Standardization perspective towards interoperable and sharing of real estate actual price registration data: An Example of Taiwan

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Key words: real estate transaction, actual price registration, open, SDI

SUMMARY

Real estate functions as a vital indicator of a nation's economic progress and fluctuations, with changes in property values reflecting governmental regional planning and societal perceptions of living standards. The management of land has historically been a primary responsibility of cadastral agencies. Recent advancements in digital cadastre have significantly transformed the management of real estate data, particularly through the emergence of geographic information system (GIS) technology. This transformation not only addresses the operational requirements of cadastral agencies but also enhances data sharing with the private sector via open services, thereby fostering policy transparency and digital transformation. In 2012, Taiwan initiated a nation-level mandatory registration program designed to capture actual real estate transaction prices on a governmental platform. This initiative enables effective tracking of real estate trends and variations across different geographic regions. The data collected serves as a reference for economic development and offers valuable insights for private real estate markets. Following the anonymization of personally identifiable information, the registered transaction price data is made publicly accessible through the government's open data platform. The real estate data encompasses a diverse array of asset types, including land, buildings, and parking spaces, which may be involved in various transactions such as sales, purchase, leasing, and pre-sales. Consequently, this data necessitates comprehensive factor consideration related to real estate transactions, including subjects, types, spatial and temporal dimensions, and pricing. This article delineates the development of an application schema and distribution strategies for real estate transaction price registration data, enabling the data to be encoded in an open format based on a standardized structure to ensure interoperability. This framework adheres to the ISO 19100 series of standards, facilitating compatibility with existing land and building data standards. It encompasses various aspects of real estate data and has the potential to support innovative applications, such as identifying transaction hotspots and conducting trend analyses. In the context of advancing national spatial data infrastructure, real estate transaction price registration data can significantly enhance the understanding of regional development conditions, thereby benefiting both governmental policies and private economic activities.

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1. INTRODUCTION

Real estate serves as a crucial barometer of a nation's economic development and variability, with fluctuations in property values indicative of governmental regional planning and societal perceptions regarding living standards. These factors are essential not only for sustaining individual livelihoods but also frequently become central to property purchase and investment strategies. Consequently, variations in the housing market are always a significant concern for governmental housing policy. Factors such as land use planning, infrastructure development, and economic strategy directly impact real estate valuation. To achieve goals such as economic revitalization, high-quality living environments, and the enhancement of public welfare, it is essential for governments to devise effective housing policies (Executive Yuan, 2024).

However, real estate transactions must ultimately conform to market dynamics. In Taiwan, the annual volume of housing transactions has continuously exceeded 300,000, with a consistent upward trajectory in housing prices observed in major cities (Figure1). A comprehensive understanding of actual transactions is essential for effective policy formulation and execution, as it allows the government to assess regional development and provides the private real estate and land development sectors with valuable insights into market dynamics. To enhance transparency in real estate transactions, legislation was enacted mandating the registration of actual prices for all real estate transactions, effective August 1, 2012(MOI, 2018). Subsequently, this registered information was made accessible online from October 16 of the same year (MOI, 2024). This initiative received widespread acclaim across various societal sectors, allowing the public to verify actual transaction prices and thereby reducing risks associated with information asymmetry. In 2020, the legislation was further revised to improve its functionality, e.g., disclose the street address data and better management of pre-sale houses (MOI, 2021).

Over the years, developments based on registration data have extended beyond mere transaction data to facilitate such innovative applications as real estate brokerage, construction, valuation, credit, financial insurance, and academic research. Given the inherent complexities of real estate transactions, which involve location, time, and subject matter (Moralı and Yılmaz, 2022), the adoption of Geographic Information Systems (GIS) to analyze market-influencing factors from a spatio-temporal perspective is evidently beneficial. For instance, Figure 2 presents a map of housing prices generated by private sectors to analyze regional disparities. This methodology can further facilitate the development of price prediction modules utilizing big data analysis and data science technologies, leading to the emergence of GIS-based platform as a prominent trend in the coming years.

Since the 1990s, Taiwan has been advancing the establishment of a national-level information infrastructure based on Geographic Information System. Authorized agencies are encouraged to participate in the establishment, management, and circulation of domain-specific data in order to foster professional specialization and facilitate interdisciplinary collaboration (National Development Council, 2018). Significant advancements have been made in surveying and land registration, including

the completion of cadastral maps, electronic maps, topographic maps, land use zoning, cadastral building property model data, and three-dimensional smart city geographic data, all managed through numerical databases and GIS-based technology. This framework robustly supports the government's digital governance and public service delivery. However, previous developments have not fully integrated real estate transaction data. Considering that public interest in real estate data generally exceeds that in other forms of land information—largely due to commercial interests and private properties owned by individuals—the government is obligated to transparently provide real estate transaction information to both the private sector and the general public, thereby enhancing information transparency and fostering a mutually beneficial relationship among government, industry, and the public.

Figure 1. Trend of housing prices in Taiwan.
(https://www.businessweekly.com.tw/business/blog/17087)

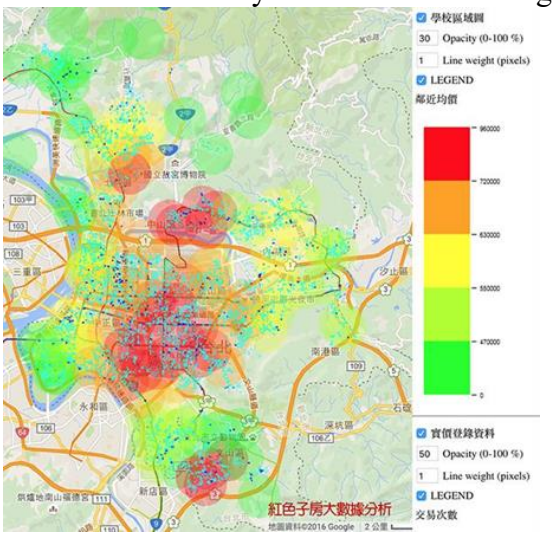

Figure 2. Example of house price maps.
(http://www.gwr.com.tw/Pages/Knowledge/NewsDetail.aspx?ID=332378)

Similar to the efforts of National Spatial Data Infrastructure (NSDI) in many countries (FGDC, 2018; INSPIRE, 2024), the National Geographic Information System (NGIS) in Taiwan seeks to establish a collaborated data-sharing framework that facilitates cross-unit and multi-objective applications. This initiative allows diverse sectors to efficiently leverage data generated by other parties, thereby reducing duplicated investment and fostering collaboration among agencies. The standardization frameworks of the NGIS are based on international geographic information technology standards, such as ISO/TC211 and OGC (Wolfgang and Fadaie, 2013; UN-GIMM, 2018), and are tailored to develop standards and service mechanism to meet interoperability demands. Over the past two decades, more than thirty data content standards have been established. Additionally, government open data platforms

(http://data.gov.tw) have been developed in recent years to encourage agencies to provide business data for free for private value-added use, which also significantly enhances government policy transparency and stimulating private sector growth. The overarching goal is to enable users to query, obtain, and utilize geographic data in a standardized and open manner, transcending the limitations of original design and application.

The core principle of the real estate actual price registration system lies in its ability to deliver comprehensive and transparent information regarding real estate transactions. This system is designed to ensure that the disseminated data accurately reflects the fundamental characteristics of various types of real estate transactions, including pertinent details about buildings, land, parking spaces and associated personal information. The aim of this research is to establish standards for the data pertaining to real estate actual price registration. The design process is aligned with national standard promotion strategies and international GIS standards to create a consensus application schema for this data. Ultimately, the data will be made accessible in an open data format to facilitate the development of national spatial data infrastructure, thereby ensuring interoperability among land, building, and urban-related thematic data within NGIS.

2. CHARACTERISTICS ANALYSIS OF REAL ESTATE TRANSACTION DATA

The existing framework of NGIS already consists of a diverse array of thematic datasets that are related to real estate actual price registration data. These datasets include three-dimensional models of buildings, three-dimensional cadastral building property models, cadastral maps, land use zoning data, and address coding data. In Figure 3, data pertaining to buildings are illustrated in purple, while those related to land are shown in light blue, with maintenance responsibilities allocated among surveying agencies, land administration agencies, and urban planning agencies. Currently, the Level of Detail 1 (LOD1) building model and certain new cadastral building property model data have been developed in a three-dimensional format, whereas data for other standards remain in two-dimensional formats. On the basis of features, real-world objects modeled by various data content standards can be linked through a common identifier, thereby enhancing the efficacy of integrated applications. This suggests that the spatial representation of building data, when integrated with actual price registration data in the future, could be three-dimensional if the links among these datasets can be effectively established.

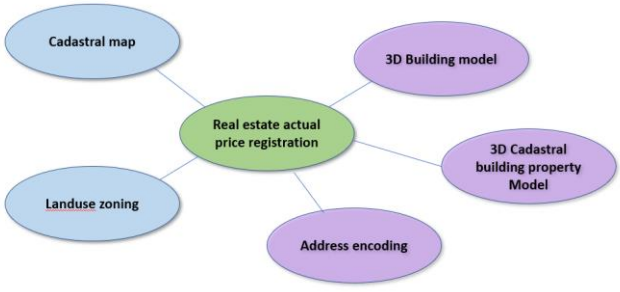

Figure 3 Standards related to real estate standards in NGIS standardization.

This research is concentrated on data pertaining to three distinct types of transactions: real estate sales, real estate leases, and pre-sale housing. While the subjects, content, and semantics associated with these transaction types vary, their design strategies and

foundational logic reveal notable similarities. These similarities typically encompass information related to transactions, properties, land, parking spaces, and persons. A significant challenge arises in the precise capture of all pertinent information through a consensus application schema specifically designed for each transaction type. A common practice is to design the application schema based upon the characteristic analysis results of the data, which serves to elucidate the meanings and application constraints of the designed content. According to the NGIS specifications, each data content standard in NGIS necessitates a dedicated chapter for characteristic analysis to assist users from diverse fields in developing an accurate understanding and formulating appropriate strategies for the data obtained. The considerations regarding the characteristics of real estate actual price registration data are as follows:

1. Feature Design

The application schema is constructed upon specific feature types with a focus on semantic considerations, serving as a technical guideline for processing the distributed data. Based on the identified scope and the database schema of the current registration data, it is determined that the primary content of the subjects will include information pertaining to transactions, buildings, lands, parking spaces, and persons. The three types of transactions—sales, leases, and pre-sale housing—are conceptualized as features for documenting the locations of the subjects. Conversely, while buildings, land, and parking spaces also possess location elements, they are modelled as data types due to the lack of location information in the existing registration data. Nonetheless, these entities can still be linked to their respective spatial representations through common identifiers when necessary. Furthermore, data concerning persons also lacks spatial attributes and is therefore modeled as distinct data types. The schema design is based on the concept that a single transaction serves as the central description, encapsulating comprehensive details of the transaction, and facilitates connections to related information about buildings, land, parking spaces, and persons. Given that a single transaction may involve multiple buildings, parcels of land and parking spaces, the relationship between a single transaction and these entities is established as one-to-many. Additionally, since a single transaction may also pertain to multiple individuals, their relationships are similarly structured as one-to-many.

2. Identification

In order to accurately differentiate individual features, it is imperative that the designed identifiers integrate or establish an identifier reference system relevant to the objects being analyzed. This research will focus on the development of identifiers for specific entities, including transaction IDs, land numbers, building numbers, and personal identifiers, which are capable of uniquely identifying the described objects and enabling the establishment of precise relationships through the same identifier values. In the current design outcomes, transaction ID is employed as the principal linking reference, while land numbers, building numbers, and addresses may function as the foundational references for associated spatial data pertaining to land and buildings.

3. Spatial Representation

The current spatial representation of actual price registration data is characterized by two-dimensional point coordinates. The location of these points is established based on the coordinates of the centroid of the largest parcel in the transaction subject. This approach offers only a rough approximation of the location and fails to accurately capture the true spatial extent of the transaction. The spatial description will utilize point

data types (GM_Point) in accordance with ISO 19107(ISO, 2019), encompassing both two-dimensional and three-dimensional representations. Although there is presently a lack of recorded coordinates for individual parcels of land, buildings, and parking spaces, these entities can be associated with cadastral maps and cadastral building property model data via their respective land number and building numbers, thus facilitating the derivation of their spatial representations. In instances where the associated data source possesses a three-dimensional spatial representation, the distributed real estate actual price registration data may also be spatially represented in three dimensions.

4. Temporal Aspect
Each instance of actual price registration data encapsulates the contractual specifics of a transaction related to the purchase or leasing of a subject property at a designated point in time. This dataset comprises two temporal components: the transaction date (or leasing date) and the registration date. These dates serve as the primary temporal indicators within the transaction data and can be employed as a reference for filtering actual price registration records, such as selecting transactions that transpired within a specified period of time. Furthermore, the attribute of “age of the building” serve as an important reference for evaluating the property's price.

5. Changes in Recording Regulations
The regulations governing the content of actual price registration data may vary across different timeframes. For instance, the categorization of "building types" was revised from 12 categories to 5 categories on July 1, 2020. This change was primarily motivated by the tendency of the public to complete forms based on subjective perceptions, resulting in inconsistencies among similar unit types within the same building. Consequently, a new function has been incorporated into the system to enable automatic classification. These adjustments highlight the significance of careful management of data that spans multiple periods.

6. Thematic Aspects
The development of data content standards must be customized to correspond with the intrinsic properties of the data and the demands of subsequent applications. The schema design process, which is based on feature characteristics, adheres to the ISO/TC211 19100 standards, as well as the standardized data types and codelists specified in the governmental data standard platform. Ideally, each feature type should incorporate identification attributes that facilitate differentiation and establish connections with data from other domains. The outcomes of the conceptual design should be illustrated through UML diagrams. The thematic attributes may demonstrate recurrence due to the nature of the objects being described; for example, a single real estate transaction may encompass multiple parcels of land. All feature classes, attributes, and relationships that are developed must be systematically documented in the data dictionary of the standard documentation.

7. Distributed Data Format
The NGIS standardization framework mandates that disseminated data be encoded using open data formats. Each data content standard must explicitly delineate the conversion protocols required to transform data from databases into the selected data formats. In light of the requirements for articulating spatial characteristics, numerous data content standards within the NGIS framework have adopted GML (ISO, 2020), as

endorsed by ISO/TC211 and OGC, as the preferred format for data circulation. This process entails converting the design outcomes derived from the UML conceptual schema into XML schemas to comply with open regulations, thereby enabling automated interpretation in GML-aware software. For the point-based and simplistic data structure relevant to this research, the utilization of a CSV data format is also a feasible choice. However, due to its inherent limitations in documenting linking relationships, it necessitates that distinct thematic data be stored in separate files, with relationships subsequently established through common identifiers at the client software environment after data acquisition.

8. Data Management and Supply

The current price registration data is derived from reports submitted by the public or real estate agencies. Among these reports, only the data related to real estate transactions undergoes verification by local government authorities, while other types of transactions are accepted as presented due to the lack of adequate data for verification and. The registration data is systematically updated in the database on the 1st, 11th, and 21st of each month, with open data released in batches every ten days. This methodology produces phased results that are made available as datasets, which the public can access and download from the website to obtain the most current information. In alignment with the proposed standard framework for this research, there exists the potential for future data to be made accessible externally through Application Programming Interfaces (APIs). This would facilitate a novel mode of service centered on individual transactions, thereby enhancing the flexibility of data request applications.

3. APPLICATION SCHEMA DESIGN

The preceding analysis of characteristics is grounded in a comprehensive evaluation of actual price registration data sourced from the Department of Land Administration under the Ministry of Interior. The findings derived from this analysis will be integrated into the design of application schemas pertinent to the three selected transaction types. Each transaction type will be delineated by a tailored application schema that connects relevant information, encompassing "buildings," "lands," "parking spaces," and "persons." The constructed application schema will delineate and furnish data content for the subsequent scenarios:

1. The status of an individual real estate transaction,
2. The historical status of real estate transactions concerning a specific subject matter,
3. The status of real estate transactions within a defined geographical area in a specified time period,
4. The status of particular types of real estate transactions within a specific geographic area and period.

The previously mentioned data can be explicitly established according to the developed schema. Following the completion of the database and API, it will be feasible to further define parameters that impose restrictions on the content of specific attributes. This will facilitate the filtering and retrieval of transaction data that satisfies certain criteria, such as those pertaining to the age or price of the property.

As previously indicated, the extensive nature of the actual price registration data necessitates the establishment of primary feature types and data types, which typically include information pertaining to transactions, buildings, lands, parking spaces, and

persons. Although the underlying design logic is consistent, it is essential to acknowledge that the attributes developed may differ based on the specific type of transaction (for instance, the terminology employed to describe sales differs from that used for leasing).

In the design of the application schema, three categories of real estate transactions are conceptually represented as feature classes, which encompass spatial location descriptions and constitute the primary data for individual transactions. Additionally, four categories of registration information—namely "persons," "buildings," "lands," and "parking spaces"—are structured as DataTypes, each associated with the pertinent transaction to enhance the richness of the data. While these four types of information can later be linked to corresponding data through common identifiers, this process necessitates careful consideration, particularly regarding the association mechanism of identifiers involving temporal variations. For instance, building numbers and land numbers are two identifier systems in which the same identifier value may correspond to different spatial extents at various points in time. Consequently, the association mechanism must integrate considerations of temporal versioning and cannot depend solely on identifier values to establish connections.

The following section utilizes the schema of "real estate sale" as an illustrative example to elucidate the designed outcomes. The schema encapsulates the content of individual transactions related to real estate sales, comprising a total of 41 attributes that generally encompass the following aspects:

1. Comprehensive Transaction Status Overview: This includes the transaction ID, administrative district, counterpart involved in the transaction, total number of transactions, and disclosure status, among other relevant details. The transaction ID serves as a unique identifier assigned to each transaction upon registration.

2. Land Characteristics: Essential attributes such as land area and zoning must be documented in the context of land transactions.

3. Building Characteristics: When dealing with building transactions, it is mandatory to record details such as building type, intended use, construction materials, transfer area, dimensions of both primary and ancillary buildings, and layout of the property.

4. Parking Space Characteristics: For transactions involving parking spaces, it is mandatory to document the type and area of the parking space.

5. Temporal Information: This encompasses critical dates including the transaction date, registration date, completion date of construction and the age of building.

6. Geospatial Information: Two-dimensional coordinates are chosen to represent the geographical location of the transaction.

7. Price Information: This includes the total transaction price, unit price (price per square meter), and individual prices associated with land, buildings, and parking spaces.

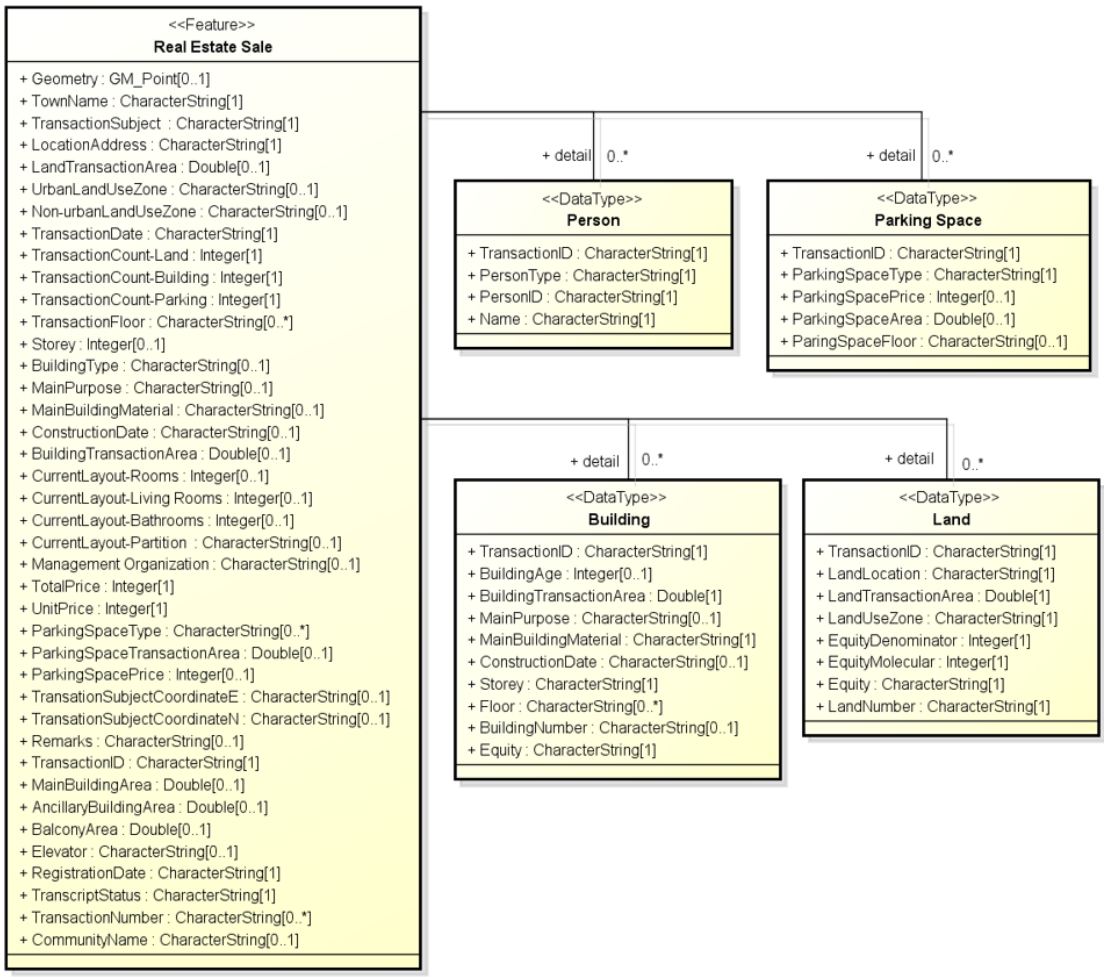

Figure 4 UML-based application schema for the real estate sale transaction.

The collection of attribute data facilitates a comprehensive understanding of the subject of a transaction. It is essential to recognize that a single transaction may encompass multiple parcels of land, buildings, and parking spaces. Nevertheless, the design framework effectively organizes this information in a coherent manner, emphasizing regulations pertinent to the subject matter, geographical area, property age, relevant dates, pricing, and location. Certain attributes may be recorded as null if the transaction does not involve a specific type of asset; for example, if parking spaces are not included in the transaction, no corresponding information will be available. As a result, the design incorporates mandatory, conditional, and optional design rules, thereby enhancing the flexibility of the information presented.

In situations where further details concerning the buildings, land, parking spaces, and people involved in a transaction are required, the design framework incorporates relationships that interconnect these four types of data with the real estate transactions. These data types are utilized to record and specify information pertaining to individual buildings, land parcels, parking facilities, and persons. For instance, the person record comprises a unique identifier and the names of the persons involved. This identifier-based design can also enable the linkage to other pertinent data, such as the building and land registration data, which proves advantageous for applications necessitating comprehensive content analysis.

4. ENCODING STRATEGIES

After completing the UML application schema, to facilitate the actual flow and exchange of data, the application schema must be converted into a encoding structure of the selected data format. It is essential to choose an open data format that supports various design data types within UML, ensuring that the design results of the application schema can be accurately converted to the selected data format. Given that the current actual price registration data is recorded using two-dimensional point coordinates, which is relatively simple in content, the following two strategies for data distribution were conducted. The first strategy uses GML for distribution, which can fully record the relational structure designed in UML and can accommodate future expansions to represent three-dimensional spatial representation, not limited to only point representation. The latter adopts the CSV data format, which can only record the current data's point coordinates and must be processed individually, with different types of data recorded in separate files, linked through the same case number.

1. GML-based distribution strategy

The GML standard is ISO 19136-1, which can support various data types defined by ISO standards in the UML application schema. The UML application schema is converted into an XML schema, referencing the schema file at http://schemas.opengis.net/gml/3.2.1/gml.xsd, and setting the target namespace of the produced XML schema to https://standards.moi.gov.tw/schema/lvr. Figure 5 shows a portion of the GML encoding examples, information about Person, ParkingSpace, Building and Land are encoded under the tag of <detail>.

Figure 5 GML encoding example.

2. CSV-based distribution approach

Following RFC4186 published in October 2005, which is applicable for actual price registration data supplied as point coordinates. The first row of the CSV file uses attribute names for each category, which must be arranged in order, with attributes separated by half-width commas “,”. If an attribute's data is empty, the empty value

must be retained, and a comma must be recorded without skipping it. Cases, land, buildings, parking spaces, and person files will be processed as different CSV files, supplied separately, and linked through the case number. Figure 6 shows the encoding examples, where different types of information are recorded in separated CSV files and a common transaction ID (A2CD1130515002501) is used to link the related information together.

RealEstateSaleAndPurchase

TownName,TransactionSubject,LocationAddress,LandTransactionArea,UrbanLandUseZone,NonurbanLandUseZone,TransactionDate,TransactionCountLand,TransactionCountBuilding,TransactionCountParking,TransactionFloor,Storey,BuildingType,MainPurpose,MainBuildingMaterial,ConstructionDate,BuildingTransactionArea,CurrentLayoutRooms,CurrentLayoutLivingRooms,CurrentLayoutBathrooms,CurrentLayoutPartition,ManagementOrganization,TotalPrice,UnitPrice,ParkingSpaceType,ParkingSpaceTransactionArea,ParkingSpacePrice,TransationSubjectCoordinateE,TransationSubjectCoordinateN,Remarks,RemarksContent,TransactionID,MainBuildingArea,AncillaryBuildingArea,BalconyArea,Elevator,RegistrationDate,TranscriptStatus

中正區,房地(土地+建物)+車位,基隆市中正區新豐街９０號３樓,26.07,其他,,1130511,1,1,1,三層,十一層,住宅大樓(11 層含以上有電梯),住家用,鋼筋混凝土造,1120928,139.7,2,1,1, 有 , 有 ,11400000,101729, 坡 道 平 面 ,41.4,1400000,329543,2781486,Y, 地 下 二 層 固 定 機 車 停 車 位,A2CD1130515002501,56.56,0,7.76,有,1130619,N

RealEstateSaleAndPurchase_Person

TransactionID,PersonType,PersonID,Name

A2CD1130515002501,30,,,

A2CD1130515002501,40,,,

RealEstateSaleAndPurchase_ParkingSpace

TransactionID,ParkingSpaceType,ParkingSpacePrice,ParkingSpaceArea,ParkingSpaceFloor

A2CD1130515002501,坡道平面,1400000,41.40,地下一樓

RealEstateSaleAndPurchase_Land

TransactionID,LandLocation,LandTransactionArea,LandUseZone,EquityDenominator,EquityMolecular,Equity,LandNumber

A2CD1130515002501,長潭段,26.07,都市：其他:住宅區(住一),100000,336,持分移轉,09710000

RealEstateSaleAndPurchase_Building

TransactionID,BuildingAge,BuildingTransactionArea,MainPurpose,MainBuildingMaterial,ConstructionDate,Storey,Floor,BuildingNumber,Equity

A2CD1130515002501,1,64.32,集合住宅,鋼筋混凝土造,112 年 9 月 28 日,十一層,三層,陽台,06246000,全筆移轉

Figure 6 CSV encoding example.

5. TEST

The following discussion uses the real estate transaction data from Taipei City as an example (9589 cases of real estate sale, 4795 cases of real estate lease and 1303 cases of pre-sale housing). By setting different conditions, it presents the spatial, temporal, and thematic aspects of the real estate transaction data through maps, emphasizing the effectiveness of geographic information system applications. Figure 7 shows the spatial distribution of three types of real estate transaction patterns in Taipei City, where highly concentrated areas can be observed. It is noted that there are a large number of real estate rental cases in the city center, indicating that the residential population in this highly developed area may not own their properties. In contrast, more real estate sales cases can be found in the surrounding areas, suggesting a trend of residential communities developing towards the suburbs. Figure 8 uses kernel density analysis to illustrate the highly concentrated areas of real estate transaction cases. Based on the fact that all real estate transaction data have location records, several highly concentrated areas can be identified. Figure 9 filters by year and shows the spatial distribution of real estate transactions in different years, allowing for observation of the market's activity level in various years, including an assessment of the potential impact of COVID-19.

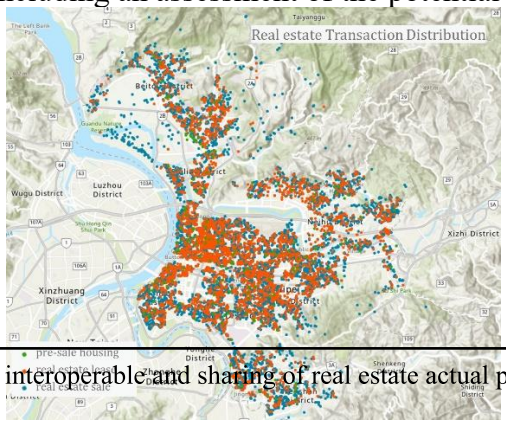

Figure 7 Spatial distribution of three types of real estate transaction of the Taipei city.

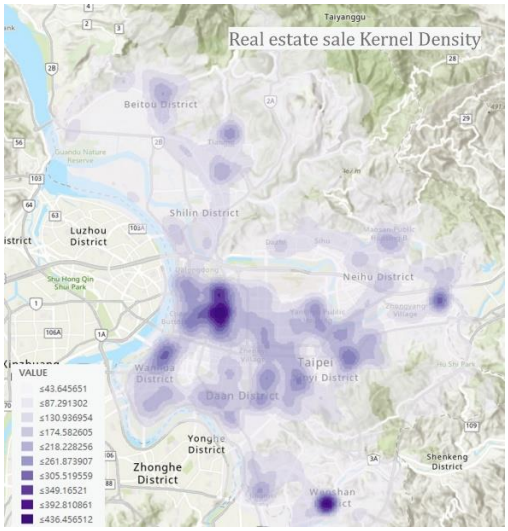

Figure 8 Kernel density analysis of the real estate transaction data.

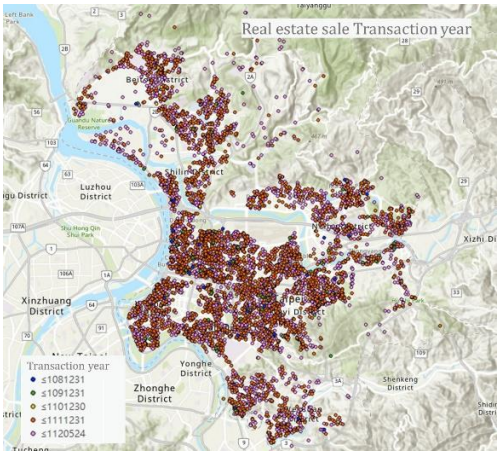

Figure 9 Spatial distribution of real estate transaction by year.

6. CONCLUSION

The Chinese proverb "Where there is land, there is wealth" has inspired many individuals to engage in real estate investment throughout their lives. However, the rapid pace of urbanization, coupled with the constraints of limited land availability and high population density, has resulted in a continuous increase in real estate prices. Consequently, younger generations are facing significant challenges in affording the escalating costs of housing. It is imperative for the government to implement policies aimed at stabilizing housing prices in alignment with broader developmental objectives. The systematic collection and analysis of national real estate transaction data, along with predictive assessments, will enable the government to devise more effective strategies. For real estate professionals, as well as potential buyers and renters, actual transaction registration data serves as a crucial and informative resource. Since 2010, Taiwan's legislative framework mandates public self-reporting of real estate transaction data, which is subsequently disseminated to private sectors and the general public through the establishment of websites and open data formats. This initiative not only promotes transparency within the real estate market but also fosters a more equitable and rational environment for real estate transactions.

This research has successfully developed a standardized framework for the registration of actual real estate prices, which includes standardized descriptions for three types of

transactions: property sales, real estate leases, and pre-sale houses. The proposed application schema complies with national geographic information system standards and thoroughly documents the specifics of real estate transactions, encompassing relevant information about buildings, land, parking spaces, and involved persons. This framework promotes the dissemination and sharing of actual price registration data in an open GIS data format, thereby facilitating access and utilization of this information by government agencies, real estate professionals, and the general public from a geographic information standpoint. The outcomes of this standardization also improve the interoperability of transaction registration data with other datasets related to land and buildings, thereby expanding and enhancing the application of geographic information technology. Furthermore, it provides a more flexible content packaging approach for future API-based service environments, which can significantly improve the user-friendliness of the data circulation system. As the richness of the data content increases, a feature-based circulation mechanism will further enhance the effectiveness of government policies and cross-domain applications.

REFERENCES

Executive Yuan (2024) “Building a healthy real estate market”, (https://english.ey.gov.tw/News3/9E5540D592A5FECD/7fa646f0-8e84-4213-b624-09e346769bb8).

FGDC (2018) “Overview of the National Spatial Data Infrastructure” (https://www.fgdc.gov/nsdi/nsdi.html)

INSPIRE (2024) “Overview” (https://knowledge-base.inspire.ec.europa.eu/overview_en)

ISO (2019), ISO19107 Geographic information – spatial schema.

ISO (2020) ISO19136 Geographic information – Geography Markup Language (GML).

MOI (2018) https://www.land.moi.gov.tw/chhtml/content/90?mcid=473

MOI (2021) Real estate actual price registration2.0 (https://www.land.moi.gov.tw/chhtml/content/1141?mcid=4254&qitem=1).

MOI (2024), Real estate transaction actual price services (https://lvr.land.moi.gov.tw/)

Moralı, O., & Yılmaz, N. (2022). An analysis of spatial dependence in real estate prices. *The journal of real estate finance and economics*, *64*(1), 93-115.

National Development Council (2018) NGIS promotion results and Development directions. (https://www.ndc.gov.tw/Content_List.aspx?n=C024A0CF08FA6878)

UN-GIMM (2018) “A guide to the role of standards in geospatial Information management” version 2.

Wolfgang K. and Fadaie, K. (2013) “ISO standards for geographic information, Springer.

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