



Scaling up Responsible Land Governance

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LAND ADMINISTRATION AND VALUATION INFORMATION SYSTEM (LAVIMS) – FIVE YEARS OF OPERATIONS IN MAURITIUS

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Abstract

Around 10 years ago the Government of Mauritius (GoM) began the process to ensure a long-lasting and ground-breaking change to the way that land is managed and transferred in Mauritius. The concept of a Land Administration and Valuation Information Management System (LAVIMS) was seen as the means of improving access to information and enhancing administrative processes, leading to greater operational efficiency in Government and delivering improved transparency. Here we present LAVIMS as it exists today and describe its operational use over nearly five years. We describe how information is shared between key stakeholders and present some indicative measurements of improved administration performance. Building on this success, GoM is now considering a broader-based spatially-enabled infrastructure and so we describe how LAVIMS could form the basis for a National Spatial Data Infrastructure (NSDI). An operational NSDI would contain up-to-date and accurate spatial data on land, infrastructure, utilities and the environment and would support Government in dealing with issues such as planning, environmental degradation and flooding, alternative uses of agricultural land, deforestation and mineral extraction. A range of eGovernment services could be based upon such an infrastructure creating increased opportunities and access to information for citizens.

Key Words:

Cadastre, Deeds, Land Administration, Mauritius, NSDI, Valuation

1. INTRODUCTION

Around 10 years ago the Government of Mauritius (GoM) began the process to ensure a long-lasting and ground-breaking change to the way that land is managed and transferred in Mauritius. At that time all transactions relating to private and public lands were registered at the Registrar General's office in the capital, Port Louis, but the existing system was far from ideal. There was very little computerisation (apart from a database of parties and relationships with deeds): survey plans were registered as paper documents in isolation from any other local information (and referenced in associated deeds with different numbers), and archived in a separate office using a completely different referencing system; the link between departments in the valuation process was entirely paper based; searches by professionals could require reviewing ancient and fragile registers; and, there was no Cadastral database showing land parcel extents and ownership.

This lack of a comprehensive register, i.e. an official database where all residential lands are registered, also had a negative impact on the control of transactions of residential lands. The concept of a Land Administration and Valuation Information Management System (LAVIMS), as developed by GoM, was seen as the means of improving the access to information and improving the administrative processes, leading to greater operational efficiency in Government as well as delivering greater transparency within the departments themselves.

This paper includes an overview of LAVIMS as it exists today and describes its operational use for land information management in Mauritius; this operational use of LAVIMS now extends to nearly five years following system go-live. We also describe how information is shared between the key stakeholders to improve administration and present some indicative measurements of this improved performance. However, building on this success, GoM is now considering how to move forward with a broader-based spatially-enabled infrastructure for the future and so we go on to describe how LAVIMS could form the basis for a National Spatial Data Infrastructure (NSDI) to fit in with the aspirations of the Government's Vision 2030 objectives.

An operational NSDI would contain up-to-date and accurate spatial data on land, infrastructure, utilities and the environment and would support Government in dealing with issues such as planning, environmental degradation, flooding, use of agricultural land for residential building, deforestation, mineral extraction and land use zoning. GoM also has a SMART Cities initiative, and we firmly believe that the formation of an NSDI for Mauritius would fully support this initiative both in the development phase and ultimately to provide a geospatial basis to support the 'Live Work Play' Concept of the Government's Vision 2030 strategy.

In an NSDI the data would be managed and collected once / used many times; i.e. there would be no duplication of effort by multiple agencies all collecting their own versions of the same data. It would be easy to find out what data exists, to view it, access it and, if required, download it. A fully developed network could be used by all Government Ministries, Departments and Agencies, by the private sector and by academia, NGOs and citizens. Government organisations could easily exchange and share data. A range of eGovernment services could be based upon such infrastructure thereby creating, particularly, increased opportunities and access to information for citizens.

2. THE DEVELOPMENT OF LAVIMS

The responsibility for the initiative to modernise land administration was shared between the Ministry for Housing and Lands (MHL) and the Ministry of Finance and Economic Development (MOFED). The LAVIMS Project was planned, designed, implemented and commissioned over the period from 2006 to 2011, when the system went live and fully operational. A competitive process to procure this was put in place, based on a technical specification that required a completely new approach, encompassing the major activities of data capture of deeds, integration of cadastral plans, the acquisition of aerial photography, a comprehensive and new property valuation and, crucially, the integration of all of these different property elements into a property information system.

The implementation project was won by a consortium of international and Mauritian companies led by what is now the Intelligence Business Cluster of Airbus Defence and Space Limited, UK. The LAVIMS Consortium undertook the design and build of the information management hardware and operating systems, development of the applications software, digital capture of the existing paper records and implementation of a property data collection campaign based on the latest mobile technology. The work began in late 2008 and, following a comprehensive programme of training and capacity-building, operational go-live began in August 2011.

The original LAVIMS Project combined four elements in an integrated information management system, in different agencies, in order to provide a modern and comprehensive system for land administration and property valuation for the island of Mauritius. The aim was to provide the key stakeholders with accurate and up-to-date digital data as well as the computer-based tools needed to perform their routine daily departmental functions. The key LAVIMS stakeholders are:

- a. The **Cadastre Unit** (CU) of MHL which has the task of maintaining and updating the cadastral index map and individual land parcel boundaries (over 483,000) that were captured in the original LAVIMS project. Since go-live in 2011, the Cadastre has grown by almost 65,000 parcels to

547,000, and, a total of 90,000 new PINs have been established with 250,000 parcels having been edited in this time. The original index was prepared using 15cm stereo aerial imagery of the whole island, and is currently being updated with the assistance of recent very high resolution satellite imagery.

- b. The **Registrar General's Department** (RGD) which now has a complete archive of digital deeds records through scanning, key data capture and indexing of several million pages of deeds from thousands of volumes. The digital data capture was originally based on the archive covering the last 30 years of records but was later extended, via a separate contract, to include all records in the RGD archive. This has enabled online access to deeds and survey plans and allows easy searches through identified links between documents. All new documents are registered digitally, and the RGD is rapidly becoming a paperless office.
- c. The **Valuation Department** within MOFED, who are required to value deeds transactions; the workflow for this process is now entirely within LAVIMS allowing direct communication between the deeds documents registered at RGD and the associated land parcels updated at the CU. Through this, The Valuation Department can now update and maintain all valuation and sales data for some 500,000 residential and commercial properties across the island of Mauritius, including in field data collection updates using mobile technology.
- d. The **Government Online Centre** where the system is now installed and managed with technical support and maintenance provided by the LAVIMS Consortium. The web-based Information Management System allows efficient interaction, retrieval and analysis of any of the LAVIMS data by any of the array of potential users and stakeholders with authorised access to the system.

The first task of the LAVIMS Project was to obtain new digital aerial imagery for the whole island, together with ground control, to enable an ortho-rectified 15cm image layer to be created; this would become the base reference layer for all future digitised vector layers. Once complete, the process of scanning the existing records and digitising parcel boundaries was initiated in order to provide the land administration database. This also included data mining of the scanned data, using Optical Character Recognition (OCR) technology to determine links between deeds and survey plans, thus enabling ownership of land parcels to be established.

In parallel the Project team worked closely with the key stakeholders to design the functional specifications of the software applications, from which the LAVIMS software suite was developed. As well as the office functions required to enable the stakeholders to complete their Business As Usual (BAU) activities, the team developed an application for use on mobile devices (Personal Digital

Assistants (PDAs)) for field data collection. This enabled the collection of detailed information about each property, making use of drop-down menus, and having information synchronised to and from the central database.

Critical to the success of LAVIMS has been the capacity development and training of departmental staff. Prior to LAVIMS few staff had access to computer terminals and consequently computer literacy was quite low. Now, many staff use the software for all their everyday tasks and in all there are some 300 users across the three main stakeholders. Read-only access has also been granted, so far, to at least one other ministry and 10 local authorities to assist their day-to-day business activities.

In the following section we describe how LAVIMS supports the operational work of the key stakeholders, how the software modules are used for specific tasks and how the full land administration workflow is managed. Some illustrations of LAVIMS actions are also presented.

3. OPERATIONS USING LAVIMS

LAVIMS, which won the Silver Award for Innovative Management from the African Association for Public Administration and Management (AAPAM) in 2012, is now an operational system where all land transactions are tracked and recorded. The award was based on a number of indicators of improved Government performance. For example the use of paper has been reduced by 50 per cent, and deeds delivery to customers is now achieved in 48 hours instead of the 15 days required for the paper based system.

LAVIMS includes a modular software application suite that provides an integrated workflow between three Government departments across two Ministries. This workflow handles the land administration process from initial application by a surveyor to the final approval of the transaction value and revenues due. The Cadastre Unit within the Survey Department of MHL as well as the Registrar General's Department and the Valuation Department within MOFED, located in three separate office buildings, are linked through the LAVIMS workflow. All access to LAVIMS for the workflow component is via a secure login; the login credentials determine which modules the user has access to, and, within each module, the specific functions available; only a super user or system administrator has access to all of the modules.

The full suite of applications modules includes the following (Figure 1 shows the LAVIMS Landing Page):

LAVIMS Cadastre Case Management Module – for the management, allocation and recording of cadastre editing tasks;

LAVIMS Cadastre Viewer – thin client GIS web viewer with view, search and query functionality for accessing a variety of image and vector layers;

LAVIMS Cadastre Editor - thick client Java application for editing Cadastre data;

LAVIMS Deeds Module - for registering and searching for deeds and survey plans, along with workflow for the revenue assessment process;

LAVIMS Valuation Module - a workflow for managing the valuation process, as well as a repository for sales information and CAMA (Computer-Aided Mass Appraisal) valuations;

LAVIMS Layer Manager – allowing specific users at the MHL to upload and manage additional GIS data layers;

User Management - to manage the access rights of all users to the LAVIMS system.

These modules provide the tools for managing the workflow in each department, and passing information/cases from one department to the other. For example, the survey plan is made and registered (fixed with a national unique Parcel Identification Number (PIN)), which is included in the deed that is registered at the land sale (with a price) and this information is automatically transferred to the Valuation Department for their internal processing (e.g. organisation of field/site visit, making comparable assessments, etc.). The complex intra- and inter-departmental flows are managed by a set of “dashboards” at each department, which enable setting of work priorities according to any pre-defined set of values. Each department can have its own case/deed/survey plan numbers, but the LAVIMS system links them in a holistic way. Additionally, national legislation is being changed so that every land transaction requires an official PIN issued by the system as an analogue or digital PIN certificate.

In the following sections we highlight the key tasks undertaken by the principal stakeholders using LAVIMS for their day-to-day work activities. The descriptions highlight how automated processes are used to keep both applicants and stakeholder staff informed of progress, calculate fees and taxes due and issue certification. Within the Cadastre Unit the implemented processes ensure continuous improvement of the content and accuracy of the database.

a. Cadastre Unit

The Land Administration process starts with the application for a PIN certificate at the Cadastre Unit. A PIN is a unique reference that is assigned to every land parcel in the Mauritian Cadastre. It has now become mandatory for every land deed to have a PIN in it and, therefore, prior to any transaction being completed and recorded in a title deed the PIN must have been assigned. Typically transactions in

Mauritius follow the pattern of subdivision of a large parcel into smaller units, whether done on an individual splitting of one parcel into two, or, a ‘Morcellement’ development of a lot of child parcels.

Application Process

There are two ways to begin the PIN certificate application process: the original way of going to the Cadastre Unit (CU) at the MHL in person and, more recently, to apply online via the LAVIMS PIN application portal. Either approach then follows the same workflow once initiated. Since the online application portal went live in December 2014, the majority of PIN applications have been initiated using the portal. In 2015, 14,050 out of a total of 22,000 applications were made online.

Following the online application, the applicant (most often a certified land surveyor) will enter details into the application portal and will upload a survey plan of the parcel location. These plans can be either an image (such as a scan of the survey) or, as is becoming increasingly common, a digital GIS or CAD file of the actual survey itself; the application is designed to accept several different file formats. The initiation of the PIN application process raises a case number on the CU’s Case Management Module. A supervisor will assess whether the information provided by the applicant is sufficient to continue; if sufficient then the case is allocated to a CU surveyor for subsequent processing. If there is not enough information then the case is rejected via an automated email derived from the Case Management Module; an acknowledgement is sent when the information is complete.

Once allocated to a surveyor (either within the Cadastre Unit or in the Ministry’s Cartography Section), the subsequent processing is managed on the dashboard of the Case Management Module. This module has an inbox view showing the tasks that an individual has currently to work on and a dashboard view which shows all cases that have ever been worked on by the logged in user. The high level steps then followed are:

- i. **Find Original PIN** – The surveyor must identify the original parcel or PIN that has been proposed to be subdivided (typically). Now that the Mauritian Cadastre has been well established for a number of years, the surveying profession are adept at using PINs and this original or ‘parent’ parcel will commonly be identified by the existing PIN itself. Alternatively a location plan may be required to locate the parcel in question. If there is a problem at this point, for example if the PIN provided does not match the plan given or the location cannot be found, then the CU surveyor will reject the case and the applicant will receive an explanatory email.
- ii. **Parcel Editing** - On launching this step on the dashboard, the thick client Cadastre Editor will be launched displaying the geographic location of the parcel to be edited from the case details (Figure 2).

Editing in the thick client is carried out within an editing case and all parcels associated with an edit are thereafter linked to this case for audit purposes. Firstly the editor must lock the parcel (boundaries and seed points) to be edited; this ensures that no two editors can be working on any given parcel at the same time and guaranteeing that no conflicts are created. Editing is carried out with full topological integrity checks to ensure the cadastre remains topologically correct following the edit. Typically an edit would comprise the subdivision of a parcel into a number of smaller ones or else a boundary edit correcting inaccurate boundaries. The editor also has the option to bring in the scanned survey plan and this can be rectified against the imagery and/or existing cadastre boundaries to enable new boundaries to be plotted. Such editing represents the use of the parcel boundaries as a Cadastral Index Map, rather than a survey accurate cadastre. Recent enhancements to the editor, however, do enable the improvement of the cadastral accuracy to fully survey accurate boundaries.

As the surveying profession in Mauritius advances its use of GPS technologies, there are more and more surveys being recorded as AutoCAD DGN/DXF files. These can be imported into LAVIMS to enable the actual points captured by the surveyor to be entered in the Cadastre. In order to do this, some preparation work is undertaken by the CU officer working the case. Typically, digital survey plans would be provided as an AutoCAD file with parcels represented by boundary lines rather than polygon features. A manual flowline has been rolled out to enable the CU officer to convert the AutoCAD files to polygon shapefiles and edit them with full topological integrity in relation to the existing Cadastre. These files can then be uploaded into the Cadastre bringing with them the improved accuracy of these surveyed parcel boundaries. The accuracy (or tolerance) of points and boundaries is maintained as an attribute in the Cadastre and can be displayed graphically in the thick client.

Following editing, a check is implemented by a supervisor to ensure that the work has been carried out correctly.

- iii. **Generation of PIN Certificate** - Once editing has been completed satisfactorily, a PIN certificate is auto-generated. The parcels edited in the case are automatically populated into the certificate, together with their area and any other relevant attribute information (Figure 3). The document is created by the dashboard and stored as an attachment to the case.

- iv. **Payment** - The PIN certificate is only sent to the applicant once payment is received. To this end, a payment voucher is also created and held on the dashboard and sent automatically to the applicant via email. The voucher details the work completed (number of PINs provided in size range, etc.), and totals the value of the certificate. The applicant can then pay either via bank transfer or by cash at the office. For bank transfer, arrangements are in place to synchronise with the Finance section's systems to ensure that payments made are recorded in LAVIMS. Following receipt of payment the PIN certificate is provided to the applicant.

b. Registrar General's Department

Once a PIN Certificate has been provided, the surveyor will then work with the Notary who can progress the property transaction and register the new title deeds containing the newly assigned PIN at the Registrar General's Department. Following the roll out of LAVIMS, no new paperwork relating to land deeds was to be stored at the Registrar General's Department, the process being that any new deed provided, would be registered onto their CHLive database (a pre-LAVIMS database linking deeds with their parties), the deeds would then get scanned, and uploaded into LAVIMS.

The scanners used generate a layer of Optical Character Recognition (OCR) text which is embedded automatically within the PDF file that is stored in LAVIMS. Once this is done, the important metadata from the deed can be copied and pasted into LAVIMS ensuring that there is no risk of manual error in this process. Of prime importance in this metadata capture is the PIN itself, which is captured from the deed as a link. This link connects the spatial entity in the cadastre with the relative deed (and by extension the owner), thereby updating the cadastre ownership as part of the registration process.

LAVIMS and MeRP

With LAVIMS being under the auspices of the Ministry of Housing and Lands, the Registrar General's Department was placed in a somewhat difficult position. Its prime responsibility is to be the custodian of deeds; but in the paperless world that LAVIMS has enabled, these deeds were now held on an MHL system. To this end, the RGD, buoyed by the overall success of the LAVIMS implementation within the Department, set out to create a new system that would ensure that the primary deeds repository would remain with them. The system that has been built is called MeRP (Mauritius e-Registry Project), a project jointly funded by ICF Africa and the Government of Mauritius through the RGD (2012 – 2015), and it is now used for deeds registration and synchronises automatically with LAVIMS to ensure that the key stakeholders are all using the same primary dataset.

IF Process

Following deed registration, it is then the responsibility of the RGD officers to ensure that the revenues collected through both Transfer Tax and Registration Fees (each 5% of property value) are appropriate. In order to do that, an assessment of the property value needs to be undertaken by the Valuation Department. A process has been established called the IF process (Immovable property transaction Folio), through which the RGD (in their Valuation Office) and the Valuation Department communicate. This process is triggered by the RGD staff who raise IF cases on their IF dashboard, within the Deeds Module, which are then transferred to the Valuation Department for processing.

c. Valuation Department

The IF cases appear in the Valuation Module on the dashboard (Figure 4); visibility of cases on this dashboard is governed by user rights. As with the Cadastre Case Management dashboard, only those cases that an officer is authorised to work on can be accessed through that logon. The IF process at the Valuation Department is a multi-stage workflow, comprising briefly the following stages:

Director's Assignment – All new cases are accessible by the director or, through delegation, the registry team who then assign to an individual Section within the Valuation Department.

HOS Assignment – Whereby the Head of Section (HOS) assigns the case to one of the Valuers within his/her section.

RIM – Reference Information Module, in this module, relevant property details are added to the case, including the FPU (Fiscal Property Unit), a subset of the PIN is attached identifying the specific building or building part.

Site Visit – This module allows the Valuer or Valuation technician to go into the field and collect information on the property through a site visit. This includes being able to capture information directly into the LAVIMS mobile application, with details on properties as well as photographs and sketches. Once complete the site visit information is uploaded back into the main LAVIMS database.

Comparables – This module allows the Valuer to search the LAVIMS Sales database for similar property sales recorded in a specific geographic location. A variety of filters is provided allowing the officer to select certain property and sales types from a given time window and get results for the sales that have taken place. This report is generated and held against each IF case as a proof of market values. The Sales recorded in the LAVIMS sales database contain back-captured sales

loaded in the original LAVIMS project as well as all sales subsequently transacted through LAVIMS.

Assessment – once the above steps have been completed, the Valuer can then make an assessment of the true market value of the property being transacted. The assessment approach is up to the Valuer, and a number of options are available; CAMA model, Rates method or a manual valuation. A basis of assessment is generated and held against the IF case on the dashboard.

Authorisation – Once the Valuation Assessment is complete the case returns to the Head of Section who will authorise (or otherwise) the Valuation of the property. At this stage the case is then classified either as:

- An OK property, where the transaction value reflects the true market value, and therefore the revenues collected through the transaction tax and registration fees are appropriate, or,
- An RD (Revenues Due), property whereby the sales value falls below the market value (as may be the case if a property is transacted between family members). In such a case, the revenue to be collected by the RGD should be based on the market value and not the actual transaction value, and, therefore further revenues are to be collected. The case then returns to the governance of the RGD who then carry out the remaining stages with the transferor until a settlement is accepted.

d. Other LAVIMS Functionality

The usage described above represents the core functionality of LAVIMS as an integrated flowline. There are, however, other functionalities available to users across Government Departments and the public which improve services provided as well as access to information. These include:

Document Searches

Deeds and Survey Plans loaded in LAVIMS are available to be accessed by anyone in the public search room of the RGD. Users can search for the documents in the Deeds Module, and have view-only access to any document stored. This accessibility is the same as was available when paper deeds could be accessed from their Volumes on the shelves, but this new functionality greatly improves the customer service and efficiency of access. It is through such searches that the linking information collected in the original LAVIMS data capture exercise, and through continuous updates since, really comes into its own. Deeds will have links recorded that show survey plans or other deeds referenced in them and access to these documents is now just a click away. Such access has also been rolled out to **Local Authorities** and the **Director of Public Prosecutions**.

GIS Viewer

The LAVIMS GIS Viewer (Figure 5) acts as a standalone module that does not form part of the property transaction flowline as such (although undoubtedly it can be used by the CU for searching for parcels). The viewer allows the user to view base layer imagery (15cm aerial photography and newer 50cm Pleiades satellite imagery), together with vector data, the Cadastre polygon layer, the buildings layer, street centrelines, easements and other Points of Interest. The viewer can be accessed by all staff at the MHL and Valuation Departments as well as registered users at **Local Authorities**, and the public via dedicated public access computers in the MHL.

Plan Registration

The survey plans that are registered at the RGD are only the LS Report survey plan type, officers at the MHL use a variety of other plans in their work and these can now be registered and loaded into LAVIMS through the Cadastre Case Management Module. Acquisition plans, Morcellement plans and State Land plans are all now loaded into LAVIMS and then become searchable in the way that LS plans are. These plan registrations may also trigger an editing task, as with the PIN Certificates, and as such are handled in exactly the same way on the dashboard.

4. SUCCESS FACTORS

As recognised by the Silver Award from the AAPAM, LAVIMS can certainly be considered a success. The principal reasons for this are indicated below. Investment in LAVIMS has improved government efficiency, enhanced access to information and, at least partially, begun to pay for itself.

a) Capacity Building

From the start of the project, it was clear that the only way that LAVIMS was going to succeed as a long term solution was if the officers in the stakeholder departments were fully committed to its implementation and fully able to operate the system without direct support. To this end the design of the system was undertaken in close cooperation with experts from within the stakeholder departments, thus ensuring that the system as delivered closely matches the end-users' requirements; this could not have been achieved satisfactorily through deployment of an off-the-shelf product and shoe-horning requirements into a pre-existing system.

Once the various modules were ready to deploy, the acceptance testing was completed by the ultimate end users, many of whom had input into the design consultancy phase. Prior to this testing, training for the User Acceptance Testing (UAT) was carried out so that the testers were fully conversant with the system.

As feature requests and bugs were handled, so the expectations of the end users and the software delivered came ever closer until the final versions were ready for deployment. Following go-live, a series of Joint Operations Phases were implemented at each department, whereby support staff from the development team worked alongside Government officers, carrying out Business as Usual tasks, and gradually ramping down this external support to a point where each department were operating the system on their own.

The long term sustainability of LAVIMS has now been established, as can be demonstrated by the increase in staff numbers at the Cadastre Unit, all of whom have been internally trained. Furthermore, new users at the Local Authorities have been trained by CU staff, demonstrating that championing of LAVIMS and the expansion within Government is in the hands of the users themselves.

One of the most endearing accounts of the LAVIMS project was of the officer who had had a long career within one of the departments, working on large cumbersome ledgers. She had had no previous IT exposure and was fearful of the changes LAVIMS would bring and how it would change her job, ultimately making her surplus to requirements. Ultimately following the Capacity Building, this fear turned to empowerment; the assistance LAVIMS gave her enabled her to become IT literate, opening up new horizons both professionally and privately. Instead of leaving her with nothing to do, LAVIMS enabled her to do so much more in her daily job; a totally rewarding experience.

b) Central to Government

One essential element to the long term success of a project such as LAVIMS is to ensure that the system **must** be used for all operations, rather than be available as an alternative to a pre-existing process. To begin, during the Joint Operations Phases there were a few ‘parallel runs’ whereby manual and LAVIMS based operations were implemented side by side, but these were very quickly shown to be unnecessary. For the Cadastre Unit, this use is implicit, as there was no ‘analogue cadastre’, and the unit itself was formed exclusively for the operation of LAVIMS. Furthermore, legislative changes relating to deeds registration have cemented the core role that LAVIMS now holds within the Land Administration process, as indicated by:

- Deeds registered at the RGD must now have a PIN in them prior to registration. This legislative change is ensuring that the LAVIMS Cadastre must be updated with each land transaction. This has the effect of improving and updating the Cadastre on a day by day basis;
- This is being further cemented by the requirement for a PIN certificate itself to be included at deed registration. Therefore any deed registered will have had work tracked through the Cadastre Module to produce the PIN certificate in the first place;

- The RGD no longer has the means of archiving paper deeds. The Mauritius deeds repository is now a fully electronic system and the paperless office that has existed for the last four years means there can now be no going back to a paper-based system,
- The IF process for valuation assessment of sale deeds, is now only run in LAVIMS, which means that all information relating to property sales is by default recorded directly into LAVIMS, thereby updating and improving the digital sales data held by the GoM.

c) Access and Transparency

It had always been possible to access much of the information that is now available in LAVIMS, but this was through very time-consuming searches in ledgers held at the various Ministries. Now, access to deeds and survey plans can be made easily by accessing LAVIMS whether at the RGD or the MHL (where the Cadastre can also be accessed). This access is available to Government officers, professionals and citizens alike. Transparency is a key factor in modernisation within Government and LAVIMS is able to deliver this, whilst providing great efficiencies to users, both within and outside the core stakeholders. The silos of information that had previously existed within individual departments are now largely open for access to all. This access and transparency can only improve as more e-Government services come online.

d) Government Efficiencies

LAVIMS as a project was entirely funded by the state. To ensure the long term sustainability of this system, it is therefore desirable that the system pays for itself, whether through revenues earned or efficiencies delivered within Government. Information being recorded and processed in LAVIMS is now far greater than had similarly been processed before, which is particularly the case thanks to the rapidly developing economy. Of particular note is the speed at which Government services to professionals and citizens has improved:

- Prior to LAVIMS, the deeds registration process would take up to 15 days to go through the manual process at the RGD. Since LAVIMS this has reduced to 1 day. Furthermore, deeds once registered are now available for online public searching immediately;
- Approximately 90,000 new parcels have been added to the Cadastre with a total of approximately 250,000 (45%) having been edited since go-live in 2011;
- Certificates for some 71,890 PINs have been issued from March 2012 up to December 2015. This has generated about Rs. 67,330,000 (\$1.9Million US) revenue;
- In 2015, some 23,000 PIN certificates have been issued and revenues of Rs. 23,000,000 (\$650,000 US) have been collected;

- Following the go-live of the online PIN application process, around 65% of applications are being made using the online application portal.

5. ENHANCEMENTS

Since the go-live of LAVIMS in 2011, there have been a number of enhancements to the original system to take into account the changing nature of business at the three stakeholder departments. The major works carried out so far are enhancements to the Cadastre Module at the MHL and preparation for MeRP at the RGD.

Some enhancements to the Valuation Module have also been scoped but are not yet implemented. In particular this most likely to involve upgrade of the PDA-based field data collection module to incorporate the significant advances in mobile technology that have occurred since this component of LAVIMS was originally designed and built.

Cadastre Enhancements

The Deeds Module and Valuation Module represented the introduction of digital processes to business operations that were already in place within these departments, though working with paper documents rather than digital files. The Business Process Re-engineering carried out at these sites ahead of the design, development and deployment of the modules was therefore quite straightforward, as the officers in charge had a clear vision of what the Go-To situation would be. At the Ministry of Housing and Lands, however, there was no Cadastre Unit in place prior to LAVIMS, as Mauritius had no Cadastre. It was therefore inevitable that following the deployment of the Cadastre Module, and initial operations by the CU, there would become changes required to ensure that the Go-To situation is as effective as possible.

The main focus of the Cadastre Module enhancements was the implementation of the PIN certificate application process and subsequent dashboard for managing the workload within the CU (as described above). Following the go-live of the LAVIMS Cadastre in 2011, the CU set up a team to carry out cadastral edits, based initially on the parcel updates after deed registration; the management of this work was however organised with spreadsheets and paper lists, making tracking and reporting difficult. By establishing the Case Management Module, senior officers at the CU were able to allocate, monitor and report more effectively on work being carried out by their teams, enabling a more efficient process, and ultimately saving money for the Government.

In addition to the Case Management Module the following were also deployed in the enhanced Cadastre Module:

Layer Management Module – enabling users to upload new external vector layers, change the view properties of layers and manage accessibility based on user permissions;

Importing Shapefiles – permitting editors to import shapefiles of surveyed parcels directly into the cadastre;

Street Editing – the editing of the street layer loaded in LAVIMS was not included in the original LAVIMS design, but this layer can now be edited for both spatial and attribute data;

Exporting layers – export of vector layers for use in offline systems;

New Imagery layer – The LAVIMS aerial photography and satellite imagery layers date back to 2008 and 2009. There is rapid urban expansion in many parts of Mauritius and the original imagery layers are increasingly out of date, with the cadastre itself in many places being more up-to-date than the imagery. As a result, very high resolution (50cm) Pleiades satellite imagery was provided as an Ortho-rectified mosaic across the whole island.

Expanding the RGD Digital Archive and Preparations for MeRP

In keeping with the RGD's wish to be the custodian of a complete digital deeds repository it was necessary to extend the capture of deeds beyond those that had been originally scanned and uploaded into LAVIMS. The original deeds scanning exercise of the LAVIMS project only went back 30 years (to 1990); in order to complete the deeds record all Volumes dating back to 1804 need to be scanned and uploaded.

A scanning team was established at the RGD to handle the scanning of all the older deeds, comprising approximately 6,000 volumes and including many deed types not covered in the original LAVIMS scanning campaign. As these deeds were older than the original LAVIMS deeds, many of them required specialised careful handling to avoid damage and far more of them needed to be scanned with A3 open book scanners whose throughput is only 10% of that possible with an A4 fast scanner. This additional scanning campaign therefore took approximately 12 months with a further six months for post processing, QA and data loading into LAVIMS.

At the end of the scanning project, it was also necessary to import all the deeds held in LAVIMS into the new MeRP system (see text box). This was done via Oracle dump files, and once verified, Registration activities were then transferred onto the MeRP system. Since this changeover all deeds have been registered and then immediately transferred, via Oracle Streams into the LAVIMS Deeds database. For RGD, therefore, the post-LAVIMS project activities have included expansion of both the data archive and software enhancements.

6. THE POTENTIAL FUTURE OF LAVIMS

After nearly five years of operational activities LAVIMS has become well established within GoM's routine administrative systems. The users within the key stakeholder departments are now largely self-sufficient in their operation of the system (although there is a supporting help desk, when needed) and individuals are comfortable in using the software for their day-to-day activities.

However, opportunities for expanding the remit of LAVIMS are now being actively considered. These include the development of further functionality for the existing software applications; as users become more familiar with the tools at their disposal they identify other tasks that could be done more effectively with specific new tools to, for example, using enhanced spatial analysis tools to try to understand the impact of market forces on property values in relation to specific geographic locations.

The development of a State Land Management System is also being pursued, based on the data and services already provided in LAVIMS for privately owned land. GoM has allocated budget for inclusion of State Land information and related software functionality in the cadastre over the next 2-3 years so that all land for the island of Mauritius can be managed within a single system.

In addition the comprehensive datasets in LAVIMS are being considered to provide the framework for establishing a National Spatial Data Infrastructure (NSDI) where, with additional datasets and functionality, LAVIMS could underpin a number of other Government activities such as urban and rural planning, emergency management and, ultimately, provide up-to-date and near real time environmental information to citizens through an appropriate data portal.

An operational NSDI would contain up-to-date and accurate spatial data on land, infrastructure, utilities and the environment and would support Government in dealing with issues such as environmental degradation, flooding, use of agricultural land for residential building, deforestation, mineral extraction and land use zoning. The Government also has a SMART Cities initiative, and the formation of an NSDI for Mauritius could fully support this initiative both in the development phase and ultimately in providing a geospatial basis to support the Live Work Play Concept of their Vision 2030 strategy.

In an NSDI the data would be managed and collected once / used many times; i.e. there would be no duplication of effort by multiple agencies all collecting their own versions of the same data. It would be easy to find out what data exists, to view it, access it and, if required, download it. A fully developed network could be used by all Government Ministries, Departments and Agencies (MDAs), by the private sector and by academia, NGOs and citizens. Government MDAs could easily exchange and share data. A

range of eGovernment services could be based upon such infrastructure, creating increased opportunities and access to information for citizens.

LAVIMS already includes many of the elements required for an NSDI. LAVIMS has information on land parcels (although currently it is missing comprehensive information on State Land), ownership and occupation, and, buildings, as well as information on roads, planning scheme boundaries, etc. high resolution image layers (both aerial and satellite imagery) and a Digital Terrain Model (DTM) covering the whole island.

However, for LAVIMS to become an NSDI, a number of actions would have to be implemented. These include six fundamental elements required to realise the vision of a **Spatially Enabled Society**:

1. **A national legal framework to provide the institutional structure for data sharing, discovery, and access** - an NSDI policy is required to address this issue and to recommend legal and institutional reforms. A framework for data sharing is an essential pre-requisite for an operational NSDI;
2. **A sound data integration concept to ensure multi-sourced data integration and interoperability** – an NSDI policy should define which spatial data will be produced, the approach to standards and how data can be managed within an interoperability framework;
3. **A positioning infrastructure to enable and benefit from precise positioning possibilities** – for example the use of CORS (Continuously Operating Reference Stations) and a suitable geographic reference system;
4. **An infrastructure to facilitate data sharing, to reduce duplication and to link data producers, providers and value adders to data users based on a common goal of data sharing** – the goal to be reached after defining the NSDI policy, a strategy and an implementation programme;
5. **Land ownership information, as the dominant issue in the interactions between government, businesses and citizens relating to land and water resources** – much of the required information is either available in LAVIMS or is being input via the update programme of the Cadastre Unit; and,
6. **Data and information to respect certain basic principles and to increase the availability and interoperability of free to re-use spatial data from different actors and sectors** – as specified within an NSDI policy.

Currently the workflow management between the three key LAVIMS stakeholders clearly demonstrates how the concept of ‘collect once and use many times’ could work in the context of an NSDI for Mauritius. Also the access to data on a view-only basis granted to Local Authorities shows how wider data sharing could be achieved; and controls are in place to ensure that all data users only have access to data that they are entitled to view or use or edit. LAVIMS already demonstrates many the principles required of an operational NSDI and could be expanded to provide this function in the near to mid-term.

7. CONCLUSIONS

The story of LAVIMS has been one of crystallising an idea into a real-world practical and operational system that has brought benefits to central and local Government and, ultimately, the citizen. In terms of the database and system functionality, LAVIMS now provides the focus for all land transaction management for the Island of Mauritius. The information within it is now more easily accessible by citizens, enabling land management to be a much more transparent process.

The LAVIMS development process required the close cooperation of a multi-disciplinary team comprised of several different areas of specialism from software engineering to data capture expertise and data mining from digitised documents. The project implementation team consisted of international and local experts and a large number of local support staff. However the principle success of LAVIMS was the collaborative approach adopted by the development team, Government and the key stakeholders; this ensured that the design of LAVIMS was fit for purpose and fully delivers the outputs required for efficient land management in Mauritius.

In nearly five years of operational activities the key stakeholders have developed the use of LAVIMS as the means of implementing their Business as Usual activities in a digital environment. After the initial design and build phases, the operational go-live was implemented following a comprehensive training and knowledge building programme that was designed to develop the capacity of existing staff to undertake their job roles entirely using the software tools in LAVIMS. This was initiated by a ‘train the trainers’ approach, in order to develop long term sustainability, and, was further enhanced by having a joint operations phase in which the contractors and trainers worked closely together over several months to finalise all the processes and workflows. The fact that LAVIMS is an operational tool and not a white elephant sitting in the corner is, particularly, a tribute to the energy and enthusiasm of the stakeholders’ staff who have fully embraced the technology.

The potential next steps are just as exciting; all based on having consistent, comprehensive and accessible information about land and expanding the database and system functionality to cover all relevant aspects of land management, including State Land, as well as planning and environmental management and, potentially, providing information of direct use to the citizen in future SMART cities; for example transport information and pollution/air quality measurements. LAVIMS itself will not be able to collect such information directly and it is well beyond the remit of the current stakeholders to do so. However, in the future, LAVIMS could be a repository for a wide range of spatial data and be linked to a much wider circle of key stakeholders in Government, academia and the private sector.



Figure 1 LAVIMS Landing page (source: screenshot of LAVIMS software application)

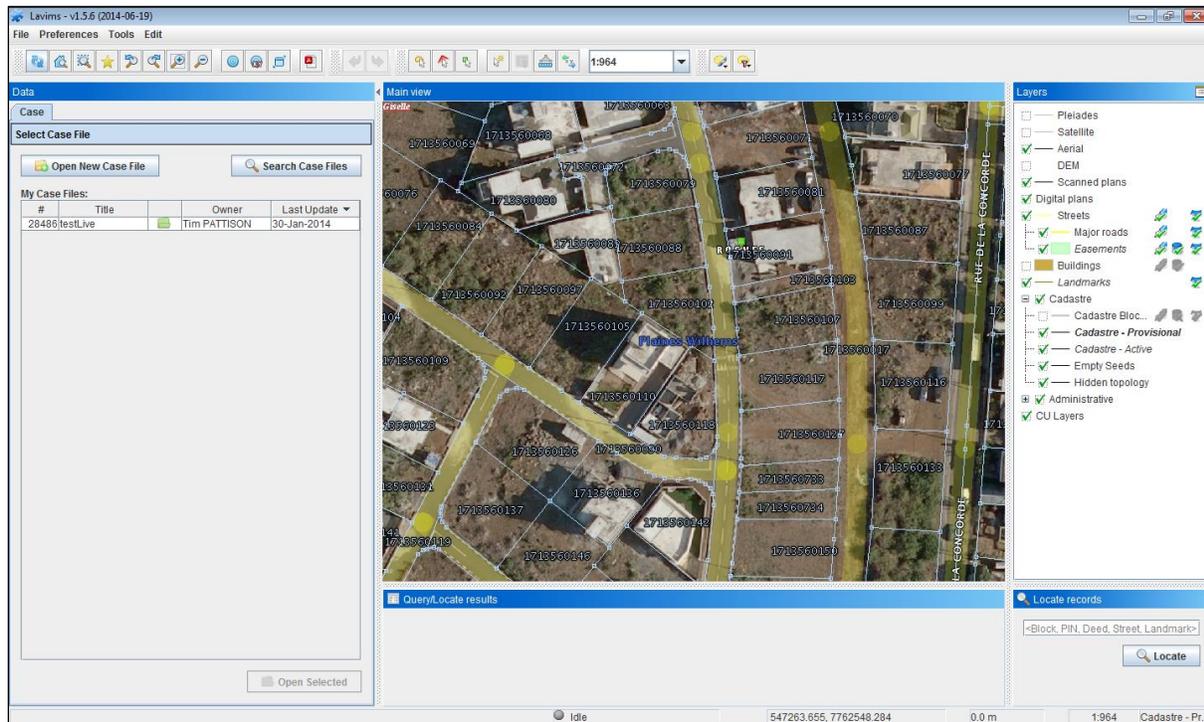


Figure 2 LAVIMS Thick Client Editor showing Cadastral Land Parcels and Road Centrelines (source: screenshot of LAVIMS software application)



MINISTRY OF HOUSING AND LANDS
PARCEL IDENTIFICATION NUMBER (PIN)
(PIN issued under Section 7(3) of the Cadastral Survey Act 2011)

Parcel Identification Number (PIN)

PCR21013/2014

Development Reference: null

PIN Attribution



SN	Lot No.	Extent (Survey)	PIN
1	LOT 1	653.0m ²	1605150227
2	Lot 2	485.4m ²	1605150228
3	Lot 3	545.0m ²	1605150229
4	Lot 4	485.4m ²	1605150230
5	Lot 5	485.4m ²	1605150231

This PIN certificate is based on the annexed plan bearing the seal of the Ministry and the PIN certificate number.

N.Luchoo
For Chief Surveyor
2.7.2014

Disclaimer: The above statements about land ownership do not constitute a proof of the land title and the Government of Mauritius or its employees do not accept any liability of whatever nature arising from the use of information other than for its intended purpose.

Figure 3 PIN Certificate as generated by LAVIMS (source: document created from LAVIMS software application)

VALUATION
Cases Dashboard | Viewer | Compare | Reports

Overview | Hide Assigned | Export to CSV | Print | Create | Refresh

CASE NUMBER	DEED NUMBER	DATE OF DEED	DAYS LEFT	STATUS	DECLARED VALUE	MVCA	HELD	DIR. ASSG.	HOS INT.	RIM	SITE VISIT	COMPARABLES	ASSESSMENT	AUTHORIZATION
e.g. 4022	e.g. TV 1000*	e.g. 1998-01-*	20	e.g. ARC	e.g. 12345									
424478	TV201508/002021	2015-08-21	20	SV	1,300,000	1204								
424495	TV201508/002001	2015-08-21	20	AS	150,000	1908								
424498	TV201508/002040	2015-08-21	20	DI	1,329,230	1213								
424499	TV201508/001952	2015-08-24	20	SV	2,300,000	1905								
424502	TV201508/001986	2015-08-24	20	SV	350,000	1310								
424503	TV201508/002002	2015-08-21	20	SV	2,000,000	1909								
424504	TV201508/002029	2015-08-21	20	SV	3,600,000	1609								
424511	TV201508/002036	2015-08-24	20	AS	250,000	1217								
424514	TV201508/001978	2015-08-27	20	SV	3,000,000	1743								
424517	TV201508/001965	2015-08-26	20	SV	9,000,000	1305								
424522	TV201508/001962	2015-08-26	20	AS	515,000	1814								
424523	TV201508/002022	2015-08-21	20	DI	4,000,000	1213								
424524	TV201508/001995	2015-08-24	20	OK	1,575,000	1307								
424527	TV201508/002037	2015-08-24	20	OK	500,000	1507								
424529	TV201508/001984	2015-08-24	20	SV	4,500,000	1305								
424533	TV201508/002010	2015-08-21	20	SV	500,000	1220								
424543	TV201508/002033	2015-08-21	20	CP	900,000	1741								
424546	TV201508/001966	2015-08-21	20	DI	3,000,000	1305								
424550	TV201508/002024	2015-08-24	20	OK	950,000	1513								
424557	TV201508/002026	2015-08-27	20	RGD	450,000	1520								
424559	TV201508/002000	2015-08-22	20	SV	2,500,000	1734								
424562	TV201508/002039	2015-08-24	20	RGD	920,000	1201								
424563	TV201508/002038	2015-08-24	20	SV	650,000	1721								
424576	TV201508/002015	2015-08-21	20	OK	2,900,000									
424578	TV201508/001961	2015-08-25	20	OK	500,000	1319								

Items 1-25, Total: 32

Figure 4 Valuation Dashboard (source: screenshot of LAVIMS software application)

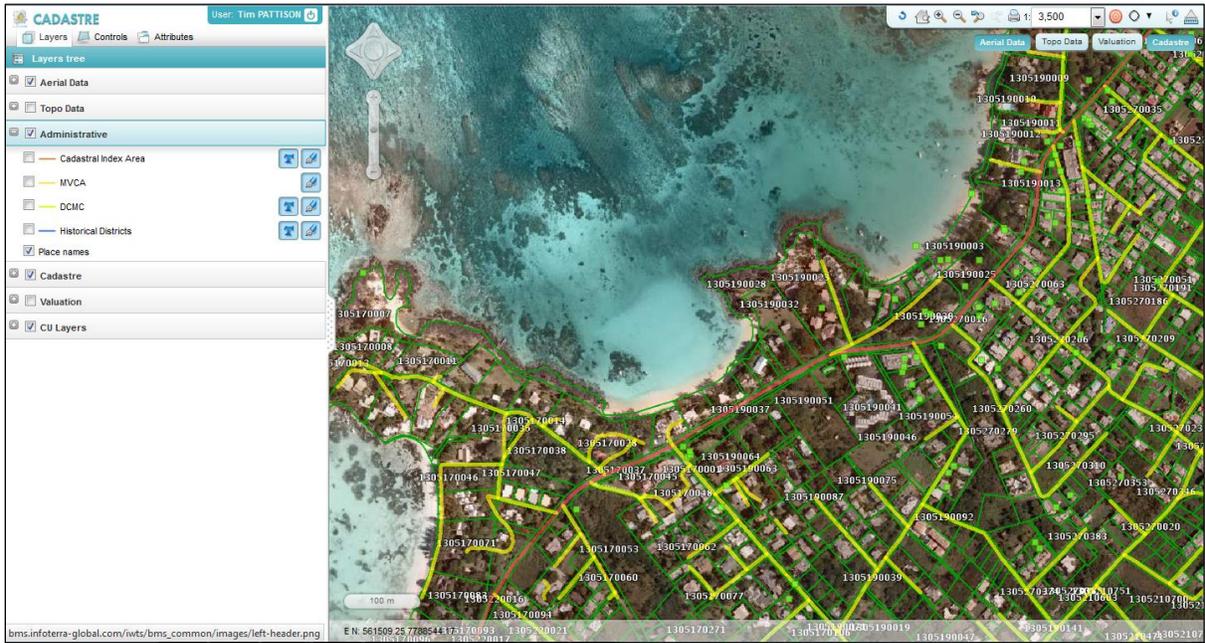


Figure 5 LAVIMS Thin Client GIS Viewer (source: screenshot of LAVIMS software application)