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Practitioner's Guide:

Digital Tax Parcel Mapping

Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung

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PROVINCE OF NEGROS ORIENTAL OFFICIAL SEAL

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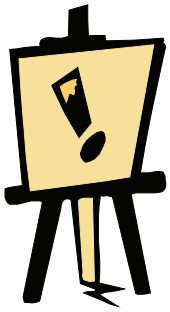
Digital Tax Parcel Mapping

Brief Description



An efficient real property tax administration depends on data that is accurate, timely, and economical to maintain. Building and maintaining the property inventory and attribute database are the most labour-intensive and costly functions of the property tax administration. Tax mapping is a core element of any integrated real property administration and taxation management system. It establishes the link between the real properties in the field and the property assessment and tax records of the tax administration.

Tax Mapping is a classical method of field operations for identifying real property units or "tax parcels". Tax maps provide the public with vital real property information. Therefore, property or parcel location maps have been maintained manually in countries with "ad valorum" real property taxation for quite some time. **Tax Parcel Maps** are fundamental to the appraisal (valuation) of real estate. They help to determine the location of property, indicate the size and shape of each parcel, determine actual land use and help to discover undeclared properties for taxation purposes. Although tax maps serve as a general reference to property locations, they are not a substitute for official cadastral survey documents and should not be used in legal land disputes. They allow the establishment of a real property record system that can be adapted to data computerization.

Digital Tax Parcel Mapping is the process of converting the paper map based part of the "fiscal cadastre" (cadastral base maps, property identification maps) into a digital form and maintaining and managing the tax maps of local government units with the help of a Geographic Information System (GIS).

Usually this is done parallel to the introduction of a computerized real property taxation management system. This process can be time consuming, costly and not easy to manage sustainable, if process flow and purpose of the system is not analysed properly from the start.

However, if based on a prudent local needs and requirement analysis, the rewards in terms of better property management and higher real property assessment efficiency, are numerous. Especially as a visual tool to produce for example "Shame maps" in concert with other tax collection efficiency measures increases in locally collected taxes can be achieved. This can widen the local tax base considerably and hence will increase the financial options and the independence of local governments to invest in improved social service delivery and better physical infrastructure. In return, visible efforts in this field will improve the "tax moral" of local residents.

At the same time the digital tax maps require that the related database are regularly updated. The best way of ensuring this is to link the digital tax maps to the database used by an integrated tax administration system. This also holds true for the need to update maps when further spatial sub-divisions or consolidations are undertaken.

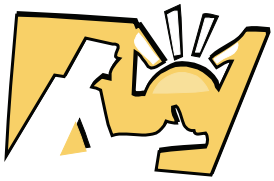
Digital Tax Parcel Mapping

Proposed Main Users

Local and Regional Real Property Tax Assessment Officers, Geodetic Engineers,

Provincial and Municipal/City Planning Officers.

Purpose of the Method



In many countries real property taxation revenues is one of the most important sources of revenue of local governments.

Today, the existing real property assessment and tax collection system is under pressure to increase its efficiency. Traditional manual workflows of partially redundant working steps cause delays and inconveniences for the tax paying public – a fact that certainly does not increase the willingness of property owners to pay their taxes regularly and on time. National governments are usually very interested that local governments increase their real property tax collection efficiency, hoping to reduce their dependency on national transfers and grants. Therefore, they often provide financial and technical assistance to modernize and increase the efficiency of the local government revenue generation system. However, computerization also requires the simultaneous redesign and adjustment of workflow processes otherwise the cost of data collection will increase.

In order to streamline the efficiency and lessen administrative costs, the computerization of the local real property tax administration system has gained high priority. Usually two connected elements or modules are at the core of the automation of a real property taxation system:

- A **digital data management** system for the storage of all taxation relevant records and automation of routine functions, such as printing of tax collection reminder letters, generation of summary assessments, tax collection and other reports (an example of an integrated tax administration system include the recently developed iTAX system in the Philippines)
- A **digital Tax Parcel Mapping component** connected to the data management system.

Digital Tax Parcel Mapping

Advantages

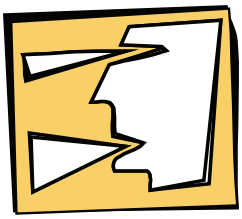
- The major advantage of digital maps is their versatility: digital tax maps can be viewed and printed at any scale and customized with different labels to suit different purposes.
- A combination of numerical, textual and visual (e.g. digital photos of properties including buildings) can be embedded into the system and retrieved based on numerous spatial or statistical selection criteria.
- Digital maps can be maintained and updated much faster than paper maps.
- Digital maps require limited physical storage space and can be easily electronically backed up and protected against data losses (a serious problem in many tax administration offices is the lack of office space and safe map storage facilities).
- Digital tax maps can be easily overlaid with other information layers such as land use planning zones, new road openings, building footprints or physical terrain features. This allows the performance of different analysis and planning tasks within a local government unit. The integration of digital tax parcel data into a multi-purpose Land Information Systems (LIS) can create a versatile spatial planning and management system. The costs and benefits for establishing and maintaining such a system can be shared by different sections of the local administration.
- Costs of using high resolution satellite images to overlay digital municipal base maps are rapidly decreasing.
- Data and maps can be made accessible through inter and intra-net and can be easily shared in an electronic working environment.
- Transparency of local direct taxation can be enhanced.

Limitations

- A condition for efficient tax collection is the computerization of the tax data management. The additional costs in digitizing tax parcel information must also be compared with the benefits arising from the digitized maps: For tax purposes, digital tax parcel maps is a 'nice to have', but it's not a "must".
- Information technology and GIS technologies incur recurrent costs for training, upgrading and hiring of qualified staff. This necessitates that these costs are integrated into annual budgets.
- Building an integrated multi-purpose Land Information Systems (LIS) incorporating a digital parcel data layer depends on adequate geographic base map data (cadastral survey, geographic coordinates of public infrastructure) that have a high resolution.
- If the manually drawn paper tax maps of the assessor lack a minimum of geographic accuracy (for example because they are not be based on upto date cadastral survey maps), it is difficult or even impossible to assemble a matching mosaic of different tax maps sections. This necessitates that a time and resource intensive GPS ground-verification survey is undertaken.

Digital Tax Parcel Mapping

Principles & General Procedures



For the manual preparation of tax parcel maps a base map covering the whole or part of tax administration jurisdiction has often been developed from reference maps and reference materials. Base map preparation requires the combination of all existing survey documents, sketch plans and property information. The maps should be updated and drawn to scale showing political boundaries, property lines, public and private infrastructure such as roads, highways, railroad lines, irrigation network and natural features like rivers, lakes etc. It is important that all cadastral base maps are secured from the cadastral authorities in order to base the parcel maps on proper geographic coordinates.

Manually drawn tax parcel maps are composed of an overview index map and individual tax map sheets of a standardized size showing blocks and sections of adjacent parcels. The index map shows location and boundaries of the individual tax map sheets in relation to major features such as roads and rivers.

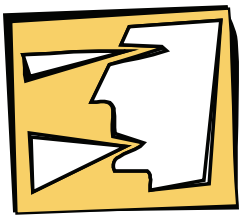
A digital tax parcel or cadastral mapping system requires the following components:

- A geodetic control network;
- An accurate base map layer (ideally, photogrammetrically derived) that is tied to the geodetic control;
- A tax parcel cadastral layer delineating all real property parcels;
- High resolution aerial photographs or high resolution satellite images to identify important property features; a unique parcel identifier assigned to each parcel; and
- Geographic layers of interest to the assessor such as administrative boundaries, zoning areas, rivers and flood plains.

Information about the parcel, such as identifier, ownership, and assessment data are linked into the GIS from the tax administration system.

Digital Tax Parcel Mapping

Principles & General Procedures



Digital Tax Parcel Map Conversion

A precondition for creating a digital tax parcel map is to define the desired spatial accuracy. Principally four different types can be distinguished, ranging from simple scanned maps to very accurate parcel maps based on the direct conversion of the primary field survey data (COGO or Coordinate Geometry based on the geodetic bearings, distances, and curve data established during the cadastral field survey).

Choice and decision among these types of digital tax maps does not have to be a final one. For a digital tax parcel map project a town or tax jurisdiction can decide to proceed through all four types over a period of years depending on funds, time pressure and available cadastral documents. However, the fourth type, a COGO-based cadastral or tax parcel layer, is by far the most accurate.

- **Scanned Maps**
  The most simple and inexpensive form of a digital tax parcel map is to scan the existing manual maps into a raster image. This can be done with scanners or digital cameras. These maps are difficult to maintain (e.g. splitting of parcels). However, they can be easily accessed and shared with anyone with a computer, and are inexpensive and quick to produce.

- **Scanned Maps with Data Points**
  The scanned maps can be augmented with a data point placed in each parcel's approximate centre. Still these maps are difficult to maintain, but the data points can be linked to data about the parcel from the database. Data can be displayed and queried.

  The scanned maps can be geo-referenced and used with other GIS data layers. This procedure may be the method of choice in cases with low spatial accuracy of the existing base data, time pressure to produce quick results for a large number of parcels and ill-defined property boundaries. Such a situation is often found in informal urban settlement areas or rural areas without mechanized farming systems.

- **Digitized Parcel Polygons**
  Manual maps (in paper or scanned form) can be traced to create digital polygons with associated parcel data. The output is a cadastral parcel layer that is adequate for most appraisal and planning analysis functions. Since parcel boundary lines do not have bearing and distance attributes, they usually are less accurate than parcel boundary lines created with the fourth method.

- **Coordinate Geometry (COGO) Parcel Polygons**
  Metes and bounds on cadastral field survey documents can be used to create parcels through coordinate geometry methods. Such maps are the most accurate and useful, the most easily maintained over time, and have a bearing, distance, and curve attributes for most boundary lines.

Digital Tax Parcel Mapping

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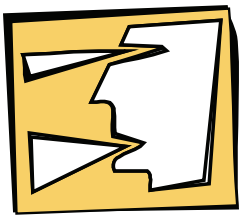

A typical procedure of digital tax parcel map generation consists of the following steps:

Step 1: Scanning or Photo Capturing of Existing Manual Parcel Maps

The paper maps will be scanned or photographed with a good quality digital camera. Special care has to be exercised to avoid distortion.

Step 2: Image Processing

The next step is to assemble a raster image that combines all images or scans of the individual parcel maps into a single parcel mosaic which covers the whole tax administration jurisdiction or the area of the tax mapping project.

Step 3: Image Georeferencing (Image Warping)

Adjustments have to be made to enhance the "fit" or "overlay" of the composed parcel map with the topographic base map features. Often a GPS field survey will be done prior to the tax mapping project in order to update control points and major physical reference features such as roads, irrigation canals or power lines. An additional control and rectification option is to use high-resolution satellite images or aerial photos as a backdrop for the geographic adjustment of the digital parcel map. Up to date high-resolution satellite images or aerial photos allow also the digitization of building foot prints of the property. This is a very important additional graphic element of a digital parcel database, since buildings commonly are subject to real property taxation as well.

Step 4: Digitizing of Parcels

The parcel image mosaic is converted into a GIS usable parcel file by digitizing all parcel boundaries. This is done by "Heads-up" or "on-screen" digitizing.

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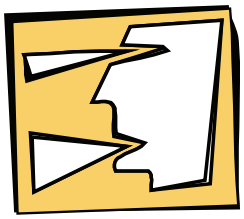

Step 5: Labelling of Parcels with a Unique Parcel ID Number to Create a Link to the Parcel Database

The unique Parcel Identification Number (PIN) links the mapped parcel polygon with the tax database. Normally a geographic code is used as PIN in order to identify the administrative location of the property.

Step 6: Creating Thematic Maps such as Landuse Map, Payment Status, Type of Ownership, Assessed Value, Market Value, Tax Delinquents and others

A major advantage of digital tax mapping is the generation of both standardized as well as custom made thematic maps. Examples are theme maps showing land use, payment status, type of ownership, assessed values market values or type of property improvements depending on the variables stored in the database.

For the tax officer it is most convenient when these maps can be accessed within the tax administration system.

An important task during the build up phase of the digital tax database is the identification of non-plausible values and the checking of the digital database on encoding errors or faulty records of the assessor. Colour coded maps show extreme and possibly faulty data records immediately.

Once the parcel database has been linked to the GIS, the following problems require attention:

- Parcel polygons with no matching database records, i.e. no Property Identification Number (PIN) related to polygon.
- Database records with no matching parcel maps.
- Wide variance between the GIS created parcel area and the surveyed area in the parcel database.
- Multiple claimants of the same parcel.

Digital Tax Parcel Mapping

References and Sources Used

Reference Literature:

Dillinger, W. 1991. **Urban Property Tax Reform: Guidelines and Recommendations.** The World Bank: Urban Management Program. Washington, DC.

Department of Finance. 1978. Assessment Regulation No. 1-78: **Tax Mapping Operations Manual.** Manila, Philippines.

Department of Finance, Bureau of Local Government Finance, Jan. 2006. **Manual on Real Property Appraisal and Assessment Operations.** 1st. International Conference on Local Government Financing.

Estiva, J.A.N. 2000. **Land Taxation in the Philippines: A Case Study of Cebu City.** Master Thesis. International Institute for Aerospace Survey and Earth Sciences (ITC), Enschede, The Netherlands.

German Technical Cooperation 2007, **Proceedings of the 1st International Conference on Local Government Financing.** 29-30 October 2007, Dumaguete City, Negros Oriental, Philippines. Edited by Simeon Agustin Ilago, Bootes Esden-Lopos, Elyzabeth F. Cureg. Makati City, December 2007.

URISA. **Methods of Digital Parcel Mapping. Experts from the Digital Parcel Mapping Handbook.**
Link: http://urisa.org/node/579