# Mining Cadastre in Africa – Lessons Learnt

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**Key words**:

## SUMMARY

Spatial Dimension and its international partner, Swedish Geological AB have a focus on the management of international mineral sector reform projects. A significant component of these projects is the design, development and implementation of Computerised Mining Cadastre Information Systems

The result is the FlexiCadastre range of products. FlexiCadastre 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 numerous others are considering implementing the solution. The Corporate version of FlexiCadastre is currently being used by Placer Dome though-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.

This presentation will address current best practise in Mining Cadastre management, current web based GIS technology as well as issues with implementations within the African context and lessons learnt.

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# Mining Cadastre in Africa – Lessons Learnt

## Bill FEAST, Jonathan DAVIDS and Toby MILLS (South Africa) and Paul DeVRIES (Sweden)

## 1. INTRODUCTION

Spatial Dimension and its partner Swedish Geological have extensive experience in managing mineral sector reform projects in Africa. A significant component of these projects is the design, development and implementation of Computerised Mining Cadastre Information Systems. While these are by nature complex systems our multi-disciplinary team has a track record of implementing cost effective, scalable, robust and sustainable solutions based on our FlexiCadastre product range.

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. The term action encompasses all tasks that are required to be fulfilled by the title holder or government agency 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.

## 2. MINERAL RIGHTS MANAGEMENT

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.

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 previous generation land management solutions often ended up with disparate systems for each jurisdiction within which they operate. These tend to

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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.

## 3. THE FLEXiCADASTRE SYSTEM

The focus of FlexiCadastre 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.
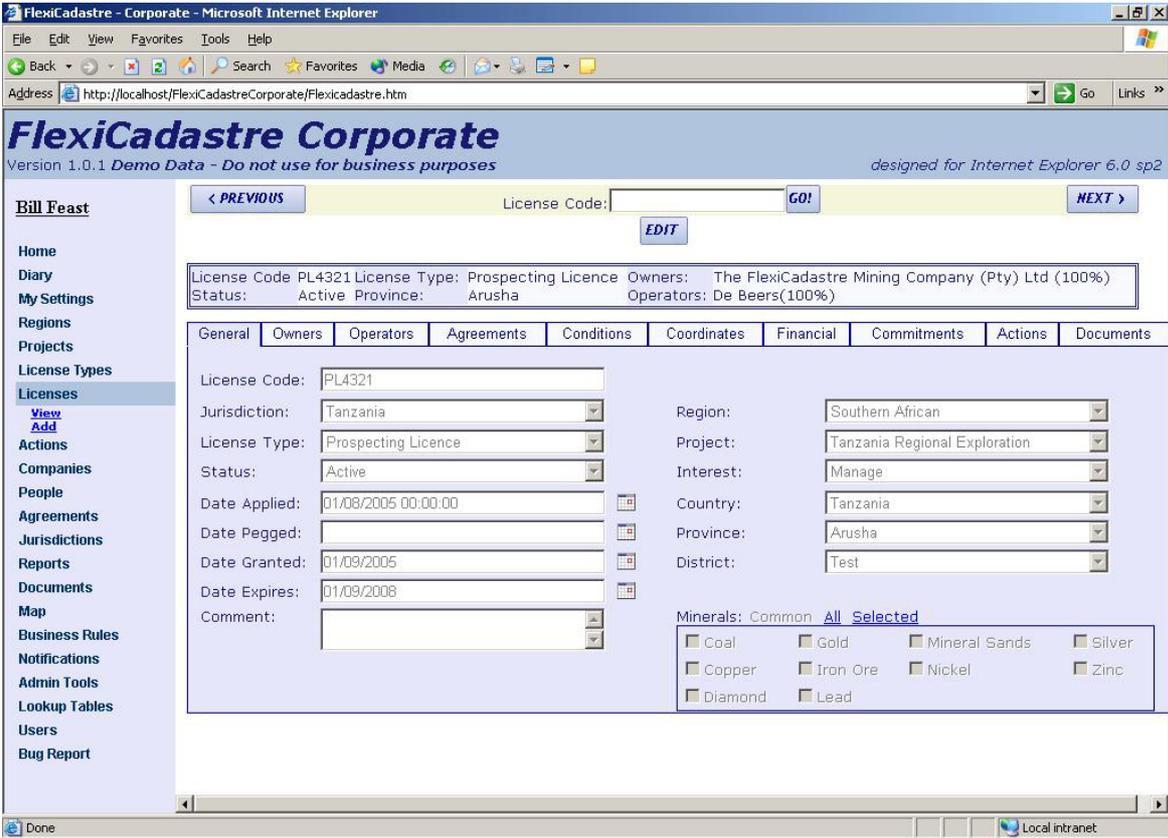


**Figure 1** The FlexiCadastre Mining Cadastre System

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FlexiCadastre 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, FlexiCadastre 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

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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, FlexiCadastre 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.

## 3.1 Logical System Architecture

The software architecture used for the FlexiCadastre 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.
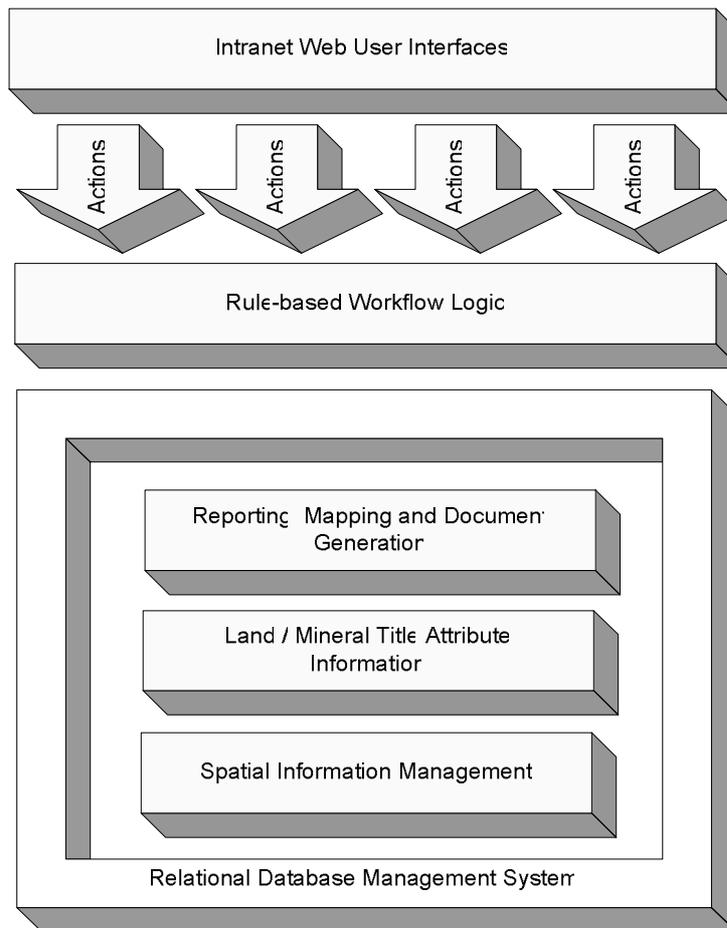
**Figure 2** FlexiCadastre Software Architecture

## 3.2 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.

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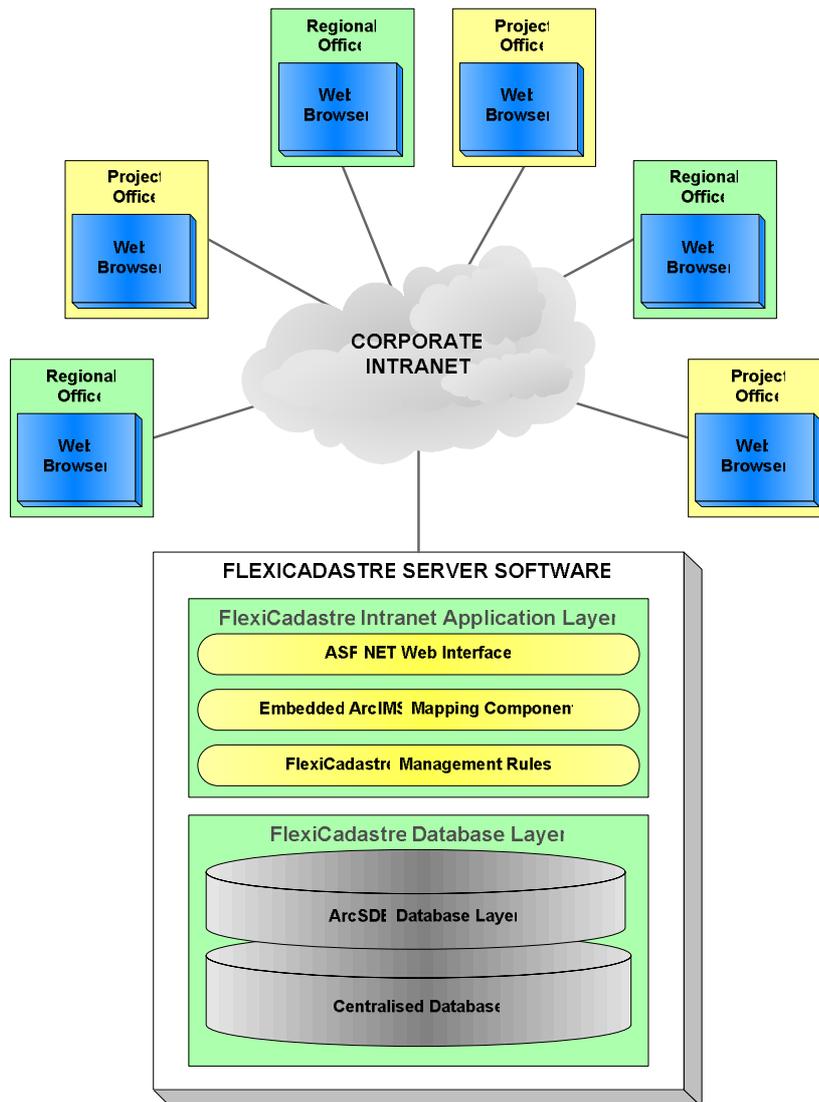
**Figure 3** FlexiCadastre High Level Database Design

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 all 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.

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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.

## 4. IMPLEMENTATION SUCCESSES

Mining Cadastre 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.

### 4.1 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 Word 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.

### 4.2 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 this 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.

### 4.3 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

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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).

**4.4 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 U$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%.

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