

# MINING CADASTRE – SOUTH AFRICAN SOLUTIONS FOR AFRICA AND THE WORLD

**Feast, Bill. Lundquist, Klas. Kuntz, Glen. Tindyebwa, John-Boscoe. Castro, Elias.**

Managing Director, Spatial Dimension (Pty) Ltd. PO Box 38668, Pinelands, 7430, South Africa.  
Mining Cadastre Consultant, Swedish Geological AB, Sweden.  
Global Spatial Data Systems Coordinator, Placer Dome Group, Australia.  
Head of Cadastre, Ministry of Energy and Minerals, Tanzania.  
Head of Cadastre, Ministry of Mineral Resources, Mozambique.

*Spatial Dimension and its international partner, Swedish Geological AB have since 2002 focused on the development and implementation of modern Mining Cadastre Systems.*

*The FlexiCadastre system uses a rules and workflow-centric approach to facilitate the efficient administration of mineral title in multiple jurisdictions. Using a web portal for data management and reporting, advanced task management, configurable business logic, best of breed GIS technologies and innovative concepts, FlexiCadastre has, from its African roots, become a world leader in mining cadastre management systems.*

*To date FlexiCadastre has been utilised by the Governments of Mozambique, Tanzania and Zambia, while a number of other African and international countries are considering implementing the solution. The Corporate version of FlexiCadastre is currently being implemented by the Placer Dome Group for use through-out their global operations, while a number of other exploration and mining companies are considering implementing FlexiCadastre to provide their operations with efficient and integrated land management tools.*

*The focus of FlexiCadastre is to manage and facilitate the workflows required for the efficient administration of mineral title. FlexiCadastre is designed to achieve this by scheduling and managing rule-based actions. These actions are dictated by the prevailing mining law and regulations in the jurisdiction that the activity is taking place.*

## 1 INTRODUCTION

Mining Cadastre or Land Management implementations succeed or fail on the basis of the implementation team's understanding not only of the technology required, but probably more importantly on the data, content, workflows and business requirements of the organisation. Successful implementations are ones that recognise the actual needs of the stakeholders, assist in streamlining existing business processes, have stakeholder support from the beginning, have expectations properly managed and are well supported and maintained in the long term.

For a Land Information System implementation to be successful it is essential that all the components of the system are fully understood, documented and optimised. The essential components are illustrated below.



Figure 1 Components of a successful Land Information System

Spatial Dimension and its partner Swedish Geological have extensive experience in implementing appropriate Land Management solutions within both the Public and Private sectors. While these are by nature complex systems our multi-disciplinary team has a track record of implementing cost effective, scalable, robust and sustainable solutions. This is due to our significant experience and thorough understanding of required outputs, the available data, workflows, resources, systems and dependencies within such systems.

Spatial Dimension has taken full advantage of the recent advances in both database and spatial mapping technologies and developed a new generation Land Information System called FlexiCadastré.

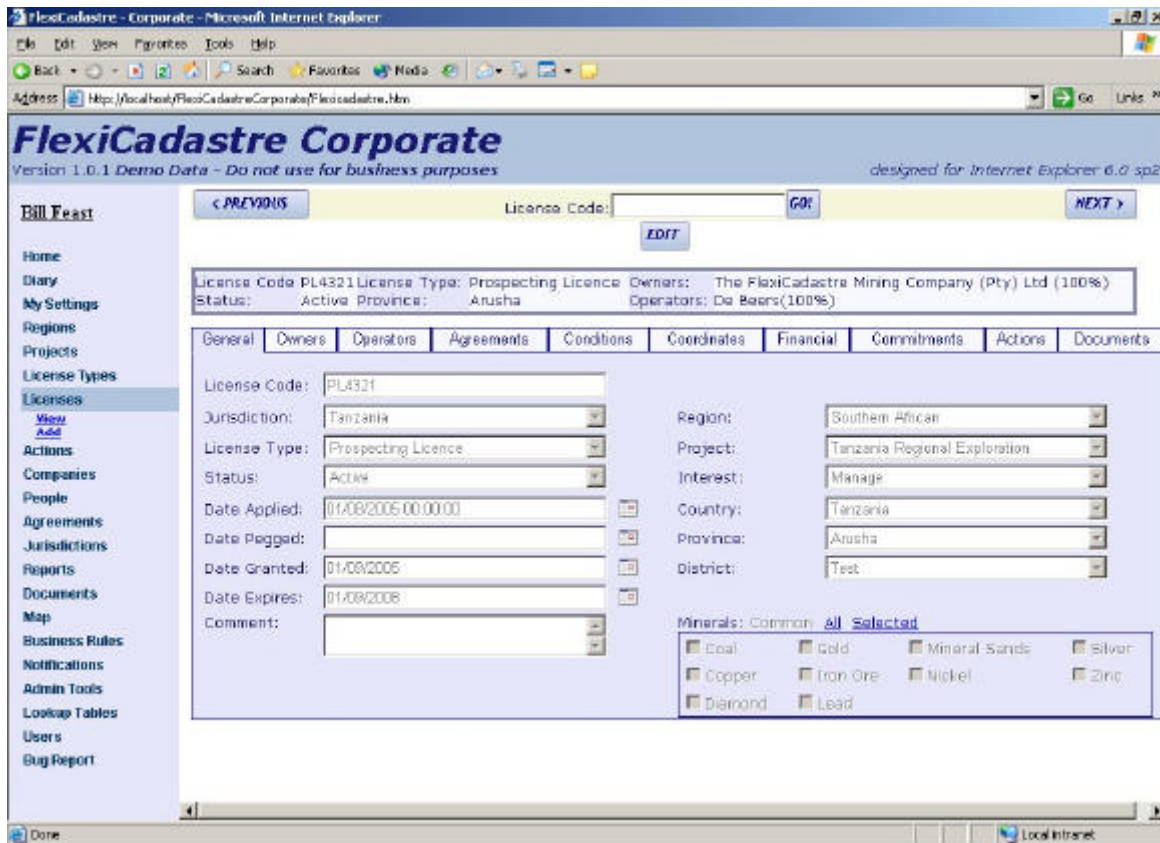


Figure 2 The FlexiCadastré Mining Cadastre System

## 2 WORKFLOW MANAGEMENT THROUGH RULE-BASED ACTIONS

The focus of FlexiCadastré is to manage and facilitate the workflows required for the efficient administration of mineral title. The system is designed to achieve this by scheduling and managing rule-based actions within an intuitive and easy to use application.

The term action encompasses all tasks that are required to be fulfilled by the title holder to properly manage the title. This includes all payments, approvals, public participations, requirements or deadlines, financial reports, work program reports, communications, notifications and other workflow related items that can be associated with a license. These actions are dictated by the prevailing mining law and regulations in the jurisdiction that the activity is taking place.

FlexiCadastré creates and schedules actions according to system rules based on the jurisdiction's mining regulations. Actions can also be manually added at anytime by the user so as not to limit the flexibility of the system.

By dealing with actions, FlexiCadastré provides a task-based and workflow-centric view of mineral title that allows the users to concentrate on important issues that need to be addressed and deadlines that need to be met. The system keeps track of all actions performed against a license, as well as the current status of the license, and creates and schedules the next action or actions that should be taken based on workflow rules.

While each action is independent of others, FlexiCadastré links actions together based on rules in order to facilitate the workflows and the mining regulations. This means that different sequences and groups of actions can be redefined by the rules to facilitate new workflows.

In order to sufficiently cover the complexities of the workflows, actions are divided into several categories. Each action category allows similar actions from different stages of the workflow to be dealt with consistently. All actions are dependant on the jurisdiction's mining legislation or the company's rules and regulations and as such these rules can be amended, deleted or added to at any time.

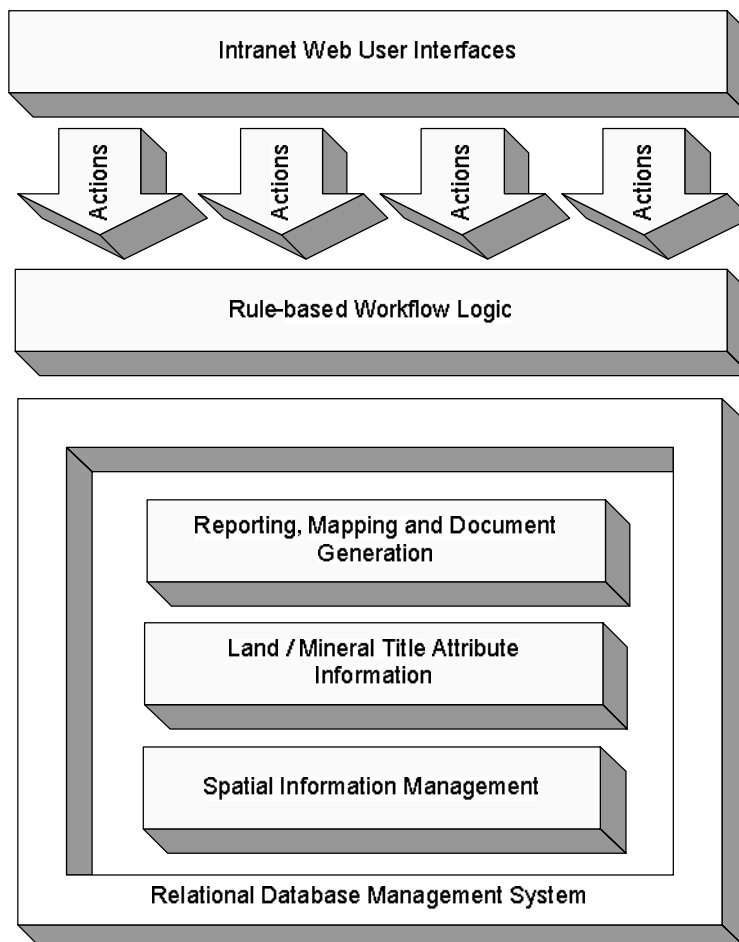
### 3 LOGICAL SYSTEM ARCHITECTURE

The software architecture used for the FlexiCadastré is a three tier architecture that separates the system into the data access tier, the business process tier and the presentation tier. The database/s underlie these tiers. The data access tier consists of a set of software components that manage the flow of information to and from the database. By grouping all of the data access functionality into a lower level tier in this manner, the database is abstracted from the rest of the system.

These complex workflows are managed by a set of rules residing in the business process tier. Separating the business logic from the data and the user interface allows the system workflows to be developed around each clients internal workflows in isolation from the actual data or user interface.

The presentation tier consists of the user interface components and provides the tools to capture and display the information handled by the data access tier in accordance with the workflows and rules defined in the business process tier.

This three tier conceptual software architecture makes the system components more robust and maintainable. The high level design is described in the Figure below.



#### 4 HIGH LEVEL DATABASE DESIGN

The centralised database is divided into a number of main data groups including core data, historical data, spatial data, workflow data, workflow variables and look-up tables. These are shown in the Figure below.

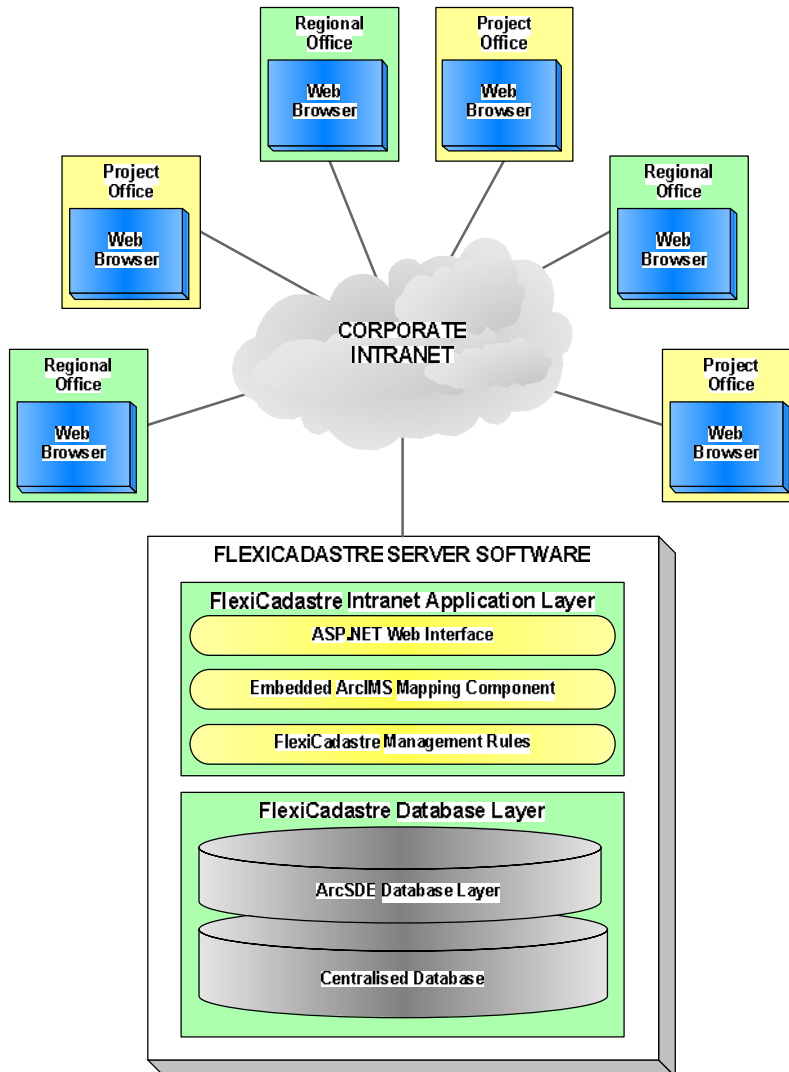


Figure 4 High Level Database Design

The core data consists of the basic information that needs to be stored and managed throughout the lifetime of a mineral title. This core data will largely remain unchanged during the license lifetime. If any changes do occur, such as a relinquishment, transfer of license or joint venture status, the old data will be recorded in the historical data part of the database so as to ensure that no data is lost.

The spatial data component of the database stores the coordinates that define the license area as well as any supplementary geospatial datasets.

The workflow data group is the part of the database that stores and manages the different actions that are associated with each license. These actions when combined in a manner determined by the workflow logic, and are the means by which every event related to a license can be scheduled and recorded.

The look-up tables are repositories for consistent lists of information such as license types, action types, countries, provinces, districts and license status. From a user's perspective this information is used to provide simple and consistent data entry and to help avoid errors. From a system perspective these tables will enable searching, grouping data and creating reports.

## **5 IMPLEMENTATION SUCCESSES**

### 5.1 Ministry of Mineral and Energy Resources, Mozambique (2002-2005)

In Mozambique, Spatial Dimension is the technical partner to the Swedish Geological Consortium that recently implemented a new Computerized Mining Cadastre System within the Ministry of Mineral and Energy Resources (MIREME). The project was funded by the World Bank as part of the Mozambican Mineral Resource Management Capacity Building Project. As part of this project Spatial Dimension migrated its Mining Cadastre System, FlexiCadastre, to the .NET platform to allow for the full benefits of recent advances in intranet technology. Both Web forms (ASP.NET) and Windows forms (VB.NET with ArcObjects) have been used in this implementation of FlexiCadastre.

### 5.2 Ministry of Energy and Minerals, Tanzania (2005-2007)

As part of the Tanzanian Mineral Sector Development Technical Assistance Project (MSDP), the Nordic Development Bank awarded a consortium made up of Swedish Geological, Swede Survey and Spatial Dimension the contract to establish a Mining Cadastral Information Management System (MCIMS) in the Ministry of Energy and Minerals, Tanzania.

As part of this project, Spatial Dimension is implementing its successful Mining Cadastre system, FlexiCadastre. A significant challenge in Tanzania is the requirement to provide the system to 21 Zonal and Regional Offices throughout Tanzania. The design architecture of FlexiCadastre allows a web based client/server operation and is ideally suited to a decentralised business model where individual regions need to be able to manage their own data but have access to updated country wide data at all times. The Web forms based system are developed in ASP.NET and include the following components: SQL Server, ArcSDE, ArcIMS and Image Web Server.

### 5.3 Ministry of Mines and Minerals Development, Zambia (2005-2006)

In Zambia, the European Development Fund's 'Mining Sector Diversification Programme' is funding the development of a new Mining Cadastre System. A Consortium consisting of Swedish Geological and Spatial Dimension will again customise and implement the FlexiCadastre Mining Cadastre System in close coordination with the World Bank financed Support to Economic Expansion and Diversification Project (SEED).

In Zambia, the management of the Mining Cadastre is the responsibility of the Mines Development Department (MDD) within the Ministry of Mines and Mineral Development (MMMD). The implementation of FlexiCadastre is being carried out in two units within the MDD, namely the Surveying and Mapping Unit (SMU) and the Mining Registry (MR).

### 5.4 Placer Dome Group (2005-2006)

In the commercial environment Placer Dome Group was the first corporate to implement FlexiCadastre. Placer Dome are replacing all their legacy and independent land management solutions with a centrally managed Global Land Information System using FlexiCadastre Corporate.

Placer Dome estimated that it cost them US\$500,000 per annum to manage their significant mineral title holdings in Canada, USA and Australia. By implementing FlexiCadastre they will reduce their overall operating and maintenance costs by approximately 40%.

## **6 CONCLUSIONS**

### 6.1 Mining Cadastre Systems In Government

One of the decisive factors for a thriving mining sector is the security of land tenure. Not only should the Mining Law guarantee this tenure but the administration of the Law and Regulations should be fair, transparent, decisive and efficient.

For the Investor, the Mining Cadastre System is often perceived as the substance of the Mining Law. It is therefore critical to have an efficient cadastre system that enhances investor confidence in the sector.

For the Government, an efficient Mining Cadastre System guarantees that the intentions of the Mining Law are carried out in practice and provides management data that can be used to formulate policy making.

## 6.2 Mining Cadastre Systems In The Private Sector

Mineral Title is the very essence of any mineral resource company. Without efficient management of their land holdings, a company runs the risk of losing its life blood.

Corporate mining cadastre management requires more than just knowing the date that mineral title comes up for renewal. Complete mineral life cycle management solutions manage all obligations to the State or Joint Venture Partners, monitor work and legal commitments, link to company financial and document management systems, provide management consistency across operations and reduce time required to generate statutory reports.

Companies that have implemented land management solutions in the past often ended up with disparate systems for each jurisdiction within which they operate. These tend to be run as discrete business silos, running diverse applications, each requiring its own maintenance and set of tools to run, generally by a very select group of individuals.