

Rwanda – Kigali City Council (KCC) Cadastral Information System

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Key words: Cadastre, GIS, Geomaps, Kigali, KCC

SUMMARY

In recent years, cadastre systems have developed from manual inconsistent systems into automated systems that highly benefit from the advancements in the Geo-Information and Communication Technology (Geo-ICT). Such advancements led to the emergence of ArcCadastre, which is internationally unique software for collecting, maintaining, processing and presenting geographic and cadastral information. It was implemented in Rwanda. ArcCadastre was used to establish the Rwanda Cadastral Information System at Kigali City Council (KCC). Rwanda KCC project has been embarking on increasing the land tax collection revenue. The project's business idea is very logical. A well developed land information system linked to a land tax revenue billing system could pay back the development investments in a relatively short time. The key challenges facing KCC relate to sustaining the development, maintenance and use of the land related database in a rational and cost effective manner. Geomaps has been awarded the outsourcing project for the establishment of a cadastral database for land and revenue management using GIS by the City Council of Kigali, Rwanda. Swedesurvey is providing services in order to support Geomaps in the implementation of the project. The services from Swedesurvey include consultancy services in the field of system design, database development, data security and ArcCadastre. The system developed has been named Geomanager.

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1. INTRODUCTION

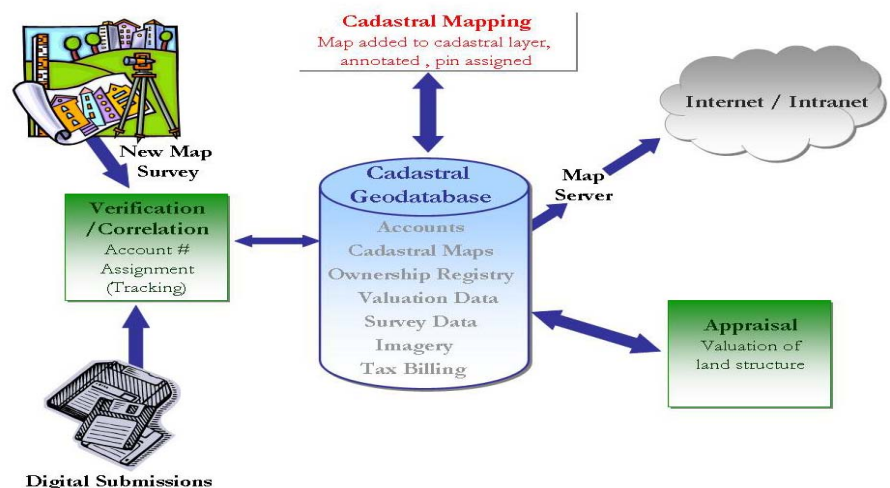
The cadastral concept has developed significantly over the past few decades. During this time these systems, whether developed from a land market or land taxation perspective, have increasingly played a multi-purpose role. Cadastre systems in early times were manual systems that were effort and time consuming to operate and maintain. Moreover, manual systems yielded inconsistency and the lack of integration and unity between the various sectors of cadastral agencies.

The increasing demand for accurate, easily accessible and up-to-date cadastral data has pressed forward the conversion of cadastral mapping registers from analogue to digital format. This process has been accelerated by the new possibilities of the Geo-ICT. Both theoretical and practical developments in ICT such as the ubiquitous communication (Internet), database management systems (DBMS), information system modeling such as the Unified Modeling Language (UML), geographic information systems (GIS) and global positioning systems (GPS), all automate and improve the quality, cost effectiveness, performance and maintainability of cadastral systems. As never before, most of the cadastral systems around the world are looking for technology to help them create efficient enterprise systems supporting cadastral organizations.

2. ARCCADASTRE

Cadastre is defined as both 'Maps and Data' that define the possessory relationship between land & man.

Cadastral systems are mainly based on GIS for map creation and maintenance with link to legal registration of ownership, and valuation.

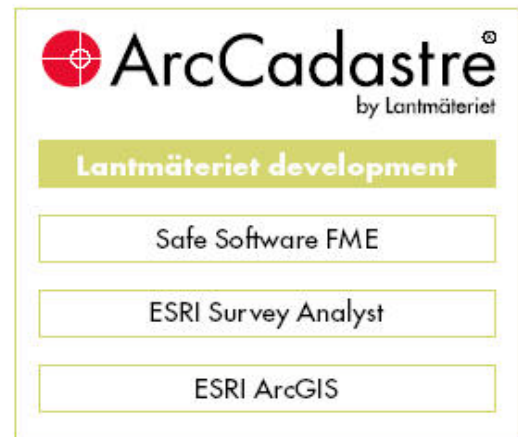


It became essential to build specialized advanced software that is written specifically to manage cadastral business. Lantmäteriet (National Land Survey of Sweden), Leica Geosystems and ESRI have joined forces to develop ArcCadastre for providing the software solution for capturing, maintaining and managing survey data and cadastral information.

ArcCadastré is developed by surveyors for surveyors, and comes in a box with all basic functions needed. Functionality has been added to the basic platforms ArcGIS with the Survey Analyst extension from ESRI and FME from Safe Software. This is the only internationally sold product of its kind.

ArcCadastré has been built on the latest, proven high technology platforms that are available within the respective technological fields:

- *ArcGIS from ESRI*
- ArcGIS is the GIS engine that has been used as the base for the development of ArcCadastré.
- *ArcGIS Survey Analyst from ESRI*
- Survey Analyst from ESRI is used for survey and computation functionality.
- *FME (Feature Manipulation Engine)*
- FME objects from Safe Software are used for import and export to and from various data formats. FME is the world's most complete data format converter.



Localization is supported with ArcCadastré. It is delivered with a localization tool kit supporting country customization for the specific country to ensure that the software is presented in the same language as that of the user, hence providing ease of use. It can also be implemented through a distributed system or a centralized system, depending on environment requirements.

In ArcCadastré, a job is the basic mechanism and all work is executed within the context of a job. Since cadastral data handling is often regulated to follow predefined processes, by enforcing the job concept, data integrity, from a legal aspect, is preserved.

The job concept is built on workflow that is used to guide the user through the job. The simplest form of workflow is a checklist in which the user must confirm (tick), as the different steps in the process are completed. A more sophisticated work-flow guides the user through the different steps in a mandatory way.

3. ARCCADASTRE IMPLEMENTATIONS WITHIN AFRICA

Cadastral industry is one of the key factors in achieving sustainable development. Accordingly, building and maintaining robust Cadastral Information Systems is an essential issue for countries in Africa for paving their way towards sustainability. Enterprise Cadastral Information Systems based on ArcCadastré have been implemented successfully in different countries in Africa. The following illustrates the cadastré implementations in Rwanda through a summary of the project objectives, scope, system architecture and modules as well as system benefits.

3.1 ArcCadastre Implementation in Rwanda

Since the late 1990-ties Kigali City Council has been embarking on increasing the land tax collection revenue. In 2000 an aerial survey and base mapping covering the entire city was undertaken. This has formed the platform on which the land related spatial data can be superimposed. On the 18th October 2002 a contract for “establishment of cadastral database for land & revenue management using GIS” was entered between the Client, Kigali City Council and a Consortium lead by Geomaps Kenya and Swedesurvey as sub consultant.

3.1.1 KCC Project Overview

The project started in October-November 2002 and its business idea is very logical. A well developed land information system linked to a land tax revenue billing system could pay back the development investments in a relatively short time. A cost benefit analysis must of course justify the investments needed. The client’s needs for this project categorize four main areas:

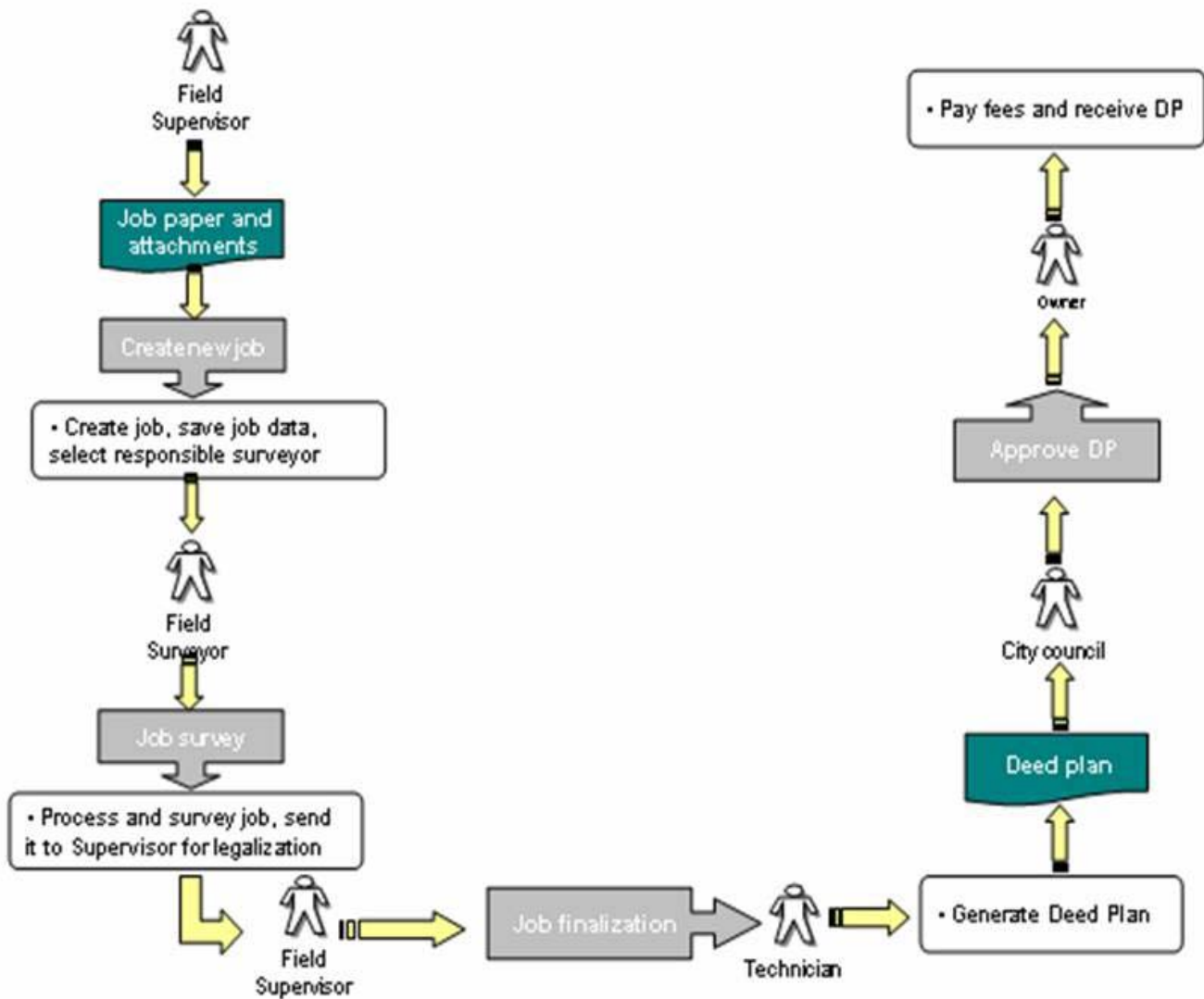
- Promote the mechanism for improved land tax revenue within Kigali City Council
- The need to develop a viable GIS based multi-purpose cadastre for land repository management.
- The need to develop a viable land related tax management system for revenue generation for the City Council.
- Development of other value-added GIS outputs that may be used for improvement of services to city residents.

3.1.2 KCC Project Objectives

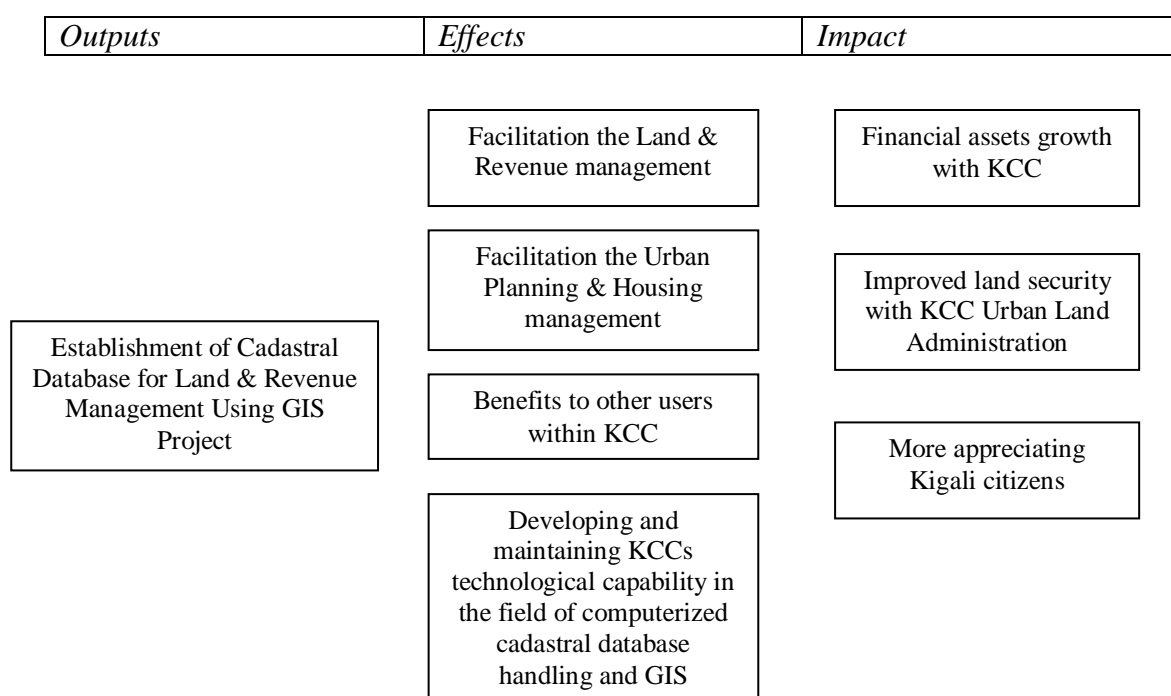
The business idea for KCC is very logical. A well developed land information system (Geomanager) linked to a land tax revenue billing system could pay back the development investments in a relatively short time, and accordingly the outputs of the system will fulfill the following:

- A computerized system designed to capture, compile, update, analyze, and present data in statistical- (attribute data), spatial- (geographical), and GIS- (combined attribute and geographical) form
- Technical documentation of the system
- A database containing attribute- and geographical data
- KCC staff at HQ- and district levels adequately trained to sustain the computerized system (maintain and develop further)
- User manuals for data- capture, compilation- and retrieval

3.1.3 The Cadastral Role Overall Workflow



3.1.4 Goal Hierarchy Structure for the Project



Overall objective

- To promote the mechanism for improved land tax revenue within Kigali City Council

3.1.5 Logical Framework Goal of the Project

Activities/inputs

- planning activities: identification of tasks for system development, data capture, training, and information of KCC land administration
- collected and computerized relevant information
- designed and developed computerized cadastral system
- adequately trained staff at KCC HQ- and district levels
- captured data (attribute and geographical)

Outputs

- A well functioning computerized cadastral system including attribute and geographical data, able to capture, compile, analyze and present information retrieved by KCC district staff
- Motivated KCC staff confident in handling a computerized cadastral system
- Kigali citizens better informed about KCC land regulations
- A well maintained database

Effects

- facilitate and contribute to more cost effective tax revenue within KCC
- contribute to more effective urban land administration within KCC
- develop and maintain a computerized cadastral system on a city- as well as national level

Impacts

- economic growth within Kigali
- economic growth within the nation
- economic and social equality within Kigali
- enhanced management of natural resources

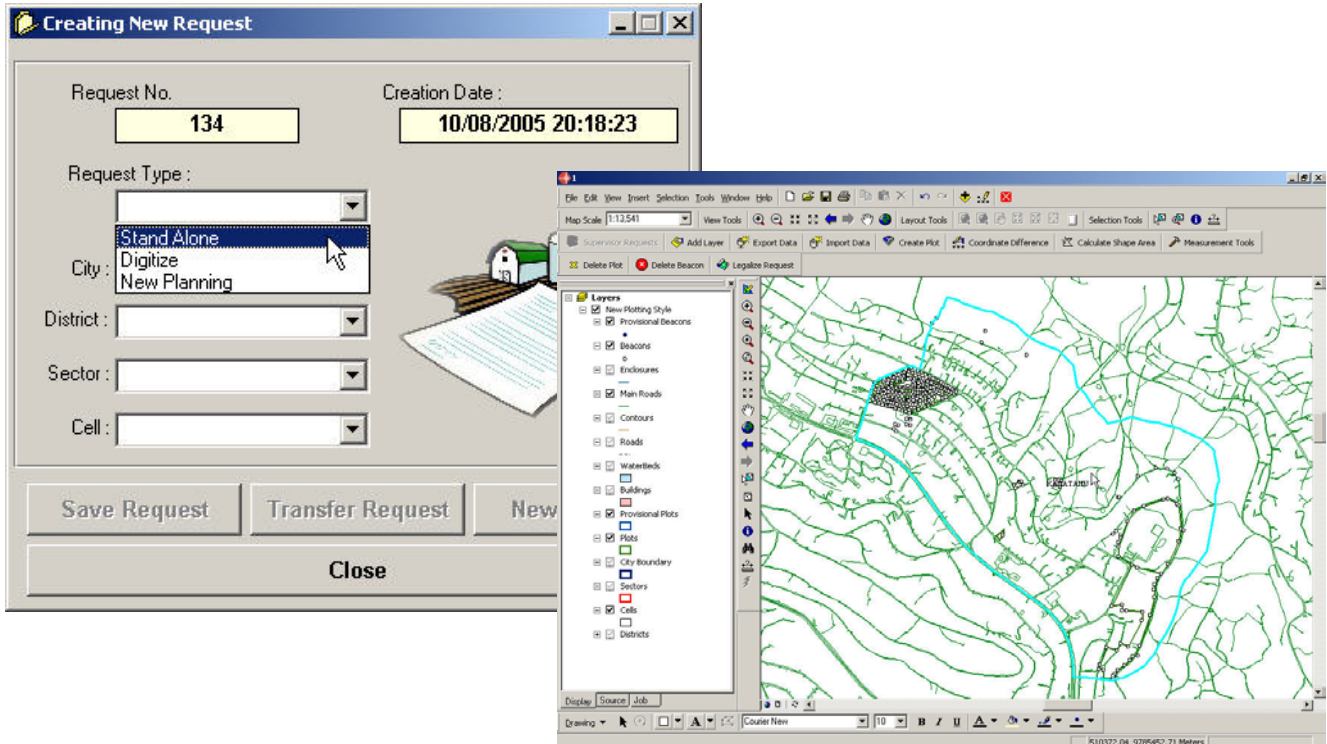
3.1.6 KCC cadastral GIS system Modules

Throughout the KCC project various modules were developed to serve the different needs of Kigali City Council. Cadastral GIS system applications were developed using ArcCadastre1.21, Visual Basic 6.0 and SDE 8.3 on SQL Server. The main GIS modules developed were as follows:

3.1.6.1 Supervisor Module

The module contains the following:

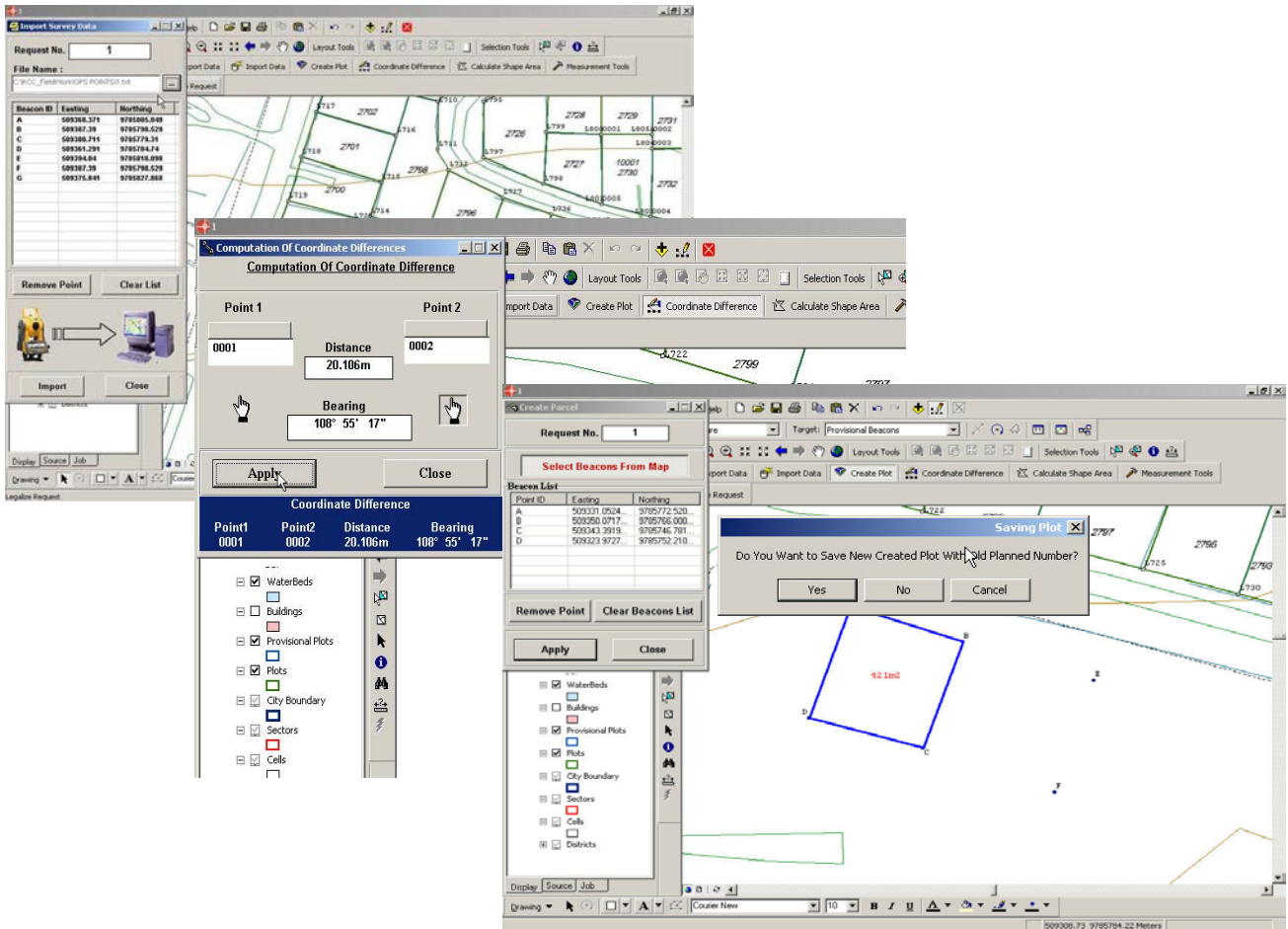
- *Create new requests*: Creating and assigning requests for the field work users.
- *Supervisor Requests*: displays the login form for supervisor to display the current active request for user and monitor the current running requests for each Technical in the field unit.
- *Add layer* to the TOC and the map.
- *Rename Feature*: Renaming selected provisional plots and beacons.
- *Export Data*: Export the selected beacons coordinate to text file.
- *Import Data*: Import the surveyed point's coordinates to provisional beacon layer.
- *Create Plot*: Allows the user to create plots from selecting beacons.
- *Coordinate Difference*: Getting the distance between two selected points.
- *Shape Area*: Getting shape area for a polygon by selecting its vertices.
- *-Measurements tools*: Open a form to allow user to make measurement on the map.



3.1.6.2 Surveyor Module

The module contains the following:

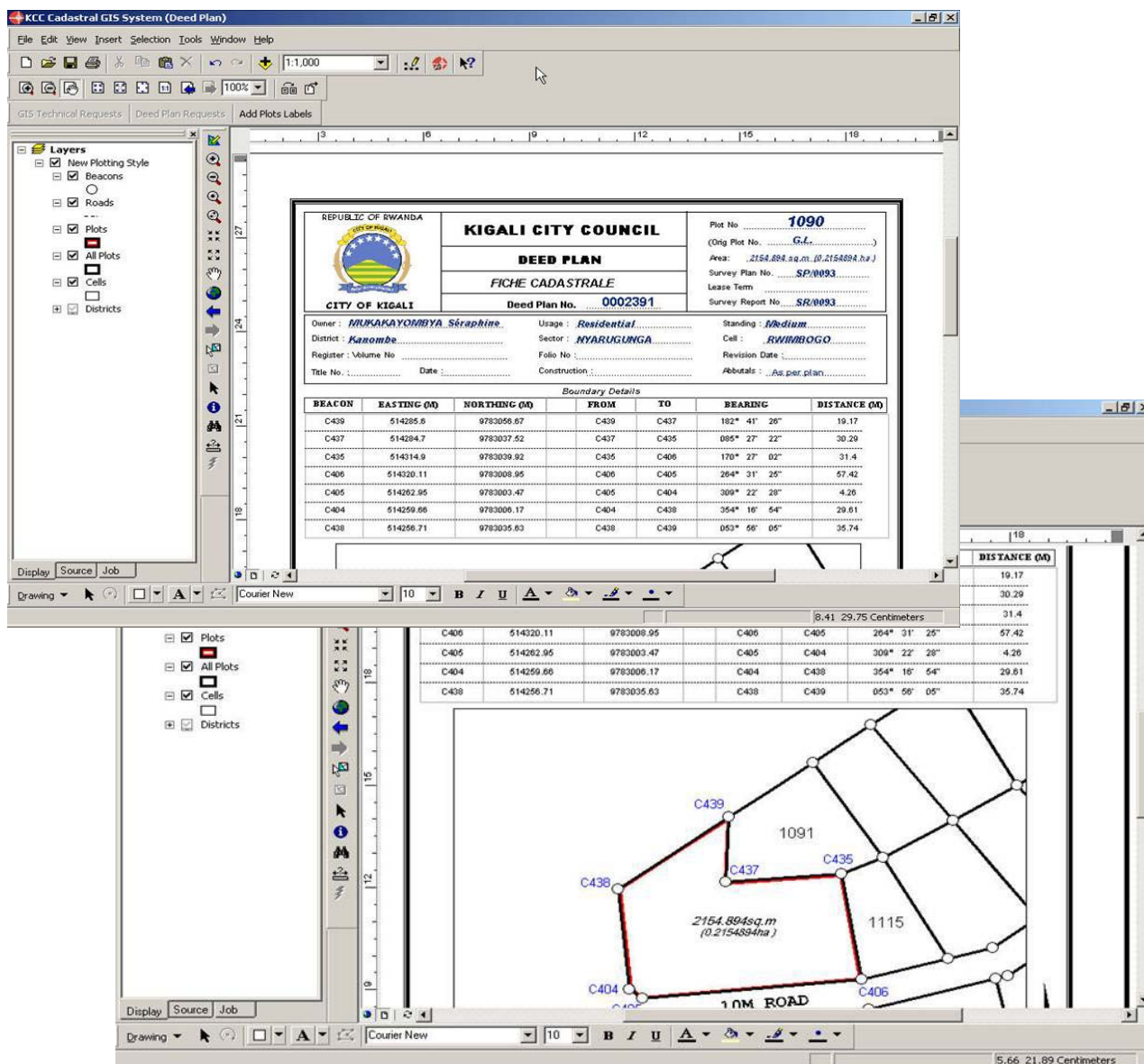
- *Surveyors Requests*: displays the login form for Surveyors to display the current active request for user.
- *Add layer* to the TOC and the map.
- *Rename Feature*: Renaming selected provisional plots and beacons.
- *Export Data*: Export the selected beacons coordinate to text file.
- *Import Data*: Import the surveyed point's coordinates to provisional beacon layer.
- *Create Plot*: Allows the user to create plots from selecting beacons.
- *Coordinate Difference*: Getting the distance between two selected points.
- *Shape Area*: Getting shape area for a polygon by selecting its vertices.
- *Measurements tools*: Open a form to allow user to make measurement on the map.



3.1.6.3 Deed Plan Module

The module contains the following:

- List displaying user requests (all transferred job to the user).
- Displays plots of the selected request from active job Tree view.
- Displays the selected plot data in Plot List.
- Start issuing Deed plan by retrieving to the data of the selected plot in the request,
- Saving Deed Plan (Mxds and images) with Deed Plan Number.
- Print Deed Plan.



3.1.6.4 KCC Project Benefits

Upon achieving the KCC project objectives a number of benefits are found, they are as the following:

- Faster processing due to less manual work.
- Faster processing due to fewer involved software components.
- No need for Shape Files.

Also there are many optimized process like:

The survey data is imported into ArcCadastre using ASCII import.

- The table of co-ordinates, calculated from the selected points, is put in the right form on the Deed Plan Layout.

- The Owner and Plot details are automatically put on the Deed Plan Layout. The details are retrieved from the cadastral Geodatabase directly

4. CONCLUSION

Although ArcCadaastre is yet in its early phases of implementation, the success of both KCC project present it as a promising package for a new era of automated cadastral systems. The flexibility presented in the modules and features of ArcCadaastre makes it an elastic tool for the GIS and cadastral developers to use for implementing specific country workflows and business rules through basic customization on ArcCadaastre without the need to create an entire workflow/job based application from scratch. This flexibility is clearly presented in the smooth implementation of the system based on ArcCadaastre which make the system more useful to the districts, making their job of collecting the revenues more efficient.

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