Development of a Cadastral Infrastructure
Case study “National Cadastre in Guatemala”

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by

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DEDICATION

To my mother,
the source of inspiration in my life.
As time has passed by when for more than a century, the Republic of Guatemala was founded by decree on May 21st of 1847, our lands have been essential to derive benefit from entries like the tourism industry, the coffee plantation, the banana production, corn, cotton, etc., promoting a growing economy to take the country to participate in the progress of the world globalisation process. This phenomenon is not exclusively economic, but penetrates in all the boundaries of life of towns and communities.

In 1996, the Peace Agreement was signed in our country prioritising among others, the indigenous subject, and the possession of land. According to this, the fair distribution and tenancy of land is one of the solutions for peace in the country.

Within this framework the Government has started a Land Administration program in which one of the commitments is to establish an efficient decentralised multi-user land registry and cadastral system, financially sustainable and subject to compulsory and easy updating.

As part of the economic process, the necessity to establish a Cadastral Infrastructure becomes each day more important, with the principal objective of promoting the development of people and the whole country. The use of tools, methods and concepts including Geographic Information Systems, Geoinformation management, Business process, Geoinformation infrastructures, and interoperability and exchange of geospatial information are key issues for that purpose.

The present work is aimed at first, to identify the process flow among the stakeholders of the cadastral infrastructure. Second to revise the business processes of the ongoing cadastral process in Guatemala using modelling and reengineering techniques to determine the framework model for the infrastructure. And third: to develop an exchange mechanism between the Cadastre and the National Property Registry through the sharing of data that OpenGIS approach provides.

The research concludes providing some main guidelines for implementing the development of the cadastral infrastructure in Guatemala.
Quiero agradecer a Dios, que con su divina sabiduría me concedió el don del discernimiento, para que desarrollara y llevara a feliz término esta formación profesional. Sobre todo, quiero agradecerle por haber puesto, en los momentos precisos, a todas aquellas personas que de una u otra forma contribuyeron para la elaboración de esta tesis.

A cada uno de ustedes, por su colaboración, hoy esta tesis es una realidad.

Thanks to God, that with his divine wisdom the gift of discernment was granted to me, because of him I was able to pursue this study during the last eighteen months. He put the right persons at the precise moments, who contributed for the success of this research in one or another way.

To each one of you, for your support and collaboration this thesis is a reality today.
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CHAPTER 1
Introduction

“...Only with the Cadastre we will be able to begin the ordering of our country in its agrarian reality. Only with Cadastre we will be able to know where we are, which our problems are and how better rights can be built.”

Carlos Cabrera, Director of UTJ-Protierra-Guatemala (2000)

1 BACKGROUND

1.1 General Overview

According to the “Acuerdos de Paz” [Peace Agreements] signed in 1997, the fair distribution and tenancy of land is one of the solutions for peace in the country, for that reason several measures have been taking place, one of them is the creation of the Technical & Legal Unit of the Inter-Institutional Commission for the enforcement of the Land Tenancy [UTJ PROTIERRA] headed by the Agricultural Ministry [MAGA]. The main purpose of UTJ is to create a Cadastral Information Registry –RIC– at National level (in the long term) that will help to regulate the tenancy of the land in the future. This system should be designed to be a decentralised multi-user land registry and cadastral system, financially sustainable and subject to compulsory and easy updating.

The National strategy well known as the “Herradura” involves a big number of institutions as can be seen in Figure 1.1. Nowadays UTJ is a government unit under the PROTIERRA and is in charge of co-ordinating the efforts towards a participatory approach to build through exchange of information a working relationship among institutions. All the institutional guidelines and policies are provided by MAGA.

Although there is a political willing and a national commitment of Top Managers (ministers and heads of institutions) there should be a strategic planning and clear definition of requirements.

The foreseen cadastre is intending to include the Property Registry’s ownership data and the Cadastral survey Registry to be the base for a multipurpose long term vision.
Parallel to the cadastral project started, a pilot project was initiated in different regions of the country executed by UTJ. Expert consultants of donor countries of the international community also assist these with their expertise. These regional projects were established with the idea of testing the technical methods and administrative procedures and regulations and give the experience for the national model currently developed by the UTJ. They are already making progress and, although there is not a revised policy process of integration or evaluation, there are some impulses coming from these regional projects, which are leading to and already led to the formulation of norms and procedures. These norms and procedures after approval should be applied in the regional projects.

1.2 Key organizations involved

1.2.1 Central Project (UTJ- PROTIERRA)

The Ministry of Agriculture through Technical/Juridical Unit (UTJ) as a coordinator between the PROTIERRA and other players, is responsible for the establishment of a national Cadastre.

Pilot Projects

After the UTJ-PROTIERRA project was initiated, a pilot Project started in different regions of the country and count with the co-operation of the international community according to the region, these projects intend to obtain experiences and give the basis for the implementation of the cadastre at municipal level and the basis for the normative in the national level. The regions to cover are mentioned as follow:

Petén. In the northern region of the country a project was initiated, supported by a grant of the World Bank.

Zacapa-Chiquimula. Sponsored by the Government of Netherlands, a four-year project for the cadastral establishment in two departments has been signed.

Sacatepéquez. A contract was signed to hire a private company to develop a cadastral project in one municipality of this region sponsored by the European Community. It was a closed contract in which the result was a digital visualisation of the cadastre on this municipality but applying the model and techniques of the company hired.

Costa Sur. A project sponsored by the Government of Sweden that aimed the transformation and updating of cadastral information established in the late 60-ies and early 70-ies in this part of the country.

Verapaces. The Government of Germany supports this project in the technical assistance for two departments. This has been created to assist the UTJ in the formulation of a concept for the nation-wide implementation of the cadastre.

1.2.2 General Property Registry (RGP)

The RGP is a public institution, and its records may be consulted by anyone. Constitution, the RGP must be organised so that there exists in each department or region both a property registry office and corresponding fiscal cadastres. Currently, two main offices comprise the RGP, one in Guatemala City and the other in Quetzaltenango.
Guatemalan law permits citizens and foreigners as well as juridical persons to register rights and interests in real property at the RGP. The inscription in the RGP is not obligatory, resulting the unfortunate situation that it is difficult a) to keep it up to date, and b) complete (as far as we talk about the rights pertaining to land registered in the RGP).

Currently the traditional manual process is being replaced by an automated registry system that makes use of electronic "books"-computer database records- to track rights and interests in real property and also visualisation of the “fincas” via Internet.

1.2.3 National Geographic Institute (IGN)
The IGN ("Instituto Geografico National") is at the centre of the mapping effort. Formerly a military agency, the IGN since the peace accords has been a civil agency open to the public. The focus of its work is on the gathering of geographic information, which can then be used to create accurate maps. Formerly the IGN has been in charge of the cadastre but due to the scarce of resources it is not decided that this institution will be the one in charge in the future.

1.2.4 National Land Fund
This fund is used to finance purchases of land by campesinos and others who meet the project's criteria. The National Land Fund ("Fondo de Tierras"), also a component of PROTIERRA, is charged with co-ordinating and financing this process.

1.2.5 National Disputes on land Office (CONTIERRA)
The Dependencia Presidencial de Asistencia Legal y Resolución de Conflictos Sobre la Tierra was created to help resolve land-related disputes in an effort to comply with the spirit of the Peace accords. This national agency is specifically charged with opening constructive dialogue and facilitating the resolution of land conflicts between disputing entities.

1.3 Prior Work
Since the 60-ies a lot of cadastral projects had begun all across Guatemala but, since they didn’t have clear directions and were not included in a national policy with the support and collaboration of all the potential users of the information, they haven’t succeed.

The Peace Accords brought a new approach to the land issue, and in 1997 the Government of Guatemala adopted a broad national program on land administration and land management (Tema Tierras). It includes: the establishing of a cadaster and the modernisation of the Land Register; the strengthening and reorganising of the national mapping; the establishing of an entity for solving land conflicts; the reforming of the system and organisation of land and property taxation, and the establishing of a land fund and other measures for rural development.

Although only a few have been developed focusing in Latin America region A lot of research studies about the development of strategies on how to implement cadastral systems or improve Geoinformation production agencies had been going on at the International Institute for Aerospace Survey and Earth Sciences (ITC). Although only a few have been developed focusing in Latin America region. These studies have been reviewed in this framework.

1. Development of a strategy for re-engineering parcel-based Information system in Bhutan, by Dorji Tshering. This work is mainly focused in the reinvention of the land information system in Buthan based on the study of the user needs to generate the appropriate strategy to implement such a system.
Chapter 1. Introduction

2. Strategic Dependency analysis for land administration organisations, by Abukari Abudulai. This work makes a study of the nature of the relationships and interrelationships of the cadastral and land registration system and its stakeholders.

3. Applying concepts of Business Process Redesign and operations management in a Geoinformation production organisation by Luz Rocha Salamanca. In this research some alternative strategies are proposed to improve the competitive power of the organisation applying some concepts of BPR and operations management.

4. A structured Methodology and Implementation strategy for Business Process Reengineering in GeoInformation Production, by James Samuel Karioki. This research analyses within the framework of BPR methodologies, the procedures for formulating a strategic plan at the organisational and business levels and proposes process optimisation using simulation as a way of achievement benefits for a reengineered organisation.

2 ANALYSIS OF GUATEMALA CADASTRAL PROJECT

2.1 Research Problem
According to some of the key problems and issues of cadastral reform (Williamson, 1994) and the paragraphs above can give a good illustration of what the problematic of the process is, and that is affecting at the same time at institutional, organisational and operational levels.

Guatemala, however, lacks a current cadastral map. Nowadays there is not a formal Cadastral Information System within the framework of an Infrastructure where, the needs for the cadastral information and the specific outputs can be identified clearly. The legal bases are still in previous phases to become a law; and the technical procedures are in the validation process. It could be added that the deficiencies in planning and monitoring leads to another part of the problem – UTJ has not yet started to systematically generate the experiences from the various regional projects in order to complement the set of norms and procedures for the Cadastre.

This research focuses on the need of identification of the users and requirements from these users of the Cadastral System in Guatemala, as well as the generation of optimal processes within the Cadastre that support efficiently the shareability and exchange of information among organisations.

In this framework is necessary to create the framework to implement local and national infrastructures which will create links among organisations to exchange and share information and produce accurate and on time products for the users of the Cadastre.

2.2 Research Objective
This research will concentrate on the generation of recommendations for the development of a Cadastral Infrastructure that supports the implementation of Land Administration System. Aiming to identify and revise the current processes and provide with a re-orient them to provide a clear reason for founding the whole process firmly, thus providing a far better basis for a customer oriented and efficient system. In order to obtain this it will be necessary to cover the following objectives:
2.2.1 To find the requirements that justify the existence of the SIC in terms of information needs from the users (stakeholders).

2.2.2 To redesign the current processes used to implement the cadastral infrastructure and generate the process flow for them.

2.2.3 To identify an approach to exchange information between the Cadastre and the organisations involved.

2.3 Research questions

Who are the potential users-providers of information provided by the Cadastre?
What are the requirements (needs) on cadastral information that can be required from a National Cadastral Organization? What necessities for co-operation can be identified?
What is the current situation for the National Cadastre in Guatemala?
How is the relationship between the National Cadastre in Guatemala and the General Property Registry?
What are the opportunities and threats within the external environment of the Project in Guatemala? What are the strengths and weaknesses within the internal environment of the Project in Guatemala?

What are the business processes currently used to establish a cadastre in Guatemala?
How to model the processes and activities?
What could be a design and redesign scenario for the business processes of Cadastre?

In the case study (exchange information between SIC-RGP) What is the relevant information to share from the SIC to other organisations and viceversa? How to implement a mechanism to share information among organisations?

What conceptual framework is necessary to implement a National Cadastral Infrastructure (the redesigned scenario) in Guatemala?

3 RESEARCH METHODOLOGY

The research methodology is based on the accomplishment of the following tasks: (see Figure 1.2)
Chapter 1. Introduction

3.1 Review of literature including internet sites on relevant concepts such as:
- Strategic management on cadastral issues
- Development of operational strategies
- Situation Analysis (Environmental scanning, SWOT Analysis)
- Development of Cadastral Systems
- Process Modelling
- Business Process Redesign
- Client/server technology and distributed databases
- Open systems and OpenGIS. Internet GIS
- Guatemalan literature on the establishment of the National Cadastre.
- Cadastral Draft-law
- Civil code related to land tenancy in Guatemala
- Peace Accords of Guatemala, 1996
- Legislature on land and agrarian issues of Guatemala

3.2 Description and analysis of current situation of National Cadastre in Guatemala.
This phase covers the study of the UTJ-Protierra Cadastral process and the status of the five Pilot Projects; the current situation of the system of the National Property Registry and the rest of organisations involved in the “Herradura”.
The information is going to be collected in Guatemala at the local offices of each institution.

3.3 Analysis of the information collected.
This phase compiles all the information collected during the fieldwork and the literature review and generates the situation analysis of the UTJ-Protierra. This includes the generation of user requirements and needs. The current Cadastral process model is explained.

3.4 Formulation of new scenario for the Cadastral System.
During this phase, a redesign scenario is created and modelled for the Cadastral system in Guatemala.

3.5 Creation of the mechanism to exchange information between the RIC and organisations of the “Herradura”
For the purpose of the case study, this phase develops a mechanism through the use of Internet technology, that demonstrates the shareability of the cadastral information produced and used by the RIC and the rest of institutions involved in the “Herradura”.

3.6 Formulation of Infrastructure.
Rationale for the implementation of the Cadastral Infrastructure in Guatemala, integrating the new scenario for the Cadastral process and the exchange mechanism.

4 THESIS CONTENTS
Following, a brief description of the contents of each chapter presented:

CHAPTER 1. Introduction.
Gives a general overview of the research and presents its problem and objectives, as well as the research questions, methodology, prior works and the main structure of the thesis.

CHAPTER 2. Development of a Cadastral Infrastructure - Theoretical foundation-
Reviews the main concepts related to: Cadastre in the framework of Land administration, Business Process Redesign, Situation analysis Process Modelling, Geospatial Data Infrastructure, interoperability and exchange of information through open systems.

CHAPTER 3. Present situation of the National Cadastre in Guatemala.
Chapter 1. Introduction

Provides the reader background of the current situation of the Cadastral Process and analyses the “AS-IS” situation. Includes the analysis of the fieldwork in UTJ-Protierra in Guatemala. The situation analysis outlines the identification of the information requirements for the Cadastral Infrastructure as a fundamental necessity for establishing this particular type of Infrastructure, as well as the current activities and main challenges that are carried out to support the cadastral establishment.

CHAPTER 4. Modelling Cadastral Processes and their Infrastructure.
This chapter introduces the fundamental processes of a cadastral infrastructure and provides a new scenario to improve the processes in which the organisations are involved in the retrieval or provision of data. Also the infrastructure framework is defined explaining what issues are to be taken into consideration to support cadastral activities. Using modelling techniques, a new scenario for the cadastral processes is modelled and proposed.

CHAPTER 5. Mechanism to implement Exchange of Cadastral Information.
Provides the reader with the ideas of exchanging information between organisations within the concept of data sharing at different levels. The model to exchange cadastral information between the RIC and the RGP is developed as an example of the case study. Finally, it also outlines the “know how” in terms of general recommendations to implement this Infrastructure.

CHAPTER 6. Conclusions and Recommendations.
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CHAPTER 2
Development of a Cadastral Infrastructure –Theoretical foundation–

“...The resulting cadastral infrastructure will facilitate access to land, support security of tenure and allow land rights to be traded, where appropriate, in an efficient and effective way and at affordable cost.”

The Bogor Declaration (1996)

2.1 Introduction

The creation of a formalised Land Administration system [LAS] is one of the main problems in the agricultural and urban sectors for all countries in Latin America, particularly for Guatemala after the 30 years armed conflict. This is also due to many other factors; among them are the uncertainty of ownership, the fast growth of urban cities, the informality of settlements and the lack of understanding of the cadastral concepts that are embedded in the context of Land Administration.

Cadastral systems as a critical component of land administration systems, are continually evolving as society’s attitudes and relationships to land change. It is necessary to produce and supply timely and at affordable cost, cadastral data in the context of an infrastructure so the land administration systems that support decision-making, primarily in support of sustainable development, will remain relevant.

In order to create a cadastral system, an appropriate infrastructure is important and this includes such as institutional policies, legal frameworks, partnerships and networked environment. A good cadastral system consisting of administrative and spatial data is closely linked to the land administration context.

This chapter introduces the fundamental concepts of Cadastre as a business process and as a component of a Land Administration System, within the concept of a cadastral infrastructure, reviews techniques for the improvement of cadastral processes and the interoperability among organisations responsible of sharing cadastral information.

2.2 Land Administration systems

2.2.1 General description and trends

According to the UN Guidelines (1996) Land Administration concerns the processes of recording and disseminating information about the ownership, value and use of land and its associated resources. There are three important elements to manage land, the first is to count with information about land; second to have clear policies on how land should be managed; and third is to motivate the participation of everyone with an interest on stake in the land to provide with source information.

Ting and Williamson (1999) relate Land Administration with current global drivers, such as sustainable development, globalisation, economic reform and information technology revolution. Lately, Williamson (2000) has related another driver that is urbanisation, which represents actions to solve the fast change of the formal and informal tenure in cities.

Sustainable development means development that effectively incorporates economic, social, political, conservation and resource management factors in decision-making for development. The challenge of balancing these competing...
factors in sophisticated decision making requires access to accurate and relevant information in a readily interactive form.

In delivering this objective, information technology, spatial data infrastructures, and land information business systems will play an important role. In this sense Cadastres may also be used in a multi-purpose role to provide a wide range of land related information.

Sustainable development is also linked to globalisation. Globalisation means the process of societies to become more interconnected from a social, economic and political perspective. This process includes events in one part of the world that have more potential to impact on peoples and societies in other parts of the world. This trend widens the perspectives from the local to the global level.

The globalisation of markets has in turn influenced micro-economic reform. This represents the initiatives of change from the institutional and governmental side. This includes initiatives such as privatisation, decentralisation, downsizing, cost recovery, quality assurance, public/private partnership, and other policies to ensure service delivery and cost effectiveness. According to Enemark (2000) these initiatives have changed the focus from the pure technological issues to include also managerial components of building and maintaining national spatial data infrastructures.

The information technology revolution with the technological development such as digital cadastral databases and the WWW are vital tools for land administration and planning both now and into the future. In Ting and Williamson (1999), it is mentioned that the advances on technology had influenced the management of land through the large spatial database management, GPS technologies and high-resolution satellite imagery, GIS technologies, and communication technologies such as the WWW.

2.2.2 Land Information Management System
A Land Information system is a combination of human and technical resources together with a set of organising procedures that produces information in support of some managerial requirement. (Dale & McLaughlin, 1990) A land information system gives support to land management by providing information about the land, the resources upon it and the improvements made to it for the purpose of land administration while implementing land management.

A Land Information Management System [LIMS] in the context of Land Administration Systems consists of a number of broad dimensions, firstly an institutional element, which includes a corporate structure in terms of policies, legal framework etc. Secondly, it consists of a set of organising procedures, which structure the relationship among the functional components and thirdly, a technological dimension that includes hardware and software. Fourthly, it includes a platform or a resource-base, on which data are stored and from which meaningful land information can be produced, analysed and disseminated. Finally, it includes an explicit, or implicit, policy towards users, transparency, information dissemination etc.

2.2.3 Cadastre and Land Registration
According to the definition of Cadastre 2014, Cadastre is a methodically arranged public inventory of data concerning legal land objects within a certain country or district, based on a survey of their boundaries. The outlines or boundaries of the property and the parcel identifier are normally shown on large-
scale maps, which, together with registers, may show for each separate property, the nature, size, value and legal rights associated with the parcel.

According to what is being discussed above, the cadastre is a part of a land information system and joint with other land management systems as taxation, land use and environmental are held in a Land Information Management System [LIMS]. In Figure 2.1 is shown how these systems are related to each other and together with the creation of open and transparent institutions, organisations, resource management, technology and adequate platforms are held in a country land administration system.

In this context, land administration **institutions** are “the rules of the game” in a society. These include the laws and regulations necessary for creating property rights, and the associated restrictions and requirements imposed by the state or the community (Williamson, 2000). The **organisations** are at operational level, the bodies involved with the information transactions. Like van der Molen mentioned (2000) “…It is not worth it to have an organisation if there are not clear, transparent and simple institutions”.

The land administration **infrastructures** may be described as the organisations, standards, processes, information and dissemination systems and technologies required to support the allocation, transfer, dealing and use of land. **Information technology** will play an increasingly important role both in constructing the necessary infrastructure and in providing effective citizen access to information.

The cadastral systems comprise a land registration system and a cadastral survey and/or mapping system as key components. The **cadastral survey** comprises processes such as the control of geodetic data, parcel demarcation and surveying, cadastral mapping, cadastral mutation and map updating. As Zevenbergen and Bogaerts (2000) mentioned, **land registration** is the process by which the documentation affecting interests in land are recorded in a public register. This is the official legal registration of properties and legal rights.

In some countries like Guatemala, the land and the cadastral registration are separated processes, even though the cadastre is still under the phase of establishment. In an ideal situation, the main task of the cadastre is the setting down on the basis of the existing or expected legal situation of parcels, which are represented on a large-scale map with a parcel identifier. This identifier is used in
the land property register to indicate the legal object and relationship with the
owner (subject).

According to Tuladhar (2000) the term Cadastre includes different types of
purposes such as Juridical: a register of ownership of the proprietary land
parcel; Fiscal: a register of properties recording their value to support taxation;
Land use: a register of land use; and when a cadastre serves as a supplier of up-
to-date and reliable land information at an affordable cost, it is then termed as
Multi purpose Cadastre.

The objective of the multipurpose cadastre is to provide a service through which
the dynamics of the land parcel may be studied and also meet the demands of the
evolution of a LAS which means the needs of the users.

2.3 Business Processes within the Cadastral context

2.3.1 General description of a BP

A business process (BP) is a series of activities within the organisation that
produces a product, service or business deliverable of value. Business processes
are identified within the context of the business strategy (Proforma, 2000). In
examining cadastral systems it is more important to examine the key processes
within the systems which are associated with adjudicating, transferring and sub-
dividing land rights, rather than looking at a free standing concept of a cadastre
(Williamson, 1995).

According to Tuladhar (1999) The main processes and sub-processes of the
cadastre can be mentioned: Property Registration: first registration of data,
transfer registration, lease registration, encumbrances registration; appealing on
decisions. Surveying and Mapping: Geodetic control, parcel demarcation and
surveying, cadastral mapping, parcel mutation, map updating. Fiscal
registration: Objects definition, inventory of objects Information exchange: Data
supply to users, data entry to the system, updating and maintaining.

In relation to what has been discussed in the previous sections, a land
administration system may consider the Cadastre system as a whole Business
Process, supported by a robust infrastructure (processes, organisations, IT, etc)
that provide the complete and consistent outputs meeting the user requirements.
Even though some of the processes are performed by different jurisdictions
(Figure 2.2).

Taking into consideration some concepts of architectural modelling (Morales, et
al, 2000) It is possible to depict the cadastre in a top-down fashion through two
stages. In the first stage, the top level, models are used to describe the system and
its external environment. Here, the inputs to the system are analysed in terms of
the functionality, purpose and services to the users. It is very important for the
monitoring of new requirements from customers, new legislation and policies.

In the second stage are shown the detailed components or processes with the
interactions and interfaces, which support the high-level processes of the
cadastre. This conception of infrastructure is going to be explained in further
sections.
2.3.2 Business Process modelling

The key management issues in business modelling are the classic business issues: Who is involved with the process? What are the activities? When are the interactions? Where (location)? Why is the process representative? And how is the flow of information between processes? Answering these questions and modelling the answers will guide process improvements and systems implementation projects.

Modelling techniques are used to develop a level of understanding—a diagram—of the interaction of the parts of a system, and of the system as a whole to reflect component activities, the organisation or job performing the activities, and the flow of work between activities.

In this research the use of dynamic modelling (Radwan, et al 1999) was studied to develop and interpret the current system behaviour through the analysis of the functionalities of cadastral business processes, and to be capable of analyse the findings and design a proposal for a particular process of that system.

From the existing types of models used in business process engineering (Franken et al, 1996) to be mentioned: i) Mathematical model, ii) Business process model and iii) Architectural design model; the last one was studied and is going to be used as a basis for design of the new process within the framework of the cadastral system in chapter 3.

The architectural model is the combination of the structure and functionality of a system, where the role of a part is represented by its functionality (what it does). It consists of creating models of the architecture of the systems being designed. Such models (designs) define explicitly the structure of the system in terms of its parts, and the role of each part to support the purpose of the system (Vissers, et al, 1998).
According to Ferreira (1994) to model system architecture the basic steps to follow are: i) model of the system structure: entities interconnected via interaction points; ii) model of the system functionality: behaviours interacting via interactions; and iii) assignment relation. The models, methods and techniques presented in further chapters allow the author to model the existing processes, analyse these processes, and redesign existing ones.

2.3.3 Business Process Redesign

Once processes are identified they may be redesigned. Business Process Redesign -BPR- demands that organisations transform and reshape themselves to maximise their potential for responsiveness, effectiveness and profitability.

Two approaches can be seen for redesigning business processes. The first is a radical approach where the process is redefined from a conceptual (clean-sheet-of-paper) view. This removes preconceptions that carry over from previous practices. The second approach identifies opportunities for incremental improvement in existing processes. This allows for a smoother evolution of current practices.

Cadastral systems have to be designed within a framework of a long-term corporate strategy, and this can be done through the analysis of the situation of the organisation in relation to the internal and external users, stakeholders and providers of the information. To be able to develop a corporate strategy is necessary to study the strategic factors that affect the organisation’s performance within the internal and external environments.

2.3.3.1 Methodology for BPR

BPR methodologies vary according to philosophical and situational differences. According to the methodology studied during preparation modules, and mentioned in the paper of Morales (2000) only some steps are to be followed for the purpose of this research, to be mentioned:

- **Definition of the organisation as a system.** The current situation of the National Cadastre has to be analysed, identifying the flow of information among the organisations involved. Also the identification of strategic factors as the environmental scanning to generate the SWOT analysis of the organisation. This can be done by using the situational analysis (see section 2.3.4).
- **Identify key processes to be redefined.** The most important processes important to the business vision.
- **Analyze existing processes.** The understanding of the existing processes in order to determine the mistakes and the way to avoid repeating them, and provide a base for future improvements.
- **Redesign and implement processes.** The solution finding. Aligns BPR approach with quick delivery or results and customer satisfaction.

2.3.4 Situational Analysis within the context of BPR

To start this process, according to Hunger & Wheelan (1997) the situation analysis of the organisation has to be studied using the Strengths, Weaknesses, Opportunities and Threats –SWOT- that are strategic factors and, as a result an analysis of those to generate alternative strategies. For this research, the SWOT Matrix of the case study is discussed in chapter 3. From the result of this
analysis, the alternative strategies are important factors to identify the areas where the organisation has to improve or change the business processes.

2.3.4.1 SWOT analysis on the present system

To generate the SWOT analysis of the organisation is necessary to elaborate an environmental scanning of the external environment to identify opportunities and threats and its internal environment for strengths and weaknesses. It will permit the identification of possible strategic alternatives to improve the current situation of the process.

a. External environment

It covers political/legal, economic, technological and socio-cultural forces. The external environment includes analysing factors, which are considered as opportunities or threats and also general forces/trends within societal environment.

After recognising the external environment for any organisation and considering these factors, they have to be analysed together in external factor analysis summary, the respective rating and overall performance of the organisation are indicated here. Table 2.1 depicts an example applied to UTJ on how to create and EFAS matrix.

<table>
<thead>
<tr>
<th>EXTERNAL STRATEGIC FACTORS</th>
<th>WEIGHT</th>
<th>RATING</th>
<th>Weighted Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Opportunities</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increasing demand for establishing the land registration for the whole country due to the peace accords commitment. Political support</td>
<td>0.75</td>
<td>3</td>
<td>2.25</td>
</tr>
<tr>
<td>Threats</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lack of solid policies in respect of land administration system (RGP-Cadastre)</td>
<td>0.25</td>
<td>2</td>
<td>0.50</td>
</tr>
<tr>
<td>TOTAL</td>
<td>1.0</td>
<td></td>
<td>2.75</td>
</tr>
</tbody>
</table>

Table 2.1 Example of an EFAS Matrix. Source Hunger & Wheelen, 1997

The opportunities and threats are weighted based upon the strategic position of the organisation multiplied by the rating given that corresponds to the organisation’s response to that particular factor. This results in a weighted score for each factor ranging from 5(outstanding) to 1(poor).

The external analysis of the UTJ is developed in section 3.2.3.1.

b. Internal environment

It covers the organisation structure, culture, marketing issues, financial issues, research and developing issues, operation issues and human resources. These factors have either a positive or negative influence on this organisation’s performance, depending on how the management handles each of them.

As a result, an internal factor analysis summary (IFAS) has to be generated such as that given in Table 2.2. This indicates how much these internal factors are important to the organisation and how this organisation is responding to the inherent strengths and weaknesses.

<table>
<thead>
<tr>
<th>INTERNAL STRATEGIC FACTORS</th>
<th>WEIGHT</th>
<th>RATING</th>
<th>Weighted Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strengths</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
There are potential capabilities, resources, products and services among units. | 0.35 | 3 | 1.05
---|---|---|---
**Weaknesses**
Lack of business planning experience and business management approach. | 0.65 | 2 | 1.30
---|---|---|---
**TOTAL** | 1.0 | 2 | 2.35

Table 2.2 Example of an IFAS Matrix. Source Hunger & Wheelen, 1997

The strengths and weaknesses are weighted based upon the probable impact of the organisation multiplied by the rating given that corresponds to the organisation’s response to that particular factor. This results in a weighted score for each factor ranging from 5(outstanding) to 1(poor).

The internal analysis of UTJ is developed in section 3.2.3.2.

c. **SWOT analysis results**

After scanning external and internal environment and defining how much the organisation is influenced by them and for what extend it responds to different factors as indicated before. There must be new thinking in the management level to take the advantage of the opportunities to make use of the strengths and minimise the weaknesses, and also, strategies to use the strengths to avoid threats or minimise weaknesses. (See Table 2.3)

<table>
<thead>
<tr>
<th>Strengths &amp; Weaknesses</th>
<th>Opportunities &amp; Threats</th>
<th>Opportunities</th>
<th>Threats</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Strengths</strong></td>
<td></td>
<td>1. Increasing demand for establishing the land registration for the whole country due to the peace accords commitment. Political support.</td>
<td>1. Lack of solid policies in respect of land administration system (RGP-Cadastre)</td>
</tr>
<tr>
<td>1. There are potential capabilities, resources, products and services among units</td>
<td><strong>SO Strategies</strong></td>
<td>Establish agreements among organisations to foment co-operation in order to share vital framework data for the cadastral infrastructure.</td>
<td><strong>ST Strategies</strong></td>
</tr>
<tr>
<td><strong>Weaknesses</strong></td>
<td><strong>WO Strategies</strong></td>
<td>Revision of the staff business plan to make an organised distribution of tasks.</td>
<td><strong>WT Strategies</strong></td>
</tr>
<tr>
<td>1. Lack of business planning experience and business management approach.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 2.3 SWOT Matrix adapted from Model Extracted from Hunger & Wheelen (1997)

The results from the EFAS and IFAS tables are listed in each block and analysed to generate a series of possible strategies for the organisation.

The SWOT Matrix helps to identify the alternative strategies that are necessary in the organisation and the possibility to apply improvements or simple modelling in some of the business processes. For UTJ analysis the SWOT matrix is develop in detail in section 3.2.3.3.

**2.4 Cadastral Infrastructure**

The Bogor declaration (UN, 1996) agreed on the following cadastral vision, “...to develop modern cadastral infrastructures that facilitate efficient land and property...”
markets, protect the land rights of all, and support long term sustainable development and land management”.

A cadastral infrastructure may be described as the processes, organisations, and standards, information and dissemination systems and technologies required supporting the allocation, transfer, dealing and use of land. One of the major challenges will be to build an infrastructure that is sufficiently robust to, amongst other things, effectively support the goal of enhancing security and access to credit, while the same time being sufficiently simple and efficient so as to promote and sustain widespread participation.

Information technology will play an increasingly important role both in constructing the necessary infrastructure and in providing effective citizen access to information. Finally there must be total commitment to the maintenance and upgrading of the land administration infrastructure.

Usually a cadastre is managed by one or more government agencies, therefore it has to be designed with the increased emphasis on strengthening infrastructure to avoid duplication of efforts and make them effective in a sustainable way.

When we talk about information infrastructure, we think issues like common resources, shareability of data, interoperability, communications, partnerships, etc. Since many different users often need information about land parcels, a unified cadastre helps to avoid duplication and assists in the efficient exchange of information. In some countries, like most of the Latin american countries where the cadastre and land register are administered separately, co-operation between the two is of particular importance.

Land records processes, like many processes, which cut across traditional organisational boundaries, are highly fragmented with many agencies capturing duplicate information and performing related tasks with little or no inter-agency communication.

The primary objective of a national spatial data infrastructure is to ensure that users of geodata who require a national coverage, will be able to acquire complete and consistent datasets meeting their requirements, even though the data is collected and maintained by different jurisdictions. The issue, therefore, is to determine what is required of jurisdictions and their datasets, to enable them to meet national needs. (Anzlic, 1996)

One important development is the recognition that a cadastral infrastructure comprises people, a clearinghouse/access network, technical standards, an institutional framework and framework data as can be seen in Figure 2.3. The framework data includes a spatially referenced framework that should be developed which can be understood and used by a wider range of stakeholders and decision-makers, with visualisation being a core component of such a framework (Fourie, 1998).

Taking into consideration what is stated in the Bogor Declaration (1996) on the cadastral vision of the 21-century, and what is stated in the Bathurst declaration (1999) this so-called “cadastral infrastructure” has to count with a legal, technical, administrative and institutional framework that evolves with the population’s growth to be able to meet with new needs and technologies.

The inherent relationships between the infrastructure and the business process in the business-infrastructure model provide a broad framework for any land administration system development.
Different literature have been reviewed and all refer to the requirements that should be consider when a cadastre is setting up, summarising all of those the following subsections will mention some of the main requirements that must be considered for a cadastral infrastructure:

2.4.1 Institutional Framework

Based on the assessment of user requirements, this framework defines the policy and administrative arrangements for building, maintaining, accessing and applying the standards and datasets. Comprise the legal and organisational arrangements to develop the appropriate communication and co-operation between stakeholders.

According to Fourie (1998) government’s major responsibility in spatial information and survey should be in creating the frameworks that facilitate decision-making. The frameworks that should be put in place include a:

- Institutional co-ordination improved through a Stakeholders’ Forum, to create the policies and climate for the Cadastral system; User requirements analysis;

- Spatial framework that all stakeholders can share –i.e. a graphical framework in the form of base maps, based where possible on the geodetic framework-;

- Regulatory framework that caters for coherent legal guidelines for the protection of society interests on land;

- Communications system between the national, regional and local areas.

Linkages should be created by technical agencies between the cadastral system and other land information systems, so that comprehensive information can be provided from a central office, to minimise overlaps, duplication and inconsistencies. For this, it has to be a main body that its main task is to manage the geoinformation infrastructure at the governmental, municipal and enterprise level for cadastral purposes and for different users.

According to Fourie (1998) this main body associated with the Stakeholders’ Forum should be in charge of producing and disseminating technical information such as:

- Norms, standards, specifications;
- Scales of information at different level;
• Assistance to users to identify their needs;

This should be done by, among other things, creating good partnerships between different institutions, first institutional links followed by technical links. By addressing institutional issues first, the costs associated with computerisation can be avoided in the short to medium term. However, at the same time the ground is being prepared for efficient and effective computerisation once the institutional linkages are in place.

2.4.2 Technical Framework

Defines the technical characteristics of the fundamental datasets, as data standard, spatial reference network, base map design, assignment of parcel identifier and other linkage using appropriate technology, such as a clearing house where the fundamental datasets are made accessible to the community of users, in accordance with policy determined within the institutional framework, and to the technical standards agreed.

As is mentioned by Groot (2000) there are two main issues to take into consideration when a technical perspective is given to the fact of putting together data from different stakeholders; from one hand resolving the heterogeneity problems of databases of the different parties involved in a GDI developed independently is the major challenge and from the other hand the communication between different applications between systems (inter-operability).

2.4.2.1 Heterogeneity in distributed systems

According to Bishr (1997) interoperable geographic information systems should be independent and yet can transparently communicate at a high level of semantics. Heterogeneity mainly arises when two or more systems are intended to share spatial information.

There are three different types of heterogeneity of databases presented by (Saltor et al., 1993) to be mentioned:

**Syntactic:** each database may be implemented in a different Data Base Management System [DBMS] with a different data model. Is also related with the geometric representation of geographic objects.

**Schematic:** where objects in one database are considered as properties or metadata in the other, or object classes of the same real world entity have different hierarchies and descriptors in different databases.

**Semantic:** a real world entity may have two different meanings in their underlying databases in order to serve various applications, giving as a consequence semantic conflicts.

For resolving the aspects of heterogeneity in the databases supporting the cadastral infrastructure, some concepts of interoperability and open systems were reviewed and shown in the following sub-sections.

2.4.2.2 Interoperability

Inter-operability is the ability for a system or components of a system to provide information sharing an inter-application co-operative process control (Groot, 2000). It refers to the ability of two or more systems (computers, communication devices, databases, GISs, networks, and other
information technologies) to interact with one another and exchange data according to a prescribed method (Bishr, 1998).

For data exchange and system integration in a multipurpose cadastre vision, which is the aim of the cadastre in Guatemala, the most important tasks are standardisation and specification for the setting up of such an infrastructure to enable the integration of data sets and the flow of information between stakeholders.

For data exchange it is necessary to have co-operation among the organisations responsible of the data that must be included. A representative technical group has to be conformed in order to work together and set up the structure and specifications to make data exchange possible.

According to Bishr (1997) GIS interoperability means that users can transparently access and share remote spatial databases and other spatial services, regardless of their underlying GIS platform.

Key issues of interoperability are the simplicity and transparency, coordination and co-operation among the parties involved.

Integrating data related to cadastre from various sources is increasingly important because of the necessity to provide reliable and up-to-date information to the customer.

2.4.2.3 OpenGIS

The OpenGIS Consortium [OGC] promotes a business and technology oriented approach for the exchange of spatial information, by providing interoperability between heterogeneous information systems. Currently is developing software specifications known as the Open Geodata Interoperability Specification (OGC, 1998) that focuses to the technical descriptions of the new geodata types and provides the specification of a software framework for distributed access to geodata and geoprocessing resources within an open information technology foundation.

Nevertheless, in this study the researcher is going to describe the topics of the OpenGIS specification without going into detail about each topic.

The OpenGIS specification framework includes:

**Open geodata model** (OGM), a common means for representing real world phenomena, mathematically and conceptually. Provides a set of primitive data types organized to enable any geoprocessing system to communicate with any other system through a shared interface that uses this geodata model.

**OpenGIS service model**, a common specification model for implementing services for geodata access, management, manipulation, representation, and sharing among information communities. It is a client-server model.

**Information communities model**: a framework for using the open geodata model and the OpenGIS service model to solve not only technical problems, but also the institutional problems.
The technology provided by OpenGIS is built upon the assumption that users are aware of the schemas, terms used and correct interpretations of underlying databases. Hence the importance of establishing the institutional framework before the technical solution.

The abstract specification is often called the (initial) architecture of the system and it is divided into 17 topics as shown in Table 2.4.

<table>
<thead>
<tr>
<th>Number</th>
<th>Topic Name</th>
<th>Number</th>
<th>Topic Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Overview</td>
<td>9</td>
<td>Quality</td>
</tr>
<tr>
<td>1</td>
<td>Feature Geometry</td>
<td>10</td>
<td>Transfer technology</td>
</tr>
<tr>
<td>2</td>
<td>Spatial Reference systems</td>
<td>11</td>
<td>Metadata</td>
</tr>
<tr>
<td>3</td>
<td>Locational geometry</td>
<td>12</td>
<td>OpenGIS Service Architecture</td>
</tr>
<tr>
<td>4</td>
<td>Stored functions and interpolation</td>
<td>13</td>
<td>Catalogs</td>
</tr>
<tr>
<td>5</td>
<td>Features and feature collection</td>
<td>14</td>
<td>Semantics and information communities</td>
</tr>
<tr>
<td>6</td>
<td>The coverage type</td>
<td>15</td>
<td>Image exploitation services</td>
</tr>
<tr>
<td>7</td>
<td>Earth imagery</td>
<td>16</td>
<td>Image coordinate transformations</td>
</tr>
<tr>
<td>8</td>
<td>Relations between features</td>
<td>17</td>
<td>Location services</td>
</tr>
</tbody>
</table>

Table 2.4 Current topics of the OpenGIS Abstract Specification.

For any detail on the topics of the OpenGIS Abstract model can be downloaded from the Internet (www.opengis.org).

Within the scope of Geoinformation management this specification provides flexibility to among others: access and distribute geodata, choose appropriate platforms, integrate geographic data and processing into a corporate computing architecture. The last one is going to be the focus on Chapter 5.

2.4.3 Fundamental Datasets
The Fundamental data for the establishment of a cadastre have to be produced within the institutional framework and fully comply with the technical standards. The core or foundation data that is going to be considered can be mentioned:
- Geodetic Reference framework.
- Topographical base.
- Existing cartographic base maps.
- Ortophoto and Aerial Photography.
- Socio-economic data of the cadastral area.

2.4.4 Human Resource
Comprises the education, attitudes and skills framework for individuals working in this infrastructure, the “Peopleware”. For Human Resources management
within the context of an infrastructure and a learning organisation, it will be important to have in mind the following aspects:

- Guidance on Top management team
- Guidance on user team
- Guidance on construction team
- Personnel for Implementation and Maintenance
- Human Resources Direction and Management
- Learning Curve Processes

This topic is not going to be subject of detail study in this research, since the focus is the study of the processes and functionalities within the context of the infrastructure.

The development of such an infrastructure especially in many developing countries is difficult and affected by many factors, including technological development and business needs as well as other significant factors such as political decisions and government policy.

### 2.5 Concluding Remarks

Cadastral systems are the main part of an infrastructure supporting Land Administration in a country. In a cadastral infrastructure, it is necessary that all the components interact effectively according to an appropriate set of rules; healthy institutional linkages through clear policies, strong partnerships and the appropriate standardisation of technical aspects.

Land registration and Cadastral systems in developing countries need to be decentralised in order to facilitate local land management and information currency, otherwise they become too expensive and/or fall into disuse.

Sharing information by providing interoperability between systems can improve decision making and reduce the cost of data collection. OpenGIS removes geoprocessing barriers to interoperability.

In this chapter all the terminology and approaches for some of the concepts were revised and explained, in order to be able to establish the managerial framework of a cadastre, comprising concepts and technology to build a robust infrastructure capable of satisfy users and providers of Cadastral data, avoiding data and resource redundancy and duplication.
Chapter 2. Theoretical foundation of a Cadastral Infrastructure

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CHAPTER 3
Present situation of the National Cadastre in Guatemala

“...The managers of Land Registry and Cadastre should aim for meeting the demands of the users of their information. The attitude should be characterised by co-operation.”

P. van der Molen (1998)

3.1 Introduction
This chapter presents a view of the continued progress of the creation and implementation of a National Cadastre in Guatemala. It is based on the presentation given by the different areas of support of the UTJ organisation and the different interviews with key personnel during the fieldwork under this research work. It is also based in the personal opinion of the author after a comparison made of the status given in documents and the status given by the interviews.

3.1.1 Background. A new vision to strengthen the tenure of the land
According to the World Bank (1998) in Guatemala, most poverty is rural: poverty afflicts over 75% of the population, 86% of the rural population and 93% of the indigenous population. Land issues are key for poverty alleviation. These issues include: (i) land property rights, which are unclear for most rural population, it is estimated that 95% of rural parcels are not registered, even if not in conflict; and (ii) land distribution.

In the treaty of Peace, December 29 1996 on Social and Economic Aspects and Agrarian Situation the land issue was strongly emphasised. In the paragraph 38 it indicates, “…to establish an efficient decentralised multi-user land registry and cadastral system that is financially sustainable, subject to compulsory updating and easy to update…” according to this, the fair distribution and tenancy of land is one of the solutions for peace in the country.

The time schedule for the implementation and fulfilment of the peace agreement gives a high priority to the land issue. Registration of titles, mortgages etc. was from the start 1877 – in the liberal era- made by a governmental institution, Registro General de la Propiedad (RGP) situated in Guatemala City. As the titles has no legal cadastral reference the quality of the title information gradually has become less secure also to mention that the titles are written in books. Also when it comes to up-to-datedness the information is not reliable.

Different institutions are responsible for cadastral activities but yet there are no regulations defined by law. Over the years this situation has created an intergovernmental confusion about what institution has the responsibility to dictate technical regulations for the cadastral activities needed in the country. Steps towards legislating cadastral information have until recently been taken. At the moment there exists no official cadastral registration in Guatemala.

In 1997 an inter-institutional commission was formed with the task to develop and strengthen rights to land, “Inter-institutional commission for the Development and Strengthening of Land Property Rights” (PROTIERRA) led by the Minister of Agriculture and representation from the following agencies: National Geographic Institute, National Property Registry, Fund of Lands and Conflicts Resolution Office.

PROTIERRA’s nature and mission is clearly established in its creation decree (1997): “...it is a co-ordinating instance for the actions to be executed within the compromises of the government due to the Peace accords related to the land tenancy”.

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The Government of Guatemala is committed to alleviating poverty and consolidating peace by means of several reforms, including those pertaining to land policy. One of the instruments of the land policy reform is the establishment of a National Land Administration Program.

3.1.2 Land Administration Program and Cadastre in Guatemala

The starting Program supports establishing democracy and introducing economic policies, which will foster sustainable growth. The overriding approach to fulfilling the Peace Accord objectives is a participatory methodology that could promote convergence in a society highly fractionated by long-standing perceived conflicts.

Establishing a national land administration program is a long and expensive process, particularly because accurate data ought to be collected at the parcel level, reviewed at several stages to ensure its quality, and maintained. This requires a firm and long-term commitment from the government in accordance with the Peace Accords. The long-term aims of the Program are: i) to increase land tenure security in Guatemala; and ii) to strengthen the legal and institutional framework for land registry and cadastre services nationwide.

3.1.3 Key organisations involved in the Cadastre

PROTIERRA gave to the technical and legal unit (UTJ), a new body, the responsibility for the overall co-ordination of the seven rural programs that constitute the backbone of the land-related peace accords (Figure 3.1). These programs are: i) implementation of national cadastral-based land registry; ii) creation of land fund; iii) development of land conflict resolution mechanisms and provision of free legal services; iv) implementation of a national geographic information system; v) development of a comprehensive land tax system; vi) agricultural development; and vii) creation of rural investment programs.

At the moment, within the framework of the objectives of PROTIERRA, UTJ is the responsible of setting the basement of the Cadastral Information Registry (RIC) at the national level. Currently the institutions that are involved in this process are: the National Property Registry (RGP), the National Geographic Institute (IGN), the Land Fund (FONTIERRAS), and the presidential Office of legal attendance and resolution of conflicts on the land (CONTIERRA).

Figure 3.1 Land Programs of PROTIERRA Related to the Peace Accords
3.1.3.1 **UTJ-PROTIERRA**

The Ministry of Agriculture through the Technical/Juridical Unit [UTJ] as a co-ordinator is responsible for the establishment of a Cadastral Information Registry [RIC].

According to the Strategic Plan of UTJ 1997-2000, the **vision** is “that Guatemala gets to be a country with security and legal certainty on the property, possession and use of the land that causes the investment and the social harmony.” Having as a **mission** the co-ordination of governmental efforts towards the right and effective execution of strategies, programs and projects oriented to the land tenancy aspect. The main **functions** that arise from this mission are:

- To process and to validate the assembly of national technical norms for the cadastre execution.
- Integrate and co-ordinate the technical work teams in the national context.
- To process the proposal of the minimum legal frame for the establishment, maintenance and operation of the cadastre.
- To co-ordinate financially, administratively and technically the execution of the National Cadastre in its pilot phase and definition of the frame of national operation.

The Operative plans 1997-2000 concentrate on the execution of the Pilot project in four regions of the national territory and several municipalities (cadastral zones) with the purpose of obtain experiences that sustain the final Project of the RIC.

The structure of UTJ-PROTIERRA is shown in figure 3.2. It is organised through a directorate, which is responsible of co-ordinate, supervise and evaluate the execution and planning of the RIC through seven functional areas.

Nevertheless, in this study the researcher is going to describe the main users of the whole RIC without going into detail about each working area of the UTJ-PROTIERRA.

![Figure 3.2 Organizational Structure of UTJ PROTIERRA](image-url)
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The specific products that have been obtained are the preliminary Cadastral Law (UTJ, 2000) that regulates the institution and its procedures. The second product currently under development is the document for the Technical Guidelines (UTJ, 2000) that indicate the technical specifications and the key producers of the foundation data that the cadastre requires.

3.1.3.2 General Property Registry (RGP)

According to what is stated by the article 1124 of the Civil Code, the purpose of the RGP is to provide legal security to property holders by publicly recording their rights and interests. It is the institution responsible for the inscription, notation, and cancellation of all acts, contracts, and rights pertaining to real property. The RGP is a public institution, and its records may be consulted by anyone. It is part of the Executive Branch, but operates autonomously.

The RGP performs a variety of functions. Chiefs among these are inscription, certification, and information management. **Inscription** involves the recording modification and cancellation of rights and interests. **Certification** is used to confirm ownership rights. Corollary functions include informing the public with information about using and accessing the Registry, providing information to other government agencies and collection of registry fees.

The most important function is the **maintenance of records of property ownership** as well as financial interests such as mortgage liens, and encumbrances pertaining to real property. Guatemalan law permits citizens and foreigners as well as juridical persons to register rights and interests in real property at the RGP.

Records in the Registry are maintained according to the Folio Real system (Spanish system), which tracks transactions as they relate to specific parcels of property. Each parcel (“finca”) is given its own unique number (“ficha”), which is used to refer to the parcel in any transaction that affects it. A separate registry record is maintained for each parcel and, in the case of written records, consists of two large pages.

Until recent modernisation efforts began (RGP, 1999), all registry records were organised into bound sections or "folios," which, in turn, were organised into large leather-bound books ("libros"). Currently the traditional manual process (see Figure 3.3) is being replaced by an automated registry system (Figure 3.4) that makes use of electronic "books"-computer database records - to track rights and interests in real property and an application for internet access is under development.

Since 1940, the Property Registry has required each user to provide a description and a plot map or plan ["plano"] of his parcel and the surrounding area (Trackman, et al 1998). **Guatemala, however, lacks a current geographic cadastral map.** Without a cadastral map, conflicts between different planos are difficult to detect, and the individual planos are not fixed to any common, designated geographic points. **Boundary disputes are much more likely to arise -- and in fact have been a persistent problem in Guatemala.**
3.1.3.3 National Geographic Institute (IGN)

The IGN ("Instituto Geográfico Nacional) work is on the gathering of topographic information, which can then be used to create accurate maps. Since 1998 for Governmental Agreement 861-97, after having been as military dependence, it is reinstated the National Geographical Institute indeed to the Ministry of Communications, Infrastructure and Housing so that this fulfils its eminently technical functions of technician-scientific character that generates, publishes and distributes the official cartographic information of the country.

According to the vision (IGN, 1998) towards the year 2010 the IGN, will be a scientific public entity of international recognition, rector and facilitator of the national geodesy, of high technology, supplier of services and precise and opportune products. Its mission is to guarantee the basic and official geographical information to users that impact in the development of the country.

Within the context of the Land Administration Program, IGN has to provide technical support to UTJ in geographic information systems, geodesy, global positioning system, production of orthophotos, cartographic information administration. The UTJ aims to take the topographic, aerial photography and ortophoto information and incorporate other relevant data to form the foundation or core data for the cadastre. Currently this is not done because the IGN still in transition phases and it doesn’t have the infrastructure for this.

3.1.3.4 National Land Fund (FONTIERRAS)

In addition to granting titles to those who already have land, the strategy of PROTIERRA project also seeks to help non-owners to acquire and title property. The National Land Fund ("Fondo de Tierras"), also a component of PROTIERRA, is charged with co-ordinating and financing this process. Donors helped the Guatemalan government finance a revolving trust to finance purchases of land by campesinos and others who meet the project’s criteria.
3.1.3.5 National Office of Disputes on land (CONTIERRA)

The Dependencia Presidencial de Asistencia Legal y Resolución de Conflictos Sobre la Tierra was created (UTJ, 2000) to help resolve land-related disputes in an effort to comply with the spirit of the Peace accords. This national agency is specifically charged with opening constructive dialogue and facilitating the resolution of land conflicts between disputing entities.

CONTIERRA handles disputes involving various parties and of varying complexity, often sending teams into the field to collect information and assist disputants reach a satisfying resolution to their conflict; also makes use of existing Registry records to provide the legal context of a dispute and, when resolutions are reached, assists parties properly register their rights.

3.2 Situation Analysis

According to what was explained in chapter 2, this section presents the current situation of the National Cadastre in Guatemala in charge of UTJ PROTIERRA, identifying the users and flow of information among the organisations involved. Also the identification of strategic factors as the environmental scanning to generate the SWOT analysis of the organisation in order to determine what are the possible solutions to implement.

3.2.1 Stakeholders involved in the Cadastral process

The stakeholders are the interest groups who share a common interest in the cadastral information. Based on the previous section the following groups that have a potential interest of use or provide data for the Cadastre were identified in Table 3.1.

<table>
<thead>
<tr>
<th>Stakeholders of the National Cadastre in Guatemala</th>
<th>Organisation’s name</th>
<th>Description</th>
<th>Main information required/provided</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ministry of Agriculture (through PROTIERRA)</td>
<td>Formulating and executing the policies related to land in accordance to the peace accords.</td>
<td>Provide policies and definition of: ✓ the conceptual strategy to follow; ✓ the pilot areas in national territory; ✓ financial strategy ✓ Technical and legal strategies. Requests for Cadastral information upon advances.</td>
<td>Public</td>
<td></td>
</tr>
<tr>
<td>Ministry of Financing</td>
<td>Formulating and executing the policies related to land valuation and taxation.</td>
<td>Request basic cadastre. Provide Fiscal issues.</td>
<td>Public</td>
<td></td>
</tr>
<tr>
<td>Property Registry (RGP)</td>
<td>General property registry under the Ministry of State (under Ministry of Interior), it is responsible for the management and maintenance of the ownership registry.</td>
<td>Provide information on Real rights, communal rights, legal proceedings, and land registry. Requests the physical description of the land and maps—”plano catastral” for each property.</td>
<td>Public</td>
<td></td>
</tr>
<tr>
<td>National Geographic Institute (IGN)</td>
<td>National geographic institute under the Ministry of Communications, Public Works, Transport and Housing.</td>
<td>Provides information on: ✓ Terms of reference drafting and control. ✓ Topography: Geodesy, GPS. ✓ Small and large scale, 70’s</td>
<td>Public</td>
<td></td>
</tr>
</tbody>
</table>
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### Stakeholders of the National Cadastre in Guatemala

<table>
<thead>
<tr>
<th>Organisation’s name</th>
<th>Description</th>
<th>Main information required PROVIDED</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>IGN</td>
<td>• IGN will provide after modernisation process, the technical support to UTJ in geographic information systems, geodesy, global positioning system, production of orthophotos, cartographic information administration.</td>
<td>cartography 1:50,000, 1:10,000; and 1:2,000; aero-photogrammetry, remote sensing, errors, verification methods. (outdated)</td>
<td>Public</td>
</tr>
<tr>
<td>Land Fund (FONTIERRAS)</td>
<td>• Organisation created under PROTIERRA to facilitate access to land and to generate conditions for integral and sustainable rural development through productive hydro-biological, forestry, and agricultural projects.</td>
<td>• Request cadastral and ownership status of potential land for the “campesinos”.</td>
<td>Public</td>
</tr>
<tr>
<td>Presidential Department for Legal Assistance and Conflict resolution (CONTIERRA)</td>
<td>• Primordial Objective is constituted in the promotion of an integral strategy geared towards creating and expanding alternative solution mechanisms in the face of land distribution problems.</td>
<td>• Requests information on ownership and physical status of the land for planning of fair distribution of land. • Provide status of conflict resolution.</td>
<td>Public</td>
</tr>
<tr>
<td>Municipalities</td>
<td>• Local governments in charge of monitor the transactions and changes of a property. • Collect the taxes. • Development planning.</td>
<td>• Requests information on ownership and physical status of the land for planning and taxation.</td>
<td>Public</td>
</tr>
<tr>
<td>General directorate of Cadastre and valuation of assets (DICABI)</td>
<td>• Dependence under the Ministry of Finances in charge of registration and control the property taxation.</td>
<td>• Provides data concerning the owner, value of land, physical characteristics and attributes of the property with its relation with the owner. Valuation data. (Outdated). • Requests updated Cadastral info.</td>
<td>Public</td>
</tr>
<tr>
<td>Notaries</td>
<td>• Public faith. Certifies the legal status of the property. Notifies the transactions upon the land.</td>
<td>• Provides deed after a transaction has been done. • Requests information from the Property Registry and the Cadastre.</td>
<td>Public</td>
</tr>
</tbody>
</table>

Table 3.1 Description of the main stakeholders of UTJ

### 3.2.2 Data flow among stakeholders and the National Cadastre

According to the previous sections, there are organisations that produce and require information from the National cadastre. As shown in the Data Flow diagram in Figure 3.5 the stakeholders of the Cadastral system have been identified and also the flow of information between them. For the purpose of the case study, the focus is in the relation between the Cadastral Information System (SIC) the RGP, and IGN. This diagram was taken as a basis to initiate the analysis of the environmental scanning of the organisation presented in the following sections.
3.2.3 SWOT analysis on the present situation

To generate the SWOT analysis of the UTJ-PROTIERRA based on the information provided, it was necessary to perform an environmental scanning of the external environment to identify opportunities and threats and its internal environment for strengths and weaknesses. It permitted the identification of possible strategic alternatives to improve the current situation of the process.

3.2.3.1 External environment

It covers political/legal, economic, technological and socio/cultural forces. The external environment includes analysing factors, which were considered as opportunities or threats and also general forces/trends within societal environment. These factors in fact are externally outside UTJ-PROTIERRA, but they have a significant impact on its performance:

- Increasing demand for establishing the land registration for the whole country due to the peace accords commitment.
- Lack of security on land ownership. There is no Cadastre established in Guatemala.
- Although there is a national strategy stated and institutional links established, there is no operational co-ordination among organisations.
- There is a preliminary design of the cadastral law that will provide a framework for the establishment of the Cadastral Information Registry.
- The National Property Registry is independent organisation and the registration of deeds is done there, while the physical cadastre has to be established with the collaboration of this institution.
- Some of the organisations are introducing GIS applications.
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- The spatial foundation -topographical info- for the cadastre is in charge of the IGN that also makes a delimitation of boundaries through the maps or photogrametry.
- Users of the existing maps -which are out of date in the IGN- are not satisfied due to insufficient and outdated data.
- There is a need for efficient and effective property registration with its correspondent cadastre map across the country to encourage investment and promote the development of the national economy.
- There is a need for service-oriented product.
- The budget is depending on political issues.
- Support from the International community in the fields of financing, education and knowledge transfer (“know how”) but depending on the commitment of the government.
- There is a possibility to enable the power of technology, which is available in Guatemala, and it is for some extent already applied in some fields inside and outside UTJ.

After recognising the external environment for UTJ and considering these factors, they have been put together in external factor analysis summary, the respective rating and overall performance of the organisation are indicated (see Appendix A, Table 3.1).

3.2.3.2 Internal environment

It covers the organisation structure, culture, marketing issues, financial issues, research and developing issues, operation issues and human resources. To illustrate the internal environment, the factors of strengths and weaknesses within UTJ are scanned and analysed. These factors have either a positive or negative influence on this organisation’s performance, depending on how the management handles each of them. Hereafter the internal scanned factors:

- There is a duplication of tasks within the units of the organisation and these can delay the delivery process of the cadastral certification.
- Some processes in UTJ are still using the very old technique in the work (going several times to the RGP to extract information) and inadequate way of archiving which can cause a big problem in case of analysing unique documents.
- The group of UTJ investigators who goes to the Registry don’t get the ultimate information (up-to-date) because they don’t have access to the Registry’ automated system.
- Inadequacies in the management and lack of business planning experience. Hence there is a need to revise the decision making process to the process based management to make an efficient system.
- Procedures of different tasks and activities are not clear to the whole staff.
- Technical assistance installed a big infrastructure of information technology (ICT).
- UTJ has a pilot project, five regional offices geographically spread over the country which can produce deliverables to test the business strategies and technical models.
- There are potential capabilities, resources, products and services.
- Human resources distribution in UTJ is showing up a wide gap between the number of professional & technical staff and other levels.
• UTJ has a small group of talented staff with long experience in interpretation of the old technique of surveying, references, old property documents and in performing surveying services over various development stages.

• UTJ has a large number of staff in the technical level enough to make an efficient work if they are well trained in cadastral surveying and legal analysis.

• Available Funds for training programs, which relies on technical assistance.

As a result, an internal factor analysis summary (IFAS) has been generated (See Appendix A, Table 3.2). This indicates how much these internal factors are important to UTJ and how UTJ is responding to the inherent strengths and weaknesses. Some of the factors were grouped for a better analysis.

Through rating for each factor it’s been deduced the current performance of UTJ. The weight for minimum performance is (1) and for maximum performance is (5).

3.2.3.3 SWOT analysis results

After scanning external and internal environment and defining how much UTJ is influenced by them and for what extent it responds to different factors as indicated before. There must be new thinking in UTJ to take the advantage of the opportunities to make use of the strengths and minimise the weaknesses, and also, strategies to use the strengths to avoid threats or minimise weaknesses.

The SWOT Matrix (see appendix A, Table 3.3) helped to identify the alternative strategies that are necessary in the organisation and the possibility to apply BPR in some of the business processes.

From the main strategies obtained, for the case study only few are taken in consideration to tackle the problem in this organisation. Some of the strategies extracted from the matrix are mentioned below:

• **Redesign processes to focus in the efficient production of the cadastral certification using information provided by IGN and RGP.**

• **Make use of the willingness of the organisations involved to be better in low cost GI production and to serve the customers better and faster through ventures in the extraction of the information.**

• **Make use of the staff competence to re-engineer new production of the cadastral system, support the introduction of new technologies to avoid duplication of activities among internal units and organisations.**

• **Provide and extract information products digitally, using the Internet technology to obtain information faster and efficiently with Quality control already checked.**

From these derived strategies it can be deduced the necessity of establishing and efficient system where the processes are modelled in a way that the benefits of technology can provide a framework to develop
an appropriate infrastructure to support the sharing of information within and throughout the organisation.

3.3 Current Cadastral Business Processes

According to the interviews of UTJ Staff and visits to the local office there were some so called main processes and operations identified. The business process, Cadastral establishment, is also based on their documents (See Appendix B). However the intention of this section is to develop a process model of the Cadastral processes, but due to time constraints, only the processes related in the cadastral certification are going to be modelled in a general way.

To understand the current processes better, a functional model is diagrammed in Figure 3.6, where the activities are distributed in a flow chart to illustrate how the process works. To complement the functional model the activities within the process are described with correspondent attributes in Table 3.2.

![Figure 3.6 Functional model of UTJ. Generation of the Cadastral certificate.](image)
<table>
<thead>
<tr>
<th>Activity</th>
<th>Attributes</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>a Declaration of cadastral Area</td>
<td>i: polygon definition</td>
<td>According to the law (article 25) an area can be surveyed and investigated on the registry.</td>
</tr>
<tr>
<td>b Spatial Data Acquisition</td>
<td>i: Foundation info</td>
<td>Request for Geodesy, topographical maps and data, aerial photography and ortophoto of the area. Administrative boundaries determination.</td>
</tr>
<tr>
<td>c Preliminary Investigation</td>
<td>i: Registry form</td>
<td>Research the ownership history and status of the parcel to be surveyed.</td>
</tr>
<tr>
<td>d Cadastral file creation</td>
<td>i: ownership history</td>
<td>Creation of a file for the specific parcel containing history and spatial. Assignation of the Cadastral id. “finca matriz”.</td>
</tr>
<tr>
<td>e Cadastral Surveying</td>
<td>i: measures</td>
<td>Notification to the owners, interviews and Field work. Parcel mapping and Cadastral analysis.</td>
</tr>
<tr>
<td>f Information consolidation</td>
<td>i: parcel file (map + forms)</td>
<td>Adding the new measures and cadastral field survey form to file. Print of maps and “planos”.</td>
</tr>
<tr>
<td>g Investigation RGP 2</td>
<td>i: Amends on registry form</td>
<td>Search of ownership track/historical information on new parcels identified by fieldwork.</td>
</tr>
<tr>
<td>h Cadastral surveying 2</td>
<td>i: validated info.</td>
<td>Field work. Parcel mapping. Quality control.</td>
</tr>
<tr>
<td>i Legal Analysis 1</td>
<td>i: preliminary status</td>
<td>Analysis of the legal status of the parcel and ownership.</td>
</tr>
<tr>
<td>j Clarification with RGP</td>
<td>i: annotations/ amends</td>
<td>Check In case of doubts on the descriptive (registry) information. Go to RGP and check the books.</td>
</tr>
<tr>
<td>k Clarification with field survey</td>
<td>i: amends</td>
<td>Check In case of doubts on the spatial (field) information. Go to field and check the measures.</td>
</tr>
<tr>
<td>l Legal Analysis 2</td>
<td>i: status</td>
<td>Analysis of the legal status of the parcel and ownership after amends. Definition of regular or irregular parcel.</td>
</tr>
<tr>
<td>m Final Resolution</td>
<td>i: final status</td>
<td>Declaration of the parcel as a part of the Cadastre according to law.</td>
</tr>
<tr>
<td>n Cadastral Certification</td>
<td>i: cadastral map and info</td>
<td>Production of certificate with parcel information including descriptive and map.</td>
</tr>
</tbody>
</table>

Table 3.2: Description of activities in the Process: Cadastral Certification.

Currently major number of activities of the Cadastral process are done in an analogue way due the lack of mechanisms that facilitate the processes to make this system efficient and faster. Specifically for this process there are two units deeply involved within the organisation, the legal unit that is in charge of the research in the RGP on all the history, keep track of ownership and make the legal analysis in the process; and the Technical unit.
that is in charge of gathering all the spatial information of the parcels (properties) and produce the cadastral map as a final product.

As a foundation data, UTJ has to work parallel with IGN and RGP to obtain the topographic and the legal information respectively. **Currently the cartography from the IGN is out of date** and analogue maps that are used to plan the surveying or locate areas. Nowadays they are modernising the procedures and turning into a GIS organisation. The RGP has a digital database of the books that hold the information of ownership (see section 3.1.3.2)

The process output is a certification of the cadastral process established in one specific area, print or digital file including both, ownership and cadastral map of the area. As mentioned before the major part of the main activities are done in an analogue way so it is a risk that this delays the process.

A process analysis was necessary to develop a precise design specification of the business processes behaviour to detect where the changes can be implemented and modelled using the Architectural model technique (Franken et al, 1997) in Figure 3.7.

![Figure 3.7 Architectural model. Current processes definition of UTJ.](image)

Nowadays, agreements among the UTJ and the other two organisations - RGP and IGN - have been established with the purpose of share information and obtain the foundation data from them and provide them with the cadastral data up to date.

### 3.4 Challenges and Bottlenecks for the current situation

Taking into consideration the previous situational analysis and the current processes modelling aforementioned, several bottlenecks were perceived associated with the establishment of the cadastre as shown in Figure 3.8.
The cause-effect analysis of the current situation of building a cadastral infrastructure situation can represent the challenges coming from the current problems of UTJ. The problem areas were divided into four groups for better understanding.

As can be seen the lack of Guatemalan professionals with cadastral experience and knowledge of the land administration concepts, trends of cadastre and modern technology is one from the biggest resistance factors to create an integrated cadastral infrastructure. Also the few experts in cadaster are technical people grasped to the traditional technique, that is to say, the manual gathering of data, paper analysis, maps drawn manually, etc.

The diversity of financing funds has generated multiplicity of cadastral models, and together with the lack of a defined business planning it has created a disorder of the activities to carry out. The cadastral zones within the pilot project began tasks parallel to the execution of national project, for that that the lack of technical and legal normative generates the diversity of work models.

The limitless growth of the project as for activities without planning has generated unmeasured decision making that should have taken in critical moments.

The above-mentioned suggests the challenges to build the cadastral infrastructure in a way that the information processed must be consistent and standardised with quality support.

A revision of the stakeholders, information requirements, functions and processes carried out in UTJ along the Land Administration project has been done. In combination with the aforementioned challenges, the framework to build the cadastral infrastructure is going to be proposed further on chapter 4.
3.5 Concluding remarks

Some of the concepts reviewed in chapter 2 were applied in this chapter to perform the analysis of the current situation of the Cadastre in Guatemala. This led to the determination of the stakeholders in the present with the flow of information, and the identification of the main processes performed to produce the cadastral certification. Also it outlined various problems encountered along the development of the processes that can be considered as challenges that may constitute the foundation for the infrastructure’s framework developed in the following chapter.

The present processes along the cadastral establishment involve manual compilation of files and data which takes a long time for retrieving information and also represents a main risk of duplication of activities. Based on the analysis of the processes modelled in this chapter a reengineering of some of them is going to be suggested and applied in chapter 4.

Although there are many bodies and organisations involved in this process, the main links between the cadastre with the National Property Registry (RGP) as provider of ownership data to the Cadastre; and the National Geographic Institute (IGN) as provider or the fundamental data were the focus of attention establishing what is the information requested and provided by each and modelling the processes in which this organisations interact, therefore a link among them can be studied.
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4.1 Introduction

In the previous chapters, the most relevant parties that have participation on the development of the cadastral infrastructure identified for Guatemala, also the requirements of information among them and the business processes “establishment of a cadastre” have been identified. This chapter introduces the fundamental processes of a cadastral infrastructure and provides a new scenario to improve the processes in which the organisations to be involved in the collection, provision and updating of cadastral data contribute in an integrated way.

4.2 Global business processes of Cadastre

As mentioned before, land administration refers to the processes of recording and disseminating information about the ownership, value and use of land and its associated resources. The cadastre as a part of a LAS is supported by business processes in order to have at high levels detailed information at the individual land parcel. The global business processes of the Guatemalan Cadastre may be defined in a general description as is depicted in Figure 4.1.

The organisation [UTJ] as a system can be analysed as a set of processes that are interconnected through a mechanism where the suppliers and the customers of cadastral data interact with each other. The dotted circle in the figure is delineating the Cadastral establishment as a business process of UTJ, where the group of activities such as legal and technical are organised and carried out in order to investigate and analyse the country parcels.

The subject of study as mentioned previously in Chapter 3, is the Cadastral certification production which is within the Cadastral establishment activities, this process should give as a final output the document that certifies the physical status of a property for legal purposes.
4.3 Description of processes to support cadastral activities

Taking into consideration the processes described in table 3.3 and having defined the general processes within the cadastre in section 2.3.1, the following table describes the activities that have to be performed during the cadastral-establishment process of issuing the cadastral certificate.

<table>
<thead>
<tr>
<th>Cadastral process</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>a Declaration of Cadastral area (Performed by UTJ)</td>
<td>According to the law, an area can be investigated on the registry and surveyed on the field.</td>
</tr>
<tr>
<td>b Data acquisition and survey (Performed by UTJ in co-ordination with IGN and RGP)</td>
<td>Collection of existing geographical and topographical data. Control establishment of geodetic data. Parcel demarcation and surveying. Production of plans.</td>
</tr>
<tr>
<td>c Preliminary investigation (Performed by UTJ in co-ordination with RGP)</td>
<td>Analysis of Real rights data requirements.</td>
</tr>
<tr>
<td>R Extraction of RGP information (Performed by UTJ in co-ordination with RGP)</td>
<td>Exchange of ownership information (from external source) based on data specifications. Quality check on procedures and data.</td>
</tr>
<tr>
<td>R_a Connection</td>
<td>Connection via internet through the use of OpenGis Technology.</td>
</tr>
<tr>
<td>R_b Exchange of information</td>
<td>Access/exchange of information. Shareability mechanism to exchange information.</td>
</tr>
<tr>
<td>R_c Updating</td>
<td>Changes to DB / update. Data entry to the system. Change of status of the parcel.</td>
</tr>
<tr>
<td>d Information consolidation and analysis (Performed by UTJ)</td>
<td>Consolidation of parcel mapping and real rights data in the file. Check the quality of the data to create the file.</td>
</tr>
<tr>
<td>e Check of field survey data (Performed by UTJ in co-ordination with IGN)</td>
<td>When fieldwork is needed for clarification after the analysis and validation of data.</td>
</tr>
<tr>
<td>S Field work/surveying (Performed by UTJ)</td>
<td>Notification to owners. Interviews and filling of field forms. Post process of data and cadastral analysis.</td>
</tr>
<tr>
<td>f Legal analysis and problems study (Performed by UTJ)</td>
<td>Resolution for owner. Analysis of problems on real rights status. Decisions on possible changes.</td>
</tr>
<tr>
<td>g Cadastral clarification and update (Performed by UTJ in co-ordination with RGP)</td>
<td>Revision of file on possible changes and updates to the database. Quality check of procedures and information.</td>
</tr>
<tr>
<td>h Final resolution (Performed by UTJ)</td>
<td>Resolution on regular or irregular parcel.</td>
</tr>
<tr>
<td>i Cadastral certification (Performed by UTJ in co-ordination with RGP)</td>
<td>Issue of the parcel cadastral certification including registry information and parcel map.</td>
</tr>
</tbody>
</table>

Table 4.1 Main Cadastral processes supporting the production of the Cadastral certification.

All the activities shown aforementioned were studied in a general way in order to present a better understanding of the process “Cadastral certification”, especially the activities d, g, R and S include quality control on how the data is handled and shared. The five components of spatial data quality lineage, positional accuracy, attribute accuracy,
completeness and logical consistency (Kainz, 2000) have to be taken into consideration in the modelling of data and processes involved in this project.

4.4 Infrastructure needed for Cadastre

The different processes within the organisation are supported by an infrastructure that ensures the quality of the different products, and of the data that is produced in the organisation and retrieved from others. See figure 4.2, in which the processes are performed by the different organisations.

![Figure 4.2 Infrastructure supporting cadastral activities.](image)

The development of such an infrastructure as a networked distributed enterprise, requires new relations and partnerships among different entities establishing permanent links. These relations are grouped as an umbrella to make a solid framework for the data sharing and need some kind of equity between partners involved, a participatory approach, co-operation among parties, instead of co-ordination by one party, to build through the exchange of information a working relation between institutions. The framework to create an infrastructure was given in chapter 2.4, a combination of institutional, organisational and fundamental datasets. For a better analysis this combination was done and proposed in the following subsections.

4.4.1 Organisations, functions and data requirements

In the previous chapters, the main stakeholders involved in the Guatemalan cadastre were identified to determine the information requirements and the current cadastral processes and also the creation of the Stakeholders Forum was proposed as a common understanding to achieve co-operation among bodies.

Linkages should be created between the cadastral system and other land information systems, so that comprehensive information can be provided by the UTJ, to minimise overlaps, duplication and inconsistencies, to manage the geoinformation infrastructure at the governmental, municipal and enterprise level for cadastral purposes and for different users.
To find the relations that should exist between the processes and the organisations, a matrix was developed using some aspects of the Business System Planning method [BSP] (Paresi, 1999). This was done determining the relations between activities/processes and the data classes produced by different entities. See Table 4.2.

The C’s means which processes create the data and to what organisation this data belong. The U’s means which processes use the data. The dotted rectangles are delineating where the interactions among organisations have to be established. The attention is focused in the interactions where the cadastral processes use data created by other organisations. The last two columns define the functions where the interactions are done and the data that is used or created by the processes.

4.4.2 Legal requirements

The appropriate legal infrastructure is fundamental to the success of the Cadastre. By means of special programs and appropriate legislation, the determination of who are involved and have rights, the definition of procedures such as land registration, legal land survey, distribution of land information, privacy.

The State has to provide from state lands to the indigenous communities that need them for its development.” Also the constitutional article 70 establishes the obligation of emitting a law that regulates all the matters related with the Indigenous Communities; additionally, inside the Chronogram of execution of the commitments assumed by the Government inside the Peace Agreements, there are the following related with the tenancy of the land: “109. To promote the legislative changes that allow the establishment of a registration system and decentralised cadaster, financially sustainable, multi-user, efficient, and of easy and obligatory bring up to date”, and the one that settles down: “164. To regularise the titling of land of the indigenous communities and eradicated populations, As soon as of communal lands, rule the participation of the communities to assure that they are those that make the relating decisions to their lands.” For what is necessary that such a legislation is emitted and the problem of the land is assisted, since it has been relegated per years being a very sensitive social problem in our country that is decisive to improve the quality of life of most of the population for the high indexes of poverty that prevail in it.

4.4.2.1 Institutional arrangements

Assisting the priorities stated above, it is considered necessary that besides emitting the Law of Registration of Cadastral Information that will allow the establishment of the Cadaster in Guatemala like a mechanism to know what we have, where it is, to who it belongs, all is worth and which their use is, the Law of Regularisation of Titles is emitted, in order to establish an institution that will assume this function; settling down and determining the procedures to follow; keeping in mind the particularities of land tenancy that always has characterised to the indigenous communities.

This law also establishes the mechanisms of systematic and continuous attention to the conflicts that are raised, settles down and establish quick and simple steps to provide them with legal security and to endow them of titles to strengthen their rights; that establishes alternative means of resolution of conflicts recognising the traditional forms (customary) that have been put in practice for the indigenous communities; and also keeping in mind that women have been
## Chapter 4. Modeling Cadastral Processes and their infrastructure

### Table 4.2 Relation between organisations and processes. Data classes versus processes.

<table>
<thead>
<tr>
<th>Organisation</th>
<th>UTJ Cadastre survey records</th>
<th>RGP Real rights data</th>
<th>IGN Geodetic &amp; topographical data</th>
<th>Municipalities</th>
<th>DICABI</th>
<th>CONTERRA Status of land data</th>
<th>Notaries</th>
<th>Function/interaction</th>
<th>Data required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Declaration of Cadastral area</td>
<td>c</td>
<td>u</td>
<td>u</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>* Declares on demand of Ministry of agriculture that a certain area has to be surveyed for the Cadastre.</td>
<td>* Studies of the cadastral area, Municipal boundaries data.</td>
</tr>
<tr>
<td>Data acquisition and survey</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>* Receives the request and delivers the final product after checking quality. * Prepares geographical data and requests for field survey and topographical information of the area.</td>
<td>* Geodetic data, Topographical data, Ortho-photo, Aerial photo data.</td>
</tr>
<tr>
<td>Preliminary investigation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Visualises the status of the parcel in relation with the owner.</td>
<td>* Existing cadastral info (property, value, owner data), Ownership info.</td>
</tr>
<tr>
<td>Extraction of real rights data</td>
<td>u</td>
<td>c</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Consults the property status</td>
<td>* Real rights data.</td>
</tr>
<tr>
<td>Information consolidation and analysis</td>
<td>c</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Merge the spatial &amp; legal information and analyse the status of the parcel.</td>
<td>* Parcel map and real rights data with quality control.</td>
</tr>
<tr>
<td>Check of field survey data</td>
<td>c</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Prepares cadastral information according to specifications. Requests for field work check</td>
<td>* New measurements.</td>
</tr>
<tr>
<td>Field work /surveying</td>
<td>c</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Interviews in fieldwork and ground survey.</td>
<td>* Field data: measures &amp; descriptive forms, Cadastral analysis.</td>
</tr>
<tr>
<td>Legal analysis and problems study</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Receives the file and checks the new field info and analyses if there is a legal problem.</td>
<td>* Real rights changes.</td>
</tr>
<tr>
<td>Cadastral clarification and update</td>
<td>c</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Revision of information and decision on changes.</td>
<td>* Revised new Parcel data.</td>
</tr>
<tr>
<td>Final resolution</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Approves the procedure and declares that the parcel has been exhaustively investigated and gives the final resolution.</td>
<td>* Regular or irregular parcel data.</td>
</tr>
<tr>
<td>Cadastral certification</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Prepares the cadastral certification according to specifications. Either run an internal procedure or send it to the interested party.</td>
<td>* Cadastral info.</td>
</tr>
</tbody>
</table>

The points of interaction to study are indicated in the table.
discriminated and they have bigger access difficulties to the formal systems of any order, especially the ownership of the property, due mainly to cultural, educational and institutional barriers, although in Guatemala due mainly to the internal armed conflict a high percentage of women is family head, but they lack the information and knowledge about the ability that attended them of claiming their rights.

For the development of the registration-cadastral establishment activities, maintenance and bring up to date, the Registration of Cadastral Information [RIC], by means of the law, has to establish co-ordination relationships with the Property Registry, with the municipalities, with the National Geographical Institute, with the Land Fund and with other entities of the State and of the private sector.

4.4.2.2 Co-ordination
The object of the co-ordination among the Registration of Cadastral Information [RIC] and the Registration of the Property [RGP], (the main focused of this research) is to establish the agreement between both through their respective technical operatives.

The RIC will contribute the RGP the descriptive and spatial data of each parcel or property, especially its limits, other real rights, surface, indexes cadastral, localisation and regular.
The RGP will contribute the RIC with the name of the holders in domain or of other real rights of the co-ordinated properties, identified with the Cadastral Classification Code (unique identifier).

The instrumental means to co-ordinate the RIC and the RGP are the following ones:

- The **parcel map** of the RIC and the complementary documentation. To such effect, the RGP will be able to count, in the environment of its competition, with the mentioned information that will be facilitated by the RIC in the formats and appropriate technological supports that allows easy handling, file, conservation and bring up to date.
- The **Cadastral certifications** extended by the RIC containing the descriptive and spatial data of each parcel or property and the map of this;

The **co-ordination between the RIC and the RGP** will be operated when the descriptive data or identifiers of the parcel or property in the effective cadastral certification coincide with those that figure in the title that will give place to the co-ordination.

4.4.3 Technology and communication
As mentioned before, cadastres are managed by one or more government agencies so they have to be designed with the increased emphasis on strengthening infrastructure to avoid duplication of efforts and make them effective in a sustainable way.

Figure 4.3 adapted from the “four dimension approach to GIS” by Traub (1997), depicts the different stages of the technology implementation supporting the infrastructure. The four dimensions within the infrastructure are particularly supporting the business processes of the organisation by the technological
implementation of new approaches. The reader can observe that inside the dotted rectangle covers the main aspects considered in the first stage of the development process. The implementation of a distributed environment applying the concepts of open systems is the next stage to be developed.

Figure 4.3 Information Technology Prototype using the 4D approach.

**4.5 Model for Cadastral Processes**

As analysed in chapter 3, there is duplication of activities and repetition of processes in the interaction with RGP, which complicates the process and maybe a delay in the production of the final result. Taking in consideration some of the alternative strategies resulted in the SWOT analysis and the infrastructure proposed in the previous section, a new scenario can be modelled for the improvement of the current situation in UTJ.

**4.6 Analysis of the alternative solution**

For the process analysis, the UT Architecture modelling technique was used. The result of this was a precise design of the business process behaviour and from here enables an analysis of its performance. To obtain the new design the methodology applied was:

- Identify and scope the process
- Select the workflow
- Allocate processes to entities
- Identify interaction points
- Identify the behaviours of the process

From the current process modelled in chapter 3 (Figure 3.7) it was possible to identify the bottlenecks or the problem areas at a general level of the architectural model (also see table 4.2, main points of interaction). An alternative scenario is proposed (see Figure 4.4) that is intending to solve the repetition of the consults made to the RGP, and implement a
digital information sharing system to exchange information, that will be developed in detail in chapter 5.

The solution is proposing that the link with the RGP should be a digital connection through distributed networks and databases using the Internet to access the other organisation’s database application within the OpenGis concept. It is intended to make the query to any parcel through the cadastral classification code (CCC) and obtain the information regarding ownership of any property “finca”, extract the data required and after the cadastral survey and analysis is done, if changes to that data are done, update automatically to the RGP database. This mechanism also may be open to both users of RGP and UTJ in a transparent way.

4.7 Conditions for the proposed solution

There are some conditions to accomplish the purpose of re-design this process:

The agreements among organisations must facilitate the access to the information that each of them is producing, so a good operational link has to be established.

Introducing Quality control in the main processes that are the key processes in the whole system, such as: information consolidation and first analysis, cadastral clarification and update; connection to RGP’s database and Fieldwork. If this QC is applied there is not necessity to do again a revision of that activity as a separate process. That will reduce time and repetition.

Establishing a digital connection to the Registry through the use of OpenGIS concept will facilitate the access to the database in terms that the researcher can work his own computer and invest more time in the analysis of the quality of the information than going personally to the Registry.

4.8 Concluding Remarks

All the concepts related with BPR and modelling techniques that were mentioned in the objective of this research exercise were studied and applied in the aim of designing an alternative scenario for the Cadastral processes.

The situation analysis generated a new alternative scenario of the processes for one of the cadastral processes (Cadastral certification) within the business process “Cadastral Establishment” this was proposed and modelled. This model provided a clear visualisation of the interactions between the main providers of the fundamental datasets for the cadastre. The communication and share of information between them is going to be the main focus in chapter 5 using the technology to implement such a link.

As a concluding remark it can be mentioned that dynamic process techniques provided the necessary functionality to analyse the process functional behaviour and determined what changes can be done.

The infrastructure that supports the new alternative cadastral processes was explained in this chapter dividing its components in four main groups: i) Participation of the organisations involved; ii) legal framework that comprises the basic law for cadastre and institutional arrangements; iii) functions and data requirements and iv) technology and communication.

With the aforementioned structure, the participation of the organisations along the processes has to be co-ordinated by the UTJ in order to promote co-operation among them.
Figure 4.4 Architectural Model. Proposed scenario for process “Cadastral certification”.

Development of a Cadastral Infrastructure
Evelyn Y. Godínez García
GIM.2 Cadastre - 2001 -
CHAPTER 5
Mechanism to implement exchange of information

“... Data sharing makes sense, for the simple reason that there is only one Earth, and we share it.”
Open GIS Consortium Technical Committee

5.1 Introduction
In the previous chapter the infrastructure to support the cadastral activities was proposed. This infrastructure creates the framework to foment the interoperability between systems through implementing a workflow that requires to fetch geodata files from three or four different government departments and requires the immediate integrated display in a single window to query the properly registered files as if they were a single integrated database integrated the union of the files, properly registered in a single window, and requires the ability to query the union as if it were a single integrated database.

This chapter introduces in a general way, the factors that contribute to achieve interoperability among organisations responsible of sharing cadastral information such as the technical challenges and the basic data from both organisations to be shared. The conceptual model for the exchange of information that supports the cadastral processes is designed. As well as the general requirements to implement the technical solution.

5.2 Challenges in exchanging cadastral information
The purpose of the mechanism is to make cadastral (geodata) information of various suppliers be combined, visualised and retrieved via the Internet. A fundamental aspect of this mechanism is that UTJ intends to provide and request information not only from the cadastral survey but also from the RGP, IGN and the other suppliers/users identified and mentioned in the previous chapters.

From the problem analysis performed in chapter 3 (see Figure 3.8) several problems were identified, such the diversity of cadastral models, the lack of definition of standards, duplication of work, etc. that at technical level are potential risks to successfully implement the infrastructure. With this premise the following technical issues have to be taken into consideration before proposing a solution to share information among organisations:

- **Data redundancy.** The result of various organisations working in the same project or in the same discipline collect similar data in different ways, falling in duplication of effort and existing data.

- **Database Heterogeneity.** Due to the existing different data models, different system architectures and lack of integrated policies there are semantic, schematic and syntactic differences in the spatial data handled by the RGP and UTJ.
• **Up-to-dateness.** The benefit of sharing information is that the newest updates can be obtained through the extraction of the data from the other databases in a distributed environment.

### 5.3 Information sharing among organisations -Data to exchange-

From the side of the Cadastre [UTJ], emphasis will be made in the investigation and obtaining of information related with the property real rights and in that sense the investigation will be prioritized in the RGP and the stakeholders identified that offer this type of data.

Figure 5.2 shows how the contents of the existing information from the RGP (left column) and the data from the cadastral survey (right column) previous to the cadastral analysis, are currently extracted and matched manually. With the information attributes provided above from each organisation, and through a query to the distributed Databases, it will be possible that accessing with the Cadastral Classification Code [CCC] related with the Registry number to the RGP a specific property can be located and consulted.

Analyzing the proposed process model (Figure 4.4) from the previous chapter, where the interactions among processes generated between the RGP and UTJ are identified, and analyzing the information that has to be exchanged from this processes, a solution for data sharing can be established. Considering this, in Figure 5.2 the process named R [extraction of RGP information] shows the interaction point where the query generated from the UTJ triggers the exchange to the database of the Registry and gives back as a result the real rights data from a particular dataset.

Information exchange between spatial database management systems involves two main steps. The first is to search for the information resource in a web of data providers. The second step is to communicate with the provider in order to search and retrieve the data set (Bishr and Radwan, 1998). The mechanism of exchange is going to be generated from this point and explained further more in section 5.4.
5.3.1 Data from the Property Registry [RGP] to enable the exchange

The attributes that fundamentally should be obtained from the digital system of the RGP and that should combine to the survey database from UTJ are the following:

- **Property’s Real Rights**
  - **Registry Number**: Property number, folio number, number of the book and to the series that correspond, in combination with the CCC (see next section).
  - **Sector**: Urban or rural (rustic).
  - **Location**: Departmental and municipal jurisdiction in which is located.
  - **Denomination** or name with which is known.
  - **Property origin** that can be for subdivision or unification, but very old inscriptions indicate origins for Governmental Agreement and they also exist for supplementary title that constitutes the effective procedure to register surfaces that don’t have inscription in the RGP.
  - **Historical transactions**. If it is verified previously that refers to an individual right, the names of the holders will be transferred in successive order, indicating the numbers, the dates of the inscription and the reason of the transaction.
  - **Area** or original registered extension.
  - **Other real rights** as encumbrances and usufructs.
  - Each inscription of a transaction that has been taken effect.
  - **Annotation** of the subdivisions that have been operated in the property that is investigated.
  - **Boundaries** such as they are expressed in the first inscription and subsequent inscriptions by some rectification.
  - **Inscriptions** that refer to re-measures or area rectification.
  - Copy of the **plan** attached in the physical files of the RGP.

5.3.2 Data from the Cadastre [UTJ] to enable the exchange

The data that fundamentally should be obtained from the UTJ (cadastral survey) and that should be combined with the RGP database are the following:

- **Parcel**
Refers to the general information of an urban or of a rural property, captured by the Cadastral survey in the fieldwork.

- **Cadastral Classification Code (CCC)** it is the code created to identify geographically and in a unique identifier to the property inside the national territory. It uses the established codes for each department and existent municipality, being based on the Administrative Political division of the Country. It has to be assigned to each of the records in the RGP.

- **Type of Property**: Urban or Rural.

- **Total surface of the property**: In this space the area should be written, that is to say, the registered dimensions.

- **Number of Parcels**: When in the same registration there are two or more bodies separated from the whole area. These parcels don't have a correlative order and they should take the same CCC.

- **Location of the Property**: refers to the data that identify to an urban or rural property, according to their location, in urban or rural area, for example 1ª Av. North #27, Antigua Guatemala (urban property); Finca la Hermosa, San Lucas Sacatepéquez (rural property).

- **Plan of the property**: Cadastral object.

- **Cadastral Owner**
  Refers to the individual or legal person that is landholder of the property. Also when several proprietors exist for one property. The data to compare are the following:
  - Cédula (personal identification number)
  - Gender
  - Marital status
  - Main occupation of the Holder: Teacher, Graduate, Carpenter, etc.

- **Tenancy Without Registration**
  Refers to the holders that don't have registered their property (parcel), in the General Property Registry, but may have some document that credits it as proprietor.
  - Name of the not inscribed holders
  - Time of having the possession
  - Type of the Possession: sale and purchase, inheritance, etc.

### 5.4 Interoperability and OpenGIS Solution –Technical level-

The OpenGis concept aims at solving the problem of data sharing through a mechanism, which ensures that data transfer is application independent, the “interoperable GIS”.

Open system model is an approach to software engineering and system design that enables and encourages sharing of data, resources, tools, etc. the stakeholders of the cadastral infrastructure, in this case the attention is focused to the Property Registry and the Cadastre [UTJ].
The solution proposes that a distributed system is set up implementing a Client-Server concept. This architecture is a model of computing, in which system functionality is divided among the components that make request (the clients) and the components that respond to them (the servers). Servers are defined as entities that own the resource, which could be in this case the RGP’s Real rights system. Clients are elements that require services from the resource, like UTJ request for Registry data.

With this model the roles in some cases may become inverted and the client can be the server in other cases. The client server application may be built through the use of graphic user interfaces, application code and distributed databases concept.

Figure 5.3 illustrates the architecture of the mechanism to exchange cadastral related data. It aims to achieve interoperability between multi-users, either within the organisations of Protierra and also the final users. Through Internet using the OpenGIS, running on a single site, accesses to the several remote servers holding heterogeneous spatial(cadastral survey) and descriptive(ownership) datasets, and visualize, overlay them on the screen of the user.

The cadastral related data (from RGP) held in other system with OpenGIS specification conformant interfaces will be accessible by the UTJ using other software with OpenGIS specification conformant interfaces. These interfaces will allow the user from UTJ from his computer running a OpenGIS-conformant mapping application to query the remote data server(RGP) on the Internet. The data from RGP stored in a relational database management system (RDBMS) configured with the OpenGIS interface. This process can be the other way around, i.e.: the RGP’s user wants to consult the mapping application from the cadastre. This solution allows that the data delivered by the server might have been created in any GIS system (Integraph MGE™, or ESRI ARC/INFO™) or it might be a set of corporate RDBMs records whose spatially fall within a region defined graphically in the query that the user executed through the mapping application.

One of the goals in the near future is that the datasets have to be standardized through the use of the OpenGIS specifications. The implementation of local metadata and joint into a catalog server is important to give a description of the data for browsing and searching, quality, and documentation at high level.

This information sharing model is a system based upon information related to cadastre, specially the real rights data and cadastral survey data can be incorporated to enable organisations to have regular and automatic updates of their relevant information which they do not produce themselves.

When the relevant shareable data has been determined, appropriate local metadatas within the global catalog server have to be provided to enable the organisations access to the information according to the level of OpenGIS specifications. Each organisation will only have to maintain its own data and make it available in the shareable database.
5.4.1 Architecture components

The architecture developed in the previous section was modelled according to the OpenGIS specifications (OGC, 1998) putting together software components and Client-Server model. The three main components are distributed according to the architecture (see Figure 5.3):

a. Web mapping components: all the setting up of the repositories where the geodata is going to be handled.

b. GIS Information community Enablement Interfaces: all the administrative managerial arrangements of the data.


For the purpose of this study and due to time constraints only the Web Mapping components are explained in the next section.

5.4.1.1 Web Mapping components

a. Data Server. Delivers data across an interface to any client. This local server contains a description of the shareable information that each participating database is willing to share. The shareable data is supported by a metadatabase,
which contains information about all data stored in the database.

b. **Sharable Data**: This is the part of the database of any organisation relevant for the design. In the case of RGP and UTJ will be ownership data and parcel data respectively.

c. **Map Server**: Delivers symbolised graphics to a viewer client. The main functions of this server are map rendering, feature streaming; geocoding; query and data extraction.

d. **Catalogue Server**: Delivers dataset identifiers across a common interface to any client. A catalogue is a collection of metadata, which may apply to various levels of aggregation. It determines the relevance, extent, cost, as well as valid ways to query the data and may contain a data dictionary and formal data models.

e. **Service Registry**: delivers service identifiers across a common interface to any client. Plays the role of a clearinghouse for providers and users.

f. **Viewer Client**: Displays graphics that come from the map server using a template and sending the map to the browser.

The above architecture for exchange data is a model based upon which information on cadastral survey (parcel data) and ownership data can be incorporated to enable organisations to have regular updates of their relevant information. When the sharable data has been put together, appropriate Metadata has also been created specifying the characteristics of the data, schema and mapping definitions to enable the organisations access the information through the catalog server.

### 5.5 Guidelines to implement the technical solution

With the aforementioned technical framework this section offers a manual and checklist for enabling to make a picture of which activities already have been done and which have yet to be done concerning an effective implementation of the cadastral infrastructure and the exchange mechanism.

As said this chapter does not contain detailed descriptions of the proposed architecture’s components, but it only mentions the functionality of them as well as all relevant facts for finding and realising the solution. For instance, important components and attribute data of attention, in this specific case, the RGP and the UTJ data.

The realization of an ad hoc implementation mentioned in the previous sections needs management and organisation of the necessary activities and also secure the same kind of data are collected, stored, processed once, unless there is a need to do it twice or more times. However, some coordination must be compulsory, otherwise it would be too costly for a society to maintain and develop a number of cadastral systems doing partly the same activities.
Table 5.1 Steps for implementation of a cadastral infrastructure’s “data exchange mechanism”

Table 5.1 shows the suggested steps to achieve the implementation of the data exchange mechanism among the RGP and UTJ information systems. According to Graafland (1999) the following criteria was the base to implement the solution:

<table>
<thead>
<tr>
<th>Organisation</th>
<th>Co-ordination</th>
<th>Legal foundation</th>
<th>Property Registry information system</th>
<th>Integration of information systems</th>
<th>Exchange of data</th>
<th>Maintenance</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓ Revisions of Protierra’s land Policy and redefinition of tasks.</td>
<td>✓ Coordinate activities for bringing the content of the Property register in conformity with the cadastral survey, and vice versa (see section 5.3.1 and 5.3.2).</td>
<td>✓ Adoption of legal informatics to introduce the cadastral system within the new technology. ✓ Security, copyrights and distribution legal guidelines.</td>
<td>✓ Converting integral RGP-UTJ pilot towards a whole regional office.</td>
<td>✓ Inventory and description of land related and cadastral information systems. ✓ Data quality and standardisation specifications</td>
<td>✓ Setting up of communication channels (telecommunications) ✓ Internet accesses. ✓ Clearing house: access to the fundamental datasets.</td>
<td>✓ Introducing new technologies through R&amp;D (Research and Development)</td>
</tr>
</tbody>
</table>
1. Technological change: design and construction of elements concerning the infrastructure;
2. Organisational structure change: build-up of an organisation structure to maintain the infrastructure;
3. Organisational culture change: realisation of acceptance of the infrastructure; involvement of the infrastructure in operational work processes.

The criteria related in the previous table with the aforementioned aspects in previous sections are important factors that may lead to the successful implementation of the cadastral infrastructure. This can be implemented in UTJ to introduce a modern cadastral system.

Having this as a basis the following guidelines are important aspects to be considered in an implementation plan of the cadastral infrastructure:

1. Considering the present research study as a foundation to implement the cadastral infrastructure in Guatemala.
2. Call to a Stakeholders forum where the re-definition of the tasks and responsibilities of the Stakeholders have to be a main priority.
3. Addressing co-ordination, liaisons and public relationship issues.
4. Establish procedures and guidelines for technical implementation in order to fulfil the OpenGis specification. (Metadata, semantic interoperability, client-server model, etc.)
5. Addressing training issues.
6. Implement a pilot project of data exchange with a specific regional office. And keep feedback of the results to the rest of stakeholders for future implementation.
7. Using all indicators for allocation of financial requirements as input for the cost recovery approach since the organisation is going to move to be cost recovery (self-supporting).

5.6 Concluding Remarks

Several issues pertaining to the exchange and sharing of cadastral-related data have been presented. These issues must be dealt with for an organisation to have a successful implementation of a technological solution to resolve systems heterogeneity. The conceptual model for the exchange of information that supports the cadastral processes was defined in order to determine the factors that contribute to achieve interoperability among organisations responsible of sharing cadastral information.

Finally the steps to implement the link between RGP and UJT organisations within the framework of an infrastructure was presented in order to start the process of realization of data sharing. During the realization of the implementation plan it is necessary to take into account changes in presumptions, policy basis, technology trends, circumstances and final results of activities.
CHAPTER 6
Conclusions and Recommendations

“...The Cadastre is highly complex, but not difficult...and because it is ours, it’s worth it...”
UTJ staff – Guatemala (1998)

6.1 Summary
This research focused on the development of a Cadastral Infrastructure that supports the implementation of Land Administration System in Guatemala. It analyzed three main issues: i) the identification of the users and requirements to the Cadastral System, ii) the generation of improved processes within the Cadastral establishment business-process, and iii) a model that supports the shareability and exchange of information among organizations.

The conclusions and recommendations that arise from this research are elaborated in the following sections.

6.2 Conclusions
The requirements that justify the existence of the Cadastral infrastructure were identified through the study of the potential users and providers of cadastral information. This was done performing a situational analysis of the National Cadastre towards the implementation of a Land Administration program in Guatemala related to the accomplishment of the Peace accords, complemented with the information collected during the fieldwork for this research.

Although a broad range of stakeholders in cadastre can be defined, the most relevant ones were identified in order to remain within the framework of the specifications from Protierra’s rural development programs which constitute the backbone of the land-related peace accords.

The current situation between the Cadastre [UTJ] and other institutions was analyzed in order to define the status of the existing links. The relation between the RGP’s legal registration data and the cadastral survey data from the UTJ, was emphasized because this is the main focus of the cadastre. Therefore it can be said that the willingness from the stakeholders to integrate efforts exists, but the lack of communication channels and definition of institutional-operational and technical cooperation mechanisms, will not permit the right development of the infrastructure.

Using the architectural approach, a process model design was developed from the current cadastral activities defined by UTJ. The functional behavior of the business processes was analyzed in order to detect potential problems in the creation of the cadastral infrastructure, and also the challenges and bottlenecks were detected from the cause-effect analysis applied.

The results from the situational analysis and the current-situation process model analysis related to the existing challenges that represent risks to the successful implementation of the cadastral establishment processes, led to the proposal of applying BPR concepts to the current processes of UTJ in this research. A new alternative scenario for the Cadastral certification process within the BP “Cadastral Establishment” was modeled. This model provided a clear visualization of the interactions between the main providers (RGP and IGN) of the fundamental datasets for the cadastre.
The components and requirements to create the Cadastral infrastructure for the Guatemalan process were suggested and explained. This infrastructure enforces the new alternative cadastral processes to support the business processes of UTJ. The components were divided in four main groups: i) Participation of the organizations involved; ii) legal framework that comprises the basic law for cadastre and institutional arrangements; iii) functions and data requirements; and iv) technology and communication.

Because of the aforementioned, the first and second objectives can be considered as achieved.

As far as the third objective is concerned, the interactions identified and the points of coordination were the base to model a mechanism to implement the exchange of information between organizations. Within the scope of this study it was considered to emphasize the relationship between the Cadastre [UTJ] and the Property Registry due to the relevance of the ownership data to perform the cadastral analysis in UTJ.

To find the relations that should exist between the processes and the organizations, a matrix was developed using some aspects of the BSP method. This was done determining the relations between activities/processes and the data classes produced by different parties.

The model of the architecture to exchange data was designed under the OpenGIS specifications. It aims to achieve interoperability between different users (in particular, between UTJ and RGP) through the Internet, running on a single site, accessing to the several remote servers holding heterogeneous spatial and descriptive datasets, and visualize, overlay them on the screen of the user. This solution proposes that a distributed system must be set up implementing a Client-Server concept.

Organizational structural, cultural, and technical changes are the criteria that may lead to the successful implementation of the cadastral infrastructure. From these criteria the steps are derived for the implementation of the exchange mechanism among the RGP and UTJ information systems. Finally the phases that should be considered as the general guidelines for the in the implementation plan of the cadastral infrastructure were proposed.

### 6.3 Recommendations

The following issues are mainly focused on the work towards a cadastral infrastructure to support a land administration system and should be carefully considered in the initial phase of the implementation.

a. **Stakeholders and information**
   - Set up a general project plan description where all the stakeholders participate through a stakeholder Forum in order to define integrated tasks.
   - Compile an information/demand study based on this research and make it subject for considerations to selected interested parties in order to obtain a customer oriented approach.
   - Involve the stakeholders related to the cadastral infrastructure at an early stage of the development work.
b. **Infrastructure supporting Cadastral Business Processes**

- UTJ should consider the business processes explained in this study in order to define a business model to start the development of a customer oriented approach for the Cadastre.
- It is recommended that the Cadastral Infrastructure must be treated as a national priority with the full commitment of UTJ as a coordinating body to provide the framework discussed in this study in order to avoid the aforementioned risks.
- In order to complement the Geoinformation management framework in relation with land administration, and besides the technical side of the infrastructure, it is recommended to enrich this study integrating the socio-economic-development aspect and the policy aspect (what can we realistically do today and what may we expect from the future, taking into consideration that the whole process started as a commitment to the Peace Accords).

c. **Exchange of information**

- The model architecture to enable the data sharing among organizations developed in this research still needs to be improved in its conceptual model. Further implementation of a prototype is recommended to test the consistency of the concepts applied.
- To implement the proposed mechanism of exchange of information in UTJ, it is necessary to make organizational agreements with the external parties on cooperation-basis and technical-basis such as input/output delivery. Base the agreements on a detailed description. Each type of data has to be carefully described in terms of contents and procedures.
- Organizational and economic issues as self-sustainable mechanisms, related to the information sharing are areas that will require more attention once the creation of the infrastructure starts.
- The relation and exchange of framework data with the National Geographical Institute would be advisable for further research as support for the Cadastre’s process of foundation data acquisition and production, hence this organization is in a transition stage from a out-dated status to a digital up-to-date status.
- Due to the advances in the field of open systems, it is recommended to go into further research towards the OpenGIS specification.
# Table A.1 External Factor Analysis Summary (EFAS Matrix)

<table>
<thead>
<tr>
<th>EXTERNAL STRATEGIC FACTORS</th>
<th>WEIGHT</th>
<th>RATING</th>
<th>WEIGHTED SCORE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Opportunities</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increasing demand for establishing the land registration for the whole country due to the peace accords commitment. Political support</td>
<td>0.15</td>
<td>3</td>
<td>0.45</td>
</tr>
<tr>
<td>Enabling power of technology among organizations. Some organisations are introducing ICT applications. (RGP &amp; IGN) because the availability of top technology on the market.</td>
<td>0.10</td>
<td>3</td>
<td>0.30</td>
</tr>
<tr>
<td>Support from the international community(“know how”)</td>
<td>0.05</td>
<td>1</td>
<td>0.05</td>
</tr>
<tr>
<td>Inter-institutional co-ordination and institutional participation</td>
<td>0.10</td>
<td>1</td>
<td>0.10</td>
</tr>
<tr>
<td>Start from scratch system approach. There is no formalized cadastre in Guatemala</td>
<td>0.10</td>
<td>3</td>
<td>0.30</td>
</tr>
<tr>
<td><strong>Threats</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lack of solid policies in respect of land administration system (RGP-Cadastre)</td>
<td>0.20</td>
<td>2</td>
<td>0.40</td>
</tr>
<tr>
<td>No revised politic process of integration or evaluation among organizations</td>
<td>0.20</td>
<td>2</td>
<td>0.40</td>
</tr>
<tr>
<td>Political influence on the objectives and activities of the UTJ</td>
<td>0.10</td>
<td>2</td>
<td>0.20</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>1.0</td>
<td>2.20</td>
<td></td>
</tr>
</tbody>
</table>

Model Extracted from Hunger & Wheelen (1997)
Table A.2  Internal Factor Analysis Summary  
*(IFAS Matrix)*

<table>
<thead>
<tr>
<th>INTERNAL STRATEGIC FACTORS</th>
<th>WEIGHT</th>
<th>RATING</th>
<th>Weighted Score</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Strengths</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>There are potential capabilities, resources, products and services among units.</td>
<td>0.10</td>
<td>2</td>
<td>0.20</td>
</tr>
<tr>
<td>Existing talented staff in the interpretation of surveying old documents and traditional surveying work, as well as potential staff in the modern GI technology if well trained</td>
<td>0.20</td>
<td>2</td>
<td>0.40</td>
</tr>
<tr>
<td>Technical assistance installed a big infrastructure of information technology (ICT)</td>
<td>0.10</td>
<td>1</td>
<td>0.10</td>
</tr>
<tr>
<td>Available funds for personal training.</td>
<td>0.05</td>
<td>2</td>
<td>0.10</td>
</tr>
<tr>
<td>Tendency to marketing oriented culture attitude ready to change</td>
<td>0.05</td>
<td>1</td>
<td>0.05</td>
</tr>
<tr>
<td><strong>Weaknesses</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Duplication of tasks within the units of the organization and these can delay the delivery process of the cadastral establishment.</td>
<td>0.25</td>
<td>2</td>
<td>0.50</td>
</tr>
<tr>
<td>Lack of business planning experience and business management approach.</td>
<td>0.05</td>
<td>2</td>
<td>0.10</td>
</tr>
<tr>
<td>Procedures of different tasks and activities are not clear to the whole staff. Monopoly of some activities to particular staff due to unclear works procedures.</td>
<td>0.10</td>
<td>1</td>
<td>0.10</td>
</tr>
<tr>
<td>Some processes in UTJ are still using the very old technique in the work (going several times to the RGP to extract information) and inadequate way of archiving which can cause a big problem in case of analyzing documents.</td>
<td>0.10</td>
<td>2</td>
<td>0.20</td>
</tr>
<tr>
<td>TOTAL</td>
<td>1.0</td>
<td>1.70</td>
<td></td>
</tr>
</tbody>
</table>

Model Extracted from Hunger & Wheelen (1997)
### Table A.3 SWOT Matrix for UTJ

<table>
<thead>
<tr>
<th>Opportunities &amp; Threats</th>
<th>Opportunities</th>
<th>Threats</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Opportunities</strong></td>
<td>1. Increasing development of the country.</td>
<td>1. Lack of solid policies in respect of land information system (RGP-Cadastre)</td>
</tr>
<tr>
<td></td>
<td>2. Government need for effective land administration system.</td>
<td>2. No revised politic process of integration or evaluation among organizations</td>
</tr>
<tr>
<td></td>
<td>3. Enabling power of technology among organizations.</td>
<td>3. Political influence on the objectives and activities of the UTJ</td>
</tr>
<tr>
<td></td>
<td>4. Inter-institutional co-ordination and institutional participation.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5. Availability of well educated people in GI and ICT.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Strengths &amp; Weaknesses</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Strengths</strong></td>
<td>Establish agreements among organizations to foment cooperation in order to share vital framework data for the cadastral infrastructure.</td>
</tr>
<tr>
<td></td>
<td>Make use of the staff competence to re-engineer new production system, support the introduction of new technologies and provide product and avoid duplication of activities.</td>
</tr>
<tr>
<td></td>
<td>Provide information products digitally, through the Internet to meet the demand for digital data.</td>
</tr>
<tr>
<td></td>
<td>Make use of the capacity built by UTJ to enforce the strategic liaison between organizations. Win-Win relationship.</td>
</tr>
<tr>
<td></td>
<td>Make use of the willingness of the organizations involved to be better in low cost GI production and to serve the customers better and faster trough ventures in the extraction of the information.</td>
</tr>
<tr>
<td></td>
<td>Increase the production of geodata (cadastral info) using IT trends to increase revenue.</td>
</tr>
<tr>
<td></td>
<td>Revision of the strategic plan according to each organization deliverables in order to distinguish the participation of each of them within the process.</td>
</tr>
<tr>
<td></td>
<td>Provide and extract information products digitally, over the internet to obtain information faster and efficiently with Quality control already checked.</td>
</tr>
<tr>
<td></td>
<td>Revision of the staff business plan to make an organized distribution of tasks.</td>
</tr>
<tr>
<td></td>
<td>Improve budgeting and cost control.</td>
</tr>
<tr>
<td></td>
<td>Build-up good relationships with organisations, potential partnerships and suppliers to develop and increase the business and customer oriented system approach.</td>
</tr>
<tr>
<td></td>
<td>Redesign processes to focus in the efficient production of the cadastral certification using information provided by IGN and RGP.</td>
</tr>
</tbody>
</table>

**Model Extracted from Hunger & Wheelen (1997)**
# ACTIVIDADES ESTABLECIMIENTO CATASTRAL

<table>
<thead>
<tr>
<th>Macro Acitivity</th>
<th>Actividad</th>
<th>Documentos Relacionados a la fecha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Declaración zona catastral</td>
<td>Declaratoria</td>
<td></td>
</tr>
<tr>
<td>Comunicación estratégica y difusión</td>
<td>Programas de comunicación social y promoción</td>
<td></td>
</tr>
<tr>
<td>Plan de trabajo y selección de metodología</td>
<td>Reconocimiento físico del Área</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sectorización de la zona catastral de acuerdo al método</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Recopilación de información geográfica existente</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Aprobación del plan de trabajo</td>
<td></td>
</tr>
<tr>
<td>Geodesia</td>
<td>Diseño</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fase de campo</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Gabinete</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Validación</td>
<td></td>
</tr>
<tr>
<td>Investigación documental sobre la tenencia de la tierra</td>
<td>Recopilación de información en instituciones</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Diagnóstico registral</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Armado de fincas matrices</td>
<td></td>
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<tr>
<td>Fotografía Area</td>
<td>Toma de Fotografía aérea</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fotocontrol</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Aerotriangulación</td>
<td></td>
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<tr>
<td></td>
<td>Producción de ortofotos</td>
<td></td>
</tr>
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<td>Cartografía</td>
<td>Foto identificación de elementos de cartografía</td>
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<tr>
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<td>Levantamiento de elementos de cartografía</td>
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<td>Toponimia</td>
<td></td>
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<td>Determinación de límites administrativos</td>
<td>Recopilación de información municipal</td>
<td></td>
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<td>Definición de Límites municipales</td>
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<td>Taller de polígonos</td>
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<td></td>
<td>Definición de límites de polígonos</td>
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<td>Levantamiento catastral</td>
<td>Aviso a titulares catastrales</td>
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<td>Entrevista y llenado de Ficha de Campo</td>
<td>Instructivo Ficha de Campo Código de Clasificación Catastral</td>
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<td>Geo-posicionamiento de esquíneros</td>
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<td>Cálculo y digitalización en gabinete</td>
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<td>Análisis Catastral</td>
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<td>Llenado ficha Base de datos RIC</td>
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<td>Traslado de los datos a Base de datos</td>
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<td>Impresión de planos y mapas</td>
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<tr>
<td>Análisis Jurídico</td>
<td>Emisión de resolución para el propietario</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Resolución y análisis de las impugnaciones</td>
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</table>

Table B.1 Description of Macro activities and processes of the Cadastral Establishment BP
Appendix B. Cadastral Activities
<table>
<thead>
<tr>
<th>Macro Actividad</th>
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</tr>
<tr>
<td></td>
<td>Sectorización de la zona catastral de acuerdo al método</td>
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</tr>
<tr>
<td></td>
<td>Recopilación de información geográfica existente</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Aprobación del plan de trabajo</td>
<td></td>
</tr>
<tr>
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<td>Fase de campo</td>
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<td></td>
<td>Gabinete</td>
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Table B.1 Description of Macro activities and processes of the Cadastral Establishment BP

Appendix B. Cadastral Activities
Appendix B. Cadastral Activities and Processes of UTJ-Protierra

Figure B.1 Processes of the Cadastre Establishment
Source: Área Técnica. Unidad Técnico-Jurídica de Protierra 2000

Table B.1 Description of Macro activities and processes of the Cadastral Establishment BP

Appendix B. Cadastral Activities

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Appendix B. Cadastral Activities and Processes of UTJ-Protierra

COMISION INSTITUCIONAL PARA EL DESARROLLO Y FORTALECIMIENTO DE LA PROPIEDAD DE LA TIERRA
PROTIERRA
UNIDAD TECNICO JURIDICA

**ESTABLECIMIENTO CATASTRAL**
**DIAGRAMA DE FLUJO**

- **Difusión**
- **Comunicación Estratégica**
- **Declaratoria de Zona Catastral** (Artículo 25 Ley RIC)
- **Estudios Socioeconómicos, Técnico-Jurídicos**

**Actividades Previas al Levantamiento**

- **Redes Geodésicas Complementarias**
- **Fotografía Aérea**
- **Poligonación Catastral**
- **Levantamiento Catastral**
- **Análisis Jurídico**
- **Exposición Publica o Notificación a Titulares**
- **Declaración de Predio Catastrado Predio Regular o Irregular**

Figure B.2 Flow chart of the Cadastral establishment process

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Appendix A. Environmental Scanning of UTJ-Protienda

- EFAS Matrix
- IFAS Matrix
- SWOT Analysis
Appendix B.  

Cadastral Activities and Processes of UTJ-Protierra  
(Spanish)  

- Diagram of the Cadastral Establishment Processes  
- Description of Cadastral Macro-activities  
- Flow Chart of the Cadastral Establishment Process
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