13-NQ/TW dated January 6, 2012 of the 4th congress of the XI Central Committee of the Communist Party of Vietnam on developing comprehensive infrastructure system for a modern and industrialized Vietnam in 2020 provides orientations for the national information infrastructure development, including the formulation of database for affordable housing management and development (N. V. Tuyen, 2019).

Ministry of Construction is assigned by the Government of Vietnam to take lead role in managing the information system of affordable housing projects, for which Department of Housing and Real Estate Management is working on its behalf. Ministry of Construction is responsible for consolidating the information of affordable housing projects and reporting to the Government of Vietnam. Its provincial departments directly manage affordable housing projects in each province/ state-run city, consolidate and report in writing to the Ministry of Construction. Shortfalls are still visible in the management of such information system in Vietnam. Information of affordable housing projects from provinces have not been reported properly to the Ministry of Construction. The reported information is not accurate and mainly aims to complete the required tasks. This fact leads to the incorrect and inconsistent information received by the Ministry of

Construction, which hinders their consolidation and reporting to the Government of Vietnam. In the province, the public can only access to affordable housing information through advisements of apartment leasing or sales. Information of related projects and statistic data on apartment rental/purchase is not made public by the Owners, causing difficulties for the local residents in their pursuit of apartment rental/purchase. Meanwhile this study reveals the fact that managing apartment lessees/purchasers in province is a difficult task. For example, a number of owners of affordable apartments in An Trung 2 project are not eligible (Tan Viet, 2019b), violations were found in the approval of affordable housing management in Nesthome and Vicoland residential buildings (Tan Viet, 2019a), some apartment owners of Hope Residences project advertised their property for sales right after the purchase (Bao Viet Securities Homepage, 2020), or one person owns various affordable apartments (Tran, 2019). The local authorities have not been able to adequately manage the rental/purchase transactions of affordable apartments. The study team highlights the importance of developing a consistent management of affordable housing information system in the sector from Ministry of Construction to local level which should be updated regularly and open to the public.

It is vital to develop affordable housing management database to facilitate the systematic management of all levels, from the Government of Vietnam to Ministry of Construction and local authorities. Such database will promote transparent information of affordable housing projects, convenient access to affordable apartment information of the public as well as regular updates and accurate consolidation of information.

1.2 Objectives of the Study

This study proposes to develop an affordable housing management database system to support such sector management as well as to contribute to fulfill an e-Government.

The study's specific objectives are to (i) develop a suitable affordable housing information management model that adapts to Vietnam conditions, (ii) formulate a database for affordable housing management, (iii) set up a procedure for affordable housing data update and approval, and (iv) establish data process procedure for affordable housing management.

2. Methodology

Approach: The study applies inter-sectoral management approach. It consolidates and analyses information and relevant documents on current status of affordable housing database in Vietnam to determine the outstanding issues of affordable housing database system. From these findings, the study proposes recommendations to develop an affordable housing management database system suitable to Vietnam conditions, taking into consideration of the management trends in the world.

Methodology:

- Desk review: This discussion paper has reviewed documents on affordable housing database management in the world for lessons learned and knowledge about its development trends. It also reviewed studies and relevant documents on affordable housing information system management in Vietnam to identify issues that require actions.
- Charting method: The discussion paper applies the charting method to illustrate the affordable housing information management procedures.
- Analysis, design and development of database management software: The study selects a number of suitable technologies to develop the affordable housing database management software. These technologies meet the requirements of low costs, easy operation and convenient transfer in practice.
- Experiment and operation: This discussion paper develops a pilot software to verify the proposed model, database system and management activities. The pros and cons of the proposed solutions are identified thanks to the application of this software.

3. Affordable Housing Management Database Systems in the World

Affordable housing projects "was introduced in UK, USA and Canada in 1970s and later applied in other countries such as Japan and South Korea" (The National Assembly, 2013). The system structure, data formulation, management and usage of affordable housing database vary from country to country. It is necessary to analyze their experiences for valuable lessons learnt and successful development of affordable housing database in Vietnam. Below are examples of the database system development in the world.

3.1 USA

A number of organizations have developed their own affordable housing database systems in USA, including Council for Affordable and Rural Housing, National Affordable Housing Management Association, ApartmentSmart, Low-Income Housing Tax Credits, Public and Affordable Housing Research Corporation, National Low Income Housing Coalition, Housing Authority Insurance Group, etc.

We analyze one of these systems as below:

Database system: Affordable housing database system including houses owned by local authorities and housing documentation managed by local authorities (this documentation allows families to rent private apartments).

Database management agency: local authorities are responsible for managing, collecting and reporting on public housing database.

Type of collected data: data are constantly updated on its physical features (quantity, identification number, status, etc.) and residents (number of apartment residents, age, income, etc.)

Database establishment and operation: the federal government established protocols which allows automatic report from local authorities. Due to the size and privacy of the data, only operating agency can access to individual profile, the public can access to brief summary reports which are referred to "Picture of Subsidized Housing" (The U.S. Department of Housing and Urban Development, 2018).

3.2 South Korea

Database system: affordable housing database system is part of the national housing and land data system in South Korea. This spatial big data include National Spatial Data Infrastructure, Korea Land Information System, Real Estate Management system, Land and Housing Information System, Urban Planning Information System, Architectural Information Services, etc. (Junyoung, H, Jaeseong, & Jungik, 2015).

Database management agency: The Government manages through individual codes.

Type of collected data: Local governments collect data of affordable housing projects upon receiving requests to update the housing database.

3.3 China

Database: China has developed an efficient housing and real estate database system which operates based on SuperMap. The system can be structured into two components: Client/Server and Browser/Server. All data can be stored in this database and can be connected to the Client/Server through the application server or to the Browser/Server and GIS through an intermediate server. The system's key functions are integrating all transactions; GIS, MIS, OA and CAD; data; internal management and external services (Huong & Huong, 2018).

Data management agency: Hangzhou Department of Real Estate.

Type of collected data: maps, files and documents related to the city's real estates, including affordable housing data.

Database establishment: by applying Unmanned Aerial Vehicle, picture, data processing software, GIS software, etc.

System management/operation: This database system is established to meet the needs of managing real estate market, affordable housing subsidy candidates, reallocation, assets, housing rehabilitation and housing degrading prevention policies, housing appraisal, housing mapping and survey, etc. It applies OA technology to process workflows and procedures when there is a change in the real estates. It benefits professional activities such as registration and transaction, verification and approval, result issuance, configuration query, statistical analysis, etc. (Qian, 2013)

4. Status of Affordable Housing Information System Management in Vietnam

4.1 Affordable Housing Information System Management at Ministry of Construction

Affordable housing is defined as "government-assisted houses for beneficiaries of housing supporting policies that are regulated in the Law on housing" (The National Assembly, 2014). Ten groups of people are eligible for affordable housing policies, including "low-income people, poor and near-poor households in urban areas"(Government of Vietnam, 2015). A household can apply for renting, purchasing or rent-purchase of the affordable housing if at least one of its family members meets the requirements mentioned above. Affordable housing is delivered in a real estate development project, however it is the "special project" (P. D. Tuyen, 2019) targeting the huge demands of those who cannot afford to buy/rent the housing on market price or build their own houses. Affordable housing development programs contribute to ensure social equality and the "right to have legal accommodation"(Da Nang city Department of Construction, 2017) of every citizen. Those who rent-purchase or purchase affordable housing "must not mortgage and transfer housing in any form in at least five years after the final settlement of renting fee or instalment that is regulated in the signed contract with the seller" (Da Nang city Department of Construction, 2017). In contrast, houses for low-income people is a commercial product where "the buyers have ownership as per prevailing regulations" (Hoa & Ha, 2012). Since a transparent and consistent affordable housing database has yet been established, the management of affordable housing information system has not demonstrated its meaning at proper level.

The Housing and Real Estate Market Development Department of the Ministry of Construction is directly managing the affordable housing information system in Vietnam. The Department is tasked to "coordinate with the General Statistics Office under the Ministry of Planning and Investment to develop criteria for housing surveys and statistics; organize and implement housing surveys and statistics to provide inputs to the state management of housing; compile

and publish, every five years and annually, national housing data” (Ministry of Construction, 2013) and “develop, operate and manage databases and information systems on housing, offices and real estate market nationwide; provide guidance on development and management of the database on housing, offices and the real estate market in provinces” (Ministry of Construction, 2013).

The affordable housing project information system of the Ministry of Construction is based on reports delivered by its departments across the country. The reports provide information on the number of buildings and apartments under two categories: “being used” and “under construction” (Da Nang city Department of Construction, 2017).

Information on affordable housing managed by the Department is prepared as Excel and Word files, then reported to the leaders of the Ministry and the Government or included in official letters to provinces/cities in the country. Affordable housing information managed by Department of Housing and Real Estate Management includes website of the Department of Housing and Real Estate Management (with “housing and real estate information system” (Ministry of Construction Homepage, 2020)), related legal documents such as decrees, decisions and circulars, projects and programs.

However, this information system is established, operated and managed by the Ministry’s Information Center. This decentralization leads to the shortcomings in the affordable housing database development and management such as difficulties in human resource allocation and technical infrastructure system development, conflicts in information updating (since affordable housing information collection is assigned to the Department of Housing and real estate management, but the Information Center is in charge of updating such information).

4.2 Affordable Housing Information Management at Departments of Construction

Currently, “provincial/municipal Departments of Construction act as the focal point in providing information to interested investors” (N. V. Tuyen, 2019). However, because the management of affordable housing information is scattered across different places and there is no official web page on approved affordable housing projects and investment projects, it is impossible to provide people in the province and neighboring areas, as well as domestic and foreign investors with sufficient and accurate information. On the other hand, the management and provision of affordable housing information, construction investment information in the locality and in many other provinces nationwide remain manual and inadequate. This fact explains the limited and inefficient promotion of investment into affordable housing.

The provincial authorities are still capable of managing and providing information since the number of planning projects and information requests is humble. However, it is expected to fall short of the actual requirements from investors in the next period. The articulation of information among the pool of investors in Hanoi remains weak and inaccurate (Hanoi Department of Construction, 2017). If manual information synthesis continues as current practice, it is difficult to produce accurate and quick results. Above all, when there are changes in information from investors due to changes in the implementation process, it will be a challenge to update as well as to ensure the information consistency and accuracy. In particular, the current manual practice hinders government authorities in Hanoi and other cities in the country from documenting the planning implementation results and updating information. Therefore, though the current information management practice still meets the current demands, it is not able to satisfy future needs.

Information technology has been applied to the management of affordable housing information in provinces/cities, but only in the form of result announcement webpages. Information on affordable housing is mainly taken stock and edited in paper-based formats, i.e., information at provincial Departments of Construction is consolidated and presented in Excel and Word files, then reported to the Housing and Real Estate Market Management Agency under the Ministry of Construction in form of official letters and published on the website which is administered by the Department.

4.3 Provision of Affordable Housing Information to Residential Communities

Information is published on bulletin boards in apartment buildings in the form of legal documents such as announcements, official letters, decisions, etc. Field surveys of affordable housing projects in provinces/cities are published at bulletin boards at apartments’ entrance or main halls, at project management company or at the sites. Information on affordable housing refers to regulations on home renting/purchase, renting and purchasing mechanisms, financial policies for home purchase, house information, etc.

However, bulletin boards in apartment building are usually restricted to the news related to such apartment building. Therefore, people wishing to buy affordable housing are now seeking for information on websites (general websites about affordable housing or project web pages of real estate development and investment companies), referrals from friends and family members, or information from real estate brokerage agencies, etc.

Websites mainly provides general information of the projects such as: project name, developer, location, planned area, total investment, project size, number of floors, planned population size, construction density, guarantee bank and construction stages; purchase conditions; purchase dossiers and procedures; purchasing process; contact information. This information is provided by developers or real estate companies without verification or control. A lot of deviations exist between the actual housing and the web page, undermining the trust of home buyers.

General comments: Affordable housing information is provided with very different contents, in various forms and managed by different agencies. Therefore, a great deal of published information has not been verified and managed in a unified manner. Much out-of-date information is posted on the bulletin boards or published on websites.

There are some reasons behind this fact such as no systematic databases have been developed for use by construction authorities, real estate businesses and housing management companies; information does not meet the demand of management agencies, businesses and residential communities since it is not constantly updated; information is not provided to residential communities due to restrictions on information disclosure of authorities and enterprises.

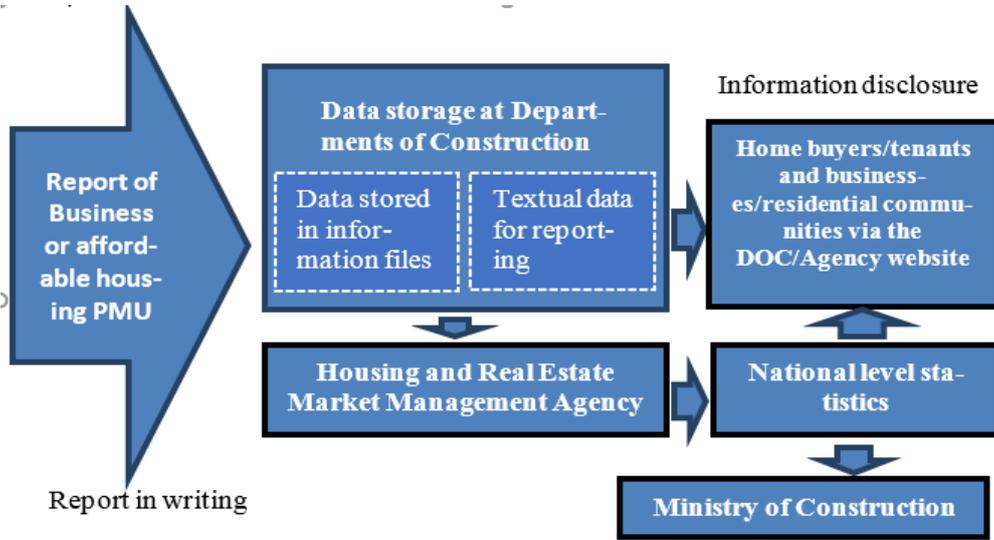


Fig. 1 - Current management of affordable housing information in Vietnam

5. Technology Selection

The system applies open source technologies to develop the data system following “Decision No. 235/2004/QĐ-TTg on application of open source software” (N. V. Tuyen, 2019). Its aims to ensure the convenient synchronization with other available servers of the Government of Vietnam as well as to support global integration efforts. Priorities were given to the studies and applications of the most popular open-source technologies to address the needs for efficient management of affordable housing while taking advantages of these technologies to develop practical and suitable solutions.

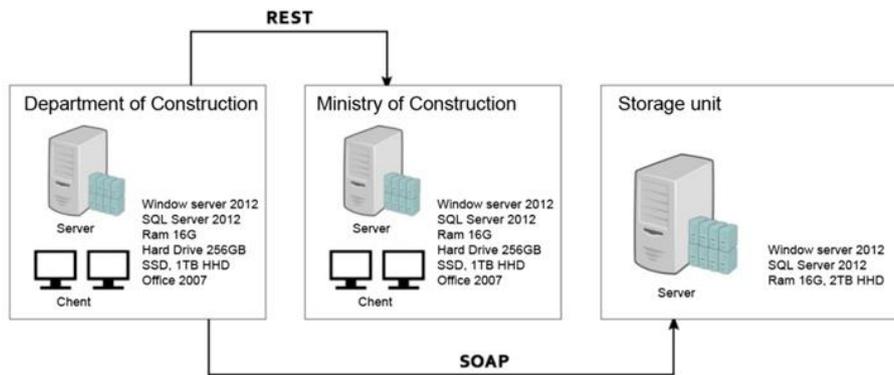


Fig. 2 - Digital protocol model of the system

Figure 2 presents the overall infrastructure of the affordable housing management information system where REpresentational State Transfer (REST) is engaged to establish the interactions between different computers (private computers and server of the portal) which shall formulate the data exchange system between data updating partners in a bottom-up hierarchy (i.e., from Departments to Ministry). Figure 3 illustrates the REST structure.

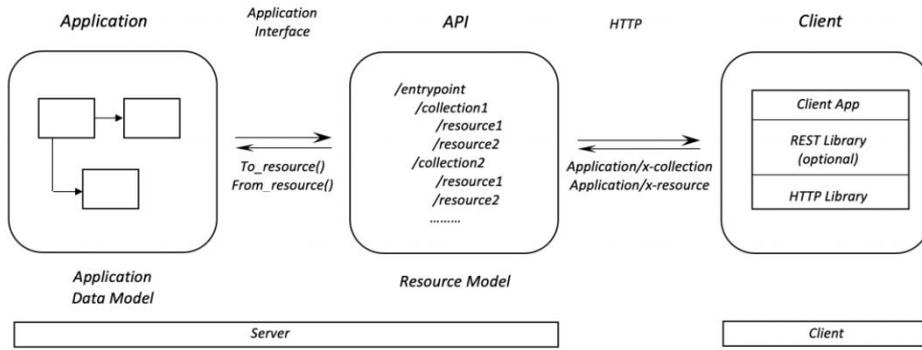


Fig. 3 - REST structure (N. V. Tuyen, 2019)

Simple Object Access Protocol (SOAP) helps to define document data via HTTP and transmits data through Webservice. SOAP provides simple interactions via proxy and firewalls which take advantages of data transmission. SOAP is strong in supporting programming languages in Java and .NET. Confidentiality and authenticity are ensured in SOAP.

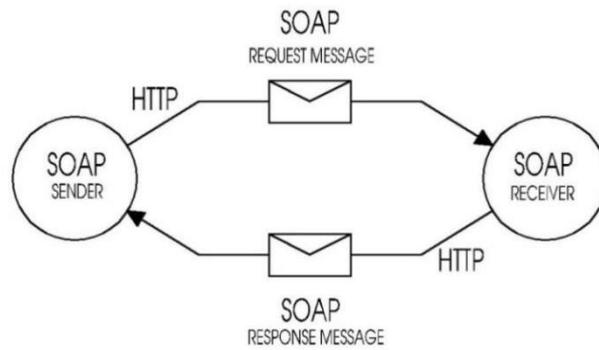


Fig. 4 - SOAP structure (N. V. Tuyen, 2019)

Web Application Programming Interface (WebAPI) is mobilized to retrieve data from server as well as to connect to other libraries and applications. WebAPI supports the development of scenarios –script for connecting to an external API server, this data will be converted to HTTP format and displayed on the website without requiring entries to these servers.

Visualizing project and apartment locations on the map is a significant function of the system. The authors decide to apply the OpenStreetMap (OSM) technology to display and process activities on the map; OSM allows storing online maps in vector format, and internet users can create, share and update information of the map every day in different formats free of charge.

The system development follows Model View Control (MVC) framework and applies C# programming language based on ASP.NET technology – an advanced and efficient technology that is constantly updated by Microsoft. Websites that are programmed on ASP.NET operate smoothly and stably with better downloading speed than other programming languages, thus bring about more comfort to the users and gain their confidence. Loading speed of ASP.NET has been highly appreciated by professional experts, even in comparison with PHP and JS. ASP.NET has good capacities to customize, adjust and expand which facilitate the compatibility of the website to various selection of screen sizes and devices. It also allows automatic HTML code generation for the efficient operation of the website on any browser.

The project applies SQL Server to store and exploit affordable housing project data. SQL Server is a Relational Database Management System that uses Transact-SQL to enable the data exchange between the client’s device and SQL Server. SQL Server is optimized to ensure good operation in huge data environment (Tera-Byte) and serve thousands of users simultaneously.

6. Proposed Affordable Housing Database Management Model

6.1 Open Model for Affordable Housing Database Management

This discussion paper suggests applying an open model for the affordable housing database management which is adapted to the practice in Vietnam. The database development applies a “conical” approach, i.e., the data is updated according to the progress. The data is taken from enterprises/ client with reference to the Ministry and provincial department during the database development. Local residents are the target users and evaluators of the service.

Advantages: The data is comprehensively updated; Socialization of public services is promoted; The relationship between central and local authorities are shifting toward decentralization with more authorization given to local level; Decentralization and authorization in management activities are encouraged; The administrative organizational structure is working on demand basis; Innovative government staffing mechanism is promoted; Public and enterprise engagement is strengthened.

Disadvantages: A comprehensive and consistent technological infrastructure is required.

6.2 Affordable Housing Management Data Model

The structure of the affordable housing data includes: Project code, total area, total investment cost, the number of apartments, location, status, attached portfolio (plan dossier, drawings, etc.)

Table 1 - Structure of affordable housing datasheet

No.	Data	Field name	Type of data (format)
1	Project code	<i>DuAnID</i>	Varchar
2	Project Title	<i>TenDuAn</i>	Nvarchar
3	Investor	<i>ChuDauTuID</i>	Int
4	Consultant	<i>TuVanThieKeID</i>	Int
5	Funding source	<i>LoaiVonDauTu</i>	Int
6	Total investment cost	<i>TongVonDauTu</i>	Decimal
7	Total area	<i>TongDienTich</i>	Decimal
8	Number of buildings	<i>TongSoToaNha</i>	Int
9	Number of apartments	<i>TongSoCanHo</i>	Int
10	Lot area	<i>DienTichODat</i>	Decimal
11	Construction scale	<i>QuyMoXayDung</i>	Nvarchar
12	Location	<i>MoTaViTri</i>	Nvarchar
13	Description	<i>MoTaDuAn</i>	Nvarchar
14	Status (completed/ incompleted)	<i>TrangThai</i>	Int
15	Year of construction start	<i>NamXayDung</i>	DateTime
16	Year of construction completion	<i>NamHoanThanh</i>	DateTime
17	Project dossier		Attachment
a	Plan dossier		
	Layout and boundaries		JPEG/PDF
	Spatial, architectural and landscaping maps		JPEG/PDF
	Planned land use area maps		JPEG/PDF
	Drawings of underground work area locations		JPEG/PDF
	Technical and environmental infrastructure systems maps		JPEG/PDF
b	Construction drawings		
	Total area		JPEG/PDF
	Overall landscape		JPEG/PDF
	Layout of facility in the project area		JPEG/PDF
	Layouts		JPEG/PDF
	Elevation plans		JPEG/PDF
	Cross sections		JPEG/PDF
	Interior/ exterior landscapes		JPEG/PDF
...			

The structure of apartment data includes: Apartment number, area, leasing/selling rate, direction of main door, floor number, status (leased/ purchased/ available for lease), direction of the balcony, ownership-owner information.

Table 2 - Affordable apartment datasheet structure

No.	Data	Field name	Data style (format)
1	Apartment number	<i>MaCanHo</i>	Nvarchar
2	Building	<i>ToaNha</i>	Nvarchar
3	Floor number	<i>TangSo</i>	Nvarchar
4	Total area	<i>Area</i>	Decimal
5	Direction of main door	<i>HuongCuaChinh</i>	Nvarchar
6	Direction of balcony	<i>HuongBanCong</i>	Nvarchar
7	Selling rate (/m2)	<i>DonGia</i>	Decimal
8	Leasing rate (/m2)	<i>DonGiaThue</i>	Decimal
9	Detail information	<i>ThongTinChiTiet</i>	Nvarchar
10	Ownership (Yes/No)	<i>DaCoChuSoHuu</i>	Bit
11	Owner's information	<i>ThonTinChuSoHuu</i>	Nvarchar
12	Handover time	<i>ThoiGianBanGiao</i>	Date
13	Leasing period (month)	<i>ThoiGianThue</i>	Int

The structure of the affordable housing registration dossier data includes Dossier code, name of the purchaser, ID number, permanent resident address, targeted apartment number, project title, eligibility for purchasing affordable house (income level, marriage status, housing status).

Table 3 - Structure of the affordable housing registration dossier datasheet

No.	Data name	Field name	Type of data (format)
1	ID number	<i>SoCMTND</i>	Nvarchar
2	Name of the purchaser	<i>NgnoiDangKy</i>	Nvarchar
3	Registration date	<i>NgayDangKy</i>	Date
4	Targeted apartment number	<i>CanHoID</i>	Varchar
5	Project	<i>DuAnID</i>	Varchar
6	ID issued by	<i>NoiCap</i>	Nvarchar
7	Date of ID issuance	<i>NgayCap</i>	Date
8	Permanent Residential Address	<i>DiaChi</i>	Nvarchar
9	Income status	<i>TinhTrangThuNhap</i>	JPEG/PDF
10	Marriage status	<i>TinhTrangHonNhan</i>	JPEG/PDF
11	Housing status	<i>TinhTrangNhaO</i>	JPEG/PDF
...			

6.3 Database Model

Affordable housing database model is structured on relationship basis. This database includes 47 datasheets which are composed by approximately 600 data fields. Table 2 below presents the structures of the main datasheets such as apartment, residents, affordable housing datasheet which regulates the data information, etc.

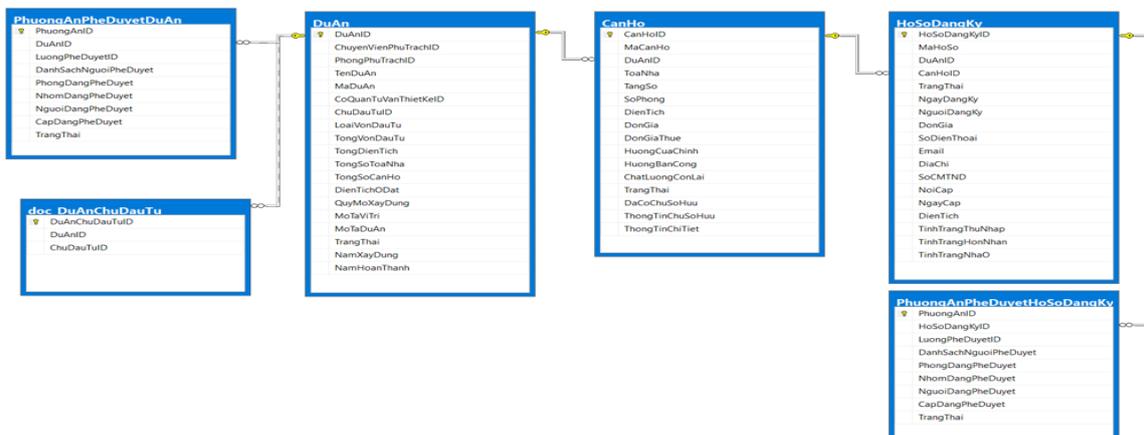


Fig. 5 - Brief affordable housing database model

6.4 Professional Procedures to Develop, Manage and Exploit Affordable Housing Information

The writers propose to apply a set of six steps to manage affordable housing projects so as to support the work of related stakeholders from ministry’s staff to local residents. Figure 6 illustrates these professional procedures.

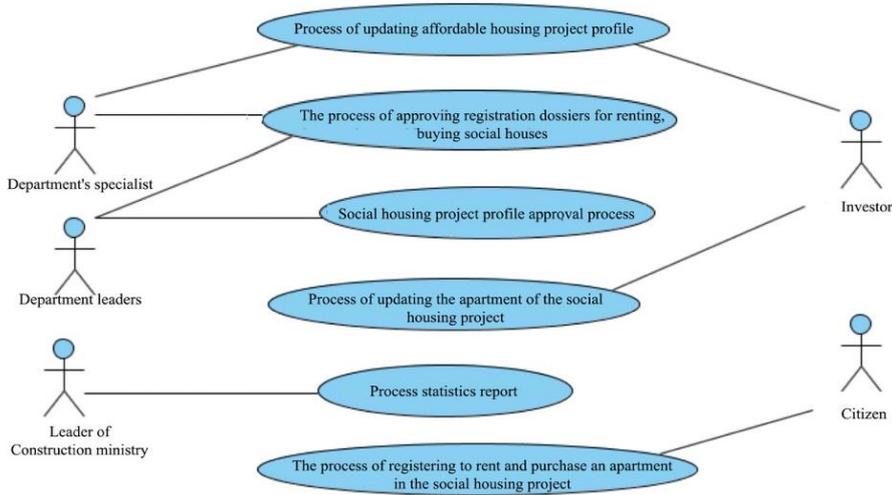


Fig. 6 - Professional procedures to manage and develop affordable housing projects

Professional procedures to develop affordable housing data: Only two government agencies are authorized to manage the system data, namely provincial Departments of Construction and Ministry of Construction, to ensure the ownership, accuracy, legacy and safety of the data.

The overall structure of the affordable housing development and management database includes: Provincial affordable housing data (Technical infrastructure, applications, human resources, investment and programs/projects, service provider system, type of IT service and industry), IT resource management and exploitation program (management and exploitation of related IT resources at provincial departments, agencies and local authorities in the province/city) and Information management system.

System architecture: The affordable housing development and management database system is composed of two main components, namely data integration and portal. The Ministry of Construction is responsible for integrating all collected information. The portal provides supporting services to management activities.

Departments of Construction are responsible for updating dossiers by monitoring the development of new projects by the Investor; updating information of ongoing, undergoing or planned projects; submitting to Division Head/ Director of Department for approval of the information; entering the information into the system; developing statistic tables for reporting to the Ministry of Construction (with name of the province, the number of the projects which are implemented, undergoing or planned, number of available apartments, planned number of apartment for the upcoming year) as well as for internal report (consolidated project information on quarterly basis).

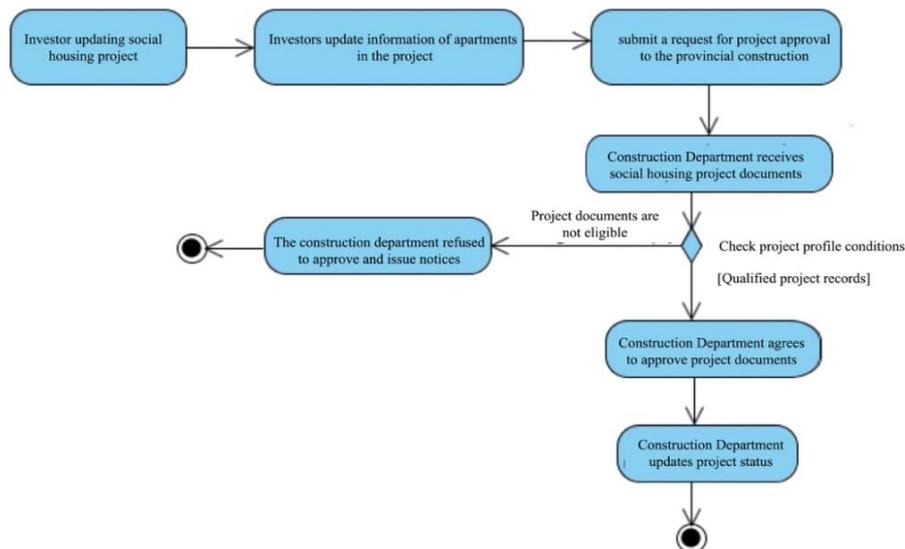


Fig. 7 - Procedure to update affordable housing project dossiers

Enterprise is responsible for updating the status of project apartment; receiving automatically emails from the server for their evaluation once every six months on the quality of the facility, environmental conditions and management activities; sending responses to the system; entering the information into the system. Then the system automatically reports the project quality.

Management and extraction of affordable housing information by the Housing and Real Estate Market Management Agency (Ministry of Construction), Departments of Construction and enterprises: The extraction of information is done by security software with clearly decentralized access rights, details as below.

Ministry of Construction: The Ministry of Construction is entitled to extract all information of the Database System for the management, administration and implementation of the Strategy and Program on Affordable Housing Development and Management. The Ministry can access the site by entering its code to perform the following operations: check project information systems of provinces; check apartment information systems of provinces; check the feedback of residential communities in provinces. The Ministry of Construction uses this information to prepare reports to the Government for management purposes.

Departments of Construction: Departments of Construction are entitled to extract relevant information for the implementation of local affordable housing development programs (plans). They can access the site by entering their codes to undertake the following operations: taking stock of new policies; taking stock of the information related to their province; aggregating assessments delivered by local people/businesses; submitting to the manager for approval and sign-off; printing and publishing consolidated reports and statistics.

Businesses, households and individuals: Businesses, households and individuals may extract information that is permitted by competent agencies for their investments in construction of affordable housing projects, fulfilling their rights and responsibilities in renting and buying affordable houses and building houses by themselves. Enterprises, households and individuals perform the following operations: access to the general information page; searching for projects; submitting registration documents for apartment purchase/renting; sending e-request for documents and making appointments to submit hard copies for comparison; requesting for application approval from department head/Director of Department; sending email to notify about successful approval documents and making appointment for completion of renting/purchase contract; confirming payment; and hand-over of the apartment.

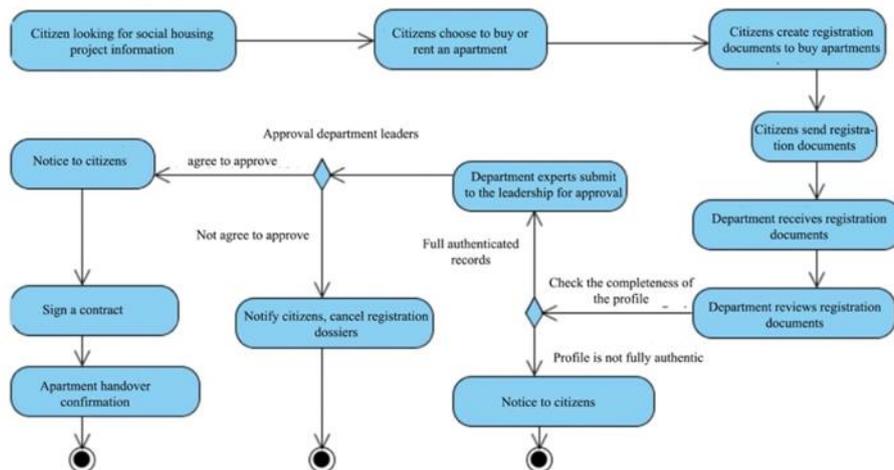


Fig. 8 - Registration and approval for application documents to buy affordable housing apartments

7. Conclusion

It is a pressing need to conduct research on the development of affordable housing database system to facilitate the digital transformation process in Vietnam. Such database is an important support tool for the effective management and operations of affordable housing projects.

The management of affordable housing in Vietnam still has many limitations, from data collection, classification to management. Infrastructure system for building a database system at the provincial/municipal level is not complete. Gaps in human resources, overlaps in responsibilities and lack of trainings on specialized technology are witnessed in the sector. In addition, the transfer and use of database management software from the ministry level to department level remains a challenge.

By assessing the development of affordable housing database system in the world and in Vietnam as well as the current status of affordable housing database system in Vietnam, this paper proposes a number of recommendations for developing affordable housing database system as follows:

1. Affordable housing information system data model should include information of affordable housing projects, apartment as well as management data on purchase/lease applications for affordable housing.

2. The open data management model is suitable to Vietnam's development orientations of e-government and the development orientations of the world.
3. Affordable housing development, management and operation procedures: six professional procedures should be applied to manage affordable housing projects from the Department level to the citizen level.
4. Web-based technologies such as Web API, OSM, REST, SOAP should be applied to develop experimental software for the proposed model.

The procedures are proposed based on the consolidation and analysis of information on current status of affordable housing project management activities in Vietnam. Currently, affordable housing information storing and reporting are mainly conducted in manual manner without the support of any system. It should be noted that proposing professional procedures for relevant authority of different level is beyond the scope of this study; therefore, the study team recommends applying the open-source database management system with the participation of agencies involved in the affordable housing management system. The study team focuses on the study's objective of developing an affordable housing database system for all provinces and state-run cities which is technically feasible and suitable to Vietnam conditions to facilitate the direct, accurate and transparent management and exploitation of affordable housing information. This means the proposed procedures cannot cover all potential scenarios of the management and reporting practices.

Within the limitations of a research paper, these recommendations aim to propose procedures for developing a successful model. The applied technologies are experimental and require follow-up research on technology transfer to apply these findings in practice.

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References

- Bao Viet Securities Homepage. (2020). Retrieved August 10, 2020, from <https://bvsc.com.vn/News/2020810/808189/goc-khuat-mua-ban-nha-o-xa-hoi.aspx>
- Da Nang city Department of Construction. (2017). *Report No. 6277/BC-SXD dated July 14, 2017 on the development of residential buildings under the program for affordable housing and dormitories in the city*
- Government of Vietnam. (2015). *Decree No. 100/2015/ND-CP dated October 20, 2015 on affordable housing development and management*
- Hanoi Department of Construction. (2017). *Report on Situation of affordable housing in 2017 and plan to 2020*
- Hoa, N. M., & Ha, M. (2012). Affordable housing - Houses for low-income households. *Vietnam Architect Magazine, 04*, 32-33
- Huong, L. L., & Huong, N. T. V. (2018). Worker housing database: Foundation for creating a national common information system on real estate. *Viet Nam Architectural Magazine, 04*, 53-57
- Junyoung, C., H, K., Jaeseong, A., & Jungik, K. (2015). *FOSS4G for rapidly urbanizing cities and UN sustainable development goals (SDGs); SDG 11 cities and human settlement*. Paper presented at the Seoul, Korea: LH-OSGeo Joint Seminar: Open Source GIS for UN and Developing Countries
- Ministry of Construction. (2013). *Decision 983/QĐ-BXD on defining the functions, duties, powers, and organizational structure of the Housing and Real Estate Market Management Agency*
- Ministry of Construction Homepage. (2020). Retrieved October 26, 2020, from <http://batdongsan.xaydung.gov.vn/>
- Qian, R. (2013). *The application of GIS in the real estate management system*. Paper presented at the Proceedings of the 2012 international conference of modern computer science and applications
- Tan Viet. (2019a). Da Nang also executed a strict investigation on the Nesthome residence. Retrieved August 24, 2019, from <https://plo.vn/bat-dong-san/da-nang-xu-nghiem-vi-pham-ve-xet-duyet-mua-chung-cu-nesthome-854104.html>

Tan Viet. (2019b). Detecting many people buying social housing with the wrong target. Retrieved December 25, 2019, from <https://plo.vn/bat-dong-san/phat-hien-nhieu-nguoi-mua-nha-o-xa-hoi-khong-dung-doi-tuong-879747.html>

The National Assembly. (2013). *Constitution of the Socialist Republic of Vietnam*

The National Assembly. (2014). *Law No. 65/2014/QH13 dated November 25, 2014 on housing*

The U.S. Department of Housing and Urban Development. (2018). Assisted Housing: National and Local. Retrieved March 15, 2018, from <https://www.huduser.gov/portal/datasets/assthsg.html>

Tran, B. (2019). Carefree buying, selling, renting social housing. Retrieved April 19, 2019, from <https://www.giaoduc.edu.vn/vo-tu-mua-ban-cho-thue-nha-o-xa-hoi.htm>

Tuyen, N. V. (2019). *Building the database system for affordable housing development and management (Code: RD06-17)*. Research project of the Ministry of Construction, Hanoi

Tuyen, P. D. (2019). *Research on technological solutions to create models of affordable housing development (Code: RD99-13)*. Research Project of Ministry of Construction