SIGIT: an Information System for Integral Approach of Land Management: an LADM Implementation in Honduras and Guatemala

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Key words: Land Administration Domain Model, Land Management, Cadastre, Land Registration, LADM, Honduras, Guatemala

SUMMARY

In a new and integral land management approach in four municipalities in Honduras and Guatemala the Land Administration Domain Model has been used as a tool in support to system development for land administration.

A pilot implementation for municipal information infrastructure in four municipalities (Puerto Cortes, Omoa and Tela in Honduras and Puerto Barrios in Guatemala) should test improved management of geographic information. Data should be published on the web for web access by citizens, a one stop shop has been introduced, and integration of data at different levels avoids data duplication. Very important impact of improved access is in building trust by more transparency.

New work procedures have been defined and implemented and the information system SIGIT (Sistema de Información Gestión Integral de Tierras) has been designed and implemented supporting these concepts. Apart from forming the basis for sustainable land transactions and land use planning, the SIGIT can be supportive to a situation where all citizens in a municipality pay the land tax and where land-possession can be converted to legal land ownership.

SIGIT operates as a one-stop shop at the municipal side. The design of SIGIT is based upon the Land Administration Domain Model ISO 19152 to manage the cadastre and land use planning data from this point of view. To meet the requirements additions to the LADM were designed. The LADM additions to implement SIGIT in Honduras and Guatemala are necessary to store extra information about spatial zones, parcels and buildings as required by the municipalities during development. Furthermore, the information regarding building and operation permits, with their respective user-defined spatial and administrative rules, were out of scope of LADM. Therefore, the corresponding additions were necessary as well.

The paper provides an overview of the SIGIT goals and requirements, the design and development. Within this context the focus is to the use of the LADM and its modifications for SIGIT development and a short evaluation of the LADM as a tool for development.

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1. INTRODUCTION

In a new and integral land management approach in four municipalities in Honduras and Guatemala the Land Administration Domain Model has been used as a tool in support to system development for land administration. With the necessary additions to the core LADM conceptual schema it was possible to implement a complete and coherent system for land administration (Koers and Cerrato, 2013).

In Honduras the responsibilities for land administration are distributed over different organizations at national and municipal level. Four organizations have duties related to the representation of parcels – this is the legal cadastre. The National Property Institute (NPI) is responsible for the cadastral and registry part for the whole of the country. Additionally, it is responsible for the process of titling of private parcels in urban areas. The National Agrarian Institute is responsible for land titles in the rural areas and the Institute for Forest Conservation for titling in national forest areas. Finally, the Municipalities are responsible for titling in areas which are property of the Municipalities. Municipalities also have a separate fiscal cadastre in order to collect land tax.

The complex situation in legislation in Honduras has caused that a consistent and complete registration has been difficult to achieve. It is unclear to citizens where to go in case of land transactions, for this reason there are many informalities related to ownership. The government recognized the complexities and legislation was modernized about ten years ago. The new law is under implementation now, a slow process. The new legislation establishes the integration of fiscal and legal cadastre. Additionally, the legislation arranges the possibility for local governments to become associates in maintaining the cadastral data at national level, integrating their local data with the central database. The NPI uses a central information system called SURE (Sistema Unificado de Registros – Unified Register System) for land administration data. The legislation for land use plans also has been modernized defining strict procedures for the design and elaboration of these plans by the municipalities.

It should be noted that in Honduras communal land titles exist for indigenous communities. Occupied lands can be titled under certain legal conditions. In general it can be observed that social tenures are integrated in the adjudication processes.

In Guatemala the situation is different and has a more centralized approach. The National Cadastre is responsible for the cadastral registration while for the land registry there is a separate institution, the Real Estate Registers. The municipalities are not an official player in the maintenance of land record and cadastral maps, although they have their own cadastral

database for taxation purposes. Land use plans and regulations are directed by the Secretary General for Planning.

This environment has been the basis for the GIT project (Gestión Integral de Tierras - Integrated Land Management), focussing on one side on the acquisition of cadastral data and the elaboration of land use plans as a fundamental basis for the land management and other side on the decentralization of the maintenance of these data by municipalities to augment the sustainability of the maintenance of these data and to promote the integration of the use of this data at local level.

This paper presents the GIT Project and its goals in section 2. Then the SIGIT (Sistema de Información Gestion Integral de Tierras) is outlined in section 3. Chapter 4 is the core of the paper – with the focus on the use of LADM in the SIGIT system while Chapter 5 depicts the development methodology used for the building of the system. Chapter 6 shows some details concerning the implementation of the system. Finally Chapter 7 finalizes with conclusions and recommendations.

2. THE GIT PROJECT: GESTIÓN INTEGRAL DE TIERRAS (INTEGRATED LAND MANAGEMENT)

The main goal of the GIT project is to improve the legal security of property rights in the beneficiary towns of Puerto Cortés, Omoa and Tela (Honduras) and Puerto Barrios (Guatemala), and to provide adequate conditions for improving internal and external investment in the area. For an overview of the involved municipalities see Figure 1.

The public policies promoted or strengthened by the project are: help with territorial planning and development policy, municipal taxation, public participation policy and quality and transparency in public management. The project has also propitiated the introduction of a new political line: the decentralisation of land registry upkeep plus territorial planning and development policy.

Specific goals are to:
− carry out a land registry and property project covering the two neighbouring countries,
− design, develop and implement a process of integrated land management at a municipal level,
− protect the interests of the local population and specific ethnic groups,
− draw up and update, where necessary, territorial planning plans for the municipalities in Honduras,
− draw up the Urban Planning Plan for Puerto Barrios, and:
− design, develop and implement systems that will allow the start-up of a "digital municipality.

Duration of the project: January 2009 – March 2013.

The European Commission, by means of its Agency Europe Aid, within the framework of the program URB-AL III granted financial aid for the GIT project. The total budget for the project was 3,7 million Euros.
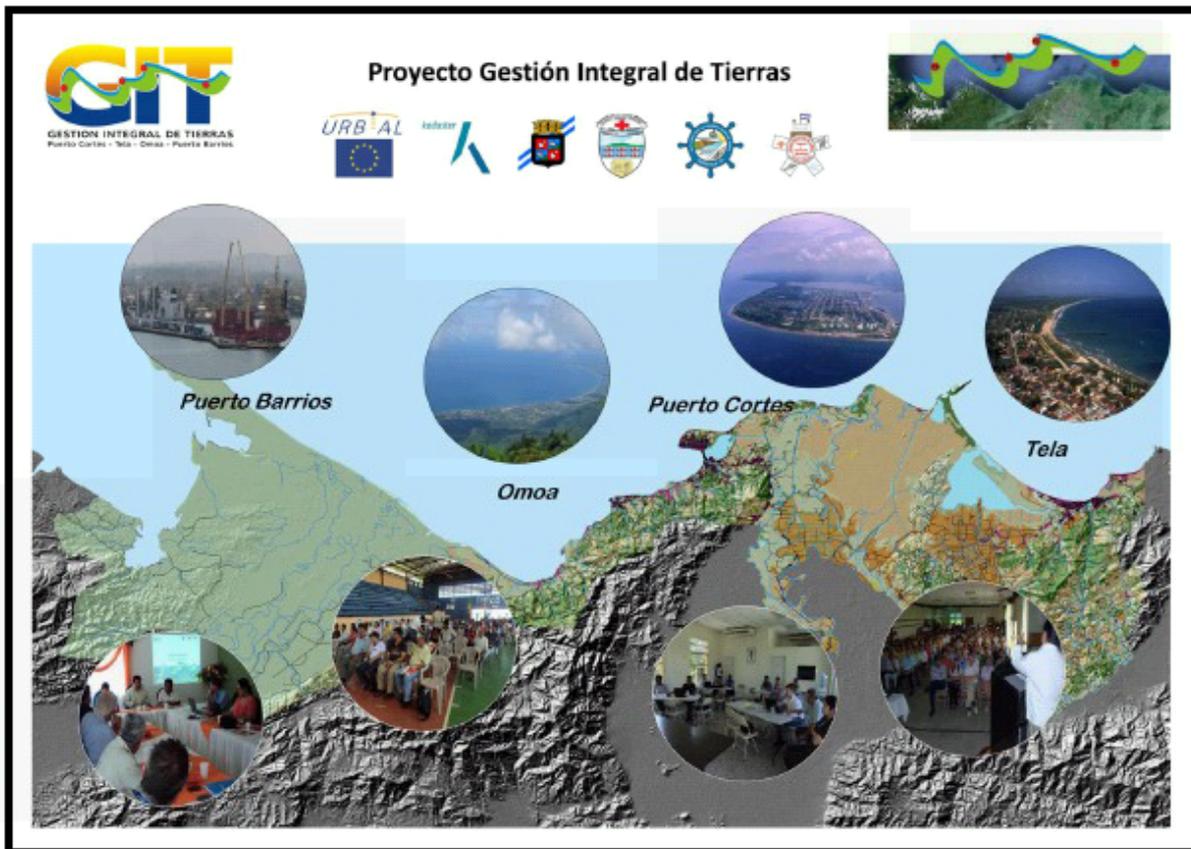
Figure 1. Involved Municipalities: Puerto Cortés, Omoa and Tela (Honduras) and Puerto Barrios

A pilot implementation for a municipal information infrastructure in the four municipalities in two countries should test improved management of geographic information. Data should be published on the web for web access by citizens, a one stop shop has been introduced, and integration of data at different levels avoids data duplication. Very important impact of improved access is in building trust by more transparency. For this purpose the LADM based SIGIT (Sistema de Información Gestion Integral de Tierras) has been designed and developed.

3. SIGIT: SISTEMA DE INFORMACIÓN GESTION INTEGRAL DE TIERRAS

The design and implementation of the municipal infrastructure for the management of land administration data in the municipalities have been based on proposed concepts of integral local maintenance and use of the land tenure and land use data, making use of existing information systems and bridging the gap between them. Those proposed concepts were based on an analysis of the existing work processes with related data management. It was clear that

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there were duplications in data and data maintenance (for land transactions, permits, spatial planning processes). The proposal was accepted by the responsible authorities at municipal and national level.

Therefore SIGIT has the following functional requirements:
– registry of the cadastral data at local municipal level by managing cadastral transactions
– registry of the land use data at local municipal level by managing permit transactions
– data exchange between the municipal cadastral registration and the national registration SURE in Honduras;
– data exchange between the municipal system and the national system for land use planning, Registro Nacional de Normativas de Ordenamiento Territorial (RENOT) in Honduras
– data exchange between the municipal cadastral registration and the municipal information systems for taxes
– maintenance of the land use data
– data exchange between the municipal system for land use planning and the municipal systems for building permits, public services and other relevant systems
– publish information online on the internet relevant for the Integral Land Management process at local level.

New work procedures have been defined and implemented and the information system SIGIT has been designed developed and implemented supporting these concepts.

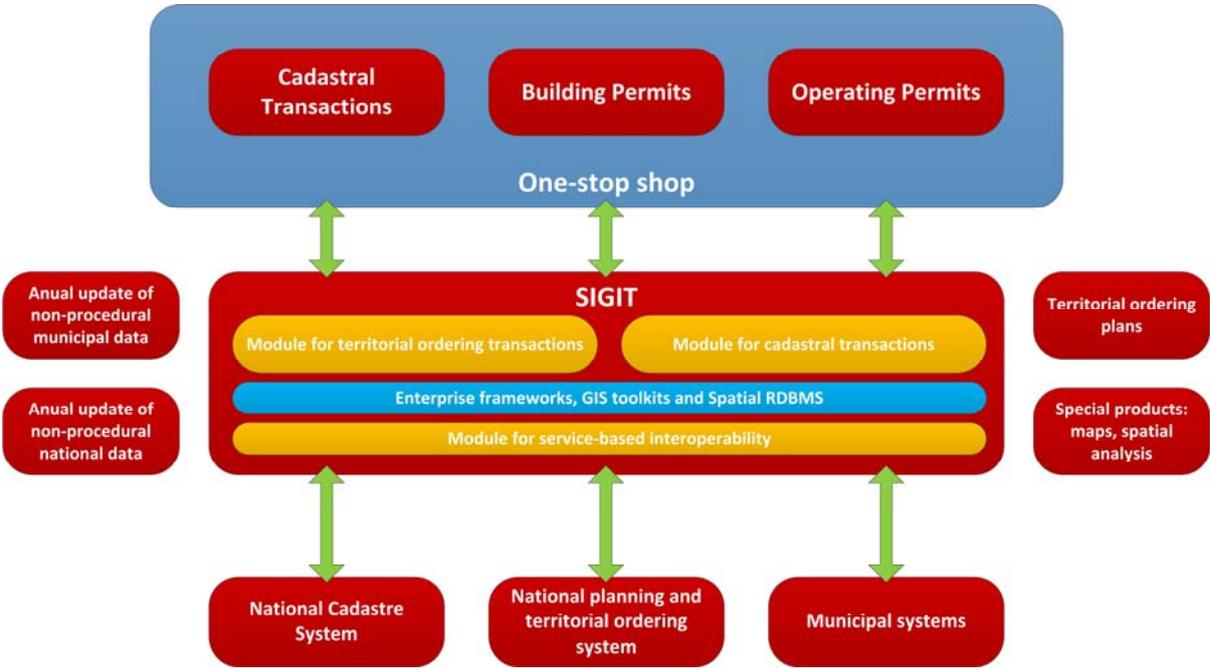The concept of SIGIT is depicted in Figure 2.

Figure 2. SIGIT system concept

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Apart from forming the basis for sustainable land transactions and land use planning, the SIGIT can be supportive to a situation where all citizens in a municipality pay the land tax and where land-possession can be converted to legal land ownership. This will be based on an up-to-date and complete data set in a transparent environment.

SIGIT functions as follows: customers can go to the municipality with their application forms; in case of cadastral transactions this includes notary documents and may include the survey sketch in case of a subdivision. From SIGIT, after the reception, the verification and pre-editing of transaction data, a Cadastral Certificate will be provided on paper. The customer will take the certificate, the deed and (if needed) the survey sketch to the NPI. The municipality will send the transaction data digitally from SIGIT to SURE. Then NPI can compare both datasets (from customer and from SURE). A transaction will be processed in SURE and the municipality will be informed digitally after approval by the NPI of this transaction in SURE.

4. USE OF LADM

4.1 Data model
SIGIT operates as a one-stop shop at the municipal side. The design of SIGIT is based upon the Land Administration Domain Model ISO 19152 to manage the cadastre and land use planning data from this point of view. The LADM provides an extensible basis for the development and refinement of efficient and effective land administration systems. The organisation of LADM allows for implementation in a distributed environment. It was proven that LADM could be used for design of the system. Because LADM is an overview of all relevant data for land administration the model proved to be very useful in design discussions. The LADM contains legal/administrative attributes on parties and rights, geometric attributes and survey data. The LADM includes documentation: field documents, deeds, transaction documents, imagery, etc.

To meet the requirements, additions to the LADM were designed. The LADM additions to implement SIGIT in Honduras and Guatemala are necessary to store extra attributes about spatial zones, parcels and buildings as required by the municipalities during development. Furthermore, the information regarding building and operation permits, with their respective user-defined spatial and administrative rules, were out of scope of LADM. Therefore, the corresponding additions were necessary as well.

The SIGIT LADM based conceptual schema is represented in Figure 3a (Party and Administrative Package) and 3b (Spatial Unit Package).

Two new packages were added to extend the LADM core model. Those are the HND_Administrative (includes Party Package) and HND_Cadastre (= Spatial Unit Package) packages. The HND_Administrative package includes all the information related to municipal transactions, operation and building permits. It also includes the class HND_Property that extends LA_BAUnit to include legal national registration attributes like tome, folio and

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annotation number. This is in addition to the attributes provided by the LA_BAUnit that includes all RRR data and associated spatial units. Only one-to-one relation cardinality was used in SIGIT even though the model allows for many-to-many relationship cardinality.
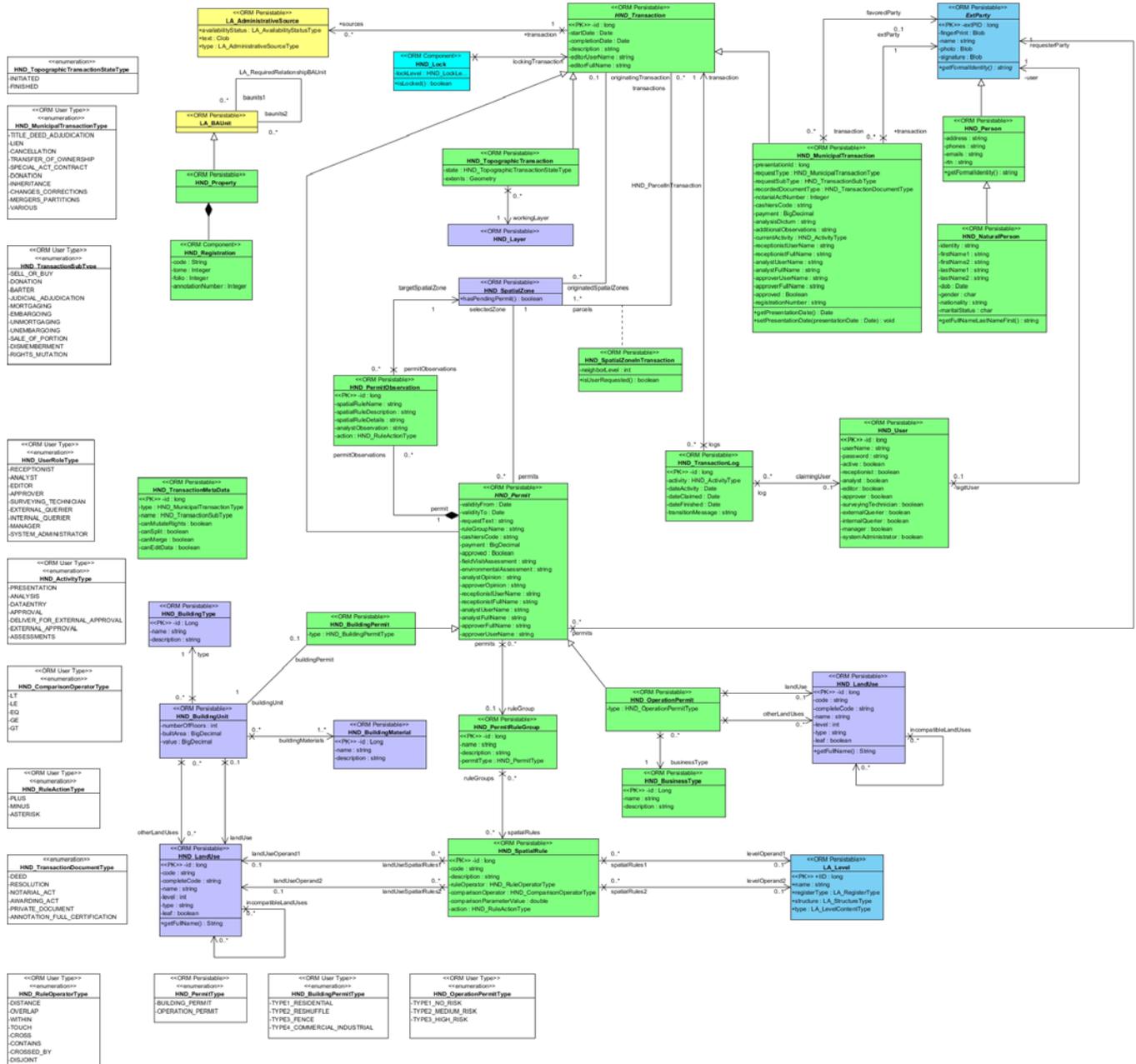

Figure 3a. SIGIT LADM based conceptual schema – Party and Administrative Package

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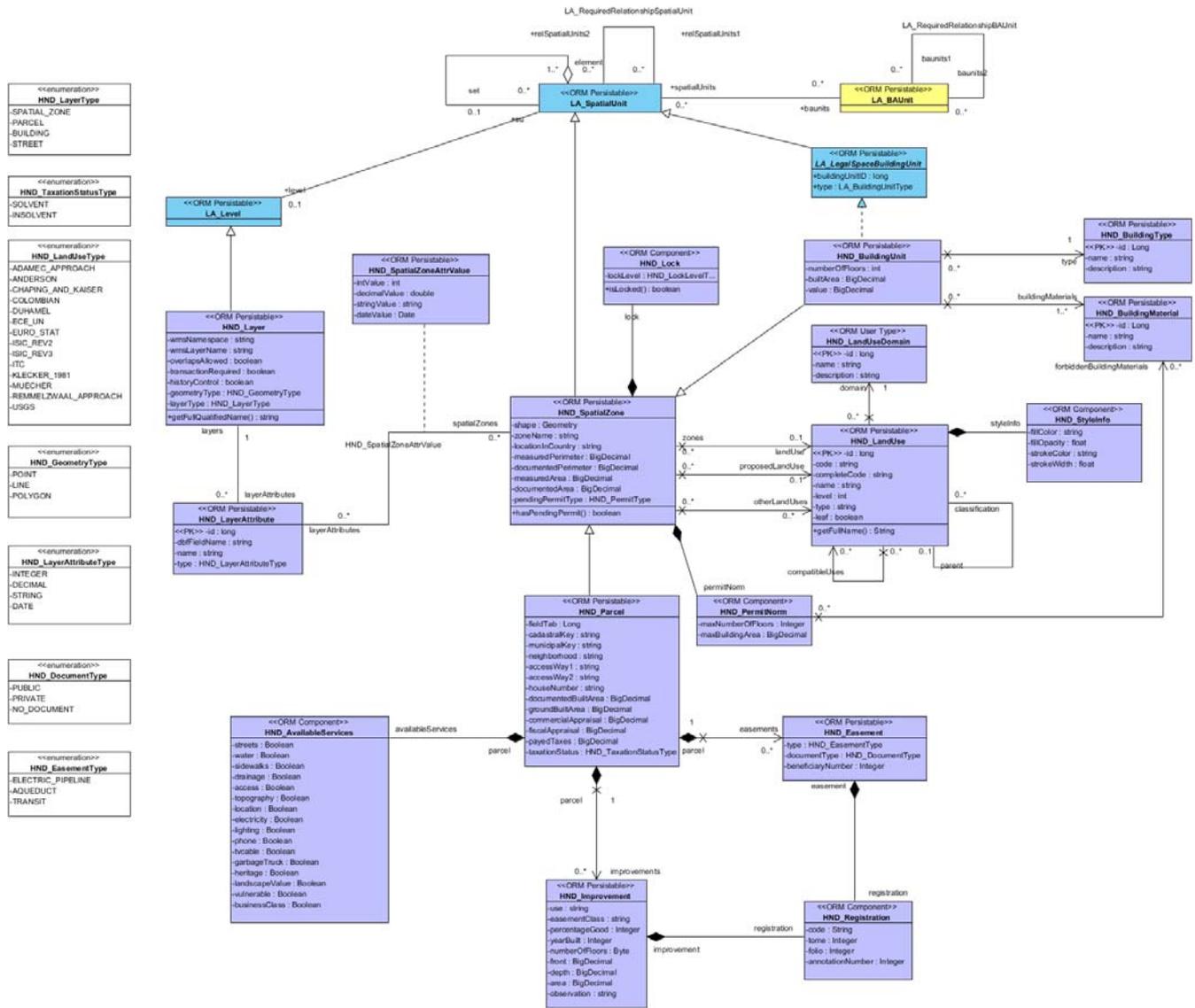24-25 September 2013, Kuala Lumpur, Malaysia

Figure 3b. SIGIT LADM based conceptual schema – HND_Cadastre package (= Spatial Unit) Package

Regarding operation and building permits, it contains the custom spatial rules that municipality can enforce during the assessment of a new permit. Those rules are comprised with two operands and a spatial/topology operator like distance, within, intersection, etc. The operands are associated with a land-use code and a spatial zone such as a zoning layer, a parcel, or a building. In this way it is easy to define rules like for example "a building for educational purposes cannot be inside an industrial zone or within 100 meters from a bar". Or, "a new building cannot be less than 2 meters away from a street", just to name a few that can be very flexibly defined by the user. Those rules are enforced during the assessment of a new permit.

The HND_Cadastre package (= Spatial Unit Package) includes all information regarding parcels, zoning, physical buildings and land-use information. The most important class in this

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schema is the HND_SpatialZone that derives from LA_SpatialUnit and extends it by including additional attributes like the actual polygon of the zone (in addition to the reference point provided in Spatial Unit), the corresponding land-use, documented and calculated area, perimeters, etc. Other classes that extend HND_SpatialZone include HND_Parcel and HND_BuildingUnit. The class HND_Parcel also contains attributes like the national's cadastral key, available municipality services to the parcel like streets, water, sidewalks, electricity. Parcel's improvements and easements are also important data required by the municipalities.

4.2 Process model

Process modelling is outside the scope of ISO 19152 – because they are too "country specific". For this purpose all transactions have been developed within the requirements. The process for Honduras has been implemented based on the legal possibility in Honduras that municipalities can be associates in cadastral maintenance. For the time being no specific Guatemalan process has been defined until an official role for municipalities in cadastral transaction will be established.

SIGIT has been implemented at local level and specific procedures have been elaborated between the NPI and the Municipalities to define how cadastral transactions will be executed in a decentralized way. Figure 4 shows a general scheme of the process of a local cadastral transaction. For the transactions of building permits and operation permits similar procedures have been developed and implemented.
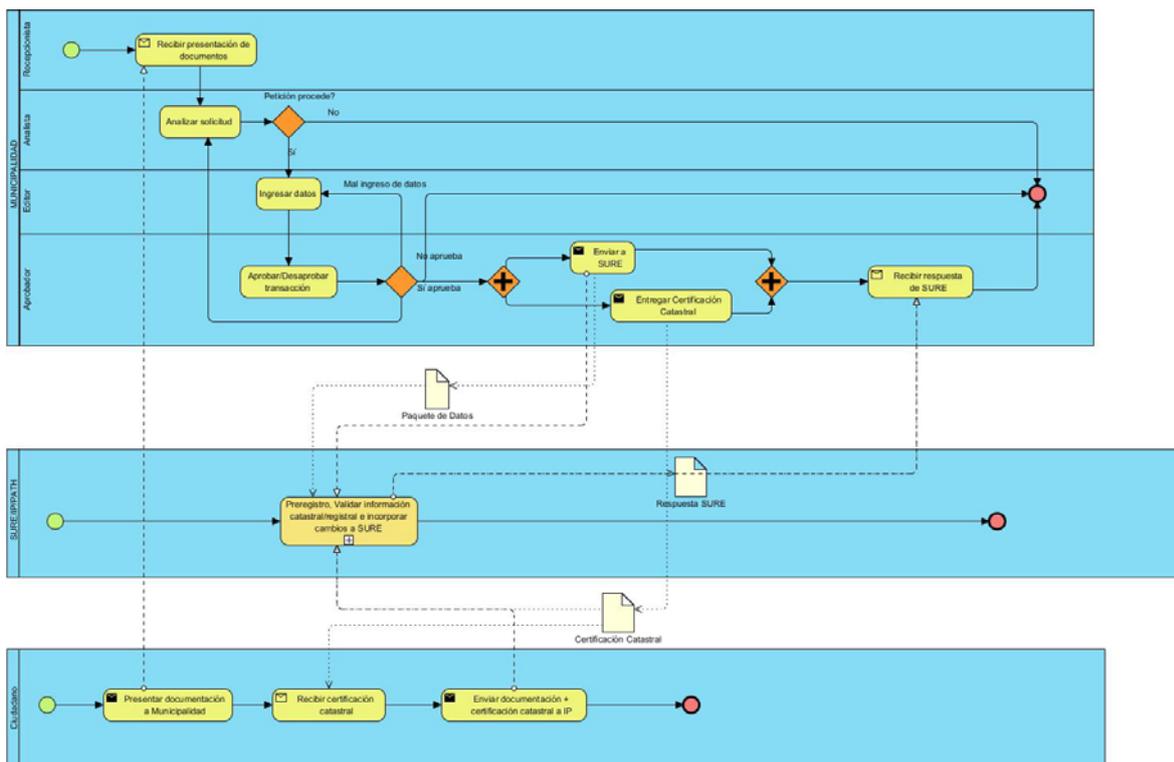

Figure 4. General scheme of the process of a local cadastral transaction (design by Cerrato, Koers and Lemmen)

5. DEVELOPMENT METHODOLOGY

The SIGIT system has been developed in a multi-user and business process oriented way with history and transaction support and with a 100% web user interface with international language support and open source technology programmed. The technologies used are shown in Figure 5.
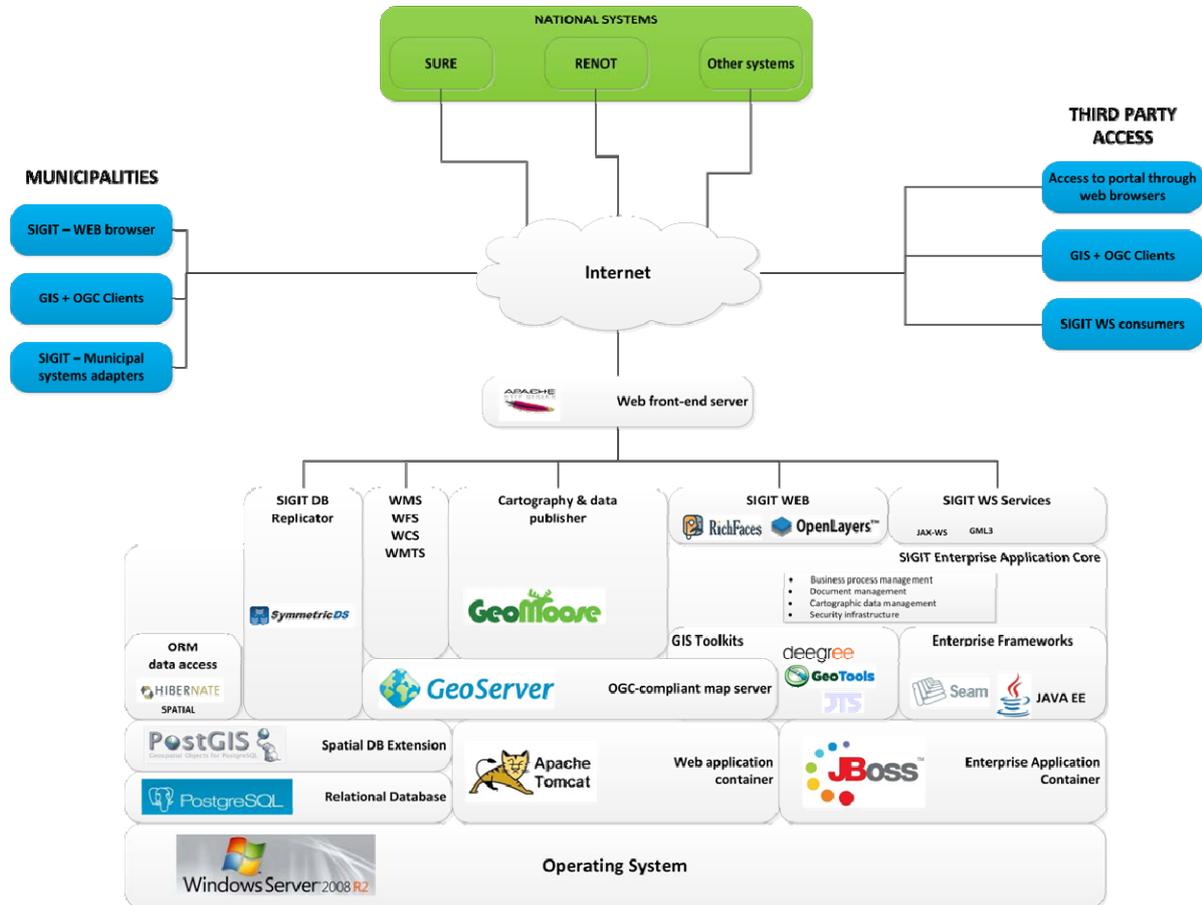

Figure 5. Technologies used for the SIGIT design (Cerrato)

The LADM implementation was done using object-relational mapping technology called "Hibernate" using mostly Java EE standard JPA annotations. A Hibernate extension called "Hibernate Spatial" was used to support handling of spatial data. During SIGIT development, one important goal was to make it self-contained in the sense that no additional or external application was strictly necessary to perform topological operations and calculations over spatial data. Everything is done in the browser. This has the benefits of no extra costs for deploying and learning external tools to achieve that. Figures 6 and 7 show a parcel dismemberment operation by drawing a border to obtain the two new parcels. All within the web interface. History support is paramount within SIGIT. It is always possible to track changes since the beginning. This is generally supported within LADM by required

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relationship (LA_RequiredRelationship) in addition to tmax and tmin attributes. Furthermore, no data change can be done without the confines of a transaction.
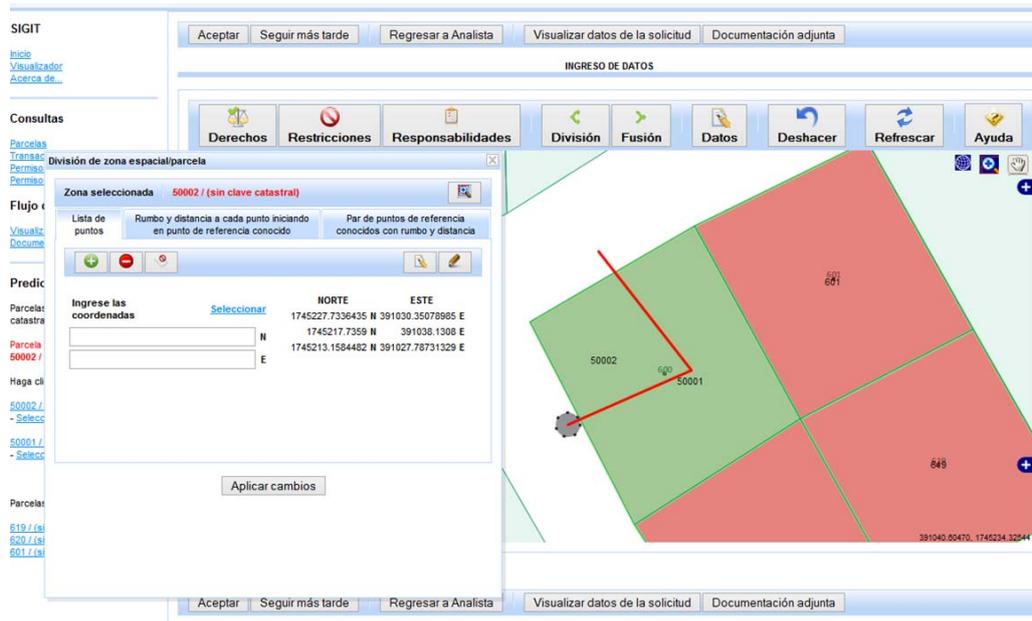

Figure 6. Interface for changes in a parcel dismemberment (Cerrato)

F
igure 7. Interface parcel subdivision

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6. IMPLEMENTATION OF SIGIT

SIGIT has been implemented at local level and specific procedures have been elaborated between the NPI and the Municipalities to define how cadastral transactions will be executed in a decentralized way – in a one stop shop environment. For the transactions of building permits and operation permits similar procedures have been developed and implemented.

A citizen who requests a municipality service goes to the municipality's one-stop shop and is attended by a municipality officer who receives all mandatory legal documentation. The officer begins new municipal transaction that is controlled by the workflow depicted in the BPMN diagram in figure 4. From that point, other specialized officers analyze what has to be done in the system. Most of those transactions require changes in RRR data, topological changes such as splits and merges of parcels. Once both the municipality's internal approver and the centralized system have approved the changes, the results are applied to the LADM schemas to reflect the changes publicly. This means that people who query the system through the system interface do not see those intermediate changes that are internal to the municipality.

Web services are used to manage the transfer of transaction-data between local and central information systems or between different local information systems.

The main impacts of the GIT project in relation to the goals of the EU Programme (contribution to social and territorial cohesion) have been reported as follows:
− An average increase of 60% in municipal income from property tax.
− Increased legal security as regards land tenure: an average 80% of the population feel more legally secure after going through the land registry and territorial planning process.
− Reengineering work processes, including the decentralisation of land registry upkeep to prevent inconsistencies between national and local levels and prevent the possibility of fraud.
− More direct participation by the key players in territorial management.

7. CONCLUSIONS AND RECOMMENDATIONS

Four municipalities (coordinated by the Municipality of Puerto Cortés) have developed and implemented the Integrated Land Management System based on the LADM:

− Municipality of Puerto Cortés (Honduras)
− Municipality of Tela (Honduras)
− Municipality of Omoa (Honduras)
− Municipality of Puerto Barrios (Guatemala)

Generally speaking, we think the use of LADM as the foundation for SIGIT's data model represents a measurable step forward in the design of future serious land management systems.

The SIGIT is recommended to be used for future developments for land administration in Honduras and Central America. First considerations are recognised already by national institutions in Honduras and Guatemala where the concepts of SIGIT have been mentioned as the basis for future land administration systems.

ACKNOWLEDGEMENTS

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BIOGRAPHICAL NOTES

Jan Koers holds a MSc in Geographic Information Systems, from Salford University, GB. He worked in local government administrations and in the private sector in the Netherlands and in international consultancy for Kadaster International in Central and South America. He specializes in project management, the design and implementation of geographic information systems, and information management in the domains of Land Administration and Cadastre, Topographic Map Production, Development Planning, Urban and Rural Planning, Spatial Analysis, GeoStatistics and Integral Municipal Management.

Rodimiro Cerrato Espinal holds an MSc in Computer Science, with a minor specialty in Geographic Information Science, from University of Minnesota, US. He has extensive experience in enterprise application software development in several programming languages on many platforms. He is expert in spatial data management and the architect of the Integrated

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Land Management System (SIGIT) in Honduras. He also worked with the development of SURE, the national registry system managed by the Land Administration Project of Honduras (PATH). He is designer and developer of a system enabling onthefly advanced promotion deployments accessible through SMS codes to cellular subscriptors.

Christiaan Lemmen holds an MSc in Geodesy from Delft University of Technology, the Netherlands. He received a PhD from the same University for his thesis 'A Domain Model for Land Administration'. He is sr geodetic advisor at Kadaster International and visiting Assistant Professor at Twente University (Faculty ITC), the Netherlands. He is chair of the Working Group 7.1 'Pro Poor Land Management' of FIG Commission 7, and contributing editor of GIM International. He is director of the FIG International Office of Cadastre and Land Records, OICRF. He is one of the co-editors of ISO 19152 (together with Uitermark and Van Oosterom).

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