

1. An ILS White Paper on Integrated Registry and Cadastral Systems

The purpose of this white paper is to provide an overview of land registration systems and how and why their integration with cadastral systems is so important. We include references to the terms “land registration”, “land administration”, “title registration”, “deeds” and “deeds registration” and how they differ and why they might be important. We also present the concept of cadastral mapping and surveying and specifically the concept of general and fixed boundaries. We also present the important relationship between the cadastre and the registry, why they are so inextricably linked and why ultimately one cannot exist efficiently without the other, and why in increasing numbers governments are looking to the concept of a single unified land agency.

This paper is intended for managers and practitioners of Registry and Survey and Mapping offices worldwide, as well as potential and current business partners and systems integrators and consultants as a way to present a unique GIS based offering that solves the registration and cadastral issues worldwide. Partners International Land Systems (ILS), Inc and Swedesurvey/Lantmateriet of Sweden have successfully implemented more than 100 installations worldwide of our respective products. This GIS based solution is one of a kind – there is no other proven integrated registry and cadastre solution based on any other GIS technology anywhere at this time.

2. Why do we need efficient Land Registry and Cadastral Systems?

Good governance and effective public administration recognize land as the principal source of wealth and indeed wealth generation in a society. Land rights that provide secure tenure and facilitate broad private ownership enable society to develop dynamic land trading practices and formation of land markets. No country can develop or sustain a civil society or promote economic development within its boundaries without internal confidence and public acceptance in its land rights and system of land administration.

Property is a cultural concept of the relationship between people and things. In market-based economies, people can gain the right to process, use, enjoy and dispose of “things”. This has led to the concept of a “Bundle of Rights” - the rights related to the ability to possess, use, enjoy and dispose of. Figure 1 illustrates the general concept of the bundle of rights of property. The government’s role is to define property rights and to protect those rights. Therefore property has a legal dimension. Property also has a physical dimension; the things we can gain rights over may be tangible or intangible. Property has an economic dimension as well; property is a store of value, an element of wealth, a safe “harbor” for individuals to place savings and wealth – something of particular importance in emerging economies where monetary systems may not yet be fully stable.

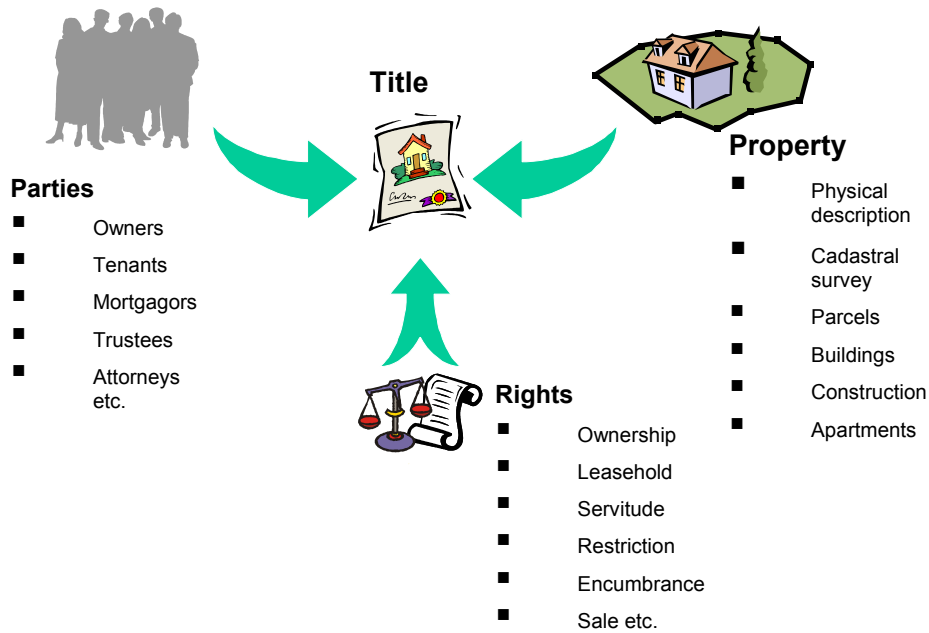


Figure 1: Concept of Bundle of Rights for Real Property

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Modernization of the financial sector is predicated on the creation of primary land markets in which land is bought and sold and each transaction recorded. All transactions, both initial grants and subsequent derivative transactions, must be tracked and on the public record. As markets mature and confidence is established in the land administration system opportunities arise to create innovative financial instruments that allow commercial interests in property to be traded and land becomes a commodity. Securitization of commercial interests in land mobilizes funding and further develops and strengthens capital market formation. Therefore, the wealth multiplier effect of good governance and sound land administration is potentially enormous. (See [Figure 2](#)).

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Figure 2: Evolution of land markets (Wallace and Williamson 2004 after Menelaws 2000)

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A key component in land administration is the creation of a civil law registry that promotes confidence between the public, its commercial enterprises and government.

Where countries lack robust and tested land administration systems significant dysfunctions can occur such as:

1. Diminished market operations in land; conflicts of ownership and even civil unrest,
2. Lack of an essential policy tool that can assist government create a civil society with democratic norms, and
3. Reduced potential for economic growth as the huge amount of capital typically invested in real estate property is never formalized and integrated into the financial system.

Modernizing property registration is a difficult and complex process. Nevertheless there is no real alternative and this is the task facing many governments worldwide.

3. Deeds Registration versus Title Registration Systems

The right of private property is defined by a contract, normally between two or more land owners. After the agreement between land owners about a transfer of rights, a deed or a title is created then the transaction of rights only becomes legally effective by the registration of either of deeds or titles in an official land register. Private conveyancing¹ is the system whereby two land owners enter into a contract but do not register the transaction in the registry and therefore no protection under the law is provided.

Most nation states use a process to inventory and maintain information about real property – this is generally referred to as “land registration”². How this is done i.e. procedures and process and supporting laws differ from country to country (and even within a country). Historically, two formal systems of recording and making inventories of property have evolved. These are the Deeds Register Systems and the Title Register Systems. A third less common system is private conveyance. The United States has all three. All three can also be found in Europe – including multiple variations of each type.

Deeds systems involve extended title searches. A deed is a written record of an isolated transaction and is evidence that the transaction took place, but is not by itself proof that the party conveying the land actually owned it. Before any dealing can be safely effected the person intending to purchase an interest in land must therefore trace the vendor’s legal right to sell back to a good root of title, and this search must be repeated each time there is a dealing in the land.

A Deeds Registration System has a person or entity (i.e. corporation etc.) provides a document proving their right as the owner of a piece of land or apartment etc., in which the document describes the transfer of the rights referring to them. This document, the deed, becomes legally effective, when it is booked or registered in the official land register in relation to the rightful claimant. The document is then stored in the system as a sequential document with no relationship to the document that precedes or follows it. This means that to “search the chain of title” in a deeds system one has to look through the sequential records to find a deed that is related to a prior deed, look at that prior deed and see who the prior owner was and find that deed and so on until a good “root of title” is established. This can be a time consuming and expensive process and it is difficult to verify other restrictions and obligations that may have been filed against a particular property or owner(s).

¹ Private conveyancing is currently the method by which most transactions seem to occur in Cairo [Why Cairo: should be explained.](#) Note that in many cases throughout the world private conveyancing is still used – particularly as transfers through wills etc. may occur within families.

² Land registration is the process of official recording of rights in land through deeds or as title on properties. It means there is an official record (land register) of rights on land or of deeds concerning changes in the legal situation of defined units of land. It gives an answer to the questions who owns and how they obtained ownership.

RELATIONSHIP BETWEEN MAN AND LAND IN DEED SYSTEM

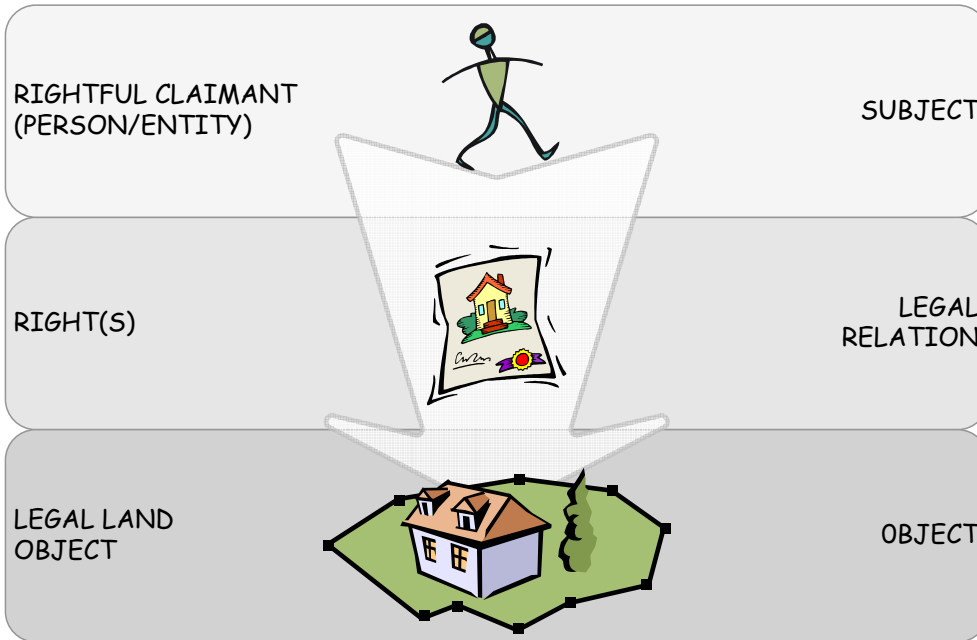


Figure 3: Principle of a deeds system. (Taken from Hanssen 1995)

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In a deeds system it is possible to have several variants based on the way the records are organized, some of these are:

1. A deeds system that is organized by name (grantor and grantee) such as is found in the US, Belgium and many other countries and for which there is no guarantee by the agency managing the deed records that the record is complete and accurate. In the US protection is provided to the mortgagor(s) and mortgagee (s) by private title insurance which protects the lender and purchaser against a mistake being made in the reading of the chain of title, and
2. A deeds system that is organized and indexed not solely by owner name but by the property number (tract index as it is sometime known in the Western and mid western United States). In the remainder of the US the documents are still protected through private title insurance but other locations such as Holland that have parcel indexed deed systems are certified to by public notaries.

In a system of registration of title, however, it is the land parcel (or flat/apartment) itself that is registered and therefore the title is registered together with the details about the transaction in relation to the real property unit. The primary focus is not on the person claiming or temporarily in possession of a property but on the immovable and defined real property unit that is the basis of record. The title register is proof of title and its correctness at all times is commonly guaranteed by the State. This means the title must be inspected but unlike in the deed system there is no need to trace ownership back to a good root of title.

RELATIONSHIP BETWEEN MAN AND LAND IN TITLE SYSTEM

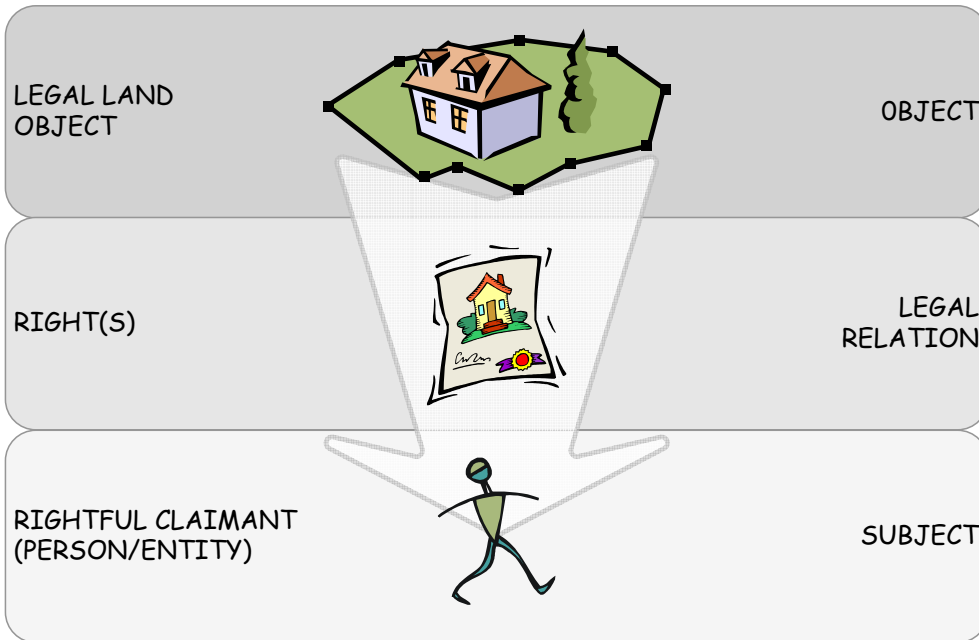


Figure 4: Principle of a title registration system (from Hanssen 1995).

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A more modern title registration system adopted in Australia and New Zealand (Torrens based) and for which variants worldwide can be found are driven around three main principles which are:

- **Mirror principle:** the register accurately and completely reflects the state of the title, and/or;
- **Curtain principle:** the register is the sole source of title information i.e. curtain effect that blocks out all former transactions so there is no need to go back beyond current record, and/or;
- **Insurance principle:** the state is responsible for the veracity of the register and to provide compensation in the event of error through an indemnity fund.

4. Cadastral Mapping and Surveying

Effective maps, cadastral surveys³ and cadastral index maps are all fundamental to an efficient and speedy land registration process. They are needed to ensure that rights and restrictions about properties can be quickly identified by referring to the same unique place on the earth.

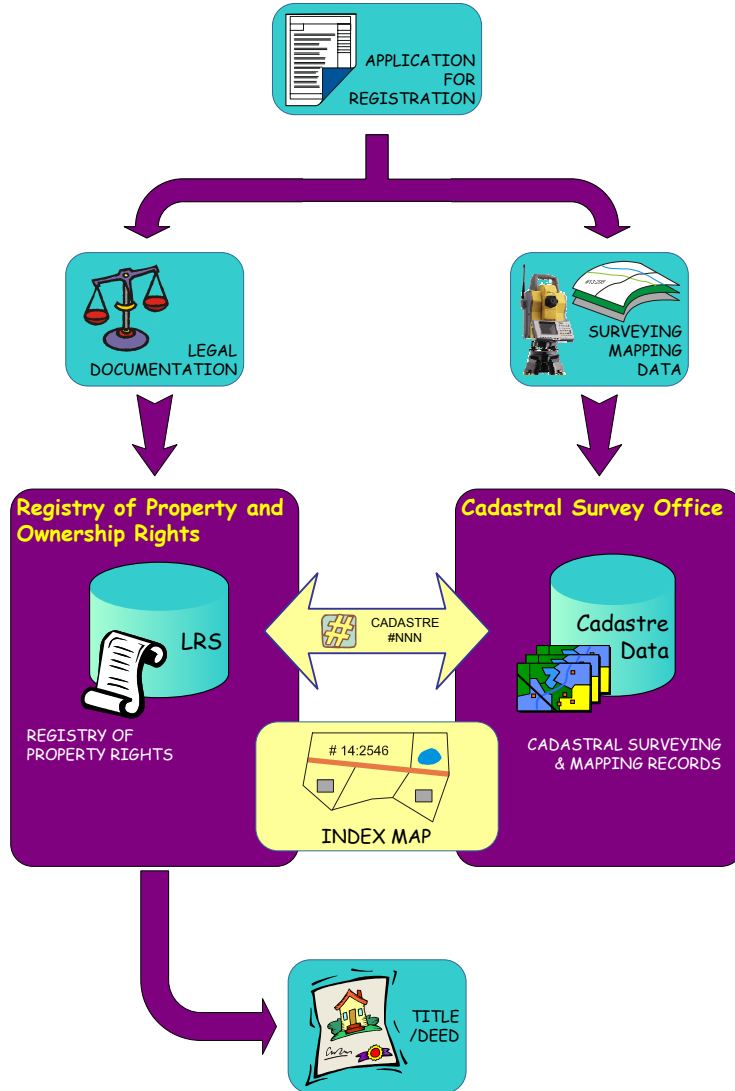


Figure 5: The relationship between the Registry and the Cadastre

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³ In the US these are known as property surveys.

Maps, cadastral index maps and surveys all work to define the boundary of a real property. Property boundary systems have been classically divided into two types: 'fixed' and 'general'. In a fixed boundary system, the boundary is an invisible straight line between two terminal points, which are physically demarcated with a monument⁴ (artificial or natural). In a general boundary system, the boundary line is demarcated by a fence, wall, ditch, hedge or some other physical and/or man made feature. No monuments are required and the boundary is usually treated like other topographic map features. The latter is predominantly found in the United Kingdom.

Until relatively recently these two boundary systems were regarded as distinct, but they are now being viewed as two options within a single system (a combined approach). Many registration acts now incorporate both types of boundaries as an acceptable means of defining the legal limits of property rights. The advantage of a combined or integrated approach is that it makes the accuracy requirements more *flexible*, a criterion which is important in an environment of widely varying real estate object types and values such as might be found in emerging economies in particular.

In the context of a combined or integrated boundary approach, a wide range of cadastral surveying information can be admitted in support of title registration. This may include, but is not limited to:

- (a) 'Index maps', dimensions (angles and distances), and boundary descriptions with little or no geo-referencing data;
- (b) Features identified on topographic base maps, or digital orthophotos ('general boundary');
- (c) Artificial or natural monuments and associated coordinates and diagrams ('fixed boundary'); and
- (d) Any combination of 'fixed' and 'general' boundary elements.

For economic reasons, it is important to maintain a flexible system, which acknowledges the range of real estate object values. Thus, the cost of survey (i.e., the cost of obtaining cadastral surveying data) must be commensurate with the value of the object and property values increase or change; the system must accommodate the upgrading of cadastral surveying data.

In order to speed up and streamline the process of property registration integration it is important to develop a flexible yet accurate cadastral surveying system – that is a system that follows these basic principles as guidelines:

- (a) Cadastral surveying data (maps, plans, coordinates) constitute evidence to support the definition, validation or re-establishment of a real estate object boundary,
- (b) All available evidence will be evaluated in support of the validation or re-establishment of a real estate object boundary. Evidence may include surveying and mapping records and data, physical indications, verbal testimony, etc.,
- (c) In addition to the delineation and demarcation of real estate object boundaries, cadastral surveying is the basis for the delineation and demarcation of spatially defined encumbrances to property rights (e.g., servitude's), and

⁴ A cement block or marker or iron rod buried in the ground or even a face plate on the corner of a building.

- (d) In general, all available legitimate boundary evidence will be considered (weighed) when validating or re-establishing a boundary. The principle of the *preponderance of evidence* will prevail.

It should be emphasized that accurate (reliable) cadastral surveying information constitutes very strong evidence, and therefore contributes significantly to the **security of title**.

5. An integrated Cadastre and Registry System

The ILS and Swedesurvey approach is to provide a high-quality integrated land registration and cadastre system based on International Land Systems' Land Registration System suite (LRS) and Swedesurvey/Lantmateriet's ArcCadastre both of which can be localized, configured, and customized and both of which are designed around the emerging FIG⁵ Cadastre 2014⁶ data model. This integrated system is designed for offices that deal with managing surveying and mapping and the legal registry, worldwide.

Cadastre 2014 is a new concept⁷ designed to create a systematic documentation of the legal situation of land using GIS combined with traditional land cadastre and registration procedures. ILS's LRS solution provides registration of land and real estate rights, including all office functions needed by a Registry such as document intake, cashiering, scanning, indexing, public access, and property title reporting, while ArcCadastre provides land and parcel management capabilities through workflow, job management, survey data processing, and geodatabase management.

⁵ FIG is the acronym for the International Federation of Surveyors – more information can be found at www.fig.net.

⁶ The term Cadastre 2014, is derived from the year 1994 when a working group 7.1 of Commission 7 of FIG was formed, and adding 20 years – the time expected for development and adoption - hence 2014. A Cadastre 2014 booklet (Kaufmann, Steudler, 1998) was produced in 1998 and has since been translated into more than 20 languages, including Arabic, Russian and Spanish.

⁷ The initial terms of reference from FIG called for "Study cadastral reform and procedures as applied in developed countries, take in consideration automation of the cadastre and the role of cadastre as part of a larger land information system, evaluate trends in this field and produce a vision of where cadastral systems will be in the next twenty years, show the means with which these changes will be achieved and describe the technology to be used in implementing these changes."

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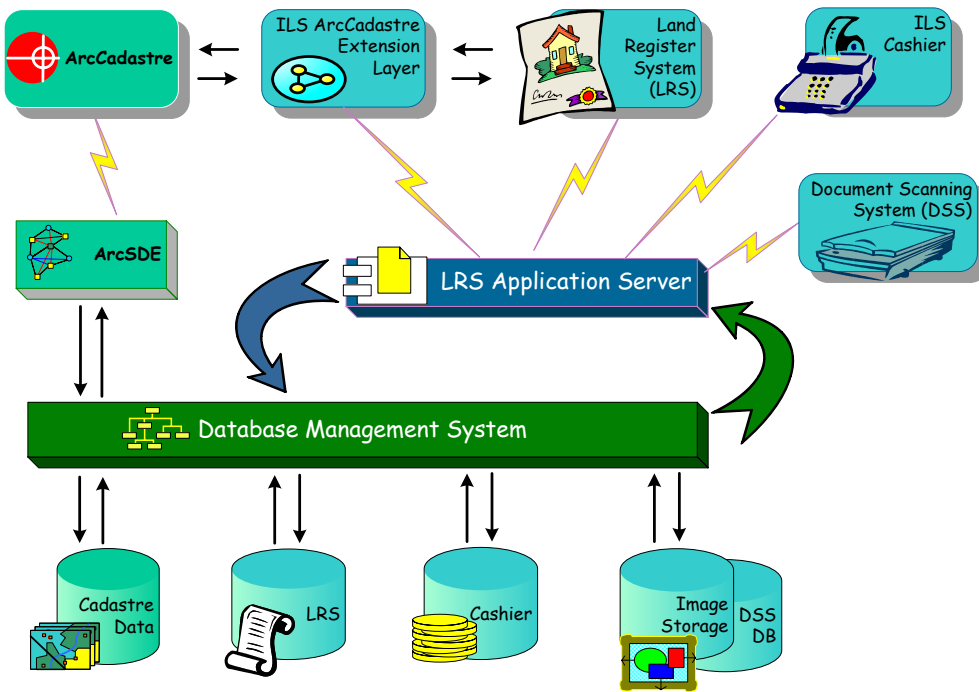


Figure 6. Overview of ArcCadastrre/LRS integrated architecture.

Figure 6 provides a high level look at the integrated architecture of ILS's LRS and Swedesurvey's ArcCadastrre. Both applications are multi-tier enterprise software systems based on scalable, modular platforms. The technical advantages of the LRS and ArcCadastrre solution include:

- Based on ArcCadastrre and LRS, the leading international cadastral management and registration solutions with more than 100 install sites worldwide,
- Both solutions are built in accordance with international GIS/LIS standards,
- Flexible open solutions with localization layers allowing straightforward language localization,
- Flexible open workflow configuration tools and functions that allow for most local documents and processes to be configured locally by partners, and
- Open, Windows-based system⁸ offering easy interoperability with other systems and future flexibility and scalability.

⁸ ILS offers other platform support such as Solaris and Linux for our web based public access solution.

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6. Land Register System – LRS

LRS is ILS's leading solution for real property title registration. LRS contains powerful capabilities for automating real property title registration offices, including document intake, cashiering, scanning, indexing, and property title reporting. LRS also contains a workflow engine allowing flexible configuration of data models, user profiles, document types, workflows and reports.

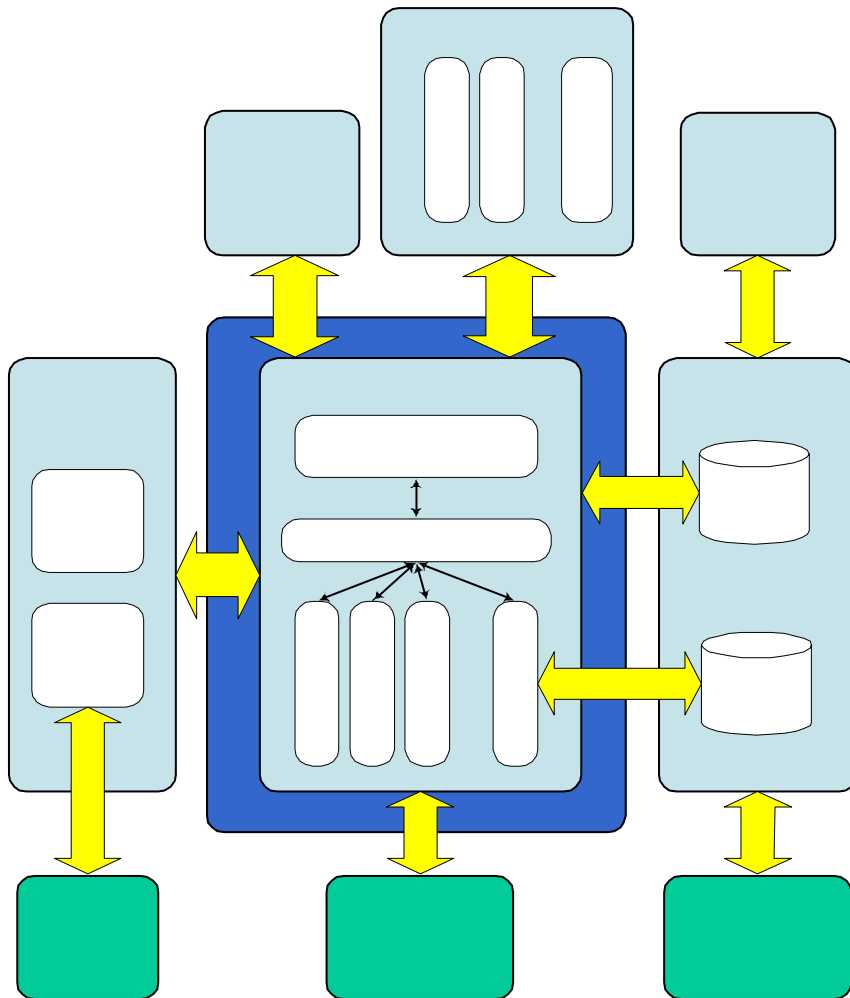


Figure 7. LRS Architecture including scanning, cashiering and ArcCadastrre plug-ins.

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LRS is a multi-tier solution based on the Microsoft .NET Framework. It consists of a core application server, document management and scanning servers, client applications, integrated applications such as ILS Cashier and ArcCadastral, and administrative tools.

The application server contains a workflow engine and data access modules which interact with the system databases. LRS can be installed on top of many different RDBMS's, such as Microsoft SQL Server, Oracle, DB2, MySQL and others. The RDBMS is used to store the property title registry and cashier data.

LRS's main user applications are the LRS Production Client, ILS Point-Of-Sale cashiering program, DSS scanning tool, and LRS Public Access.

LRS's main administration and configuration tools are the LRS Workflow Administrator and LRS System Administrator snap-ins for the Microsoft Management Console.

The LRS application server and most of the client components are written in C#, with some components developed in Delphi and Visual Basic. Workflow tools are provided to the end user and several fully documented Application Programming Interfaces (API's) are also provided for custom application development.

1.1. LRS Workflow Engine

At the core of LRS is a workflow engine for automating title registration workflows. The core engine uses states, transitions, users, document types, and other objects arranged into appropriate workflow scenarios. LRS includes workflow configuration tools that that can be used to customize the details of the required registration workflow. In addition several API's are provided allowing the use of VBA or similar development tools to customize access and interface to the title registry engine and data.

LRS's configuration tools are flexible enough to accommodate most customer needs. The tools allow addition of attributes to data objects, setting specific permissions for users, objects, workflows or groups of objects, and assigning specific workflow order. [Figure 8](#) shows an example of the LRS workflow configuration tools illustrating how workflows can be configured within the title registration system.

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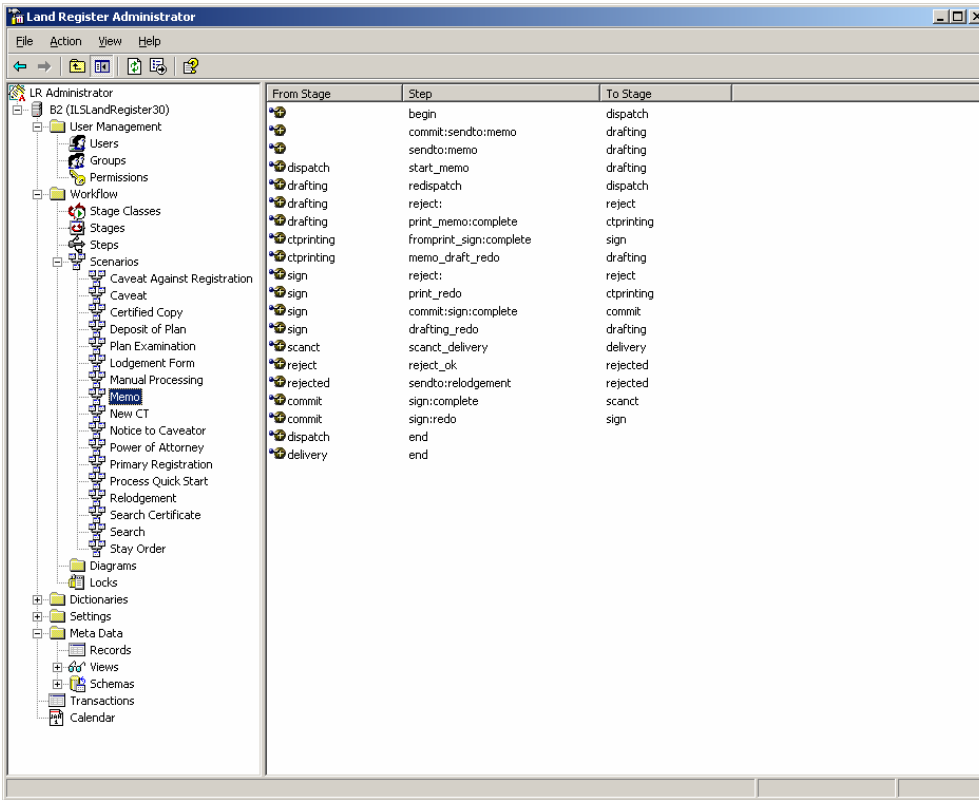


Figure 8. LRS Workflow administrator.

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Note that the object types appear in the left pane and the corresponding workflow scenarios in the right pane. Workflow scenarios shown here include title caveats (also called servitudes or easements), lodgements, memorials (memos), creation of a new certificate (s) of title, search, stay order, etc. The dictionaries function allows unique data fields to be coded and configured, and the calendar allows specific work schedules to be configured for local conditions, i.e. holidays, vacation schedules etc. This is important for reporting on productivity analyses.

Figure 9 shows the graphical workflow configuration view which allows the workflows to be built up from specific states and transitions (stages).

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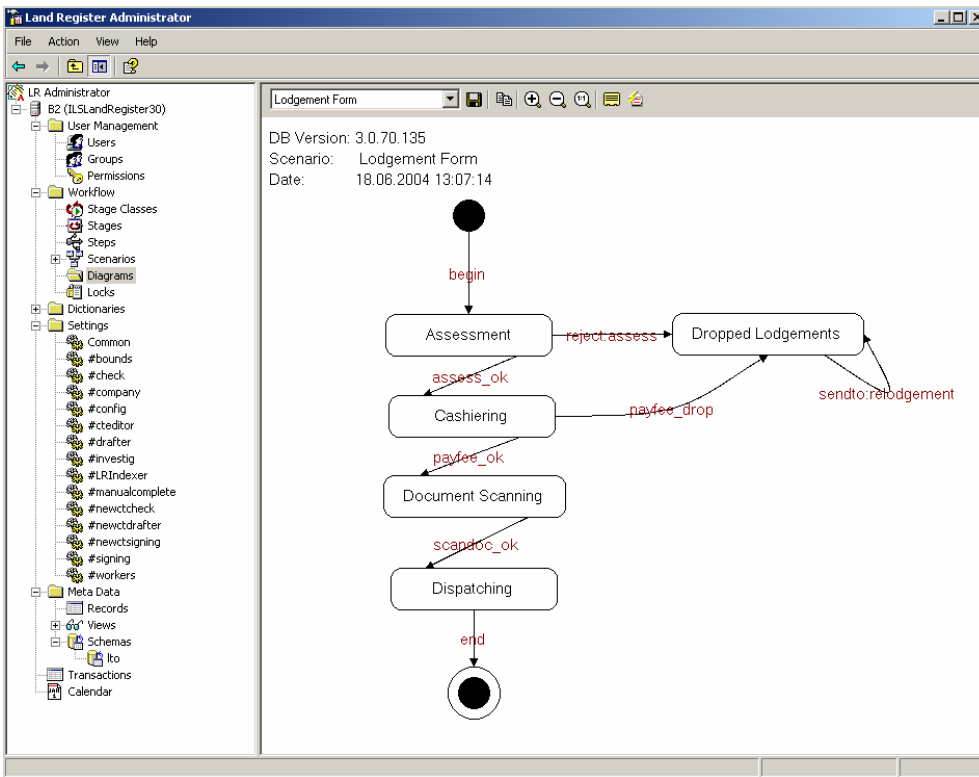


Figure 9. LRS Graphical Workflow interface.

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Note the workflow steps with transitions (stages and approvals) indicated. The LRS administrator uses these simple graphical tools to allow for the configuration of any of the work processing flows.

1.2. LRS Production Clients

The LRS Production Clients are the client applications which run on the individual operator workstations. The LRS Production client consists of a framework within which individual functional modules are loaded and executed. Typical functional modules include document intake, document dispatch, indexing, title memorial preparation, document scanning, etc.

The LRS Production Client provides a user-friendly Windows-based user interface that follows standard guidelines and practices for Windows applications. Many of the more complicated transactions are controlled by wizards which guide users through the required title registration workflows. This reduces the number of pull down menus and the use of cascading menus.

Figure 10 shows the LRS production client and a corresponding data entry wizard that has been configured using the workflow administrator. In this case the user will have to fill in the relevant transaction information for the instrument being registered.

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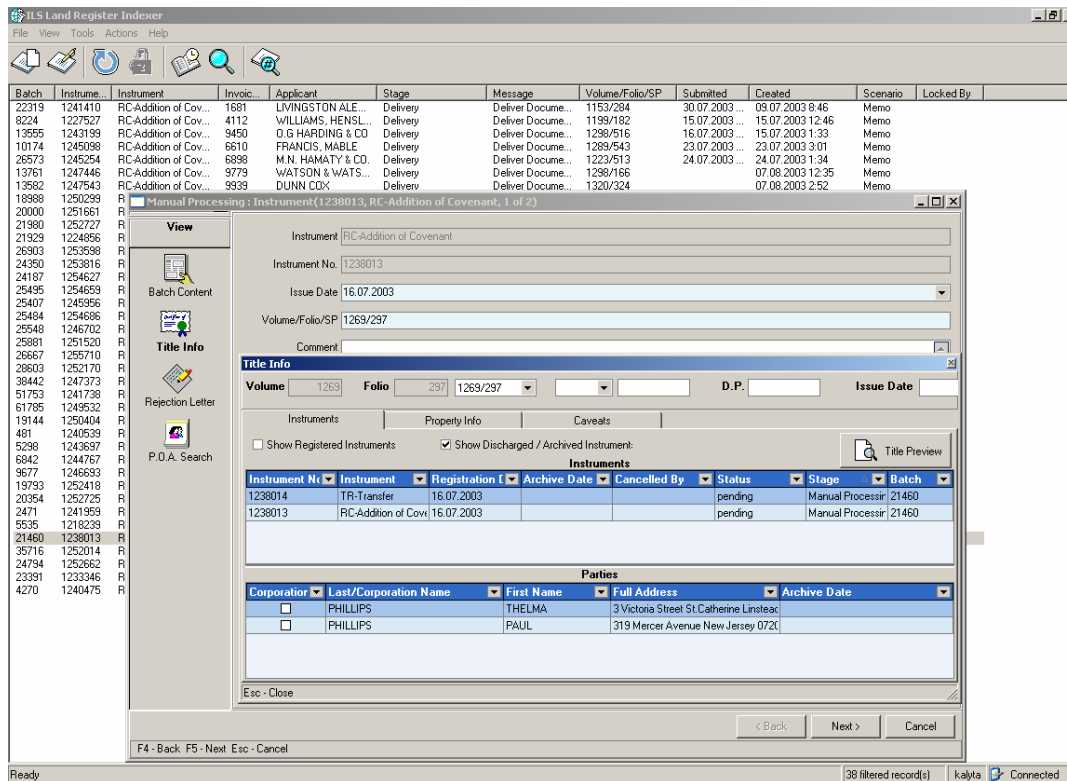


Figure 10. LRS Interface sample - ease of use.

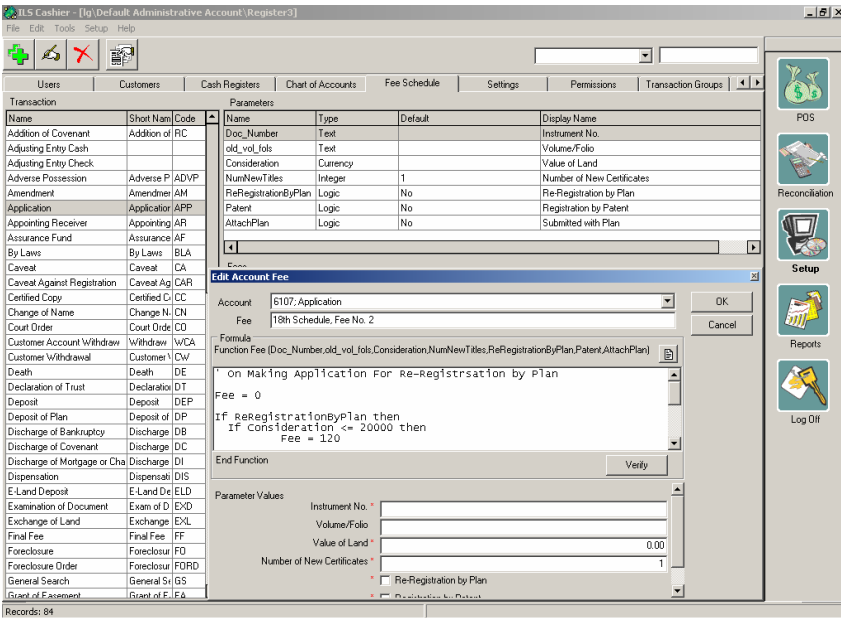
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In this example, the LRS Indexer operator is preparing to index a new lodgement from a list of filed registration documents.

1.3. ILS Cashier

ILS Cashier is ILS's integrated point-of-sale cashiering module and is often an important first step for the registration process. Monies are charged for the registration of documents based on assessments made of the transaction being lodged. These monies have to be accounted for and the information passed through a general ledger accounting process to a full financial management system. The ILS Cashier module interfaces with many financial accounting packages such as Microsoft's Navision, Sage, ACX and many others, through XML protocol interchange.

ILS Cashier is highly configurable and allows the entry of complex formulas for calculating registration and other transaction fees. New fees and assessments can be configured on the fly by an administrator using Visual Basic scripting. The user interface is easy to use and allows staff to quickly move through the assessment and collection of registration and other fees.



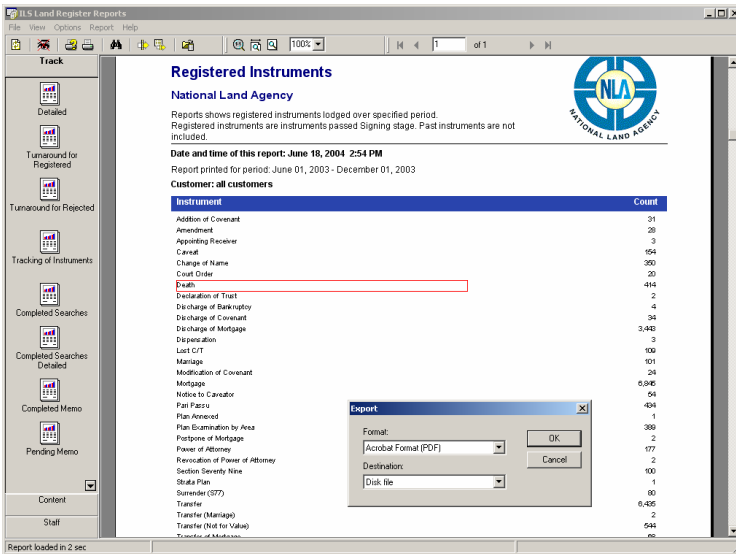
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Figure 11. Configure Fee Schedule using Visual Basic script.

In this example shown in Figure 11, the LRS Cashier administrator is configuring a new fee schedule for title registration applications. The administrator assigns parameters defining the transaction type, any default parameter values, and the final fee calculation formula. These formulas can be as complex as required by the user and as the local environment demands. ILS Cashier also includes standard accounting and reporting functions as shown in Figure 12.

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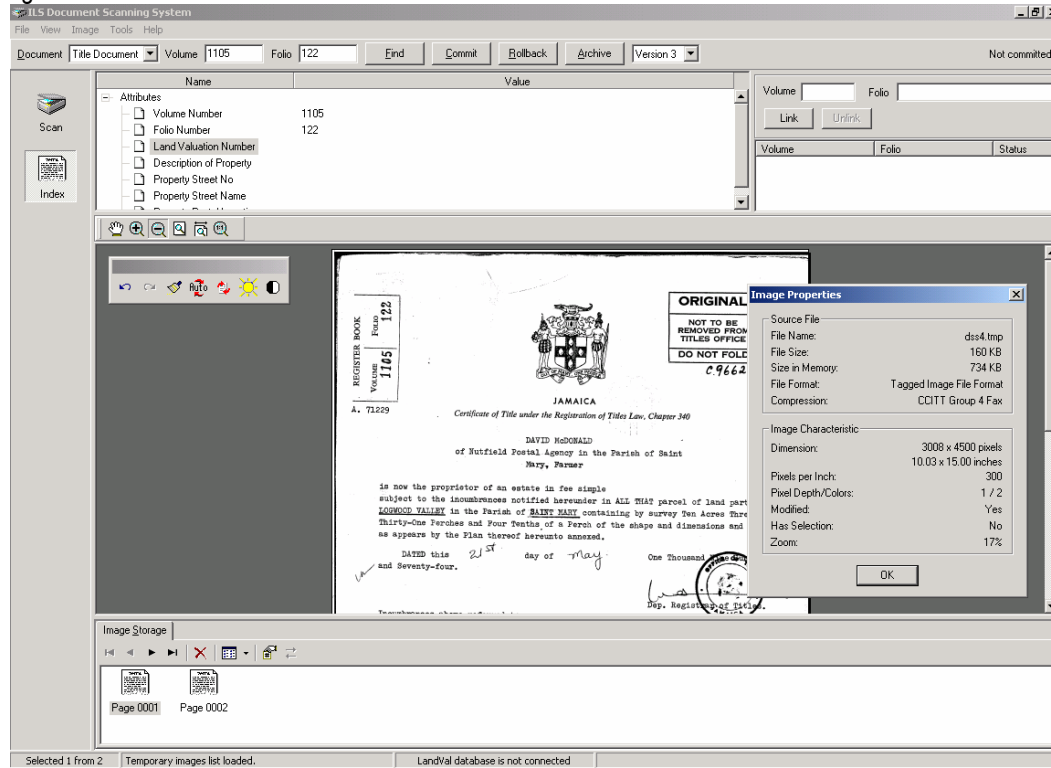


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Figure 12. Sample report showing daily transaction totals.

1.4. LRS – Integrated Document Imaging through DSS

LRS includes the integrated ILS Document Scanning System, an electronic document imaging and management system. DSS is used to image the cadastral and real property title documents. The figure below shows the DSS interface.



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Figure 13. DSS Scanning interface.

In this example we have used DSS to scan sample cadastral documents from Azerbaijan. DSS features a simple interface on top of powerful scanning and document management features. A document number is assigned and the document pages are scanned. The document can be automatically de-skewed and de-speckled and the page order changed. The system also detects blank pages and supports any TWAIN or ISIS compliant scanner. It can scan in color, grayscale, black and white, duplex or simplex modes.



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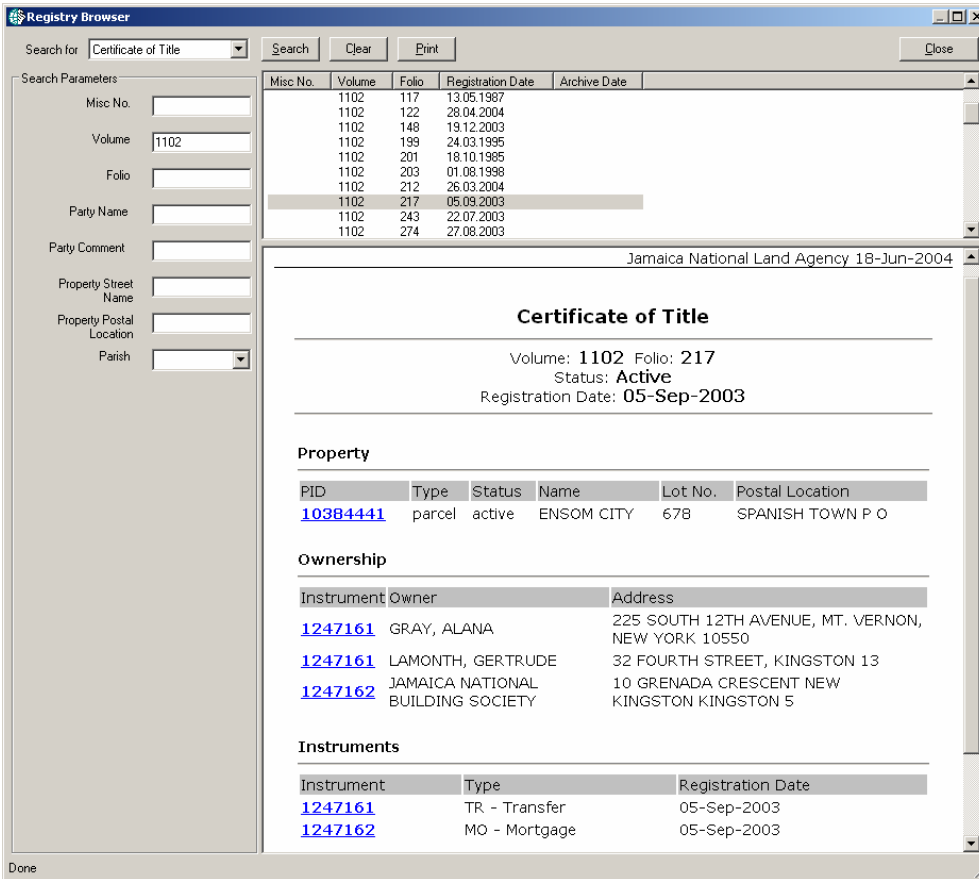
Figure 14. Scanning control bar.

This graphic shows the DSS image processing tools including cropping, rotation, contrast, despeckle, deskew, etc. The system also supports rollback of documents and multiple versions of the same document, a critical feature for title registry systems.

1.5. LRS Public Access

LRS contains convenient public access capabilities to allow managers, line operators, and the public to browse, search and view property title records.

The figure below shows the LRS Registry Browser, one of the LRS public access search and query tools.



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Figure 15. Public access: searching the registry database with LRS Registry Browser.

In this example, the searcher needs to find servitudes registered within a certain date range. LRS returns all servitudes registered during that time period and detailed information for a particular servitude can then be reviewed per that title. Hyperlinks are provided for each transaction that is currently “live” on the title providing a “real time” digital title.

7. ArcCadaastre

ArcCadaastre is Lantmateriet's (the National Land Survey of Sweden) powerful solution for parcel management. It brings together the strength of a world class GIS platform (ESRI ArcGIS) with versatile survey functionality (ESRI Survey Analyst) and the world's most complete format converter (Safe Software's Feature Manipulation Engine). The core product contains all functionality needed for surveying and mapping purposes as well as the greater part of the functionality that is common to cadastral workflows in different countries.

With ArcCadaastre, users work sequentially from field measurements via computation, processing, presentation of maps and reports, to final storage in flexible object-oriented databases. The Job concept within ArcCadaastre is a highly efficient approach for automation of cadastral office tasks. With its power and flexibility, ArcCadaastre is rapidly becoming the world's leading cadastral management solution used by more than 100 customers worldwide, and as the main tool for property formation and land management within Lantmateriet's production lines and local authorities all over Sweden.

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In order to increase efficiency in handling all kinds of spatial data Lantmateriet, has developed ArcCadaastre. ArcCadaastre is a tool specially adapted for cadastral and mapping activities with varying spatial management needs for different situations around the world. It's a unique solution that extends mapping functionality with survey and cadastral functionality.

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Figure 16. ArcCadaastre Platform

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The main areas of use for ArcCadaastre are cadastral work and mapping. Both depend on the efficient handling and management of geographic information (GI) together with attribute data.

ArcCadaastre provides the software solutions for capturing, maintaining and managing survey data and cadastral information. These solutions will also take into account the legal requirements for handling this type of information. ArcCadaastre is basic cadastral software that contains the greater part of the functionality that is common to the cadastral workflow in different countries. Functionality that may differ from country to country because of different local legal requirements can be added by customization of the basic ArcCadaastre system.

To support property formation and mapping, ArcCadastré can handle geographic information both in the form of direct measurements and as data imported data from other systems. This data can be edited in many different ways. Attributes can be stored in the user's own databases (and used provided that can communication is possible via ODBC.

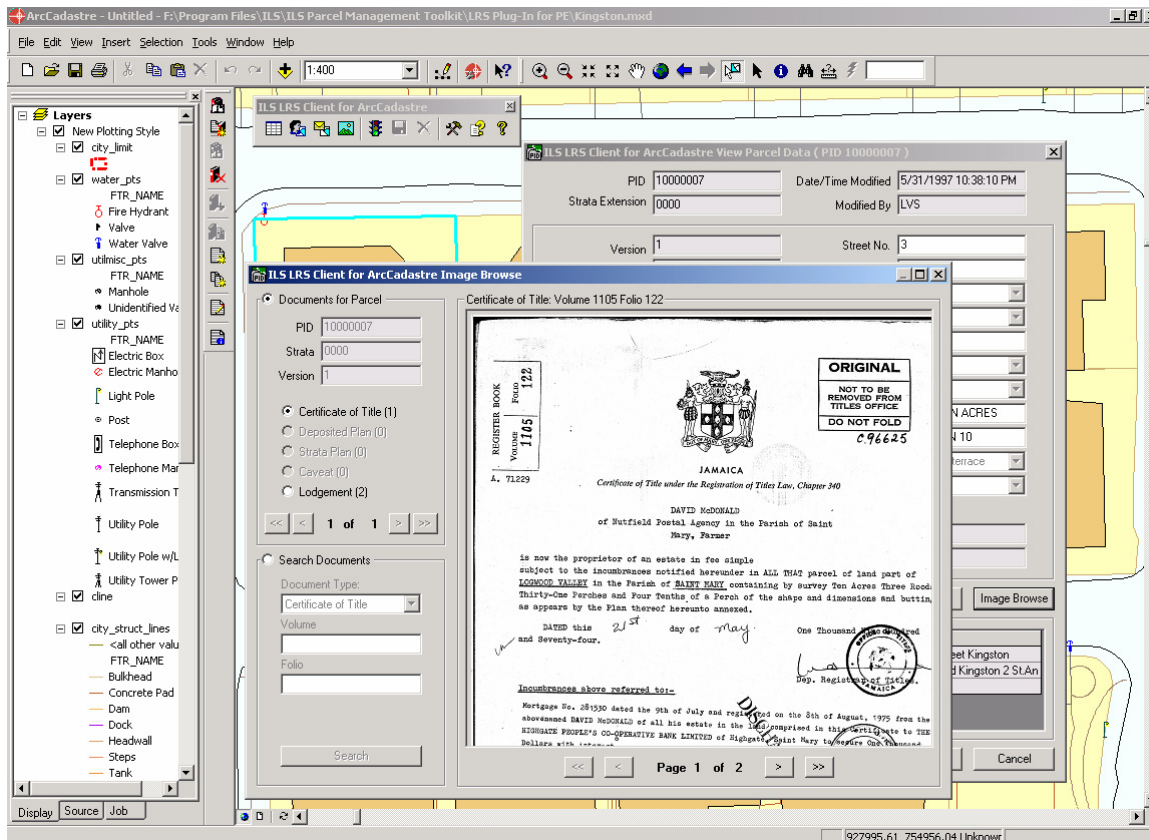


Figure 17: Integration example of LRS and ArcCadastré

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As several communication techniques are supported it easy to interface to other applications. Figure 17, shows the integration of LRS with ArcCadastré where a property has been queried in ArcCadastré using the identify tool, and all relevant title data including imaged documents are provided within ArcCadastré.

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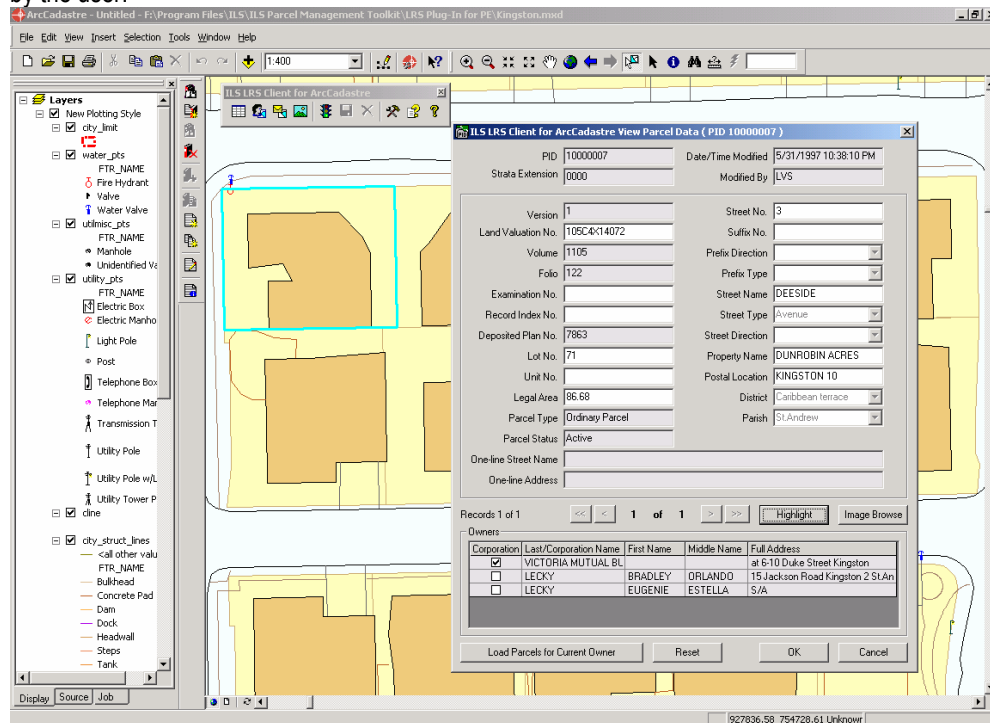
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Job handling with workflow support makes carrying out everyday tasks easy and reliable. The possibility to model custom features in the database ensures quality control and data integrity in a multi-user environment. For maximum security, the system for handling access rights makes use of the functionality of the operating system. Only the ArcCadastré-specific part is managed internally within the product (access rights on functions).

The data model provided with ArcCadastrale is object-oriented and open for extensions to support special user requirements. The so-called pessimistic checkout, data-locking model is supported as an option. Survey tasks, such as mapping and measuring, are supported in a both easy-to-use and easy-to-customize way. ArcCadastrale is delivered with pre-defined wizards to facilitate customization. Transformations and projection systems can be chosen from an extensive list, to which the user can add their own formulas when needed.

Maps can be presented on-screen and on a printer. A plotting style is used to steer the presentation. It is easy to change the way the map data is presented by simply choosing a different plotting style. ArcCadastrale is also delivered with a number of pre-defined map templates, which can be used as they are or customized.

It is possible to import and export of geographic data in many different ways, which can be selected by the user.



In short, ArcCadastrale is a very flexible tool that can easily be adapted to suit every users own requirement. You can see it as an extension to the ArcGIS platform with additional tools for customization, especially in areas such as:

- Process support (Job, Workflow, Access control)
- Computation (Transformation, measurement and construction tools)
- Data models
- Plotting styles

Deleted: ArcCadastrale incorporates the foundation technology of Survey Analyst, a unique solution jointly developed by Leica Geosystems AG and ESRI Inc. Survey Analyst extends the GIS functionality of ArcInfo through survey specific tools.¶
 ¶ FME Objects from Safe Software Inc. is used to import and export data in different file formats.¶
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Global or National Spatial Data Infrastructures, (NSDI's or GSDI's) are emerging as the framework for a number of different spatial related information services. Land information is one basic pillar within this context covering all aspects of the property market, from creating single land parcels to land reform programs and the financing and investments in land and infrastructure. Managing land information is therefore of great importance regardless the stage of development in each particular jurisdiction. In recent decades the IT-development has had an increasing influence on the business of land information on the cadastre evolution. The internet boom has created a new and rapidly changing environment for the further development.

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