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ADDRESSING THE PROBLEMS OF LAND REGISTRATION PROCESSES IN COMPLEX LAND TENURE SYSTEMS USING COMPUTATIONAL TECHNIQUES: EVIDENCE FROM ACCRA GHANA

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Abstract

Land registration processes have been described to be simplistic in simple land tenure environments where land rights are treasured and registered by the state on behalf of the people. Duplication of tasks, repeated preparation of land registration documents, and wrong definition of tasks affect the activities and processes of land registration characterising complex land tenure environments. Many qualitative land registration models such as the use of Unified Modified Language (UML) diagrams have been developed to show the frameworks of land registration processes in most parts of the world. However, most researches avoid the technical implementation of these models. This paper presents the quantitative approaches to addressing the problems of land registration processes in complex land tenure systems using computational techniques such as Process Maker and Java Script. The paper used case study approach to collect data and systems design method for the output. Semi-structured interviews were used to collect data from the Lands Commission of Accra and its stakeholders. Process maker software was operationalised using GeoJSON parcel file. Results show that, the simplification of land registration processes is based on the rationale behind the change (Data error, improved capacity, service quality), and the semantics (process re-engineering) involved in the computation of the modelling processes. The outcome has the ability to simplify an otherwise complex tenure system by avoiding delays and therefore improving the land registration processes.

Keywords: land registration, land tenure, computational techniques, process modelling, enterprise architecture, Ghana.

1.1 Introduction

Over the past decades, varied land registration systems have been implemented to help improve tenure security for all. These systems are mostly successful in simple land tenure systems, thus, where the ownership and regulation of lands are controlled by a tenure group such as the state as opposed to the multiple tenure structure in Ghana. However, land registration systems fail where nested landholding systems such as customary and state tenure systems with interwoven classes of ownership and related issues, negatively affect registration processes (Srinivas, 2015). The interwoven classes of ownership is especially so in Sub-Saharan Africa and some parts of Latin America. This, therefore, results in more people's land rights falling outside the formal register which has created complex interaction between actors of land registration and landowners (UN-Habitat, 2014). The complex interaction creates bureaucracy and duplication of functions which delays the land registration in some parts of Africa (Larbi, 2006 ; Obeng-Odoom, 2016).

In Ghana, land registration requires detailed proof of land ownership especially lands owned by families and stools. Since 2003, Ghana introduced the Land Administration Project (LAP) I and II. The intention was to solve the problems of Land Administration such as land conflicts arising from multiple sale of land, boundary disputes, delays in land registration. in the land tenure system. However, these LAP projects yielded little results because of the complexity of tenurial arrangements and long registration processes (Duncan, Lufkin, & Gaafar, 2013).

Later, the LAP II brought all the land sector agencies under one umbrella called Lands Commission with identifiable units called Divisions. The Survey and Mapping Division is responsible to supervise, regulate, and control the survey and demarcation of land for land use and land registration. Land Valuation Division responsible for assessment of stamp duty and values of land. Land Title Registry responsible for registration of title to land and other interests and the Public and Vested Land Management Division to facilitate the acquisition of land for government among other things.

The purpose of merging the institutions was to avoid duplication of efforts as well as to share its core competence with other relevant institutions. However, service delivery by the Lands Commission following the merger is still characterized by lack of coordination between the divisions mostly with unclear mandates, infiltration of administrative politics in the registration process, and low technical and administrative capacity of the Customary Land Secretariats (Abubakari, Richter & Zevenbergen, 2018). This has resulted in overlaps and duplication of

functions among the Divisions of the Commission (Duncan et al., 2013). Transparency International (2016) indicates that delays like double preparation of site plans, delays in the issuance of tax clearance certificates, official request for search report from Land Title Registry and the Public and Vested Land Management Division as well as deficiency of information on the progress of applications by clients still abound and affect the business processes of land registration.

Zevenbergen (2002) ; Deininger, Ali, Holden & Zevenbergen (2008); Stig, Clifford, Christiaan & Robin, (2014) and Lemmen, Oosterom & Bennette (2015) have qualitatively expressed their ideas using UML diagrams in re-engineering the land registration processes in some parts of the world. However, the qualitative description of these processes seems to not significantly address the issues of land registration in complex land tenure systems. Few system design applications have been tested to facilitate this process, yet, efficient land registration processes fail. Therefore, modelling land registration processes with extreme modern applications with well-defined computational parameters will help improve the land registration processes. This paper seeks to model and operationalise the land registration processes in Accra Ghana.

1.1.1 Land Ownership and Registration Systems

There are existing studies to qualitatively describe the land registration processes in simple land tenure systems (Deininger et al., 2008; Mburu, 2017; Tuladhar, 2002; Zevenbergen, 2002). According to Lambrecht and Asare (2016), interlocking land rights among traditional institutions influence land registration. For stool lands, chiefs exercise influencing rights at the outskirt of their individual domain to transact land right which creates chieftaincy disputes (Barry & Danso, 2014). This creates power struggles among current and successive chiefs regarding 'who must sell what' (Biitir, Nara & Ameyaw, 2017). Sometimes ineffective communication, harmonisation and coordination between customary landholders lead to a situation where chiefs and family members dispose of land i.e. multiple sale (Owusu, Oteng-ababio & Afutu-kotey, 2012). According to Barry and Danso (2014) rigid procedural rules from chiefs and families make the registration complex, hence make it difficult to register lands at the Lands Commission. For example elders, chiefs and family heads must sign indentures before registration.

Theoretical studies on land registration processes in complex land tenure systems are purely based on the use of fit-for-purpose approaches to document land rights, which facilitates land

tenure documentation. This is based on the fact that securing land rights for the world has been challenging, but it is a feasible objective that can be achieved (Lemmen, 2015). De Soto (2000) made a claim that when lands are registered, it gives people the opportunity to engage in any investment venture. However, there has been positive evidence in Deininger, Ali, and Alemu (2009); Deininger et al., 2008; Zevenbergen (2002) that, despite the sole benefit of land registration to an individual, it provides a positive economic benefit without even realizing its cost involved in acquiring the land right. However, Zevenbergen (2002) describes the processes as complex which involve at least technical, legal, and organizational aspects, which influence each other. One significant advantage of being an absolute or interim owner of land is by having a legal backing through the proof of ownership.

Land registration processes in some parts of the world have seen much improvement. In Moldavia, the agency of land registration and cadastre were merged to solely be responsible for registration of land using a cadastre that is multifunctional (PCC, 2016). Sweden has also seen much success in its registration processes through the merger of data and realigning of institutions and their functions (de Vries, Muparari & Zevenbergen, 2017). The purpose of these improvements is geared towards increasing efficiency, economic and technical gains through calibration and reduction of redundancy of functions among land registration institutions. Consequently, realigning institutional roles in status and leadership according to EuroGeographics and PCC (2016) is likely to affect land registration in duties and workload. Some parts of Africa such as Rwanda and Uganda have seen some improvement by going digital in land registration. In Kenya, data standardisation and data interoperability are still an issue facing the implementation of Land Information Systems (Mburu, 2017).

1.1.2 Mechanisms of Modelling Land Registration Processes

Land registration facilitates all transactions concerning land, such as land development, and make transactions easier, faster, and more secure. However, the success of land administration of every nation rests on vibrant and co-ordinated land sector agencies. It has been proven that the collaboration of land agencies in the land administration has contributed to the effective and efficient delivery of developable land for housing (Muyiwa, Rajabifard, & Bennett, 2014). Steudler, Rajabifard, and Williamson (2004) argued that the definition of well-structured objectives, strategies and evaluation of results of institutions supports its performance. Simbizi, Bennett, and Zevenbergen (2014), therefore, suggested the need for modelling land registration

processes to ensure a smooth land transfer and tenure security. Tuladhar (2003) previously suggested this as the use of cadastral domain models.

However, according to Lemmen, Oosterom, and Bennett (2015), the model should have a shared ontology that ensures secure communication between actors through determining the required attribute and a set of responsibilities. This constitutes the use of Unified Modelling Language (UML) diagrams and Workflow Management Systems – WFMS, Geamba, (2012); Chimhamhiwa, Molen, Mutanga, and Rugege, (2009); (Mutambo, 2003). Tuludhar (2004) supports this argument that the model should not only support land registration but should also help in alienation, valuation, transfers, and utilization of land at a faster time. Lemmen (2017) shows that the decentralization of transaction roles in the UML diagrams makes the process faster. It depends on the nature of the chain of the activity diagram of the organization, transaction time and cost involved in the process (Kurwakumire & Kuzhazha, 2015). Consequently, the mutually limited use of UML graphical or textual modelling is not enough for the development of complex systems established by large heterogeneous players (Anjorin, Eds, & Hutchison, 2017). Phuong's (2015) idea of modelling shows the use of reference architecture characterized by atomicity, isolation, consistency, and durability of data. Some systems designers argue that the reference architecture must be able to select variables applicable to solve the problems efficiently considering some assumptions in the future (Correia, Maria & Reis, 2017).

However, the need to evolve beyond traditional cadastral paradigms to embrace a fresh understanding of the relationship between land, property, and rights that support the benefits of land registration calls for a new paradigm (Grant, Williamson, Ting, 2004). Enemark et al. (2005) therefore developed a new paradigm that; institutional registration arrangement can support land tenure, use, value, market, and development. Williamson, et al. (2008) refer to them as special tools in the Land Administration toolbox that led to sustainable development. This shows that systems designers need to take the extended benefits of land registration into consideration in realigning institutions and their functions in the system.

The existing works have shown that there are limited works done to ensure efficient land registration process in some parts of sub-Sahara Africa. This paper presents a modelling approach using process maker platform. The outcome of the paper adds to existing study, supplementary evidence on how complex land registration processes can be simplified and automated.

1.2 Research Methodology

The methods include both case study approach and systems design methods. The research used qualitative semi-structured interviews with the Lands Commission of Greater Accra. The qualitative approach was applied to examine the activities and functions of the land registration institutions. The purpose of choosing this research method was to develop more understanding about the land registration processes through reviewing the existing land registration system specifically the workflow. This enabled the researchers to draw a comprehensive picture to model and test the implementation of the land registration process. Process maker software was used to model and test the implementation. The registration process shows how information flows within each division of the Lands Commission and with its stakeholders. PgAdmin III software was used to design the database showing the records tables of the modelled land registration process. The system design process was analysed as follows:

- Selection of software application
- Data organization
- Task operationalisation
- System output interface
- System output generation
- Rules and conditions
- Database connection and records tracking

Process Maker software was selected for the design and testing of the land registration model in figure 1. The software is a business process design and open source software, which can be hosted in the cloud. The software manages spatial data and supports other software applications. By principle, the software supports a PHP web language that links PostgreSQL database and other databases. For this research, the process maker platform was selected because it provides an extensive toolbox that helps to create digital registration forms in different formats that can be viewed, managed on a web interface, and coordinated between users of Lands Commission and its Stakeholders.

The platform can also assist Lands Commission to design, automate, deploy, and communicate between a technical unit of the Lands Commission and its stakeholders more efficiently. Even though unavailability of internet can disrupt the functioning of the software on this platform, it can be converted to a desktop application for easy usage. Alternatively, the model can be designed and tested with other software. Among them include: Business Process Management

System (BPMS), SharePoint, Enterprise Architecture, Webcast, and Process Visio. This software can connect to other applications and work efficiently. However, this software is expensive and involves lots of computer programming and computer knowledge to ensure its automation.

1.3 Results

The focus of modelling and implementation of land registration processes is aimed at ensuring efficient and transparent land registration system. This first section presents the existing land registration process of the various tenure types i.e. stool, family and public. The outcome of the processes enables the remodelling of the land registration processes. The section finally presents the implementation process of the modelled land registration process in Accra, Ghana.

1.3.1 Land Registration Process in Accra

The land registration process in Accra involves three registration types. These include lands owned by families, stools and state. The registration phases officially involve the acquisition of land right, verification of client's documents, processing of client request, certification of request, and tax clearance. The institutions involved in the processes include; Customary Lands Secretariat, Public and Vested Lands Division (PVLMD), Clients Service and Access Unit (CSAU), Lands Valuation Division (LVD), Administration, Survey and Mapping Division (SMD), Legal Department, Land Title Registry (LTR) and the Universal Merchant Bank. Figure 1,2,3 shows the registration of land right from the acquisition stage to the certification stages of each registration type in Accra. From the figures we can infer that there are bottlenecks in the processes. For example, there is duplication of registration task between the Customer Service and Access Unit and the Legal Department in the assessment of site plans and land indenture (see bottleneck 1) of figure 1. The persistence of the verification and assessment of site plans and land indenture is to determine the legitimate family land owner(s) by the Legal Department. However, the Customer Service and Access Unit can conduct the verification and assessment of the land indenture at the initial stage of the process. The best means is by keeping records of all names of family (s) to avoid double verification thereby slowing the process. Following this, it can be realised that there are more duplications of task among some division of the Lands Commission in the workflows.

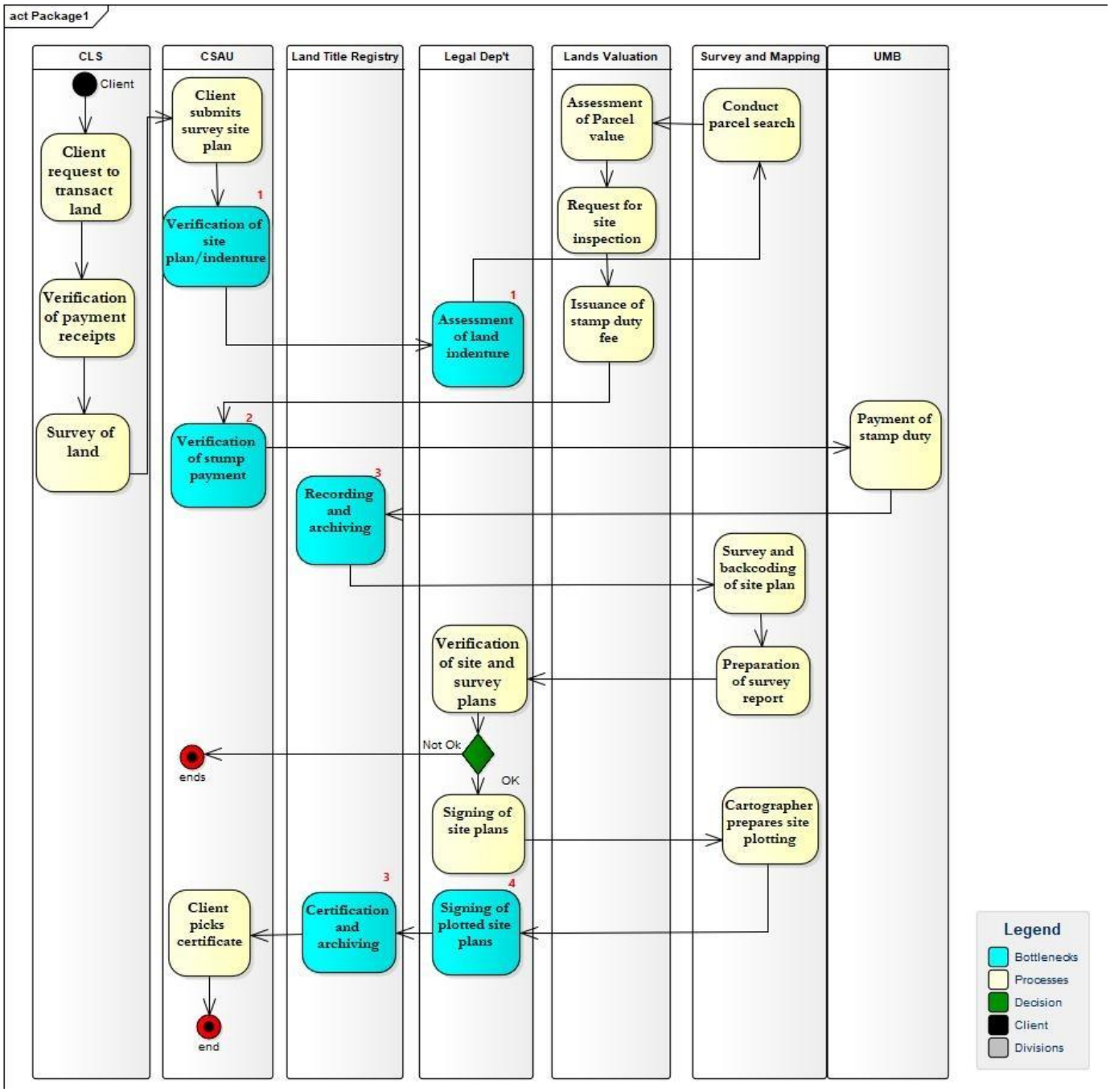


Figure 1: Family lands registration process

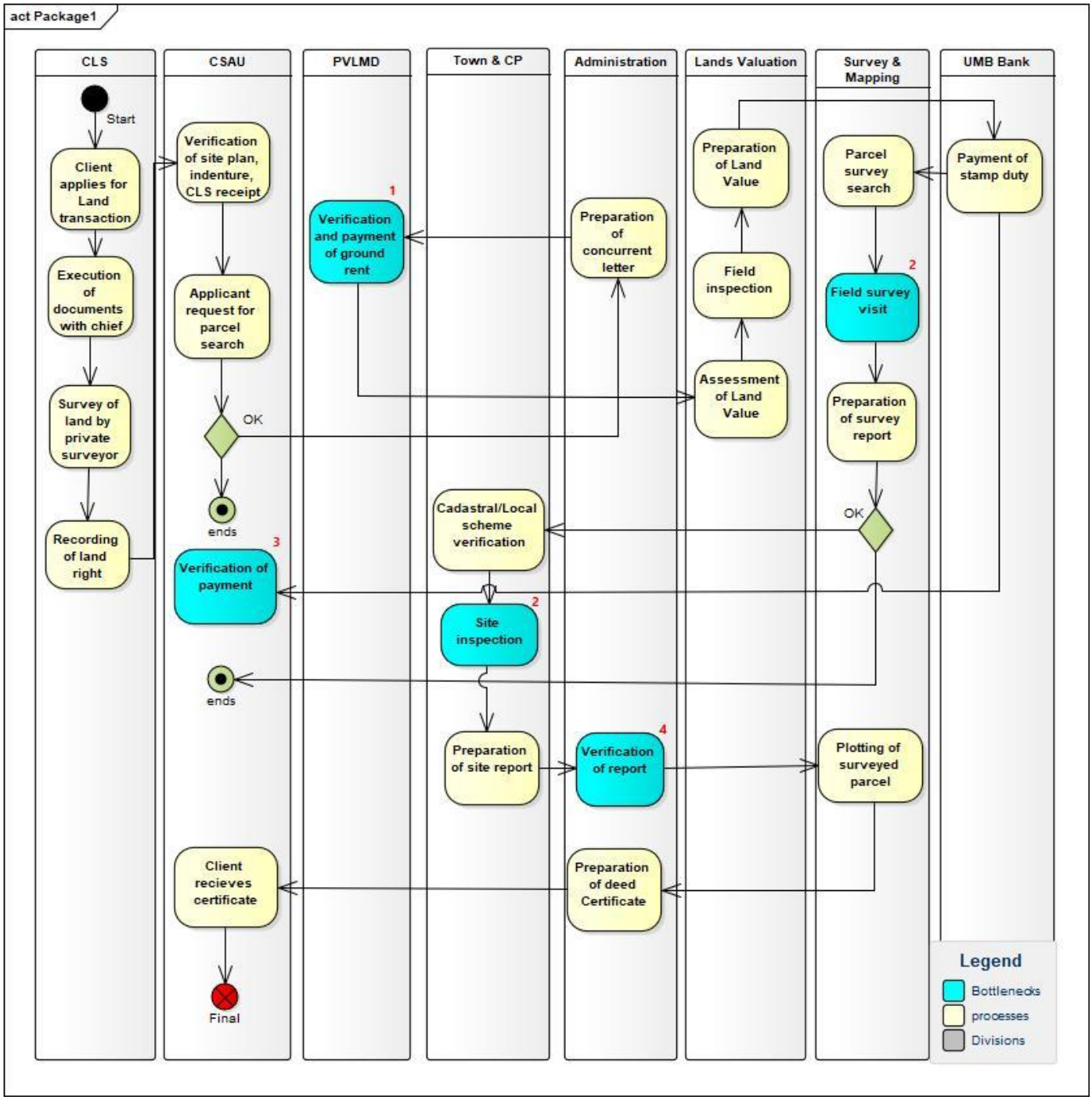


Figure 2: Stool lands registration process

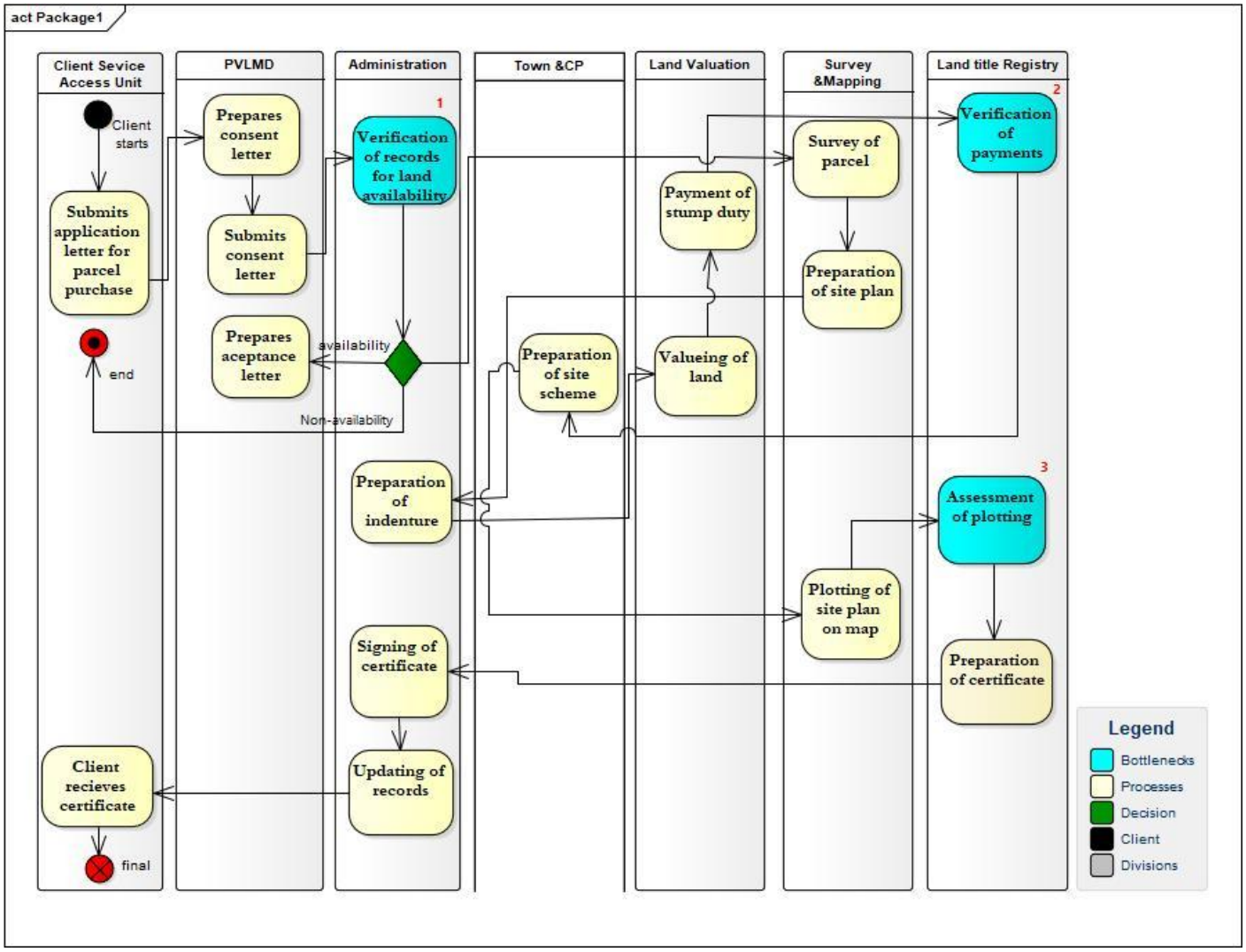


Figure 3: Public lands registration process

1.3.2 Rationale for the Proposed Change

Figures 1, 2 and 3 indicate that the land registration processes are based on the three types of land ownership i.e. stool, family, and public lands and registered by the same divisions of the Lands Commission and its stakeholders with similar responsibilities. It is therefore possible for responsibilities that are redundant, wrongly defined and duplicated in the old system to be removed without any problem. The rationale is purposely influenced by:

Service quality: Client focus is lost regarding quick information delivery on client's application status by the Client Service and Access Unit of the Lands Commission. This is because some officials fail to communicate to clients on time and even send wrong text messages to unknown clients. Therefore, clients' follow-up on their transactions may affect the process. i.e. waiting

time and task delivery time. Data responsiveness and reliability among the divisions of the Lands Commission and its stakeholders are not effective because of lack of quality data management i.e. visibility is lost regarding boundaries of old site plans which are sometimes referred to during map plotting and scanning. Efforts can be made to scan all site plans from the Client Service and Access Unit and the Land Title Registry to keep track of all sites plans in the database since they serve as the entry and exit points of the registration process respectively.

Risk of data error: The multiplicity of survey functions among the Survey and Mapping Division, Customary Lands Secretariats, and the Town and Country Planning Department regarding the preparation of site plans results in errors on site plans since there is no unique template where all site plans are drawn. It can confuse clients regarding which of these site plans is the most authentic. This research will address this challenge as well.

Improvement of capacity: There is a weak relationship between the Lands Commission and its stakeholders regarding data sharing because they work at separate places. Exchange of documents among themselves takes time to be transferred from one unit to the other. This increases the overall length of time taken to complete registration, which will be resolved by this model to facilitate teamwork, co-operation and understanding of each other's roles, and responsibilities, which will prevent delay and loss of documents. The model below shows the processes described above.

1.3.3 Characteristics of the Modelled Land Registration Process from System Administrator's Perspective

System administrators from the study area are the staffs that work directly with the land registration process of each division of the Lands Commission. Interviews from one of them indicated that "*when the land registration processes are reengineered, it will help us work within time and ease the pressure mounted on us by clients*" According to some staff members, the modelled land registration process should:

- Facilitate electronic data storage and access to digital documents from the Lands Commission to its stakeholders
- Secure and record land information such as use, ownership, security of title, valuation, and ground rent details
- Ensure timely access to land documents

- Facilitate land administration best practices such as archiving and certification of land rights and
- Monitor and access land information in the registration process

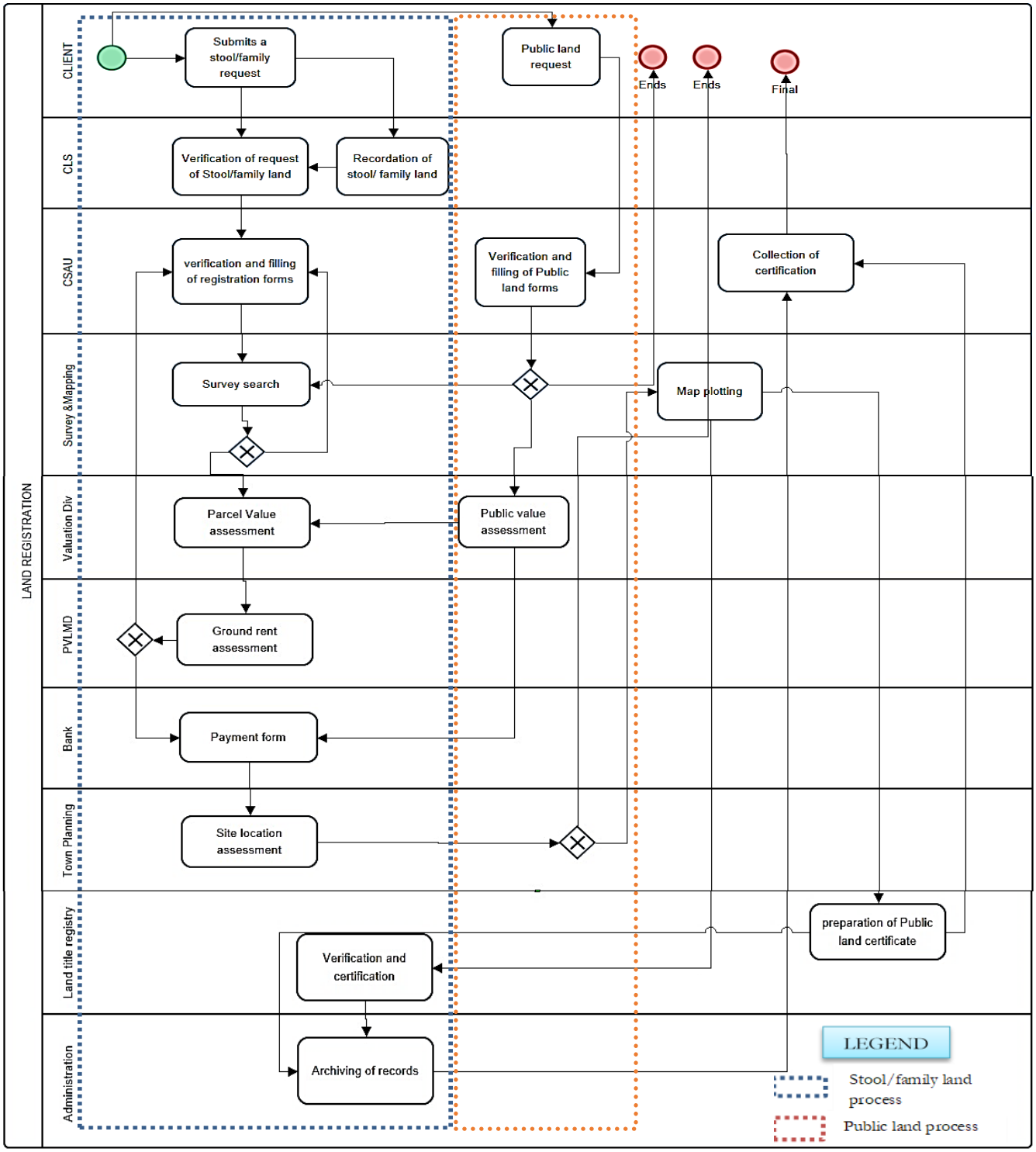


Figure 4: Modelled land registration process

1.3.3.1 Operation of the Model for Stool/Family Land Registration Processes

It is evident from figure 4 that the stool and family land registration processes have been merged into one registration workflow because these processes are similar to the same actors. The steps below explain stool/family land registration process contained in figure 4.

- Client applies to the Customary Lands Secretariat for recordation and assessment of land right. At Customary Lands Secretariat, the client completes a recordation form showing the name of the applicant, the right owners, email, and the purpose of recordation.
- The output of the recorded form is saved in the database and sent to the Client Service and Access Unit to verify attached documents (indenture and site plan) and the recordation request form from Customary Lands Secretariat. Client Service and Assess Unit requests for parcel survey search for the client, showing the name of landowners, ownership type and the location of the parcel.
- Survey and Mapping Division receives a survey search request from the Client Service and Assess Unit and verifies the request, i.e. name, site plan and the location of the parcel from the database.
- Survey and Mapping Division notifies Lands Valuation Division to assess stamp duty and then the Public and Vested Lands Management Division to assess ground rent upon completing search. Where a different party has registered the searched stool/family land, the Survey and Mapping Division sends the search results form back to Client Service and Assess Unit for the applicant to end the process. Land Valuation Division and Public and Vested Land Management Division notify the Bank to receive payment of stamp duty and ground rent from 'successful client' on their behalf respectively.
- The bank sends a notification to the Town and Country Planning Department to assess land use conformity and prepare site location report to the Survey and Mapping Division for map plotting.
- Town and Country Planning Department notifies the Client when the parcel land use does not fall within the local scheme of the parcel location. Where it falls within the scheme, Survey and Mapping Division is notified for map plotting.
- Survey and Mapping Division notifies the Land Title Registry to prepare certificate upon complete map plotting. The certificate is prepared and sent to the Administration Unit to archive it. Thereafter, a notification is sent to the client to pick the certificate.

1.3.3.2 Description of Proposed Public Land Registration Process

Public land registration starts from the Client Service and Access Unit with the following steps below explaining how the public land registration process takes place as contained in figure 4.

- Client requests for parcel purchase at the Client Service and Assess Unit. Client Service and Assess Unit requests parcel availability at the Survey and Mapping Division on behalf of the client. Where a client's request is met, the Survey and Mapping Division surveys and prepares a site plan for the applicant. Otherwise, a notification is sent back to Client Service and Assess Unit when client request fails.
- Survey and Mapping Division notifies the Lands Valuation Division to value the land and prepare stamp duty to be paid at the bank in the instance that the client's request is successful.
- Bank notifies the Town and Country Planning Department to assess land use. Survey and Mapping Division studies the report from Town and Country Planning Department and plots the site plan on the map location of the parcel.
- The plotted map is sent to the Land Title Registry to prepare certificate and archived at the Administration Unit.

1.4 Land Registration Process Model Implementation

1.4.1 Data organization

The model's dataset includes an ESRI-map of Accra showing both public and stool/family lands. The dataset is hosted on a local server to enable display of the map in the map panel of the Process Maker Software. The map was attached to the Process Maker interface using the java scripts in figure 5 in open street map layers *(openlayers.org/en/v4.6.3/css/ol.css, cdn.polyfill.io/v2/polyfill.min.js?)*, which enabled the determination of the location of Accra on the open street map.

```
$('#Location').setValue("Accra Ghana");

var aoiSource = new ol.source.Vector({wrapX: false});
var vector = new ol.layer.Vector({
  source: aoiSource
});

var familySource = new ol.source.ImageWMS({
    url: 'http://41.57.108.208:85/geoserver/wms',
    params: {'LAYERS': 'Kwame:Family'},
    serverType: 'geoserver',
    crossOrigin: 'anonymous',
    wrapX: false
});
var familyLayer = new ol.layer.Image({
    source: familySource
});
var stateSource = new ol.source.ImageWMS({
    url: 'http://41.57.108.208:85/geoserver/wms',
    params: {'LAYERS': 'Kwame:State'},
    serverType: 'geoserver',
    crossOrigin: 'anonymous'
});
var stateLayer = new ol.layer.Image({
    source: stateSource
});
var map = new ol.Map({
    target: 'panel0000000001',
    layers: [
        new ol.layer.Tile({
            source: new ol.source.OSM()
```

Figure 5: Data organization script

1.4.1.1 Task Operationalisation

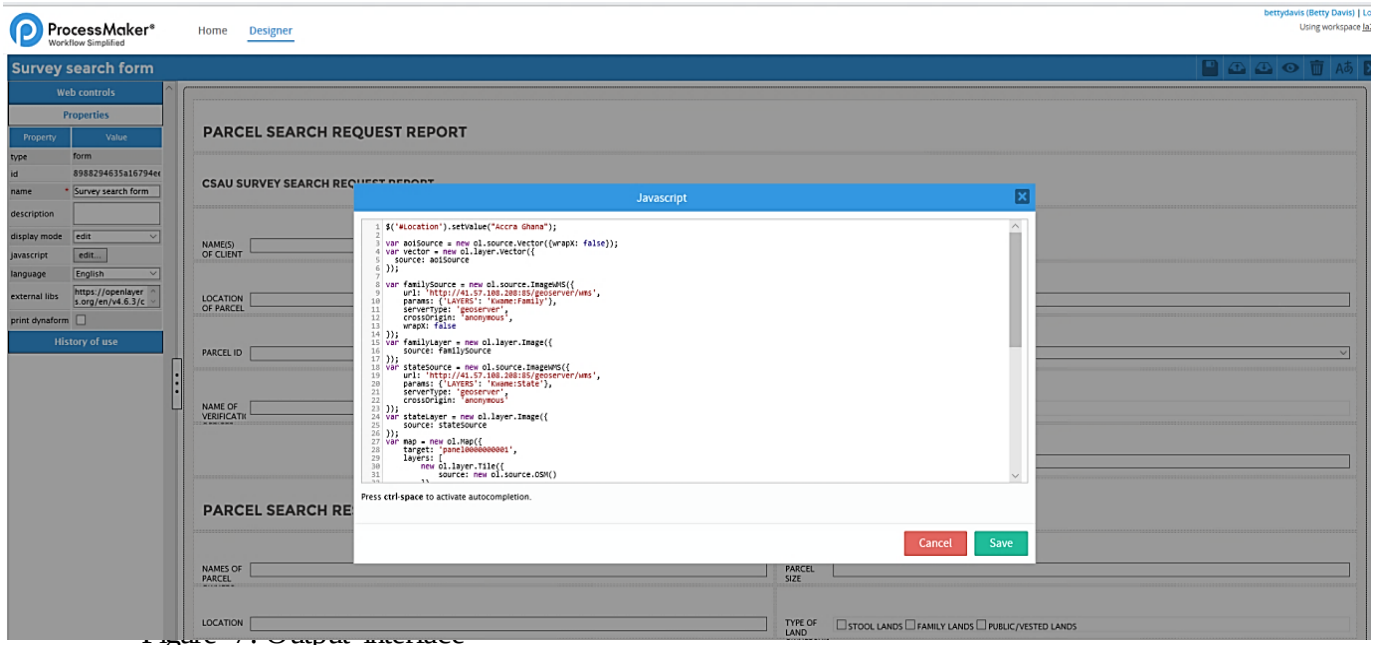
The model defines the parcels based on the type of land ownership in Accra (family/stool and state lands). The target of these parcels shows a map panel which enables the parcels to display on the form to assist the Survey and Mapping Division, Town and Country Planning Department and the Land Title Registry to perform special tasks (draw polygons) depending on type of client request. To perform digitizing function on an area of interest of a client request, the javascript written in figure 6 below permits the Survey and Mapping Division to draw polygons and save parcel coordinates. Lines 44, 52, 57 and 60 of the script show the interaction between the open source layer and the area of interest that will help execute the drawing of the polygon by an officer.

```
        vector
    ],
    view: new ol.View({
        center: ol.proj.fromLonLat([0.13980, 5.76690]),
        zoom: 10.5
    })
});


/*var draw;
function addInteraction(){
  draw = new ol.interaction.Draw({
    source: aoiSource,
    type: 'Polygon'
  });
  map.addInteraction(draw);
}
addInteraction();*/
var draw = new ol.interaction.Draw({
  source: aoiSource,
  type: 'Polygon'
});
draw.on('drawstart', function(){aoiSource.clear()});
map.addInteraction(draw);

aoiSource.on('addfeature', function(){
  var coords = $.extend(true, {},aoiSource.getFeatures()[0].getGeometry());
  $('#cordinates').setValue(coords.transform('EPSG:3857','EPSG:4326').getCoordinates());

});

```

Figure 6: Map operationalisation script

1.4.1.2 Output Interface

Notification received from a division is opened in a dynoform. The results of executing figure 2 and 3 produce an output interface where tasks are operationalised. Where an officer draws a polygon for parcel survey, the properties of the polygon automatically fills the dynoform (see Figure 6). The interfaces are the same for all the divisions with unique dynaforms and passwords. From the Survey and Mapping Division interface (Figure 6), parcel search request form is operationalised in the map panel container. In the panel, officers can search, draw, and save polygons depending on the request type. Figure 6 shows the detail of the dynoform derived from execution of actions in Figure 5.



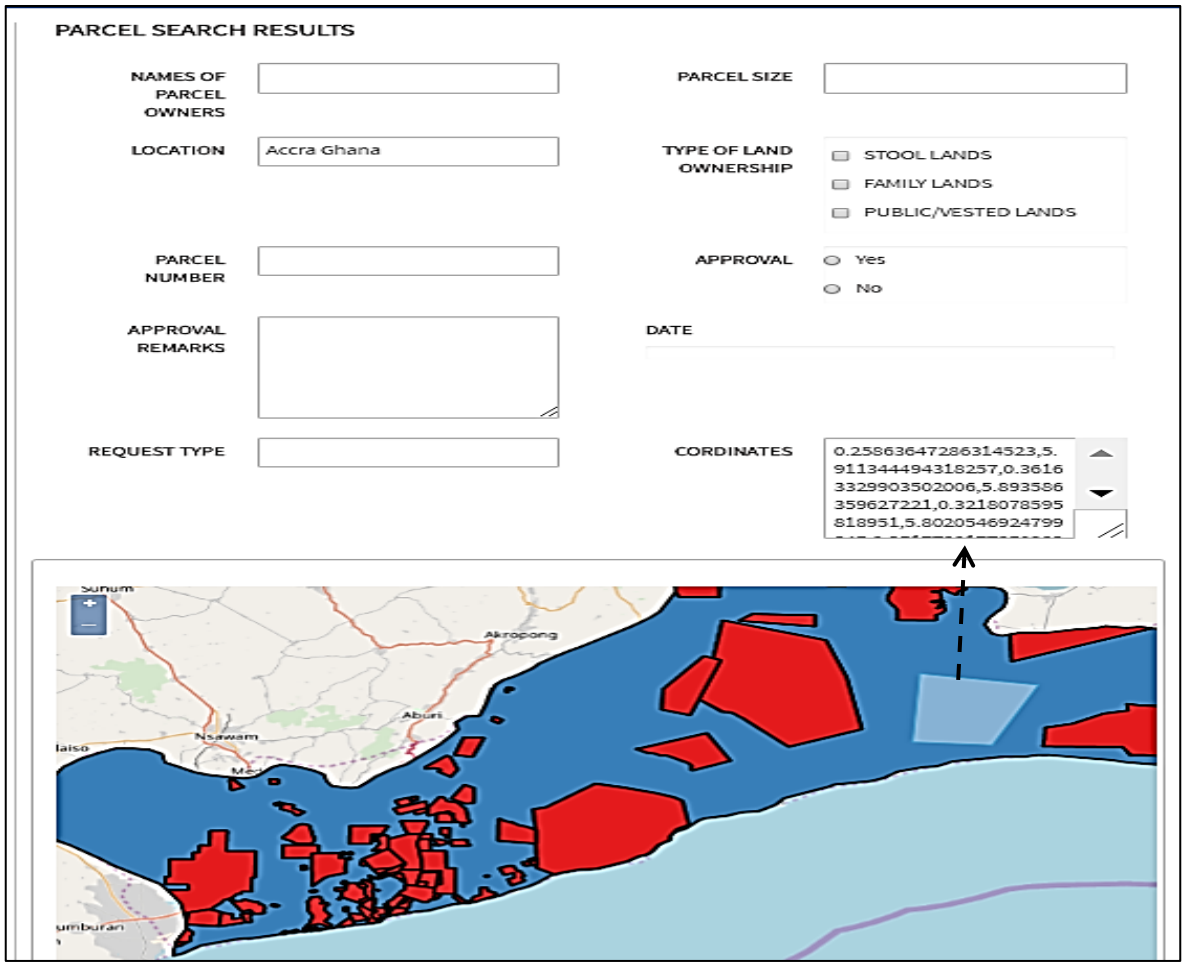


Figure 8: Parcel search generated forms

1.4.1.3 Output Generation

The model shows the generation of output document at each stage of execution. When a client submits a request for parcel search at the Customer Service and Access Unit, the details of the client are indicated in an output document. This displays in PDF or word document, which will enable the Survey and Mapping Division to evaluate the details of the client on the request, form and execute a survey of parcel or search for the surveyed parcel. The output-generated report is operationalised by HTML codes that link the clients' request details from the variable picker e.g. @@First_Name, @@Request_Type among others. At the Land Title Registry, certificates are prepared using the HTML function. The HTML function indicates the structure of the report, which includes the alignment of text, paragraphing, font size, a style, which enables each officer to write a report and save in a word or PDF format for the next officer to view and act on it.

The HTML executes the format of the dynoform, email templates, and certificate. The output documents are easily archived in the database. Figure 6 shows the HTML function and the output of an initiated client request in the model.

```
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN" "http://www.w3.org/TR/xhtml1/DTD/x
<html>
<head>
</head>
<body>"firstname""lastname""location""request_type"
<p align="justify"><font face="times new roman,times"><span>&lt;!DOCTYPE html PUBLIC "-//W3C//DTD
<p><font face="times new roman,times"><span>"http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.
<p align="justify"><font face="times new roman,times">&lt;html&gt;</font></p>
<p align="justify"><font face="times new roman,times">&lt;head&gt;</font></p>
<p><font face="times new roman,times">&lt;style&gt;</font></p>
<p><font face="times new roman,times">&lt;/head&gt;</font></p>
<p><font face="times new roman,times">&lt;body&gt;</font></p>
<p><font face="times new roman,times">@@date</font></p>
<p><font face="times new roman,times">&lt;br&gt;&lt;br&gt;</font></p>
<p><font face="times new roman,times">Dear Mr./Mrs. &lt;span style="font-weight:bold; "&gt;@@Firs
<p><font face="times new roman,times"><span>&lt;</span><span>p align</span><span>=</span><span>"c
<p><font face="times new roman,times">This is to certify that (@@FirstName; LastName), is </
<p><font face="times new roman,times">&lt;h1&gt;</font></p>
<p><font face="times new roman,times">This is a Test @@UserName</font></p>
<p><font face="times new roman,times">@@cordinates</font></p>
<p><font face="times new roman,times">&lt;/h1&gt;</font></p>
<p><font face="times new roman,times">&lt;/body&gt;</font></p>
<p><font face="times new roman,times">&lt;/html&gt;</font></p>
<p align="left"><font face="times new roman,times"><span>&lt;!--footer starts--&gt;</span></font>
</body>
</html>
```

Figure 9: Report generation script

1.4.1.4 Rules and Conditions

The rules and conditions are embedded logic behind the decision-making stage of each step of the processes in Figure 1. The conditions are centric, meaning, completed tasks flow upon approval and rejection of request using the "if condition". The model shows steps of the task

assigned to each division with attached forms indicating the purpose of the task to the next officer in the registration process. In Figure 8, a rule is assigned to the Customer Service and Access Unit showing the name of the forms below the assigned element.

This implies that the Customer Service and Access Unit will be able to send a report to Survey and Mapping Division for survey or parcel search. Imperatively, an exclusive gateway condition is executed at the decision point of the Survey and Mapping Division to approve or disapprove the request to conduct a survey or survey search. This means that, where parcel survey or survey search is approved, the system sends a notification to the Land Valuation Division for land value assessment. Another exclusive gateway condition is assigned to the swim lane of the Public and Vested Land Management Division and Town and Country Planning Department to determine ground rent when it is a stool/family land as seen in Figure 4 earlier.

The purpose of using the exclusive gateway is to evaluate the condition under which the next task is assigned to the flow. A cyclical assignment is assigned to every division to perform a specific task and prevent each division from performing the task of the other. This gives every officer in charge of a task in a division to perform an exclusive action on a task requested by a division in the flow. This will provide security and ensure transparency in data handling among the divisions.

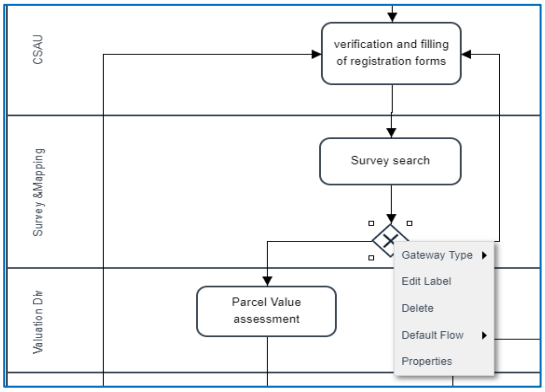


Figure 10: Workflow condition

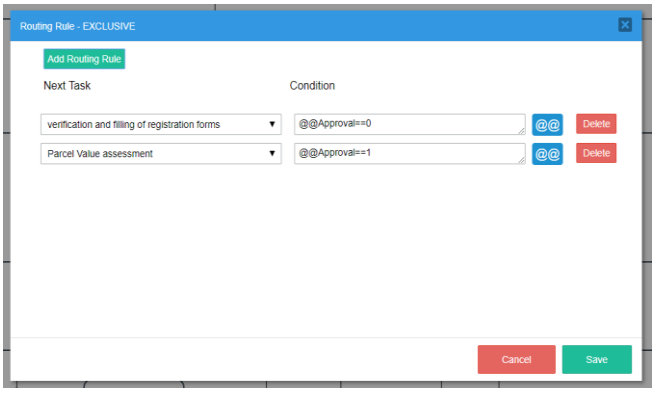


Figure 11: Process gateway

1.4.1.5 Database Connection and Records Tracking

The model is built on a PostgreSQL database. The database shows the records table of the recordation of land right, verification of application document, parcel survey search table,

valuation, ground rent payment, site assessment, map plotting, certification, and archiving table. The table keeps track of records executed by all the actors in the workflow. The client recordation table displays the client's name, ID, address, email, contacts, type and purpose of recordation. This preliminary information is used as a trigger in the client request form. This information is triggered in the database to reduce repetition of client's information whenever a completed task is sent to the next actor in the workflow. See Figure 10 and 11 for details.

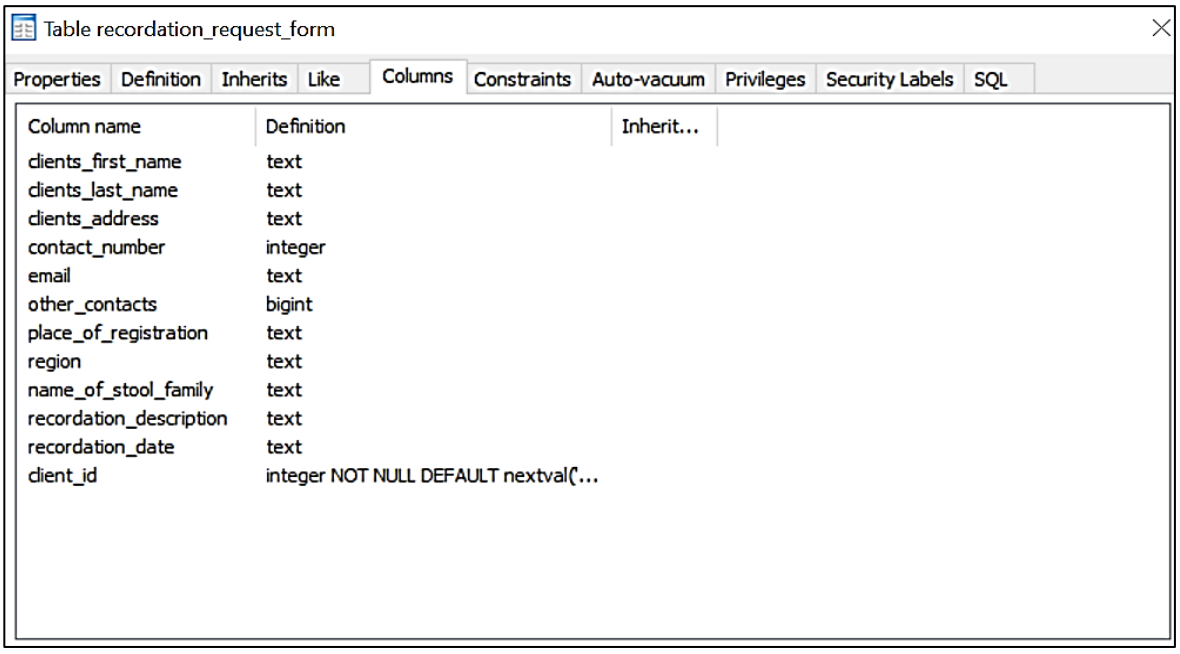


Figure 12: Database connections

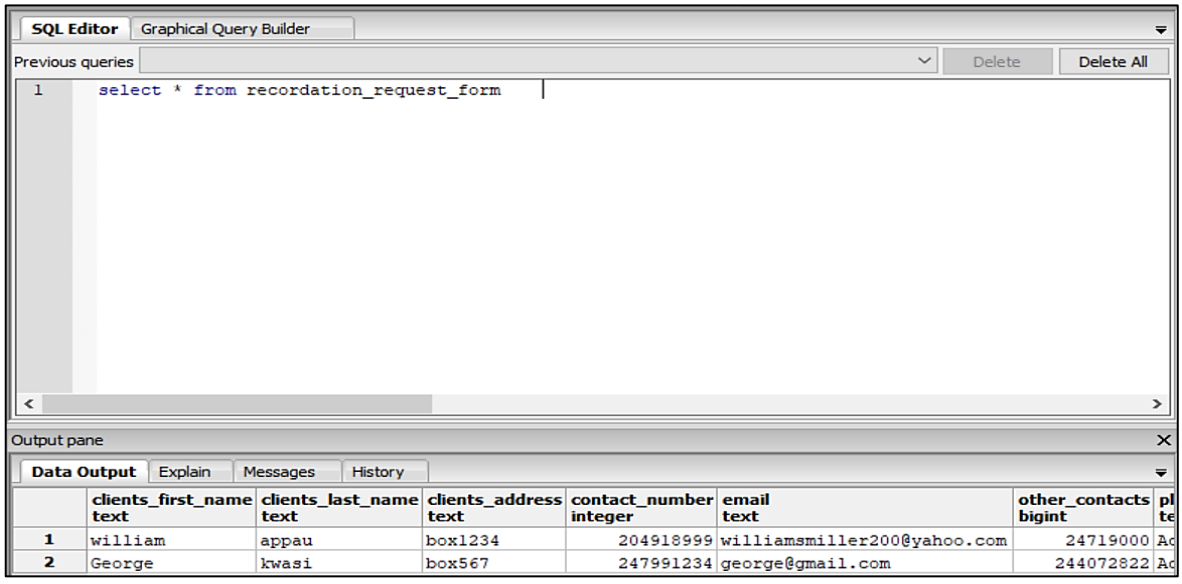


Figure 13: Database records

Figure 13 describes a tested record of an initiated request from clients. In the database, details of the clients are recorded in the client recordation form. When a client submits a request, the database gives a unique ClientID (primary key), which serves as a unique identification number of the client. This would enable the Customer Service and Access Unit and the Survey and Mapping Division to facilitate parcel search. The trigger below shows the codes that permit the database to respond to a request submitted by a client. The scripts ensure that whenever an officer initiates a request, the query "INSERT INTO'' saves into the database field details of the execution. This equally enables the execution of the Query "SELECT *'' from each records table in the database. Figure 14 shows the database connection triggers.

```
$host = 'gip.itc.utwente.nl';
$port = 5434;
$dname = 'la_exercises';
$user = 's6029922';
$password = '_s6029922_';
$db = pg_connect('host='.$host.' port='.$port.' dbname='.$dname.' user='.$user.' password='.$password);
$client_first_name = @@FirstName;
$clients_last_name = @@LastName;
$clients_address = @@Address;
$contact_number = @@ContactNumber;
$email = @@Email;
$other_contacts = @@OtherContacts;
$place_of_registration = @@PlaceOfRegistration;
$region = @@Region;
$stool_name = @@NamesofStoolFamilyLandOwners;
$recordation_description = @@RECORDATIONDESCRIPTION;
$recordation_date = @@Date;

$query = "INSERT INTO recordation_request_form(clients_first_name, clients_last_name, clients_address, contact_number,
email, other_contacts, place_of_registration, region, name_of_stool_family, recordation_description, recordation_Date)".
"VALUES ('$client_first_name', '$clients_last_name', '$clients_address', '$contact_number', '$email', '$other_contacts',
'$place_of_registration', '$region','$stool_name', '$recordation_description', '$recordation_date')";
$result = pg_query($db, $query);
if($result){
    echo 'Inserted!';
}else{
    echo 'There was error';
}

$result = executeQuery($query, $db);
```

Figure 14: Database connections and trigger

1.4.2 Discussion

The design of this land registration model as opined by Tuladhar (2003) should facilitate the land registration framework and implementation by the Lands Commission. The activities of the land registration process have been analysed considering the present rationale for a change and the modelling components. De Vries et al. (2017) acknowledge that there are institutional and technical gains when the rationale behind the change provide efficient output. Technically, the model has proven that the design of a uniform template for site plans and survey report template can avoid the risk of data error and also to enable us evaluate the details of client request and execute a survey of parcel or search of the surveyed parcel among the divisions.

Mburu (2017) on the other hand suggests that, realigning of institutional roles in a model ensures efficient land registration process.

However, he did not add that, for efficient institutional realignment, land institutions should assess the quality of service and the improvement in capacity that the changes can bring to the land registration process. Positively, quality of service shown in the model includes effective communication through notification of land reports to other divisions and data responsiveness. The output interface of the model makes it visible for users to see notifications for an action to be taken on a request.

This land registration model is based on Lemmen's (2017) suggestion that the decentralisation of roles in the workflow model makes the process faster. Although, the model supports his idea by creating a single land registration window, there are still some undesirable actors and some illegitimate tasks involved in the process. That is why the model was developed with process maker and java script instead of UML application because the use of UML diagrams are not enough for modelling especially where there are heterogeneous players in the chain as cautioned by Anjorin, Eds and Hutchison (2017).

Based on that, the land registration model has revealed that decentralising the roles of the land registration process does not appear to determine the speed of the process, but rather a semantic behind the electronic and routing of the task supported by a database system. This idea is a shared ontology that will ensure easy communication of data as indicated by (Lemmen et al., 2015). The ontology leading to the efficient operationalisation of the model shows a clear definition of rules and conditions of each process in the workflow and the connection of a database system to support data query and display. However, it is important to indicate the correct rules and conditions of each process to avoid data duplication, unnecessary delays, and loss of data.

Phuong (2015) cautions that external database should also be linked to the workflow processes to avoid data loss. This can be considered as a risk factor in the development and implementation of the workflow. We can infer that, considering external DBMSs to support the model is an appropriate variable that can be considered in future. Correia, Maria and Reis (2017) support this idea. This development indicates the need to examine how external DBMSs can be connected to this kind of model.

1.4.3 Conclusion and Recommendation

The need for land information system for efficient and transparent land acquisition and registration process has been of concern to many developed and developing countries. However, few countries have been able to achieve this objective. The analysis of the research shows a relevant guideline that can be followed to model land registration processes in countries with similar tenure systems and institutional arrangements. This complements the need for a change in thinking in research when analysing land registration systems more descriptively to model design and testing based. Land registration processes in Accra seem complex. This is due to the multiplicity of actors and land tenure and acquisition processes. This creates data redundancy, wrong definition of roles and duplication of tasks among the Divisions of the Lands Commission and its stakeholders, which creates data error and poor service quality. This is the basic rationale for change through modelling the processes. The designed model can facilitate the electronic access to digital documents between the Lands Commission and the stakeholders and secure recorded land transactions.

Technically, the success of the model is based on the availability of experts, softwares, and infrastructure. The performance of the model depends on the commitment and strong interaction between the Customary Land Secretariat, the Town and Country Planning Department and the Lands Commission. Land registration reforms should further specify and monitor the roles and responsibilities of each division and stakeholders of the land registration process. Harmonisation and strong cohesion in communication, clarity, sensitization, and evaluation among the Lands Commission and its stakeholders such as the Customary Land Secretariat and the Town and Country Planning Department will serve as an added advantage to improving the modelled processes.

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