ANALYSING THE EFFECTS OF MERGING LAND REGISTRATION AND CADASTRE

BUJAR FETAI

March, 2015

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ABSTRACT

It is widely accepted that the two main functions of a cadastral system are land registration and cadastre. Merging of land registration and cadastre is normally addressed from the organizational and legal points of view. This study focused on opening new insights on the concept of merging by adding the technical aspect as a third point of view. The aim of this study was to identify the positive and negative effects of the cadastral system as a result of merging the administrative and cadastral spatial databases. Initially, the definition and classifications of merging were done considering three main aspects, followed by a review on the cadastral systems of three European countries. The concept of merging was classified in Fully Merged, Merged, and Partly Merged. The status of Fully Merged covered organizational, legal, and technical aspects. The cadastral system of Macedonia was chosen as a study object as the process of merging administrative and cadastral spatial databases is taking place. The triangulation principle was applied as a method of data collection within the study object. Challenges that occurred during this process of merging were on correcting the inconsistencies between two databases. The differences in area between the databases were considered as problematic, which were present in digital cadastral maps produced indirectly. From the strategy applied as master area was chosen the area calculated from the cadastral map which led to a change of area in the land title certificate. The new system approach had impact on cadastral procedures and services. This led to simplification of internal and external workflows of subdivision procedure as well as on efficiency of purchasing administrative and graphical data by the private sector. The main positive effects of the cadastral system that were derived from this merging process consists of data of higher quality and up-to-date information, the internal workflow of subdivision procedure involves with one step both components to be updated as well as the increased transparency. Besides the positive ones, the new system also provides negative effects as a result of changing the area in land title certificate such as legally 'winners' and 'losers'.

Key Words: *Merging, Land Registration, Cadastre, Databases*

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1. INTRODUCTION

1.1. Background and justification

A cadastral system usually consists of two components, land registration and cadastre. With regard to the practical implementation of the land registration (recording who has what right and under which conditions) and cadastre (recording what spatial unit the right concerns and how much area this has) most of the countries have developed their own cadastral system because of huge differences between the systems.

In some countries the land registration and cadastre organizations have been merged into one organization and in some other countries such a merger did not take place (yet). In countries where the merger did not take place, the content of both recordings is very similar. Bogaerts and Zevenbergen (2001), claim that some 70 % of the attributes can be found in both types of records. The disadvantage of the separate cadastral records is to keep both registrations up-to-date and identical, to maintain the consistency of data, and to align fees which each organization charges for their services and procedures. According to 'Cadastre 2014' the separation between 'maps' and 'registers' needs to be abolished (Kaufmann & Steudler, 1998). This initiative reflected the changes in many countries in Europe, such as the Netherlands, Sweden, Lithuania, Hungary, Romania, Turkey, and Cyprus to improve the functioning of land registration and cadastre by merging these two components into one organization (Muparari, 2013). Nevertheless, developments in Information and Communication Technology (ICT) also play an important role in improving the efficiency of storing, managing or maintaining, and supplying land information (Williamson et al., 2010).

Even when the two types of recordings are under the umbrella of one organization the information about owner and/or user, rights and parcels still tends to be stored and maintained in two separate databases, namely in the administrative database and cadastral spatial database. The administrative database tends to contain legal and administrative information of any parcel of land, whereas a cadastral spatial database contains surveying and mapping information (Wakker et al., 2003). Merging the databases alongside the organizational merger is often still a challenge.

Specifically, in a country such as Macedonia, The Agency for Real Estate Cadastre (AREC) is carrying out the project of merging these two databases into one common database with a reason to have consistency of land information in the cadastral system. Unfortunately, AREC is facing problems in merging these two databases. Problems arise as a result of agreement on common attributes that two databases have. Harvey (2006) also argues that the agreement between cadastral parcels and land registers is rarely perfect. To continue with merging process, the information from the digital cadastral parcel and the land title certificate should be the same as the main aim is to have consistency of information.

This study can be justified on the basis that many of European developed countries seek to improve their cadastral systems through comparing and sharing information about the performance of their cadastral systems (Muparari, 2013). According to van Oosterom et al. (2006) there are two main functions of every cadastral system: (1) to keep the content of land registers and cadastral maps up-to-date based on legal transactions and (2) to provide information on this registration. The current approach in Macedonia, but also in some other countries, is that in any event or cadastral process (e.g. subdivision) two updates in the system are needed. The first update is on the administrative database where the new owner of land rights

will be registered, and the second one is on the cadastral spatial database where the information of land parcel boundaries will be updated, or vice versa. This approach of updating the land information sometimes can be problematic, usually with inconsistency of the data, even if the two systems are connected with common interface using unique identifier. Therefore, one of the aims of this study is to challenge the statement that 'integrated database' or 'common database' will achieve the main functions of the cadastral system in more efficient and effective manner.

1.2. Literature Review

1.2.1. Land Registration and Cadastre

The main functions of a cadastral system, land registration and cadastre, can be performed differently in different countries. In countries where the merger did not take place these two functions or activities are organized in two organizations responsible for surveying and mapping (cadastre) and land registration (Dale & McLaughlin, 1999). In contrast to this, in countries where the merger took place these two functions or activities are performed by one governmental authority. The functions or activities in both cases are similar; the only difference is in the way of organizing these two functions i.e. in one or two governmental authorities.

Bogaerts and Zevenbergen (2001) define the land registration as the institutional concept referring to the activity aimed at creating and maintaining a public register in which the documentation effecting interests in land are kept. The organization performing this function is called land registry.
Land registration as function or activity is defined by Zevenbergen (2002) as '*a process of official recording of rights in land through deeds or title*'. In this process, the official record of rights in land is defined as land register. Land register gives an answer to the questions 'who' and 'how' (Figure1).

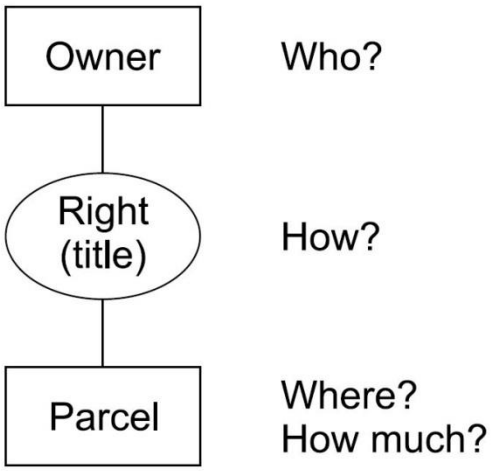

Figure 1: Core entities connected (Zevenbergen, 2002)

Cadastre is defined by Zevenbergen (2004) as '*methodically arranged public inventory of data concerning properties within a certain country or district, based on a survey of their boundaries*'. The boundaries of the property, location, and the parcel identifier are normally shown on cadastral maps. It gives an answer to the questions 'where' and 'how much'.

The defined concepts above constitute the cadastral system. For this study the concept of the cadastre has spatial focus (cadastral map) whereas the concept of land registration has legal focus (land register) (Silva & Stubkjær, 2002).

1.2.2. Administrative Database and Cadastral Spatial Database

Having defined the concepts of land registration and cadastre it is important to derive how the data/information from both components of the cadastral system is maintained and stored. Nowadays, the data/information from land registers and cadastral maps is maintained and stored in administrative database and cadastral spatial database, respectively.

Administrative database is defined as a database that contains legal and administrative information of any parcel of land (Wakker et al., 2003). It means that in this database are stored, maintained and updated non spatial data such as land right owner and/or user, parcel identifier, land tenure forms, restrictions, mortgages and other types of charges. In the literature also are used other terminologies that refer to the same definition above, such as alphanumeric database, non-graphic database, and non-spatial database.

The Cadastral spatial database is defined as a database that mainly consists of surveying and mapping records (Wakker et al., 2003). Other terms that refer to the same type of database are geo database, (geo) spatial database, graphic database etc. The specific nature of this database is that it is built around spatial entities, usually cadastral parcels. Connections to other land registers or databases are thus possible by using parcel identifiers as unique identifiers in the cadastral system.

The two databases together can generate efficient information on land, even if the two databases are merged or integrated in different ways. According to Ziegler and Dittrich (2004) merging or integrating different information systems can be categorized as: Manual integration-user manually integrates selected data, Common Interface - user is supplied with web browser and integration has to be done still by users using search engines, Integration by Applications – uses integration applications to access various data sources and returns integrated results to user, Integration by Middleware – makes possible integration of various applications that access different data sources, Uniform data access – provides unified global logical view of physically distrusted data, and Common data storage – physical data integration by transferring data to new data storage that provides fast data access.

1.2.3. Aspects of Land Registration and Cadastre

Three types of the aspects can be considered as fundamental of every cadastral system:

- Organizational
- Legal, and
- Technical

Each is further elaborated hereunder.

Organizational aspect

Here the focus is on organizations and private entities involved in cadastral processes and how they work together and complement each other. In addition, this aspect covers how land registration and cadastre perform their functionalities, as separated organizations or as combined ones, the internal structure and the way how they are managed.

Legal aspect

This aspect consists of huge amount of laws and regulations related to interests in land. Referring to Zevenbergen (2004) legal aspect also contains legislation that is dealing directly with the registration of the legal relation between persons and land. Furthermore, this aspect contains laws or regulations that cover organizational and technical aspect.

Technical aspect

Most of the technical aspects belong either to the field of land surveying or the field of Information and Communication Technology (ICT) (Zevenbergen, 2002). For the purposes of this study the focus will be more on the technologies that are used to store, maintain and supply land information from both components such as databases and geographical information system (GIS).

From the description of each type of the aspects can be seen that they are closely related to each other. A change that will be applied in any of those aspects will affect two others (Zevenbergen, 2002).

1.3. What is merging?

Concerning the three aspects described above and their interrelations, the concept of 'merging' is a bit confusing. It is unclear to which of the aspects we are referring, is that the organizational, technical, legal, or all aspects. To clarify what 'merging' really is some definitions from other fields will be considered.

In the field of business administration, Lee & Lee (2006) define the concept of 'merging' with practical example assuming that there are two companies A and B and in one possible business combination only company B survives. Company B is called acquiring company whereas A acquired.

This definition is not seen of great relevance for land administration because the concept of merging is more oriented on the financial issues. This is due the terms that are used such as 'two companies' and 'business combination'. This is irrelevant for purposes of this study but also for land administration in general because most of the land administration agencies are or tend to be cost-recovery; it means that they do not have any profit (Kaufmann & Steudler, 1998). However, the idea that A is acquired by B is still relevant.

Another definition is from organization sciences. Yankey, Jacobus, and Koney (2001) defines the concept of 'merging' as '*a statutorily alliance in which one organization is totally absorbed by another. The absorbed organization is completely dissolved and the surviving entity owns the assets and liabilities of both'*.

In the context of land administration this definition covers mostly the organizations that are able to perform the functions of land registration and cadastre as a system. This is already covered by Zevenbergen (2002) who noted that these functions can be performed by different governmental organizations (separated) or by an integrated governmental authority that will perform the functions of land registration and cadastre.

Unlike this, there are also other views on merging. Jacoby (2011) defines the concept of merging as follows: '*merging of two organizations is not merely the combination of two operations under one management authority, successful integration*[1] *combines, replaces and transforms diverse processes, systems and organizational structures'*.

This definition seems to be acceptable in land administration but also for the purposes of this study in general. It covers all three aspects and it opens different view of understanding the concept of merging, especially in merging systems (in narrow sense).

Nevertheless, this does not mean that land administration literature or scientific papers do not discuss about technical aspect. But, often the terms such as 'one database' or 'common database' are not used in a proper manner. Two databases can be queried using one interface or application (Custovic, 2010), mostly

[1] In this study, the terms of 'merging' and 'integration' have the same meaning i.e. A is absorbed by B.

using a parcel identifier (unique identifier) but that does not mean that the data from common attributes are consistent in both databases. Using one interface or linking two database systems with common application cannot be defined as one database. In terms of the research study area the focus will be more on really merging the administrative database and cadastral spatial database into one common database.

1.4. Research Problem

There are a number of reasons why merging of land registration and cadastre organizations is different from merging of other types of organization or agencies.

First of all, the nature of land registration and cadastre organizations is way too different. This emanates from a long history of being separated as organizations and serving different processes for different purposes. In Europe, land registration evolved to serve legal processes whereas cadastre evolved to serve land taxation (Muparari, 2013). In addition, land registration and cadastre are dealing with sensitive information. In most of the countries (e.g. Croatia) there is a mismatch on information that both organization have, even if transition to digital environment was made (Custovic, 2010). This shows that these organizations often are involved to E-Gov projects to automate their everyday practices (Azad & Faraj, 2009), which leads to weaken the intention for merging as organization due to increased interoperability and operational alignments. Furthermore, taking responsibilities for land registration from civil-courts or other organization is not an easy task. However, there are also countries where these two components of the cadastral system have been merged into one organization.

This leads to the question what really merging is and should always be seen from the organizational and legal perspective. When one can say that land registration and cadastre have been merged? (1) If the two components of cadastral system are under the umbrella of one organization and the information from both is maintained and stored in separate databases, or (2) if the first statement is fulfilled and the databases of both components are merged (Figure2).
The last statement (2) is not covered by a literature, in the sense that the effects that can arise from this type of merging are insufficiently known. However, the advent of information and communication technologies offered the possibility of merging these two functions of cadastral system (Bennett, Wallace, & Williamson, 2005), and is reasonable to do a research on this field.

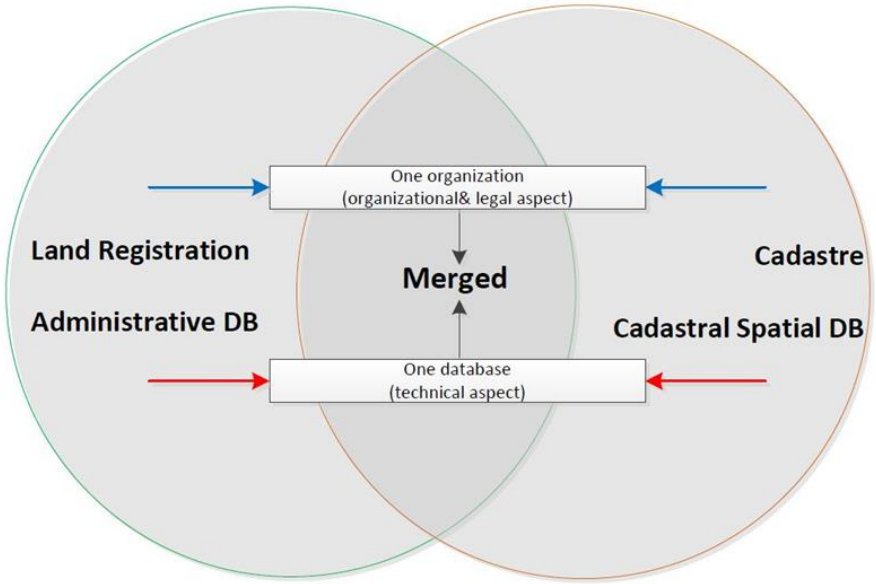

Figure 2: The concept of merging - covering three aspects

1.5. Research objectives and questions

In terms of this study the terms of land registers and cadastral maps also refers to administrative database and cadastral spatial database, respectively.

Main Objective

The main objective of this research is:

- To analyse positive and negative (internal and external)[2] effects of the cadastral system as a result of merging the administrative database and cadastral spatial database.

Sub Objectives

In order to achieve the main objective of this study, the following sub objectives are set:

A) To define and classify the concept of merging.

B) To analyse and identify the main challenges and problems that occur during the process of merging.

C) To analyse the impact of the new system approach on cadastral procedures and services.

Research Questions

To achieve the aim of each sub objective, the following questions are set:

Sub objective (A):

1. What theories exist on merging and how can one define it?

2. How can one classify merging regarding land registration and cadastre?

Sub objective (B):

1. What are the main reasons to carry out the new project of merging the administrative database and cadastral spatial database in Macedonia?

2. What are the main challenges and problems during the process?

3. Which strategies are employed to resolve the problems and which alternative is accepted?

Sub objective (C):

1. How does the new system approach affect the cooperation between the public and private sector?

2. How does the new system approach affect the internal and external workflows of transferring land rights?

3. Does this new system approach provide data of higher quality and up-to-date information?

[2] Internal refers to workflows inside the agency to perform the updating process for new cases of transferring land rights.
External refers to workflows carried out by citizens to undertake the process of transferring land rights, as well as to the external factors and systems such as citizens' trust and cooperation between public and private sector.

1.6. Research design and methods

This section describes in detail the research framework with aim to obtain answers to each of the formulated research questions. It includes description of the study area, methods of data collection, operational plan and research matrix (Table.1). This research is a qualitative study design and the type is explanatory.

1.6.1. Study Object

Republic of Macedonia is located in central Balkan Peninsula in south-east Europe. The total area is 25,713 km2. The population of Macedonia is 2.1 million inhabitants and it has little more than 4 million registered cadastral parcels. The Agency for Real Estate Cadastre (AREC) is the only legal body that performs the functions of the cadastral system. The cadastral system in Macedonia shows the complete legal situation of land. 100% of real estate cadastre has been established and it has fixed boundary approach. The cadastral system in Macedonia is maintained by the private sector. The privates surveying companies are responsible to handle the majority of the operational tasks such as cadastral surveying. This operational task is presented in a document called surveying report where changes or updates take place by submitting it to the AREC for confirmation.

The study object in this study is the cadastral system of Macedonia. The main reason why this cadastral system is chosen is that the AREC is performing the project of merging the administrative database and cadastral spatial database into one database. This corresponds with the main aim of the study which is to analyse positive and negative (internal and external) effects of merging the administrative database and cadastral spatial database into one.

1.6.2. Operational Plan

This research is carried out in three phases: pre-fieldwork, field work and post-fieldwork.

Pre-fieldwork phase

The main activity in this phase was to identify the research problem and the novelty that arises from this study. Furthermore, in this phase also were defined research objectives and questions. First sub objective of this study is theoretical and its research questions were answered in this phase. In addition, all needed preparations for the fieldwork were considered in this phase, such as identification of study area, preparation of interview questions regarding the methods and types of data collection as well as establishing communication with the relevant agency.

Fieldwork phase

This phase executes all planned activities from the previous phase. In this phase data were collected using triangulation principle. The researcher carried out interviews and direct observations as well as collection of grey literature and datasets. Furthermore, in this phase collected data were structured, translated and processed.

Post-fieldwork phase

In this phase collected data were analysed and interpreted. Furthermore, this phase covered the results and outputs from analysed data that tended to answer each of the research questions from second and third sub objective. Moreover, in this phase the researcher derived a conclusions and recommendations based on the theory and the results from the fieldwork data collection.

1.6.3. Research Framework

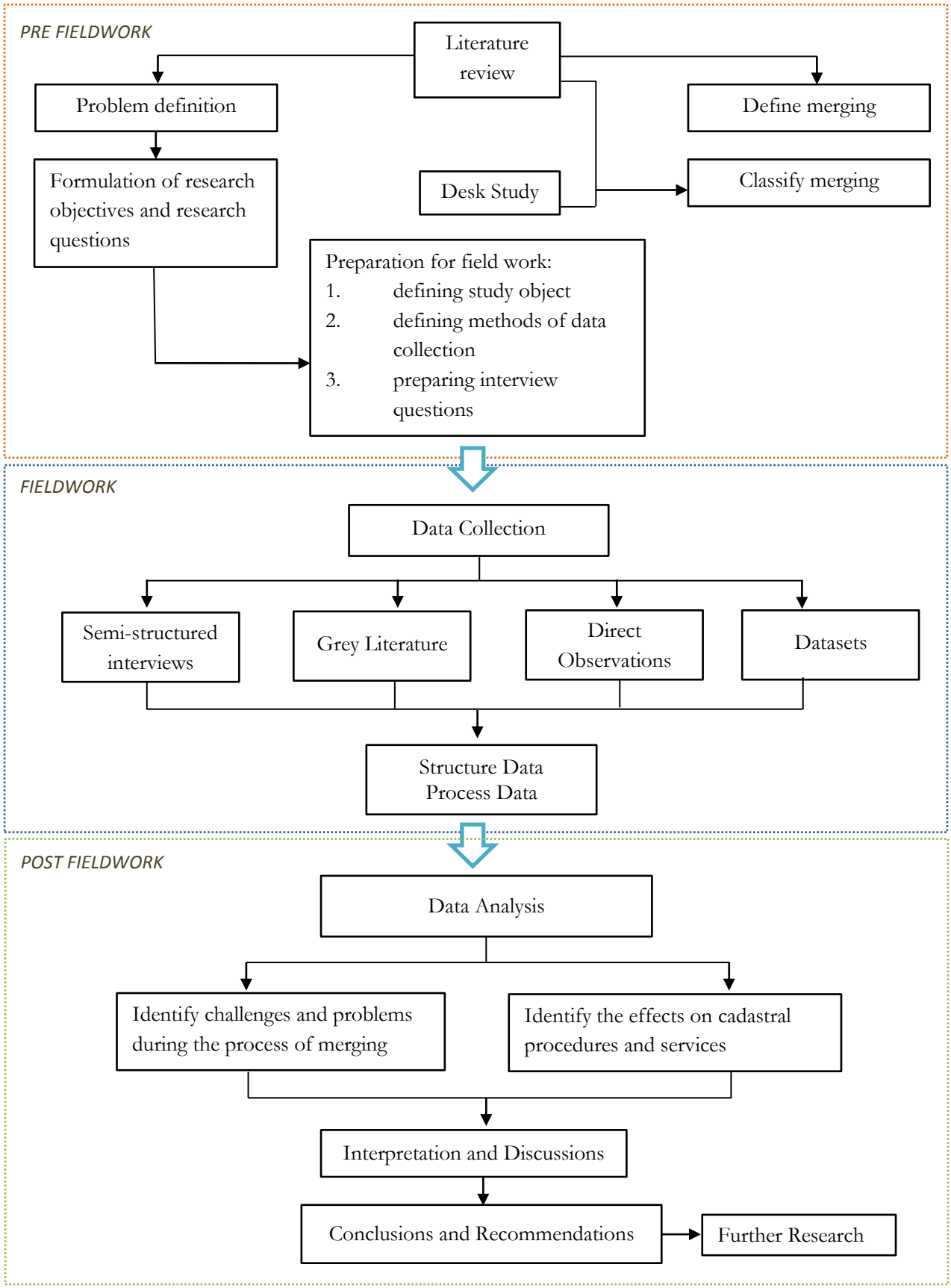

Figure 3: Research Framework

1.6.4. Methods of data collection

For the first theoretical objective desk study and literature review methods were applied. During the fieldwork, needed data were collected using triangulation principle. According to Yin (2003) a main strength of data collection within case study (in this case study object) is the chance to use different sources of information but aimed to corroborate the same fact or phenomenon. With respect to this, during the fieldwork data were collected from different sources such as: qualitative methods of data collection, direct observations, grey literature, and datasets.

Qualitative data were collected using semi-structured interviews. This means that the questions of interviews were open, designed on pre-fieldwork phase, and the researcher held interview guide.

Semi-structured interviews were planned to be held with people on management position, key informants who are involved in the project such as surveyors, lawyers and IT engineers, heads of private surveying companies, and people from people in academic field. The planned amount of interviews to carry out was as follows: 3 interviews with people on management positions, 6 with key informants, 2 interviews with the private stakeholders, and 2 interviews with professors from university. Additionally 10 citizens were interviewed. The interviewees were selected using snowball sampling. This means that first some individuals were selected and they were asked to identify others (Kumar, 2012).

Detailed description of methods of data collection and the approach of answering research questions is as follows:

- To define the concept of merging in context of land registration and cadastre, the researcher looked at some definitions from other sciences such as organization and business administration sciences.

- The classification of merging was done by reviewing literature on cadastral systems of three European countries, where land registration and cadastre have been merged as one organization. This is done by considering three main aspects of a cadastral system.

- To identify the main reasons that led to the new project of merging the administrative and cadastral spatial databases semi-structured interviews were carried out. The interviews were addressed to the employees that are in management positions.

- To identify what are main challenges during the merging process of administrative and cadastral spatial databases, and which strategies were employed and accepted to resolve the problems, the interviews were addressed to three types of professionals that are involved in the project such as surveyors, lawyers and IT engineers. In addition, grey literature (such as working/technical reports, laws), were collected to better analyse and interpret the results.

- To analyse how the new system approach affects the cooperation between public and private sector the interviews were addressed to key informants and private stakeholders.

- To analyse how the new system approach affected the process of transferring land rights of subdivided cadastral parcel, the information from the key informants was considered. In addition, direct observations on the software or applications made possible to better analyse and interpret collected data.

- To analyse if the new system approach provides data of higher quality and up-to-date information, the comparison between datasets of current land information system and new land information system was done.

- To make the insider-outsider approach possible professors from university were interviewed as well as the citizens.

1.6.5. Research matrix

Sub Objective	Research Question	Method of data collection	Approach to answer research questions
a) To define and classify the concept of merging.	1. What theories exist on merging and how can one define it?	Literature review Desk study	Definitions from other sciences: organization science business administration
	2. How can one classify merging regarding land registration and cadastre?		Literature on European cadastral systems where land registration and cadastre have been merged as one organization.
b) To analyse and identify the main challenges and problems that occur during the process of merging.	1. What are the main reasons to carry out the new project of merging the administrative database and cadastral spatial database in Macedonia?	Semi-structured interview	Interviews with employees on management position.
	2. What are the main challenges and problems during the process?	Semi-structured interviews Grey Literature	Interviews addressed to key informants involved in the project, such as surveyor, lawyer and IT engineers. Reports and Laws
	3. Which strategies are employed to resolve the problems and which alternative is accepted?		
c) To analyse the impact of the new system approach on cadastral procedures and services.	1. How does the new system approach affect the cooperation between the public and private sector?	Semi-structured interviews Direct observations Grey Literature Datasets	Interviews addressed to key informants and private surveying companies.
	2. How does the new system approach affect the internal and external workflows of transferring land rights?		Interviews addressed to key informants, professors and citizens. Direct observation on software and applications. Compare datasets from current databases with datasets from the new one.
	3. Does this new system approach provide data of higher quality and up-to-date information?		

Table 1: Research Matrix

1.6.6. Thesis Structure

Chapter 1: Introduction

This chapter offers the introduction of the study in form of background and justification. Moreover, this chapter discusses the main theoretical concepts that are needed for this research, research problem, research objectives, and planned research design and methods.

Chapter 2: Classification of merging

This chapter looks at the cadastral systems of three European countries such as Sweden, Norway, and Finland. Furthermore, this chapter discusses definition and classifications of merging.

Chapter 3: Research methodology and study object description

This chapter reflects on research methods of data collection applied and methods of data processing and analysis. Furthermore, this chapter describes the study object which in this case is the cadastral system of Macedonia.

Chapter 4: Challenges and problems of merging in Macedonia

This chapter looks at the main reasons that led AREC to perform the project of merging administrative and cadastral spatial databases. Furthermore, this chapter presents the challenges and problems that arise as a result of merging these databases. In addition, this chapter discusses the strategies that were employed and accepted to resolve the problems.

Chapter 5: Effects of the new system approach

This chapter presents the influence of merging the administrative database and cadastral spatial databases on cadastral procedures and services as well as on the cooperation between public and private sector.

Chapter6: Interpretation and Discussions

This chapter interprets the analysed results in Chapters 4 and 5, using clear statements obtained from the fieldwork and literature review.

Chapter7: Conclusions and Recommendations

This chapter gives conclusions established from the research, based on discussions, as well as set of recommendations for further research and practitioners.

2. CLASSIFICATIONS OF MERGING

The aim of this chapter is to define and classify the concept of merging. This chapter seeks to answer research questions A(1) and A(2) (*1. What theories exist on merging and how can one define it? 2. How can one classify merging regarding land registration and cadastre?*). The chapter begins with a brief discussion of the reviewed definitions of merging from organization sciences (section 2.1). Section 2.2 looks at visions on land registration and cadastre, as well as merging as part of re-designing cadastral system. Next three sections (2.3, 2.4, and 2.5) provide an overview of the cadastral systems of three European countries considering three main aspects. This overview is used to perform the general classifications of merging considering land registration and cadastre (section 2.6). Section 2.8 seeks to identify the problems that can occur on merging national information from land registration and cadastre. Final section concludes the chapter by summarizing the definitions and classifications of merging regarding land registration and cadastre.

2.1. Definition of merging

In the previous chapter, section 1.3, some definitions of merging from organization and business sciences were reviewed. In this section just the definitions that are and can be applicable in land administration science are discussed.

Firstly, it is crucial to note that the concept of merging in general should be understood as a statutorily alliance in which one organization is totally absorbed by another (Yankey et al., 2001) i.e. no third organization is established. This definition is already covered in land administration literature.

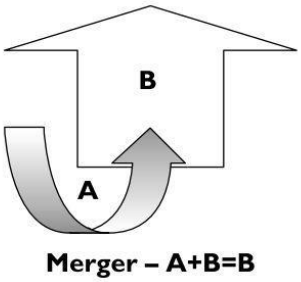

Figure 4: Merging concept - in organization sciences (Yankey et al., 2001)

According to Zevenbergen (2002), the functions of land registration and cadastre can be performed by different organizations. Usually, the organization (land registry) that performs the function of land registration can be part of regional courts or independent land registry. The function of cadastre is performed usually by a cadastral authority. In different countries these organizations are part of different ministries. This structure of land registration and cadastre organizations is applicable in countries where the merger did not take place. Unlike this, in some other countries the functions of land registration cadastre are combined in one authority (Zevenbergen, 2002). This is the case where the merger of land registration and cadastre organizations already took place.

In this respect, Bogaerts and Zevenbergen (2001) noted that one of the cadastral systems alternatives is to have land registration organization with integrated or separated cadastre. Even though, the term 'integration' is used still it has the meaning that one organization can be absorbed or acquired by another one. For that reason, in this study the term of merging and integration will have the same meaning.

Secondly, as fundamental aspects of a cadastral system were considered the organizational, legal, and technical aspects, the definition above covers only the organizational and legal aspects. In reference to the research problem (section 1.4) the concept of merging regarding the land registration and cadastre should cover all three aspects (where technical aspect is focused on ICT). The technical aspect on merging land registration and cadastre is covered by the definition of Jacoby (2011) (section 1.3).

Finally, the combination of these two definitions covers three aspects of the cadastral system, and can be applicable in land administration in general, as well as for the purposes of this study. In this study these two definitions will be used as a tool to define the classifications of merging.

2.2. Merging as part of re-desining cadastral system

The four European organizations EuroGeographics, PCC (Permanent Committee on Cadastre in the European Union), ELRA (European Land Registries Association) and EULIS (European Land Information Service) have agreed on a common vision that the information and services from cadastre and land registration are fundamental for sustainable economic, social and environment development in Europe (Eurogeographics, PCC, ELRA, & EULIS, 2012). The purpose of this vision statement, which is stated in the public report '2013 Cadastre and Land Registry vision' created and signed by these four organizations, is to raise the awareness among decision makers that information and services from cadastre and land registration are fundamental for secure land tenure, reliable land value, and efficient land use and sustainable land development functions.

The common vision of the four organizations reflects a general understanding in Europe that the information and services from cadastre and land registration organizations are crucial for well-functioning of the cadastral system. Thus, to improve the functionality of the cadastral system and provide better information and services, many countries adhere to the standards or professional guidelines for future development such as 'Cadastre 2014', ISO and OGC standards (van Oosterom et al., 2006). This approach supported the respective administrations to re-establish or to re-design their cadastral system.

The re-design of a cadastral system started from different aspects. Firstly, started by merging cadastre and land registration functions in one governmental authority that is responsible to carry out these functions of the cadastral system. In some other countries changes were made from de-centralized to centralized cadastral system, including here also the integration of the information from local or district level to national level (van Oosterom et al., 2006). Some of the countries focused just on the integration of the spatial information (Pieterzak & Hopfer, 2014), whereas some others had the intention of computerizing and integrating all registers in national level. Although, the information was merged or integrated in national level the approach of maintaining, storing and providing information for cadastral maps and land registers again varies from country to country.

With respect to the diversities of the cadastral system that European countries have, in section 2.6 a classifications of merging is done. The classification of merging is performed considering three main aspects of each cadastral system (organizational, legal and technical). Before the classification is performed, cadastral systems of three European countries such as Sweden, Norway, and Finland will be reviewed. These countries were chosen because in last seven years they have been merged as organization.

2.3. Sweden

Organizational aspect

The Swedish mapping, Cadastral and Land Registration authority (Lantmäteriet) is a governmental authority responsible for real property formation (including cadastral surveying and real property registration) and official real property and geographic information (Åstrand, 2011). Its task is to support the establishment of efficient and sustainable use of Swede's land, water and constructions (Lauri, 2007). The national office is located in Gävle and it has 90 local and regional offices spread over the country (Åstrand, 2011). There are 38 municipalities with permission from Lantmäteriet to carry out cadastral works such as property formation (Swensson & Juulsager, 2014). Lantmäteriet is also responsible for the

Land Information System (LIS) supporting information on Cadastre and Land registration. In 2008, the responsibility for Land Registration was transferred from National Courts Administration to Lantmäteriet (Åstrand, 2011).
The private sector is not part of the cadastral system, is not involved in an official land or cadastral registration, but can only have the function of consultant or advisor in particular cases (Åstrand, 2011).

Legal aspect
Lantmäteriet is responsible to manage and develop the following registers: Real Property Register, the Mortgage Deed Register, the Real Property Price Register and the Register of Joint Property Management Associations (Swensson, 2010). The information for this registers is collected by Lantmäteriet itself or in co-operation with other public agencies or organisations (Lauri, 2007).

The Real Property Register contains five parts: The General Part, Land Register Part, Building Part, Address Part, and Tax Assessment Part (Swensson, 2010). The General Part contains description of cadastral data in text format and the geographic representation in digital cadastral index map. The Land Register Part contains registration of ownership and site leasehold information, such as purchase price, purchase data and owner. This shows that the Real Property Register consists of cadastre part and land register part (Sävmarker, 2014).

The cadastral system functions such as land registration and cadastre are regulated in different acts such as Land Code, Real Property Formation Act and Law on Real Property Register (Ericsson, 2008). The most important one is the Real Property Formation Act, which states all possible changes regarding the property such as subdivision, consolidation, mutations, amalgamations, property determination and registration (Swensson & Juulsager, 2014). The law also authorises the cadastral surveyor to decide about changes in the division of land (Ericsson, 2008). The cadastral system is based on title registration (Åstrand, 2011). The cadastral procedure also includes updates on the Real Property Register and the registration is statutory (Swensson & Juulsager, 2014).

Technical aspect
Regarding the technical aspect, Swensson (2010) noted the land register part of Real Property Register and Cadastral Index Map are linked and are intended to be merged in one database. In similar way Åstrand (2011) argue that an on-going activity is to improve accuracy, completeness and contents of the cadastral data by merging or integrating the graphic and textual information. With respect to this, Sävmarker (2014) noted that Sweden started to shift to the new platform for the land register part in the Property Register in September 2014.

The cadastral system in Sweden has an integrated dissemination system, but the way of maintaining and administrating the cadastral and land registration databases is separately.

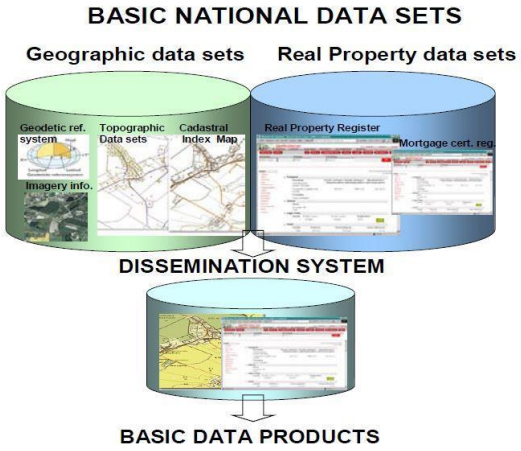

Figure 5: Administrative and Cadastral spatial database – Sweden (Lauri, 2007)

2.4. Norway

Organizational aspect

The Norwegian Mapping and Cadastre Authority (Kartverket) is public agency under the Norwegian Ministry of Local Government and Modernisation, responsible for geographical information, operating with national property registry and undertaking all property registrations in Norway (The Norwegian Mapping Authority-Kartverket, 2012b). In 2007, the Land Registry from 87 Land Courts was transferred to the Norwegian Mapping and Cadastre Authority (Frøstrup, 2008). This defines that nowadays Kartverket is the only government agency that performs the functions of the cadastral system such as land registration and cadastre. Kartverket it has four divisions: Mapping and Cadastre, Geodetic Institute, The Land Registry, and Norwegian Hydrographic Service.

The private sector is not part of the cadastral system because municipalities are responsible to register properties, including here surveying and demarcation (Herdlevær, 2007).

Legal aspect

The functions of the cadastral system are regulated by two main acts such as Law on Land Registration and the Law on Cadastre (The Norwegian Mapping Authority-Kartverket, 2012a). The new Law on Cadastre was passed in Parliament in 2005, changed and revised in 2007 (Valstad, 2008). The change was made because there was initiative to make the private sector responsible for surveying, but that was ignored by the new government in 2006. The new Law on Cadastre was enacted in 2010 (The Norwegian Mapping Authority-Kartverket, 2012a).

The cadastral system is based on title and the registration of properties in Norway is not mandatory. A contract between parties is valid and legally even without registration (The Norwegian Mapping Authority-Kartverket, 2012a).

Technical aspect

In accordance with the new Law on Cadastre which was enacted in 2010, there was also a need for re-designing the cadastral system. Before 2010, there was one national Property Register named GAB, which was just textual central database with no connection to the topographic or cadastral map, because they were maintained by municipalities (Valstad, 2008). Together with the new Law a new cadastral system named 'matrikkelen' was introduced.

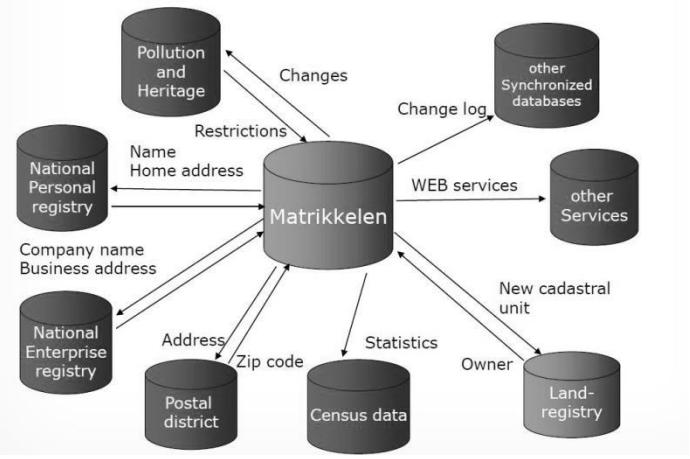

Figure 6: Administrative and Cadastral spatial database – Norway (Häusler, 2010)

Unlike the previous cadastral system the new one contains two main registers or databases at national level (Figure 5). Cadastral spatial database contains geographical information on three main parts or tables such as Properties, Address and Buildings. Land Registry is an administrative database that contains legal information such as owner of land rights as well as archived information about previous owners on that property (The Norwegian Mapping Authority-Kartverket, 2012a).

The two central databases, for Land Registration and Cadastre (Matrikkelen) are technically linked that provides merged or integrated one-stop online information and services to the users, but at the same time maintaining two central separate databases (The Norwegian Mapping Authority-Kartverket, 2012a).

2.5. Finland

Organizational aspect

National Land Survey of Finland (NLS) - Maanmittauslaitos is a governmental authority responsible for the administration of the Cadastre and Land Registration information (Halme, 2009). In the beginning of 2010, Land Registers were transferred from Local Courts to National Land Survey authority (Kokkonen, 2008). NLS is also responsible for topographic mapping and database as well as for surveying in rural areas. NLS it has 12 surveying local offices whereas 79 municipalities take care of cadastral surveying and mapping in their urban areas (Halme, 2009).

The private sector is not part of the cadastral system it means that is not involved in surveying as well as in cadastral surveying and mapping.

Legal aspect

The Cadastral and Land Registration functions are regulated by three main legislations such as Land Code, Cadastral Surveying Act and Law on Cadastre (Enemark, 1997; UNECE, 2014; Kokkonen, 2004). The cadastral system is based on title registration and the registration of land and other properties is compulsory (Halme, 2009). With respect to these legislations, the cadastral system recognises two public registers.

Information about the owner of the property, mortgages, easements, and restrictions is maintained in Land Registration. The title includes registration of ownership rights to a property and all property owners are required to obtain a title for their property (National Land Survey of Finland-Maanmittauslaitos, 2014b). The public purchase witness, or public notary, acts as a witness for the conveyance and checks the identity of the parties and the formal competence followed in the transfer process (National Land Survey

of Finland - Maanmittauslaitos, 2014). The Cadastre is public registry where are estates, plots of land, public areas, the state forest land, conservation areas, expropriation units, and water areas. Information related to the Cadastral register is presented on a cadastral certificate which may be used when purchasing a property (National Land Survey of Finland-Maanmittauslaitos, 2014a).

Technical aspect

Not just the legislations above distinguish two types of public registers but also from technical aspect the information from these registers is maintained and stored in two databases. Figure 6 shows the re-designed cadastral system in year 2013 where NLS undertook the initiative for renewing land registers in 2010 (Tuomaala, 2010). The aim of this initiative was to link the information from Land Registration and Cadastre to better provide information and services. Yet, the maintenance of these two databases is done separately (Figure 6).

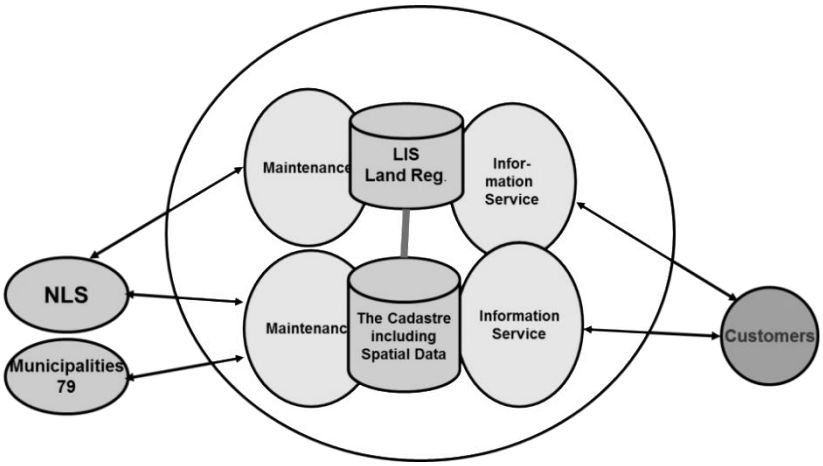

Figure 7: Administrative and Cadastral spatial database – Finland (Tuomaala, 2010)

2.6. General classification of merging

Having reviewed the cadastral system of three European countries above, the following results are derived:

- In Sweden, Norway, and Finland responsibilities for land registration were transferred from courts to national mapping and cadastre authority, in 2008, 2007, and 2010, respectively.
- In all of three cases is only one governmental agency responsible for the main functions of the cadastral system.
- Sweden and Norway according to the laws and regulations have defined one public register, in Finland except land register, cadastre is also a public register and cadastral certificate is used in sale/purchasing properties.
- In Norway, before 2010 property register was just textual central database, with no connection to the graphical database or cadastral maps.
- In all cases the administrative and graphical data /information is stored in two central databases.
- Sweden has started the merging process of these two databases into one central database.

Additionally, from sections 1.2.1 and 1.6.1 is used the following information:

- The attributes of land register should give an answer to the questions 'who' and 'how', whereas the attributes of cadastre should give an answer 'where' and 'how much'.
- In Macedonia is on-going process of merging the administrative and graphical database.

Regarding the results derived from the review, and the two sections mentioned above, the classification of merging, is done in three classes and that: Fully Merged, Merged, and Partly Merged. The above results are used to define conditions for each of the classes.

Fully Merged

Land Registration and Cadastre are Fully Merged if:

(1) There is one and only one governmental agency or organization that performs the functions of land registration and cadastre. The operational tasks are done by local officers that the Agency has, and/or by private sector, but always referring to the official data sets that the Agency provides.
(2) Legislations specify that there is only one agency/organization responsible for recording, storing, maintaining, and supplying legal information that will constitute the relation person-rights-land. There is only one public register where registration of owners, land rights, and land data, is legal only if is registered in that register. In this register are unambiguously defined the attributes of land register and cadastre (The legal document is representing consistently the information that is absorbed from the cadastral map). Technical characteristics are covered.
(3) The information is stored in one central database that consist spatial or geographical information and administrative information, where the data are consistent.

Merged

Land Registration and Cadastre are Merged if:

(1) Here applies Statement (1) from Fully Merged.
(2) Legislations specify that there is only one agency/organization responsible for recording, storing, maintaining, and supplying legal information that will constitute the relation person-rights-land. There is only one public registry or two defined public registers where registration of owners, land rights and lands is legal only if is registered these one/two registers. Technical characteristics are covered.
(3) The data/information is maintained and stored in two databases separately. The information from land register is stored in administrative database, whereas the information from cadastre is stored in cadastral spatial database. These two databases are linked through interface or applications and inconsistencies are applicable.

Partly Merged

Land Registration and Cadastre are Partly Merged if:

(1) Here applies Statement (1) from Fully Merged.
(2) Legislations specify that there is only one agency/organization responsible for recording, storing, maintaining, and supplying legal information that will constitute the relation person-rights-land. Two legal public registers and ambiguous definition of attributes i.e. attributes that should be defined by cadastre are defined by land register (Figure.1). Technical characteristics are not covered.
(3) The data/information is maintained and stored in two databases separately. There is no linkage between databases, mostly the graphical component is stored and maintained in file system.

In a summarized way the table below presents the general classification of merging.

Status / Aspect	**Organizational**	**Legal**	**Technical**
Fully Merged	✓	✓	✓
Merged	✓	✓	Two databases, linked through interface or application.
Partly Merged	✓	Ambiguous attributes. Technical characteristics are not covered.	Separate databases, no linkage between them. File system applicable.

Table 2: General Classification of merging

2.6.1. Classifications of merging in country context

Table 4 presents how the general classification of merging applies to the reviewed cadastral system of three European countries such as Sweden, Norway and Finland.

The data that are shown in this table were derived from the review made in sections 2.3, 2.4, and 2.5. The table below shows that in three cases there is only one organization that performs the functions of land registration and cadastre (Lantmäteriet, Kartverket, Maanmittauslaitos). In all of three cases land registration organization was absorbed by national mapping and cadastre authority. The functions of land registration and cadastre are regulated by adequate laws and acts. Technically, Sweden has started the project of merging the administrative and graphical database into one, whereas Norway and Finland have two databases linked with interface and application. This is the reason why Sweden has different status from Norway and Finland.

Country / Aspect	**Organizational**	**Legal**	**Technical**	**Status**
Sweden	Lantmäteriet	Land Code, Real Property Formation Act, Law on Real Property Register.	Currently two databases linked. Near future just one.	Currently: **Merged** Near Future: **Fully Merged**
Norway	Kartverket	Law on Land Registration and Cadastre.	Two databases, linked through interface and application.	**Merged**
Finland	Maanmittauslaitos	Land Code, Law on Cadastre, Surveying Act.	Two databases, linked through interface and application.	**Merged**

Table 3: Classification of merging in country context

2.7. Challenges or problems on merging land registration and cadastre

According to Eurogeographics et al. (2012) combining or merging the national information from land registration and cadastre will create added value such as quality, up-to-date, transparent and accessible data. However, in this report is also stated that merging land registration and cadastre information is not an easy task as legal valid differences can exist between the extent of property rights and cadastral parcel. In addition, in the report '2013 Cadastre and Land Registry vision' by Eurogeographics et al. (2012) is stated that neglecting the differences in Cadastral and Land Registration information can interfere legal security.

The process of merging the national information from land registration and cadastre into one database has started in Sweden. Swensson (2010) and Blixt (2008) noted that customers demand was to have correct and complete information. During the last seven years there has been a project, called Albin with the aim to improve the quality in the Real Property Register and the Cadastral Index Map (Swensson, 2010).

The main objective of the project has been to prepare introduction of the new modern Real Property Register, where merging of the Real Property Register and the Cadastral Index map will be done. The project was focused on geometric improvements such as accuracy in urban and rural areas, complete and correct representation of real property patterns and rights. According to Blixt (2008) automatic and semi-automatic comparisons are made between the databases for the Real Property Register and the Cadastral Index Map. These comparisons identify the areas that exist in the register but not in the map, and vice versa. To correct these errors, archive research was made for each cadastral parcel. Swensson (2010) and Blixt (2008) both claimed that correcting the errors is a huge task. In addition, regarding this project Swensson (2010) concluded that Lantmäteriet has to find new ways of quality improvements without losing the legal aspects. The author conclusion continues by stating that: 'one way is to clearly define different quality levels'.

The purpose of merging these two databases in Sweden corresponds with the statement from four European organizations which has to do with the improving accuracy, completeness and contents of land registers and cadastral maps.

This shows that challenges and problems on re-designing the cadastral system has to do with the quality on legal valid data that Land Registration and Cadastre have. In terms of this study, the quality will be defined as: content, actuality, accuracy, and completeness.

2.8. Conclusions

This chapter's aim was to define and classify the concept of merging regarding land registration and cadastre. This has been done by reviewing definitions of merging from organization and business sciences as well by reviewing literature on three western European cadastral systems where land registration and cadastre have been merged in one organization.

Initially, from organizational and legal aspect merging should be understood as statutory alliance where one organization is absorbed or acquired by another (Yankey et al., 2001) , there is no third organization established. However, successful merging should also combine or merge diverse processes, systems, and organizational structures. The classification of merging regarding land registration and cadastre is done in three categories: Fully Merged, Merged, and Partly Merged.

The first classification, *Fully Merged* covers all three aspects: there is only one organization which performs the functions of land registration and cadastre; one public register where registration of owners, land

rights, and land data, is legal only if is registered in that register; there is only one database including graphical and administrative information, and the data are consistent. The second one, *Merged*, differs from the first one in the technical aspect. Here there are two databases administrative and graphical one which are linked through interface and/or application and inconsistencies are applicable. Third classification is *Partly Merged*. Here just the organizational aspect is covered. The attributes between land registers and cadastral maps are ambiguously defined, and technically there are two databases with no linkage between them. The classifications of merging are used in the following chapters in context of cadastral system in Macedonia.

Merging the information from land registration and cadastre is supposed that will lead to improve the quality of data, up-to-date information, and increased transparency. However, merging land registration and cadastre into one database is not seen as an easy task. It involves challenges with the inconsistencies and legal valid differences between two components.

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3. RESEARCH METHODOLOGY AND STUDY OBJECT DESCRIPTION

This chapter describes the research methodology applied for fieldwork data collection and the study object. The chapter begins with detailed description of each methods of data collection (section 3.1). Section 3.2 discusses how the collected data are processed, analysed and interpreted. The following section gives a description of the study object which in this case is the cadastral system of Macedonia (section 3.3). Section 4.4 concludes how do the cadastral system in Macedonia relates to the general classification made in the previous chapter.

3.1. Methods of data collection

In Chapter 1, Section 1.6.4, were in detail described methods of data collection. Same methods of data collection planned in the pre-fieldwork phase were applied in the fieldwork phase. Triangulation principle was applied as method of collecting the information from different sources, aimed to corroborate the same fact or phenomenon. The information was collected through semi-structured interviews, grey literature, direct observation, and datasets.

3.1.1. Interviews

The amount of interviews was 13, where the selection of interviewees was using a snowball method. All planned interviews in the pre-fieldwork phase were carried out, following a similar interview protocol with approximate duration of 30-40 minutes, in an informal atmosphere and allowing open responses.

The respondents which were interviewed included 3 professionals in management position, 6 key informants (2 surveyors, 2 lawyers and 2 IT engineers) involved in the project[3] of merging administrative and graphical databases, 2 private surveying companies and 2 professors from university. For professionals in total were prepared five types of interviews (surveyors and lawyers had one type of interview). The interviews with people in management position, and key informants were carried out in the AREC with its central office in Skopje, except 1 key informant (surveyor) who was interviewed in Shtip, in the local office of the AREC. Private surveying companies which are located in two different towns, one in Tetovo, and one in Gostivar, interviews were carried out with the heads of each of them. The interviews with the professor and the assistant were carried out in the Faculty of Civil Engineering, department of Geodesy, in Skopje.

During the fieldwork phase, in the first four days, contacts were established with interviewees that were selected, to arrange the date and time of the interview. Selected interviewees were asked to identify other individuals for interview, which later received an invitation for interview and arrangement of the date and time. The snowballing approach was considered very useful during the fieldwork phase, because all the invitations were accepted. The communication prior and after was mostly through e-mails.

Each meeting with respondent followed a fix sequence: Firstly, the topic of the research was shortly described and the interests of the researcher were explained. This was done with the aim to avoid possible fuzziness, and avoid responses that were not related to the research objectives. Secondly, to each respondent was explained that the collected information would only serve the research objectives and

[3] The process of merging administrative and graphical databases is part of the World Bank project named as "The Real Estate Cadastre and the Registration Project". The World Bank project started to be implemented in 2005 (Gruevski, 2014).

would not serve any other purposes. This conduct is in accordance with a document named 'Request for Support' received from ITC Faculty in the pre-fieldwork phase. Lastly, each respondent was asked for permission to record the discussion, so that the researcher could focus on the content of the discussion. This approach yielded the following results: 10 out 13 interviews were audio recorded (also some notes were taken), 2 interviews were carried out through taking notes only, and 1 interview was conducted through e-mail communication (the latter, with a person in a management position, as a result of absence).

Additionally, during the fieldwork from randomly selected citizens were interviewed 10. These were clients of a private surveying company in the town of Tetovo. The reason to choose for this sampling method of respondents was that these clients had recently been involved in cadastral procedures, and this the interview could directly tap from their personal experience. These interviews consisted of four open questions, which were each responded on paper by the clients. These latter interviews were anonymous, so the names of the clients were not collected. The random selection yielded only male respondents.

3.1.2. Grey Literature

During the fieldwork grey literature was collected, such as comparative reports regarding the process of merging, legal documents, manuals, presentations, and working papers. The comparative reports are retrieved from the inspections made between the administrative and graphical databases. The reports show the differences in common attributes that exist between the two databases. The Law on Real Estate Cadastre describes all the activities and functions of the cadastral system in Macedonia. The Regulation on Cadastre Maps and Maps of Infrastructure Objects was adopted from the Law mentioned above, where in detail are described the conditions of mapping and maintaining cadastral maps. The Manuals contain information on how to use the software Mac-Edit, and the application of purchasing data E-Cad counter. The presentations collected provide facts, statistics about the cadastral system in general and AREC in particular. Some of the presentations are related to the process of merging in Macedonia.

The collection of grey literature was done in two ways. Some of the legal documents such as laws and regulations were mentioned during the interview, which later were asked to be given to the researcher. In addition, after the researcher finished with the interview questions, asked for additional documents which are in relation with the process of merging. Most of the documents were given directly by the respondents, just for few of them was stated a web-page or a link from where it can be downloaded, using the internet. All of collected documents are in digital format. Most of them are in Macedonian language and some of them in English.

3.1.3. Direct Observations

Direct observations were made to the new software Mac-Edit which is product of AREC, used for preparation of surveying reports (elaborates) by the private surveying companies. Observations were made on performing the process of subdivision using the software. In addition, direct observations were made to the application named as Electronic Cadastre (E-Cad) which is used for purchasing official alphanumerical and graphical data by private surveying companies. The information from direct observations was collected through print-screens.

3.1.4. Datasets

Various cadastral sample datasets were collected from one of the respondents. These contained official land title certificates (in .pdf format) and the geometry of the cadastral parcels (as .shp files). The sample data referred to two specific cadastral parcels, as they were recorded before and after merging cadastral spatial database and administrative databases into one. The reason of collecting the datasets before and after their integration was to compare how the data were recorded and evaluate the kind and extent of

attribute changes that occurred as a result of this merging. The software used to inspect and evaluate the datasets was: Adobe Reader XI for land title certificates, and QGIS for the geometry of cadastral parcels.

3.2. Data processing and analysis

All the interviews were carried out in Macedonian language. During the fieldwork phase the interviews were translated in English and structured in form of transcripts. The translation of audio recordings and creation of transcripts was made using two approaches. First approach was to translate and type in English directly from audio recordings through listening, whereas the second approach was first to type in Macedonian language from audio recordings and later to translate in English. After the transcripts were created, were sent to all interviewees for confirmation of the answers given by them.

After reading and re-reading the transcripts, the answers were organized in Excel sheet, where a summary of answers was made. The data from transcripts was organized in form of questions and respondents, with a purpose to look across summarized answers and to find out consistencies and differences in answers. Later the questions and the answers were divided in topics, related to the research objectives and questions. The interpretation was done using clear statements derived from the analysed results.

3.3. Study Object Description (Cadastral system of Macedonia)

In Chapter 1, section 1.6.1, it was mentioned that the study object in this research is the cadastral system of Macedonia. The main reason why this cadastral system is chosen is that the Agency For Real Estate and Cadastre i is performing the project of merging the administrative database and cadastral spatial database into one database. This corresponds with the main aim of the study which is to analyse positive and negative (internal and external) effects of merging the administrative database and cadastral spatial database into one.

Organizational aspect

The Agency for Real Estate Cadastre (AREC) is the only legal body that performs the functions of the cadastral system. In 1986 with the enactment of the Law on Survey, Cadastre and Registration of Real Estate Rights , besides cadastral-geodetic works, the organization was assigned with new function – registration of real estate rights. The AREC is responsible to: manage the geodetic-cadastre information system, perform basic geodetic works, perform real estate survey, maintain the real estate cadastre, perform mass valuation of real properties, to produce state topographic maps, establishment and maintenance to national SDI, and establishment and management of graphic registry of construction land (Gruevski, 2014). The AREC operates on the principles of legitimacy, expertise, efficiency, transparency, service-orientation, professionalism and liability for the work performed and the results achieved. The national office is located in Skopje and it has 29 local offices spread over the country (in near future the number of local offices will be reduced drastically). The cadastral system in Macedonia is maintained by the private sector that is responsible to handle the majority of the operational tasks but as well to supply official services and products to the citizens.

Legal aspect

The cadastral and land registration functions are regulated with the Law on Real Estate Cadastre. In this law, Real Estate Cadastre is defined as '*a public register which records the right of ownership and the other real property rights, real property rights data, as well as other rights and facts whose registration is defined by law*' (The Parliament of Republic of Macedonia, 2013). The land, buildings, apartments, special and common parts of the buildings, and infrastructure objects are defines as *Real Property*.

Real Estate Cadastre was established through: systematic registration, sporadic registration, and conversion of data from land cadastre into real estate cadastre.
The registration of real property rights is compulsory. The cadastral system is based on title registration and on fixed boundaries. The land title certificate is the legal valid documentation which is used as an input for selling/purchasing real estates. The land title certificate contains information about the owner and/or user of cadastral lot, land, buildings, special and common parts inside the buildings, mortgages as well as other responsibilities and restrictions (Appendix: 3).

Technical aspect

Prior to the new project of merging, the information from both components such as Cadastre and Land Registration was stored and maintained in two databases. The administrative database named as E-cad and the graphical database Mac-Edit Database. The information from both databases to citizens was provided through AREC geo-portal, which was free of use but parcel-based.
The new project that is on-going has the aim to unify all data from the Real Estate Cadastre such: data for the owners, the parcels, the buildings, the easements, in one central database that would be called e-Cadastre system (shortly E-Cad). The project tends to merge the graphical data base Mac-Edit into E-cad, where prior to merging E-Cad was just administrative database before merging process i.e. graphics are added to E-Cad. E-Cad is Oracle database and has WEB Java application. Also there is a workflow system supporting registration procedures for maintenance of Real Estate Cadastre data. ESRI ArcSDE for Oracle is for graphical data (Fajfar, Kavcic, & Ravnik, 2010)[4].

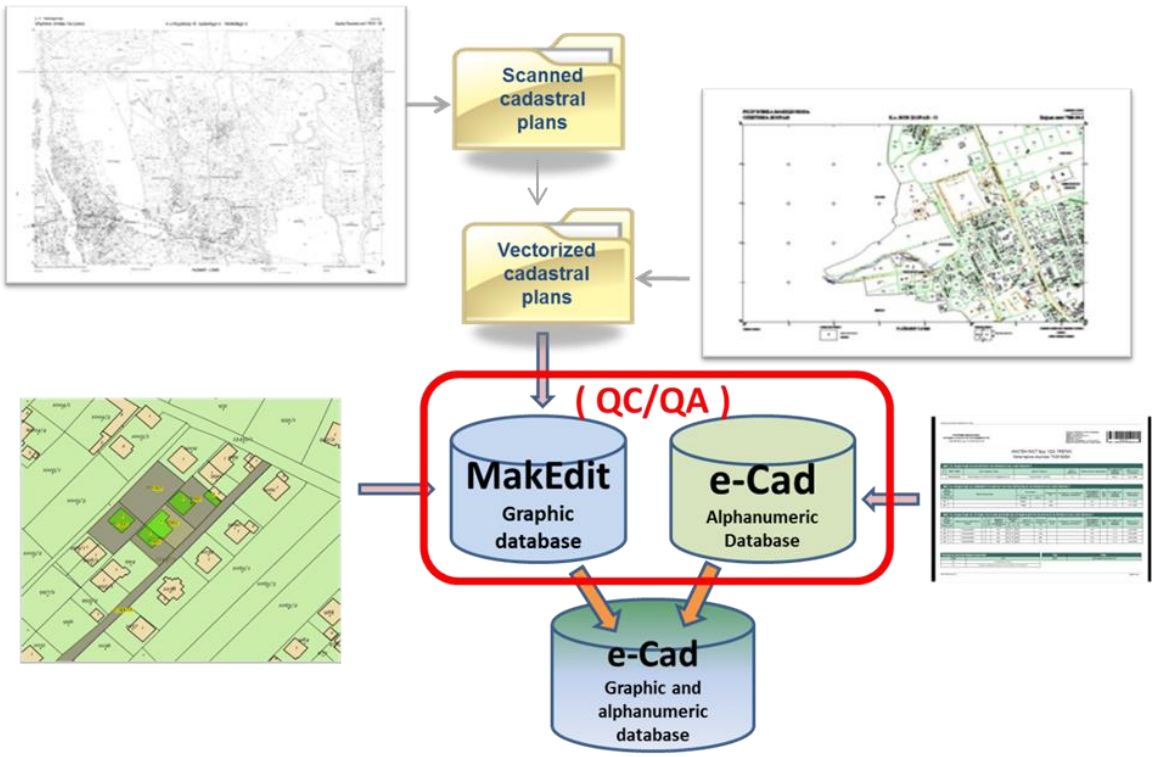

Figure 8: Process of merging administrative and graphical databases in Macedonia (AREC)

[4] In 2010 was established the E-Cad system just for the administrative database. In this paper also were discussed future intentions of the Agency.

3.4. General classification in context of cadastral system of Macedonia

In Chapter 2, Section 2.5 general classification of merging was done. From the description of the cadastral system above and classification done, the following results are derived:

- In Macedonia there is only one organization that is performing the functions of cadastral system and that is AREC.
- From technical aspect there is on-going project that AREC performs on merging of administrative and graphical database into. Prior to merging there were two separate databases for storing and maintaining, whereas for disseminating information they were integrated.
- From legal aspect there is only one public register and that is Real Estate Cadastre. The registration in this register is official and valid.

Regarding the results from the study object description conclusion and the classification made in Section 2.5 one can conclude that cadastral system in Macedonia is on shifting from the status Merged to Fully Merged. The shifting from one status to another is as a result of merging the administrative and cadastral spatial database into one. Following chapters (Chapter 5 and Chapter 6) discuss the problems and effects that arise as a result of this shifting.

4. CHALLENGES AND PROBLEMS OF MERGING IN MACEDONIA

Based on the previous chapter cadastral system in Macedonia is shifting from status Merged to Fully Merged. This chapter presents the results which are related to sub objective B, *'To analyse and identify the main challenges and problems that occur during the process of merging'*. The chapter begins with the identification of main reasons that led to merge the administrative and graphical databases in Macedonia (section 4.1). Section 4.2 describes the problems that occur during the process of merging these two databases. Section 4.3 seeks to identify the causes of these problems. Following sections seek to describe accepted strategies to overcome the problems, and to provide statistics as a result of applied strategy (sections 4.4 and 4.5). Section 4.6 seeks to identify possible challenges as a result of merging the administrative and graphical databases. Final section concludes the chapter by summarising the challenges and problems.

4.1. Reasons to carry out the process of merging administrative and graphical databases

To understand how the administrative and graphical data are stored and maintained prior to their merging into one database, which common attributes exist between two databases, and which of the data is considered as legal, were asked 3 people in management position. Their responses were consistent, stating that: *the administrative and graphical data are stored and maintained in two separate databases prior to their merging into one database, in E-cad administrative database and in Mac-Edit graphical database*. As common attributes between these two databases and as common attributes between land title certificate and cadastral map are: *the number of cadastral parcel, the number of building, and the area of the cadastral parcel*. But, *as legal are considered the data from the land title certificate*, which is legal valid document used for transaction and other events. All the information that is contained there is a valid.

Prior to merging of administrative and graphical data into one database, cadastral procedures are performed and submitted in different way to the AREC. Three responses from people in management position were that, prior to merging just notaries were able to submit electronically the deed in cases of full transfer ownership. Whereas for cadastral procedures that require changes in the administrative and in the graphical database (cadastral map), such as subdivision, expropriation, and privatization the surveying report from private surveying companies and the deed from notary were submitted in paper format to the Agency.

The question: Which were the problems you encountered in the previous system that underlie the present merging these two databases into one database? was posed to 3 people in management position.
All of them responded that *inconsistency of data* between the two components caused a numerous problems in the performance such as:

- Differences between the data on administrative and the graphical part
- Difficulties in maintaining the data; the inability to monitor the graphical component of the cadastre.
    - *Example 1:* There is subdivision of a lot, it is introduced in the attributive part, i.e. the lot is divided into two and has two owners, but the division was not introduced in the graphical part.
- Issue of inaccurate and out-dated data which affect professional users and other organizations on performing their work.

- *Example 2:* If a municipality wants to make a detailed urban plan, in which case the municipality necessitates updated data from the cadastre (mere graphical part), and the cadastre issues an incorrect document, which will lead to incorrect planning.

- Subjectivism of implementation of the permitted difference in area in process of subdivision.

Additionally, the following question was posed to three people in management position: How do the inconsistencies between these two databases affect the cadastral procedures?
Respondent 1 answered that: '*There must have been manipulations especially on subdivision procedure. One of the reasons we are doing this is to reduce the chances for manipulations to the minimum'.*

Respondent 2 and Respondent 3 fulfilled the previous answer with two similar examples, and stating that: '*These differences affect the process of dividing the lots, in particular the subdivision, when there is selling/purchasing process going on'.*

- *Example 3*: For instance, the area of the cadastral parcel on land title certificate is 1000 m2, and on the spot, or calculated from the cadastral it is 950 m2. If half of this lot is being sold, then legally it means that 500 m2 are in the process of being sold, as per the certificate, each of the parties will get 500 m2, whereas, in fact, they will get 475 m2 each.

On this issue were asked also two respondents from 2 private surveying companies. Respondent 10 answered: *'Simply said, there is space for manipulations.'* whereas the Respondent 11 stated that: '*It takes more time and energy to prepare them'.*
Respondent 10 also explained manipulations that can occur through the following example:

- *Example 4*: When the lot is 1000 m^2, according to the land title certificate, i.e. 900 m^2 as per the graphics of the lot. If 700 m^2 are in process of being sold, then actually only 300 m^2 remain both graphically and legally for the seller, i.e. 700 m^2 are bought by the purchaser, but in fact the purchaser had actually bought 600 m^2 only.

4.2. Problems during the process of merging administrative and graphical databases

This section presents the results which are in relation with the research question B(2) (*What are the main challenges and problems during the process?*) To achieve the answer of this research question were asked 6 Key Informants such as 2 Surveyors, 2 Lawyers and 2 IT engineers as well as the information from comparative reports was considered.

In response to the question: Which is the major objective of merging the administrative and graphical database?
Surveyors (2) shared the idea that: '*The major objective is making graphic and attributive data consistent with each other.'* and *'Our objective is to have only one centralized database and consistent data'.*
Lawyers (2) indicated that: *'That consistency of the data is the ultimate goal which is being reached, in fact, as the law states it, the data from the cadastral map to be in conformity with the data in the alphanumerical database, i.e. the land title certificate.'* and *'The purpose of the project is integration of the alphanumeric and graphical databases into one single database'.*
The responses from IT engineers (2) in this question were that *'the main objective is creation of one inseparable unit containing all the cadastre-related information needed for registration of the rights on the relevant lot. This will ensure consistency and accuracy of the data stored in that database.*' and '*The major objective of this merging is primarily related to the process of updating the data, i.e. entering all the changes both in the attributive and graphical part'.*

The responses on this question indicate that the main aim of merging the administrative and graphical databases is to have consistent data, especially on common attributes that two databases have. To reach this aim all inconsistencies between the databases must be identified and avoided.

The next question that was posed to key informants was: Which problems you encounter in the process of merging the administrative and graphical databases?
Surveyors (2), Respondent 4 and 5 mentioned that as problems that occur during the process of merging are the follows:

- Doubling of the lots. In the graphic it is registered as one lot, but in the alphanumerical database it is registered as two lots.
- Lot does not have its number in the graphic, but it does exist in the attributive database, and the other way round.
- The area is the key problem, in graphic you have certain area which differs from the area in the attributive database.
- Discrepancy that may occur is the difference in land use, in attributive base it is with one land use type, and totally different land use is in the graphic.
- Lots belonging to one cadastral municipality are registered in another municipality.
- The building may be registered to belong in one certain lot in the graphic, but the same building is registered in another lot in the attributive base.
- Numbering of the structures. For example, in the alphanumerical database certain objects are numbered 1, 2, 3, whereas in the graphical database the numbering is not in that order and the areas do not match.
- When in the alphanumerical data land under a structure is registered, these are structures build and entered as such in alphanumerical database, but these structures do not exist in graphical data.

Lawyers (2) regarding this question, considered the area as main problem on process of merging by stating that:

> Respondent 6: '*Areas have always been the main problem, because in the past, before establishment of the real estate cadastre, the area measurements were performed in simpler manner, applying older techniques and old-fashioned (for the present) instruments. The surveyors are very well familiar with this issue*' and
> Respondent 7: '*The problems we come across in this merging process are that we many cases the areas inconsistencies are too high, I mean, they exceed the allowed deviations.'*

IT engineers (2) had various answers in this question by stating that:

> Respondent 8: '*Quite often there were incorrect figures for the area of the lots, incorrect numbers of the lots, incorrect total number of the lots in the digital cadastral plans that are being updated now, simply because in alphanumeric you cannot conduct check-up of geometry because alphanumeric does not consider the shape of the lot nor its geometry within one cadastre municipality or on a larger scale*.' and
> Respondent 9: '*From technical aspect, first the software had to be upgraded in the part where the graphical data would be fed, which meant expansion of the data model of the database, which certainly involves risks of damaging or losing the data.'*

IT engineers (2) additionally were asked which international standards were used to design the common database. The answer from the Respondent 8 and 9 was that: '*For this new database we have used Oracle database which is supplemented with the component Spatial Data Engine from ESRI which ensures the geometry of the cadastral parcels and built structures. So, we have applied worldwide known components, such as OGC Consortium, i.e. the standards set out by it'*.

These responses show that the problems during the process of merging arise because of different types of inconsistencies that two databases have. These differences are identified by special software designed for inspection of the data in two databases. This process is repeated n-times, until the data in both databases

are consistent. Once the data are consistent, the graphical data are in introduced in E-Cad system (Figure 8).

4.2.1. Area as key problem

Differences in areas between the administrative and graphical database were considered as main problem. To avoid these differences is a challenge because one of the areas from two databases must be considered as master area if the aim of the process is to have consistent information. In other words the area is an attribute of cadastre or cadastral map that area should be represented in land title certificate.
In response to the question: Prior to merging of these two databases into one single database, will there be any permitted tolerance on area, or the match administrative data: graphical data must be 1:1? Surveyors (2), Lawyers (2), and (1) person in management position, specified: *'The tolerance is zero. The match must be perfect, 1:1'.*

To the same interviewees was posed the question: Which area is the master area you follow, the one calculated from the cadastre lot, or the area registered in the legal document? Interviewees indicated: *'The area calculated from the graphical part is the master area that we follow'.*

In response to the question: Is the area in the alphanumerical database always bigger than the one in the graphical database?
Surveyors (2) stated that: *'NO. Sometimes the area from alphanumerical database is bigger than the area calculated from the graphic, and in some other cases is smaller'.* The expected answer on this question was that the area in administrative database is always bigger than the area calculated from the cadastral map.
The next question posed to Lawyers (2) and Surveyors (2) was: Based on which regulation or law is the change on areas introduced into the land title certificate? All of them responded that *the changes are made based on the Law on Real Estate Cadastre and the Regulation on Cadastre Maps and Maps of Infrastructure Objects.*

According to the comparative reports, the differences on area between administrative and graphical databases are bigger for cadastral municipalities for which a Real Estate Cadastre has been established

COD_CM	PARCEL_ID	GRAPHICAL_DB MACEDIT_SUMAREA	ADMINISTRATIVE_DB ECAD_SUMAREA	DIFF_AREA	ΔP	SCALE	DIFF>ΔP (red)
9	100	1432	1477	45	27	1000	
9	1000	1265	1276	11	25	1000	
9	1001	3058	3070	12	39	1000	
9	1003	2422	2492	70	35	1000	
9	1004	2039	2073	34	32	1000	
9	1005	1715	1675	40	29	1000	
9	1006	1330	1316	14	25	1000	
9	1007	1663	1675	12	29	1000	
9	1010	1753	1774	21	29	1000	
9	1012	523	560	37	17	1000	
9	1013	815	837	22	20	1000	
5	100	3555	3650	95	106	2500	
5	11/1	6313	6378	65	140	2500	
5	11/2	6952	6858	94	145	2500	
5	112/1	2105	2045	60	79	2500	
5	114	2746	2627	119	90	2500	
5	116/6	3096	3176	80	99	2500	
5	118/1	1939	2012	73	78	2500	
5	119/1	3403	3281	122	100	2500	
5	119/2	2860	2953	93	95	2500	
5	123/1	1567	1465	102	67	2500	
5	124/1	3759	3685	74	106	2500	

Table 4: Differences in area (m^2), on digital cadastral maps which are produced indirectly

based on analogue cadastral maps, which later were digitized and vectorized. The difference is because a land title certificate was created when the maps were maintained manually on paper format (see Table.5). In addition, Respondent 2 mentioned that *'The difference in area of a cadastral lot depends on the scale of the maps. Accordingly, in maps with scale 1:1000, the difference is smaller than in maps with scale 1:2500'.*

Unlike this, for cadastral municipalities for which a Real Estate Cadastre has been established through new measurements using photogrammetric and ground surveying techniques i.e. the cadastral map was directly in vector format, the differences in area do not exist or are insignificant (Table.5). These two findings were not expected.

COD_CM	PARCEL_ID	GRAPHICAL_DB MACEDIT_SUMAREA	ADMINISTRATIVE_DB ECAD_SUMAREA	DIFF_AREA	ΔP	SCALE	DIFF≤ΔP (green)
17	100	1105	1105	0	23	1000	
17	1000/1	717	719	2	19	1000	
17	1000/2	346	344	2	13	1000	
17	1000/3	388	388	0	14	1000	
17	1000/4	227	227	0	11	1000	
17	1001	1144	1143	1	24	1000	
17	1002/1	2219	2219	0	33	1000	
17	1002/2	590	587	3	17	1000	
17	1004/1	1008	1008	0	22	1000	
17	1004/2	917	912	5	21	1000	
17	1007/1	1012	1014	2	22	1000	
17	1007/2	351	351	0	13	1000	
17	1007/3	1041	1041	0	23	1000	
17	1008	3509	3504	5	41	1000	

Table 5: Differences in area (m²), on digital cadastral maps which were produced directly

In response to the question: As a surveyor/lawyer, what is your opinion, which area is more correct to be changed, area from land title certificate or area from the cadastral map?

Surveyors (2) specified that: *'Of course that the area in land title certificate should be changed and to correspond with the area in graphic. Because in the past it was done by planimeters (platometer) and paper-based layouts, the accuracy of which, depending on the scale, was about 40 m2. The figure in the cadastral map is the correct figure, because that figure can be corrected, that lot can be resurveyed'.*

Lawyers (2) answered to this question in this way: Respondent 6: *'What is the purpose of updating the data, resurveying the lot, if it all comes down to matching the data with the data in the legal document? Why has all that money been wasted?'.* Respondent 7: *'Yes, maybe the actual state is the data we should rely on, but only if it reflects the data put in the cadastral map'.*

The above responses show that there is an agreement on opinions between surveyors and lawyer on choosing the area calculated from the graphics as master area.

Regarding this issue also 2 university professors were asked. The interviewees indicated: *'In my opinion, if I decide to accept the vector datum, there is no other area. What legal area are we talking about? We must forget once and forever the area taken from the attributive database.'* and *'Of course that the area from the graphical component. That area can be surveyed, that area can be changed on the spot'.*

4.3. Causes of the differences in area

To understand why the differences in area exist between administrative database and digital cadastral maps which were produced indirectly, the following question was posed to 7 interviewees: Do you think that various adjudication methods applied had to a certain extent brought about the occurrence of this differences?

Management position (3) interviewees have the same opinion that: *'Conversion is a process which has always caused problems. In the past it was applied with the purpose of creating quickly a real estate cadastre i.e. analogue maps were scanned and vectorized but as well as the area calculated in that time using a planimeter[5] was converted as legal area'* .

Surveyors (2) also agree that conversion is the cause of the problem by stating that: *'The lots we are talking about were scanned and vectorized. If we relate this to the methods applied for establishing the real estate cadastre, this method is the method of conversion, for the old maps were an input for establishing the new cadastral map in 2005. From the statistical data we have, I can say that the differences are more numerous in those municipalities where the analogous maps were digitalized.'*

Lawyers (2) have consistent opinion with the previous ones by stating that: *'The majority of the differences are due to the conversion. We kind of copied the old surveying data, wanting to make the procedure low-cost and thrifty for areas where there are generally very few transactions…where the possessory list were converted into land title certificate, the latter being a more valid legal document'.*

The above responses tend to clarify that huge differences in area are in digital cadastral maps which were produced indirectly due to the conversion method applied to establish Real Estate Cadastre. The problems with conversion do not arise because the analogue (hard-copy) cadastral maps were digitized and vectorized. The differences are as a result of methods used to determine the area from analogue maps. The area of parcel was determined using the instrument called planimeter. The determined area was shown in the legal document named as possessory list. This possessory list was converted to land title certificate (when Real Estate Cadastre was established for particular region) without checking if the old areas correspond to the areas calculated from digitized and vectorized cadastral map (using an algorithm and software).

Unlike this, about the differences in area on cadastral maps which were produced directly in digital format and administrative database, Surveyors (2) mentioned that: '*To people have been issued land title certificates that are based on digital cadastral maps, resulting into area difference of 1 or 2 m². It is due to the fact that in Mac-Edit graphics coordinates are determined by two decimals*'. This response aims to clarify that before graphical data were entered in the graphical database Mac-Edit, the graphical data were maintained in Cad and MicroStation system where the coordinates were not determined with fix decimals.

4.4. Strategies employed to resolve the problem and accepted alternative

From the results presented in previous sections was noted that the areas from graphical database are considered as master areas to overcome the inconsistencies i.e. the area in land title certificate must be changed and correspond with area calculated from the graphics. To understand more clearly and deep, the accepted strategy but as well strategies employed to resolve the problem, were asked 7 interviewees (from which 1 did not attended when the strategies were discussed). Additional information regarding the accepted strategy was retrieved from laws and regulations.

[5] Planimeter is a measuring instrument used to determine the area, by tracing the perimeter of a cadastral parcel, in analogue (hard-copy) cadastral maps.

4.4.1. Accepted strategy

On the question: Which were the strategies or ways to overcome these differences, strategies and ways applied by you, by the Agency?

Concerning the accepted strategy, from interviewees was noted that '*firstly the project starts with some changes in Law on Real Estate Cadastre'*.

The project started together with changes in Law on Real Estate Cadastre which was enacted by the Parliament in April, 2013. From the changes in Law on Real Estate Cadastre, was adopted the Regulation on Cadastre Maps and Maps of Infrastructure Objects by steering board of AREC. Article 57, of this regulation specifies that*: 'the area of the cadastral parcel shall be calculated with an algorithm, after forming of the topological structure, on the basis of the coordinates of the points'* (The Agency for Real Estate Cadastre, 2013) i.e. the same area should be presented in land title certificate .

This was also confirmed by Respondent 1 who stated that: '*We insisted on changing the Law, as I believed and I still believe that it is not OK for someone to change the area of a lot in land title certificate without informing the lot owner thereof. Now the citizens must be informed about the changes in areas that go beyond the permitted deviations. What matters most and we take utmost care of is that the lot's boundaries must not be changed'*.

Permitted deviations in area are described in both legislations mentioned above i.e. the Law on Real Estate Cadastre and the Regulation on Cadastre Maps and Maps of Infrastructure Objects. In the Article 58 of the regulation is stated that: '*The acceptable difference between the area of the cadastral parcel and the area of the same cadastral parcel registered in the electronic database (e-Cad), shall be calculated according to the formula: ⊿P= 0.0007*M*√P (where M is the module of the Digital Cadastral Map scale and P is the area of the parcel*' (The Agency for Real Estate Cadastre, 2013).

The information about cases where the differences in area are lower or exceed ΔP, was retrieved from respondents and above mentioned law and regulation. The information retrieved was consistent from both sources.

All respondents (7) stated that:

1) In case the differences in areas are lower than ΔP, then the Agency changes the area ex officio, i.e. the digital area shall be taken as the valid one, without informing the lot owner thereof.
2) When the differences in areas exceed ΔP, then the Agency issues a certificate for the digital area, and this certificate shall be delivered to the owner of the cadastral lot in question. In this case the owner is informed about the change but as well for the reasons of the change and stating that the boundaries of the land are not changed.
3) In the second case, the lot owner is entitled to filing a complaint to the Administrative Court.

For the second case, if the differences in areas exceed the *⊿P* the Agency does not undertake immediately the action of changing the area; firstly an insight shall be made into the official archived records in order to determine the cause of the differences.

In response to the question: Will you go once again on the spot and when will it happen? Interviewees indicated: *'When the boundaries of a definite cadastre lot cannot be digitalized (damaged cadastral map) by the cadastre, then the lot is resurveyed and the actual area is established'*.

This answer also corresponds with the inspections that the Agency should undertake, which are described in detail in the Regulation on Cadastre Maps and Maps of Infrastructure Objects, Articles 58, 59 and 60

(The Agency for Real Estate Cadastre, 2013). The inspections that should be done are described in the regulation as follows:

- If the reason for the difference in area is as a result of incorrect mapping of data in the cadastral map, a correction should be made on the mapped content in the digital cadastral map.

- If it is determined that the reason for the difference in area is the result of incorrect calculating of the area of cadastral parcels, a correction shall be made in the administrative database by taking the area obtained from the digital cadastral map.

- If it is determined that there is insufficient data to digitize the boundaries of some of the cadastral parcels or there is no information in the official records to determine the reason for the difference in the area, the *actual state* on site should be surveyed.

- If with the on-site inspection it is determined that the areas of the subdivided cadastral parcel (which are NOT delineated on the digital cadastral map) correspond to the data contained in the administrative database, then the *actual state* shall be drawn out in the digital cadastral map.

- If with the on-site inspection it is determined that the areas of the subdivided cadastral parcel (which are delineated on the digital cadastral map), do NOT correspond to the data contained in the administrative database, and correspond to the actual situation, the area from the digital cadastral map should be accepted, within the boundaries of the vectorized cadastral parcel.

Concerning the accepted strategy AREC also has launched a campaign in media where citizens are permanently informed about the changes that can occur in their land title certificates due to the harmonization of the data with the graphics. However, this type of campaign is a general campaign does not clarify specific issues that may occur to the citizens.

In response to the question: Do you think that the Agency should launch a campaign in order to inform the citizens better of the process going on, explaining clearly the issue to the concerned parties?
Respondent 1 indicated: '*When we began the process, we started it as a public campaign. We made a video spot, informed the citizens what we will be doing';* Respondent 2: '*This project is carried out by the loan taken from the World Bank, and it is being advertised in all the media';* and Respondent 12*: 'Yes, I do, actually, I think the Agency did it'.*

4.4.2. Employed strategies

In response to the question: Was there another strategy that was not accepted, that was totally different from this one?
Interviewees indicated that in the beginning there were 2 other strategies to overcome the problem:

- First one was to have two areas on the land title document i.e. the area from the alphanumerical database that already is used as legal area, but also the area calculated from the cadastral map for that particular lot.

- The second one was to leave the situation as it was the area in land title document to be the legal and cadastral maps to be used just for administrative purposes.

These strategies or options were not accepted because first it does not fit with the objective of the project, and that is to have consistency of data from both components, manipulations still can occur as result of the inconsistencies and this approach may give again birth of disputes.

4.5. Statistics regarding the project of merging databases

In Macedonia, in total there are 1912 cadastral municipalities (not local offices) and little more than 4 million cadastral parcels. Around 80% of digital cadastral maps were drawn up indirectly i.e. by digitalization and vectorization of analogue maps and 20% were drawn up directly in digital format. Differences in areas between digital cadastral maps and land title certificates are significant in cases where the digital cadastral maps were produced indirectly. These cases have been seen as problematic in this process of merging i.e. from all cadastral parcels in the territory 80% are problematic and 20% directly have been merged as the differences are insignificant.

It was mentioned that the project of merging the databases started in April, 2013 together with the changes in law. As a result of applied strategy till the day of the interview 3rd October, 2014 the information retrieved from Respondent 4 the percentage of integrated cadastral municipalities from all the territory into the central database was 46%.

Respondent 1 stated that: *'Luckily, as time passes, we see that the situation is not that bad as we feared it would be, that more than 70% of the lots belong to the accepted deviations, which are due to differences in the methods of calculating the area of the lots, different methods were applied at different times'* .
From this response one can conclude that from already merged cadastral municipalities into one database (46%), more than 70% belong to the accepted deviations.

4.6. Challenges that can occur after merging the databases

The challenges that may occur after merging the databases, or more precisely challenges as a result of changing the area in land title certificate to correspond with graphical data and area calculated from the graphics, are related to the citizens' trust in the cadastral system, to the processes of transferring land rights, to the processes of privatizing state land, as well as in land market.

Regarding the issue the following question was posed to 6 interviewees (2 Surveyors, 2 Lawyers, and 2 Professors): Do you expect this change in areas to have an adverse effect on the citizens, with respect to their trust in the Agency or feeling insecure regarding their real estate?

Surveyors (2) and stated that: *'Their initial reaction will be negative… All the clients who came here with complaints, left convinced that the boundaries of their lots had not been changed, the boundaries are the same, but due to technological advancements the area is changed. In a way, it is good, not to live in an unrealistic world, to believe you have something that you actually don't'*.
Lawyers (2) answered that: '*If the differences are higher, then the citizens are entitled to filing complaints to higher instances, to the courts. But I must point out that the Agency had made no changes on the lot'*.
Professors (2) stated that: '*At first, yes. However, once the areas are made consistent, there will be no additional changes, people will see that and complaints will subside*'.

The next question posed to 4 interviewees (2 Professors, 1 Surveyors and 1 Lawyer) was if these changes in area in the land title certificate, in order to match with the graphical data, may give a birth of disputes?
The answers were consistent by stating that: '*Citizens are sensitive to all kinds of changes, in particular when the citizen had made some transaction with his lot*', '*Yes, problems may occur, in cases when the respective lot area is increased or decreased legally, because many legal acts are linked with the respective land title certificate*', and '*Sale/purchase transaction of the real estate are all made based on the area of the real estate, the value of the real estate is based on its area*'.

The interviewees on this question also mentioned a couple of examples of problems that can occur as a result of changes in area in land title document. The examples were as follows:

- *Example 5:* Before merging, for instance, the client has a land title certificate for a lot measuring 12.000 m2. He concludes a sale/purchase contract for that lot of 12.000 m2. The purchaser pays the owner the money for that area. The same night we are making the merging for that lot, and it turns out, after two days, that that lot measures 11.000 m2 in the new land title document, meaning the purchaser had paid for more area. (Respondent 5)

- *Example 6:* For instance, we talk about privatization of a 500 m2 (legally) lot whose borders have never been changed, and now, with the merging process, the lot turns out to measure 510 m2. The area privatized will measure 500 m2, whereas these 10 m2 will remain to the state ownership. Since the lot owner had never changed the boundaries of his lot, he will ask for right on the whole land. In the end, he will probably have to buy out form the RM these 10 m2, all that because of the administrative change, not because of an actual change, because there has never been any actual change. (Respondent 13)

- *Example 7:* The situation when the mortgage is on a 500 m2 lot, and now it turns out the lot measures 490 m2. (Respondent 13)

4.7. Citizens' reaction

The issue of changing the area on land title document was discussed with 10 citizens. The discussion specifically aimed to address how citizens felt about a change in the area of cadastral parcels on land title certificate in order to match the registered area with the one based on surveyed data.

In the question: What would your reaction be if the area of your cadastre parcel was changed in the land title document due to matching its area to the on-the-spot surveyed data?
The responses varied. Among the 10 citizens, 6 responded that they would require further explanation: Resp.14: '*I would accept the change of the area for cadastral parcel if that is according to the boundaries defined on field*'. Resp.16: '*I would not be satisfied, but still I would go to the department for Real Estate Cadastre to tell me the reasons why that change is done'*. Resp.20: '*The area cannot be changed in that manner. I would go in Cadastre to understand how that change occurred*'. Resp.21: '*I would not be satisfied. I would like to know how this change occurred*'. Resp22: '*I would go in Cadastre for more detailed information'*. Resp.23: '*I will ask for explanation on basis of what my area I changed on the legal document*'.

Two others responded: Resp.17: '*I would agree with that area because that is the real area of my plot*.' and Resp19: '*I would accept the area because it is the real area that I own*'. Two remaining ones responded negatively by stating that: Resp15: *'It's my property and I will try everything to get the area that I had'* and *'I used that area for years and now someone shows up and tells me that the area is reduced, it is really something unacceptable*'.

These responses show that the citizens' are not satisfied regarding the changes of the area in land title document and their initial reaction is negative. They need further explanation and get convinced that the boundaries of their cadastral parcel have not been changed. Although, in the previous section it was mentioned by key informants, that the citizens' that had such a change left convinced, yet AREC has a huge task to convince every citizen that will require such explanation.
The next question that was posed to the citizens was: Would you be ready to accept this change of the lot area in the land title document?
Each of respondents had different conditions. 4 out of 10 responded in this way: Resp.16: '*If it is from justified reasons and if the situation on the spot is really different to that in property list then I would accept it*', Resp.17:'*I would accept if it is determined that area with boundaries on the spot*', Resp.18: '*I will accept only if it is the area that I use on the spot*', and Resp.20: *'Yes, if that is the real area of my parcel'*.

3 others responded that: Resp.14:*'Always, if there are better and more accurate measurements'*. Resp.19: *'I would accept the change of the area on the land title document, because only that will be the real area that I have'* and Resp.23: *'I would accept this fact of changing the area, only if that it happens as a result of any technical error'*.
3 remaining responded: Resp.15: *'In my opinion no one will accept easily the change and be satisfied. I will try to get the area that I had on the document'*. Resp.20: *'I would agree with that change only if the area does not differentiate drastically'* and Resp.21: '*Yes, if there is not major change on area*'.

These responses indicate that the area will be accepted by some citizens only if it is determined according to the boundaries on the field. Some of the citizens responded negatively to this change assuming that their area will be reduced. However, in section 4.2.1 it was mentioned that the area on land title certificate is not always bigger than the area calculated from the graphics. This means that to some citizens the area will be increased while making consistent the data from administrative database with the graphical ones. Nevertheless, the surveyed boundaries will remain the same.

4.8. Conclusions

This chapter presented the results aimed to identify the main reasons of carrying out the process of merging administrative and graphical databases in Macedonia, the problems that occurred during this process, and the strategies employed and accepted to resolve this problem (research questions B(2), B(3), and B(4)). The results were collected through semi-structured interviews and grey literature. Although there was a limited number of interviews, from professionals accurate and reliable information was retrieved, whereas from citizens' (10) (who were not planned) basic perceptions regarding the changes in area were retrieved.

The main reasons to carry out this process were considered the inconsistencies that exist between administrative database and graphical one, especially on common attributes (id, area) that two databases have. These inconsistencies contributed to AREC issuing inaccurate and inconsistent data which affected other actors to incorrectly perform their work. In addition, as a result of those inconsistencies there exists space for manipulation specifically in subdivision process. Challenges or problems that arise in this merging process are on correcting the inconsistencies that exist between databases such as: parcels that exist in in administrative database do not exist in graphics, incorrect indexing, and differences in area. The differences in area between the databases were considered as problematic in digital cadastral maps which were produced indirectly. Additionally, information about the causes of the problems was retrieved, which are due to the conversion method. The strategy applied to resolve these problems was the area from graphics to be considered as master area. Firstly, a campaign was launched to inform citizens about the process. Secondly, for the differences in areas that are inside permitted deviation (defined by law) citizens will not be informed. Unlike this, for the differences in area that exceed permitted ones the agency will inform the citizens, and they are entitled to complain in the administrative court. To leave the situation as it is, or to define two types of area were not accepted as strategy because inconsistencies in area still will be present. Furthermore, 10 citizens were interviewed to see how they feel if such a change occurs to their land. Further explanation is needed to get them convinced that the area in land title certificate is defined by the boundaries on recorded in the cadastre.

5. EFFECTS OF THE NEW SYSTEM APPROACH

This chapter presents the results related to the sub objective C, '*To analyse the impact of the new system approach on cadastral procedures and services*' and its research questions. The results are divided in sections, where each section is in relation with the research question of the sub objective. The chapter begins with some general information regarding the private sector in Macedonia. Section 5.2 presents the results which aim to identify how the merging of the administrative and graphical databases affects the cooperation between public and private sector. Section 5.2 seeks to understand how the new system affects the internal and external workflows of transferring land rights. Section 5.3 is trying to give an answer whether this new system approach will provide data of higher quality. Final section seeks to summarize the responses and relate them to the research questions.

5.1. Private surveying companies

In Macedonia, the majority of operational tasks (surveying, processing and formatting of properties) are done by the private surveying companies. In cases of transferring land rights, which require legal and graphical changes (e.g. subdivision), the private surveying companies prepare a surveying report where new changes are included. The update to take place in the cadastral system, the surveying report together with the deed from the notary is required to be submitted to the AREC. For other transactions that do not require graphical modifications, just the deed from notary is required to be submitted to AREC.

The establishment of private surveying practices was enabled in 2005, when the Law on Real Estate Cadastre was introduced. Since then, the total number of private surveying companies has been growing and reached the number of 149 in 2013 (Gruevski, 2014). All private surveying companies preform their tasks under the same conditions defined by AREC. The cooperation is regulated mainly with the Law on Real Estate Cadastre, where are described the operational tasks that can be carried out such as: surveying of real properties (land, buildings, apartments, special parts of building, and infrastructure objects such as pipes and lines), processing and formatting graphical and administrative data, in service to maintain real estate cadastre. The private surveying companies also are able to perform any other tasks for engineering purposes. The basic geodetic tasks such as maintenance and monitoring of: reference system, geodetic networks and points are carried out by AREC. In addition, the private surveying companies perform the operational tasks respecting the fees defined by AREC. In the Tariff List on Fees for Performed Operational tasks, is defined the maximal fees that private surveying companies can request to their clients.

5.2. Cooperation between public and private sector

To identify the effects of merging administrative and graphical databases, on the kind and extent of cooperation between public and private sector 5 practitioners were interviewed, 1 in management position, 2 IT engineers and 2 staff members of private surveying companies. Additional information was retrieved from direct observations and laws and regulations collected.

The question posed to IT engineers (2) was if they have worked out a new software or application as a result of the new cadastral system where the administrative and graphical databases have been merged. The answer from both respondents indicated that: *At present there is a system, the Electronic Cadastre or the E-Cad Counter system. It is the system resulting from merging of the attribute and graphical data. Accordingly, the integration of the graphical data is actually only upgrading of the already existing system.*

From direct observations was observed too that the E-Cad Counter is an application used by professional users, mainly by notaries and private surveying companies, which allows purchasing of the official data, both administrative and graphical data, electronically. The datasets are retrieved automatically to the professional users and the payment also is done online. In addition, because of these new system notaries, and private surveying companies are also authorized by the AREC to issue official datasets to other parties such as citizens.

This new system approach has effect on the way of purchasing the data from the AREC, especially the data from graphical component such as the geometry of the cadastre lot, which is as a result of merging the graphical component into the E-Cad Counter. This also was noted by respondent 9 who stated that: *'In the past, private surveyors had to come in person to the Agency for Real Estate, or they had other option to retrieve the data through online application. In both cases they had to wait for taking the data, because in two cases the data were prepared by the employees in AREC'.*
This response indicates that before merging the private surveying companies for purchasing graphical datasets had to go in person to AREC, or to use the online application for requesting graphical data. In both cases they had to wait hours or days to get the requested graphical data because they were prepared manually by the employees in the AREC.

In addition to the question posted above, 2 IT respondents indicated that there is also new software for preparation of surveying reports*:* Respondent 8*: 'Accordingly, we have worked out a new software Mac-Edit, which is used for preparation of surveying reports, which allows processing of the files from the electronic cadastre E-Cad counter, and afterwards retrieval of this changed data into the electronic cadastre'* and Respondent 9*: 'software is used for preparation of surveying elaborations, but a prerequisite for using it is to undertake the graphical data from the electronic cadastre'.*

Respondent 1 from management complemented this answer by stating that: *'Mac-Edit is a desktop-based application used for processing data obtained from the E-Cad counter. The data obtained as an extract from the integrated base are XML and GML files containing the attributes and the data regarding the geometry of the lot'.*

These responses indicate that the agency has worked out new software called Mac-Edit which is GIS software used for preparation of surveying reports digitally. For every new case the official data needs to be purchased using E-Cad Counter and process them in Mac-Edit.

The respondents from 2 private surveying companies noted that in their companies they already have installed the software Mac-Edit, whereas with the E-Cad Counter they were already familiar because before merging they used it for purchasing land title certificates electronically, now with merging also purchase of graphical data is possible.

On the question which type of data do you mostly purchase from the Agency? the responses were: Respondent 11: '*From this application we purchase the land title certificate which comes in form of PDF and is electronically signed by the Agency, then the data on geometry of the cadastre lot with all the coordinates of the main points creating the geometry of the lot, which come in ZIP form that contains GML and XML files. By means of this application the data can be bought in a few minutes, and payment is done online'.* and Respondent 10: '*Regarding the cadastre procedures, most commonly bought data is data on cadastre lots, such as the geometry of the cadastre lot and the ownership certificate for the respective lot.*'

These responses show that the cadastral data that are mostly purchased from the private surveying companies are the land title document and the geometry of the cadastral parcel. In addition, this response

indicates that the datasets retrieved automatically in XML and GML files in few minutes, but also the payment is done online.

On the question: Do you encounter inconsistent data from the lot geometry and the land title certificate? The respondents from private surveying companies noted that: Respondent 11: *'Well, it depends… For instance, regarding the cadastre municipalities that were resurveyed and for which the data was in digital form, in these municipalities there were some insignificant differences. Unlike them, in the cadastral municipalities for which the cadastral maps were scanned, digitalized and vectorized from the old, analogous layouts, here the differences are present in great number'* and Respondent *12: 'Yes, we encounter inconsistencies of this type quite frequently, which are mainly concerned with the data put in the land title document and the same data in the cadastre map'.*

In response to the question: Do you think that having consistent data both in the administrative and the graphical part means better efficiency in your work, in your operation?
The answer was consistent stating that: Respondent 11: *'Absolutely. It would be perfect for us as a private sector, because the process of preparation of the surveying reports would be simplified and would take less time'.* and Respondent 10*: 'There is no doubt that having higher degree of consistency of the data would lead to better quality in preparation of the surveying reports, which is beneficial for the ultimate users, i.e. the clients'.*

In response to the question: Does this new system enable provision of data of better quality? Respondent 10 stated: *'Certainly. We get consistent data for all the cadastral municipalities that have already been migrated into the new system'.*

These responses show that the private surveying companies before merging the administrative and graphical databases faced with inconsistencies when purchasing official cadastral data from the AREC. Now with the new system they definitely get consistent data which leads to increased efficiency and effectiveness on preparing surveying reports.

On the question, what is the advantage of the new electronic system with respect to the private surveying companies? The responses were consistent in terms of by stating that:

- All the surveying companies will be using one single unified standard and there will be no differences in presentation of the graphical part, a phenomenon which was quite common until recently.
- The private surveying companies will no longer have to use tons of paper, printing toner, CDs and other materials needed for preparation of the surveying reports.

The cooperation between public and private sector (in this case private surveying companies and notaries) can be summarized with the following services that the AREC has established:

- Electronic submission of applications directly from the Notary and Private Surveying Companies
- Electronic documents issued directly from the professional user office for the clients
- Digital signature
- Time stamp
- Online payment
- Services for data exchange

5.3. Cadastral procedures

To identify how this new system approach affects the internal and external workflows on transferring land rights were interviewed 4 key informants and 1 professional from management position.

5.3.1. Internal workflows

The question: Regarding the new system, which will be the main difference in the process of subdivision or other sort of modification of the cadastre lot? , was posed to 3 key informants. The answers were consistent by stating that:

- Till now the process involved first administrative changes, after which all the surveyors were supposed to introduce that graphic change into the digital cadastre plan which then was not yet integrated into the single database of the electronic cadastre.

- The inspection whether the change was introduced was not automatic, as the system had no information about the changes into the cadastre plan.

- Now with merging of databases this process is drastically simplified.

- In one step both administrative and graphical part is updated.

In response to the question: In case of subdivision, will the areas from the graphical part be automatically entered into the land title document?

Respondent 5 answered: *'Yes, it all goes automatically. The private surveying company takes an extract from the digital cadastral maps, makes subdivision, this digital plan is immediately fed into the database by opening the respective case. The system automatically reads the digital map and automatically creates the newly created lots, the new numbering, automatically registers the area of the lots. So, the proposal made by the private surveying company for a new state is automatically registered into our database'.*

On the question: Can we conclude that in the past we had to update two databases separately, and now only one database will be updated, i.e. with one updating both contents are simultaneously updated?

Five respondents answered in consistent way by stating that: *'Yes. The system itself carries out all the alphanumerical and topological inspections',* and *'with the new system, with one database, one step will be sufficient to introduce the change both into alphanumeric and in graphic'.*

On the question: Will that be performed automatically or manually, meaning, there will be two officers in the Agency updating the alphanumeric and then the graphic part?

The answer again was consistent by stating that: *'Yes, the workflow process is one single, and while it lasts the process involves a legal expert and a surveyor who just visually checks. The surveyor visually checks the geometry made by the private surveying company, whether it observes the geodetic norms and rules. Additionally, the system itself carries out all the alphanumerical and topological inspections and informs the surveyor of possible inconsistencies, as well as if they can be corrected. Having completed this procedure, the surveyor lets the case be considered from legal aspect. Provided everything is OK, the legal expert records the change which is introduced both in the attribute and in the graphic part of the single integrated database'.*

This response indicates that one step is needed to automatically update the graphical and administrative component, but the process still involves a legal expert and a surveyor who just visually cheek the deed from notary and surveying report, respectively.

5.3.2. External workflows

In the question: What about the external aspect, what are the customers expected to do and what will be different from this change? Five respondents responded in this way:

Subdivision procedure

- Till now the citizens first had to go to private surveying company. They were supposed to take the paper-based surveying report from the private surveying company, take it to the notary who was then interested only in the legal aspect of the document and preparation of the deed, after that the citizens were supposed to send the surveying report together with the deed to AREC. All this procedure was paper based.

- With the new system, citizens have to go to the private surveying company. The surveying company can obtain all the documents needed to go to the spot, to perform the subdivision, to prepare the surveying report, to check it automatically in our system whether it is well prepared, after which the surveying report can be stored in the database, and the customer is issued a document with a unique code. Afterwards the customer goes with this code to the notary in order to conclude the contract for subdivision. After being signed by the contractual parties, the notary forwards it in digital form to the agency. The notary shall inform the customer that the procedure is finished.

Full transfer ownership

- In case of buying-purchasing of real estate already registered in the cadastre, the purchaser and the seller of the real state go to the notary public, declare their intentions and identify the respective real estate, the notary public is legally authorized to enter the cadastre system through the E-Cad Counter and provide all the papers needed for the sales/purchase procedure, to compose notary sales/purchase contract that have it signed by the contractual parties, and to submit this document electronically to the Agency for Real Estate Cadastre for its electronic registration. All this can happen without the parties' coming to the cadastre; they stay in the notary's office. Once the procedure is completed and the notary is informed of the new owner of the respective real estate, the notary receives the registration certificate based on which he can obtain the new ownership certificate for the new owner of the real estate.

To verify this, the following question was posed to the IT engineers (2): If there is no modification in the piece of land, is the notary public obliged to send to you the documents for the lot, or the contract only? The answer was: '*NO. Only the contract will do'.*

The procedure of full transfer ownership still is the same as prior to merging. This is because the administrative database already has been electronically in use before merging.

Regarding this issue 10 opinions were collected from the clients of a private surveying company. The question that was posed to them was: What is your opinion about the fact that in case of any sort of a cadastral procedure, you as a customer need to go to the private surveying company or a notary public only, and the surveying report or the purchase/sale document will be electronically submitted to the Agency?

All of them answered in positive way. Following examples are presented: Respondent 16: '*Great, it would be much easier for me and I would save money and time',* Respondent19: *'That is wonderful idea'* and Respondent 21*: 'This is a great thing it would be easier, we will save time and avoid queues at the counters*'.

5.4. Quality of data

To verify if the new system approach will provide data of higher quality, during the fieldwork cadastral sample datasets were collected for two cadastral parcels. The sample datasets were collected before and after their integration into one database. According to the analyses made, the sample data collected prior to merging, resulted that there were differences in areas, when comparing land title document and the area calculated from the cadastral map. Contrary to this, from the analyses made on datasets collected after their integration resulted that the areas are the same in land title certificate with the one calculated from the cadastral map (Appendix: 4).

However, there also were asked 2 IT engineers regarding this issue their answer was: Respondent 8: '*Definitely yes. In fact, the quality is expected to improve only, not to get worse. Putting all this data integrated into one single database means also application of a number of tools used to make analyses, to identify possible mistakes, etc. In fact, all the mistakes will be immediately identified by the system, it will disable occurrence of these sometimes unintentional mistakes.*' and Respondent 9: *'It definitely will. Previously there may have been differences depending on the way of transferring the data, now there is time harmonization which improves the quality of the data.'*

These responses indicate that all the inconsistencies should be eliminated before their merging into one database. With the elimination of these inconsistencies the new system will provide data of higher quality. In addition, in section 5.3.1 was identified that the new system will automatically carry out all administrative and topological inspections when new cases for registration are submitted. This leads to understanding that the system not only will provide data of higher quality and up-to-date information (considering the official recordings that the agency has), but as well will prevent future errors.

To make sure that also human errors will be avoided the following question was posed to 4 key informants: When a surveyor wants to divide a lot, does the system provide automatic numbering of the lot and automatic placing of the divided areas into the new layout?

The answer from both respondents was: '*No, there isn't manual registration of the areas. That is the major benefit from this project.'* What about numbering? *'The same, it will go automatically, too. The base of the number will be automatically the surveyor has to propose the latest division number'.*

University professors had following opinion regarding the process of merging administrative and graphical databases. Respondent 12 stated that: '*The very fact that these two entities were merged into one organization as early as in 1980s, shows that the idea is not new…Our cadastre is defined as a united, single information system. Advancements in the field of technology and computer sciences have led to closure of this issue, to finalization of the years-long processes'.* In the question: Do you personally approve of this project? Respondent 12 answered in this way: '*Yes, I do. This project will definitely mean obtaining exact, accurate data that will never again in future need to be changed.'*, whereas Respondent 13 answered that '*I strongly believe this process will help to clear the database from these errors, and also the merging of the two databases will contribute to reduction in generation of new errors in the future'.*

5.5. Conclusion

This chapter presented the results aimed to identify how merging of administrative and graphical databases affected the cooperation between public and private sector as well as the internal and external workflows of cadastral procedures (research questions C(1) and C(2)). In addition, were presented the

results which seek to give an answer whether this new system approach will provide data of higher quality and up-to-date information. The results were collected through semi-structured interviews with key informants and two private surveying companies. Additional information was collected from direct observations on software applications, Law on real cadastre, Tariff List on fees, and cadastral datasets before and after merging the databases.

The operational tasks such as surveying, processing, and formatting properties are performed by the private surveying companies. Based on the interview responses, as a result of merging the private surveying companies and notaries are able to purchase administrative and graphical data online using the E-Cad counter. In addition, AREC has worked out new software for processing the data bought from E-Cad counter and preparation of surveying reports which will be electronically checked and submitted to AREC. The new system approach also affects the internal and external workflows of transferring land rights. Regarding the internal workflow of subdivision process, the unified database will allow in one step both administrative and graphical changes to take place. With two databases the internal workflow of subdivision involved first legal changes, after which surveyors were supposed to introduce the graphic change. The external workflow of subdivision also has changes because of the unified database. With the new system parties have to refer only to private surveying company and the notary. The documentation needed for registration will be submitted electronically to the agency. Before merging the graphical database with the administrative one, parties had to link private surveying company-notary-agency with paper documents. The process of full transfer of ownership remains the same as it was before merging. Parties have to go just to the notary, and the deed is submitted electronically to the agency. According to the analysis made with datasets, the new system provides data of higher quality and up-to-date information regarding land registers and cadastral maps.

6. INTERPRETATION AND DISCUSSIONS

Based on the analysed results presented in Chapter 4 and Chapter 5, the purpose of this section is to attach meaning and significance to the results covered in the two previous chapters, which are categorized in topics and are related to the empirical research questions. The interpretation of the findings is done using clear statements and their discussion regarding the literature covered in Chapters 1 and 2.

6.1. General discussion on merging

Merging land registration and cadastre on organizational and legal aspect resulted in a process of merging that is not yet finished. Even if there is only one organization that performs the functions of the cadastral system, still there are issues with maintaining and storing the data/information, data quality that two databases have, as well as efficiency and effectiveness on cadastral procedures. Merging of administrative and graphical databases can be considered as the last step and challenge to achieve the status of Fully Merged (section 2.6).

In case of Macedonia the functions of land registration and cadastre have been merged since 1986 into one organization. However, after almost three decades there was a need of merging the administrative and graphical databases, which is still on-going process. In other cases such as Sweden, Norway and Finland the functions of land registration and cadastre have been merged into one organization in 2008, 2007, and 2010, respectively. In Sweden there is also on-going process that tends to merge the administrative and graphical database, whereas Norway and Finland have integrated land information system, administrative and graphical databases are separately maintained. This shows that due to the new possibilities created by the rapid development of the ICT, the demands of the system such as completeness and correctness between two components have increased dramatically.

6.2. Reasons to carry out the process of merging administrative and graphical databases

Inconsistent and inaccurate data on common attributes between administrative and graphical databases, the inability to monitor the graphical component, and manipulations in cadastral procedures, are the main reasons to carry-out the new project of merging databases in Macedonia. These were considered as main reasons, because issuing of inconsistent and inaccurate data by the agency affected professional users and other organizations on performing their work, such as municipalities to make incorrect urban planning, and private surveying companies to prolong the preparation of surveying reports. The inability to control whether the administrative change took place in the graphics contributed in increasing the inconsistencies and inaccuracies of data. Furthermore, the inconsistency of data on common attributes, especially in area, opened a space for manipulation in cadastral procedures specifically in subdivision procedure. The kind of manipulation that occurred was explained in section 4.1 with the Examples 4: If a land has 1000 m^2, according to the land title document, i.e. 900 m^2 as per the graphics of the lot. If 700 m^2 are in process of being sold, then actually only 300 m^2 remain both graphically and legally for the seller, i.e. 700 m^2 are bought by the purchaser, but in fact the purchaser had actually bought 600 m^2 only. In relation to this, similar reasons were found in Sweden. The project called Albin aimed to improve quality of data because the customer demands was to have correct and complete information (Swensson, 2010).

6.3. Problems during the process of merging administrative and graphical databases

Challenges that arise in this merging process are on identifying and correcting the inconsistencies that exist between databases. First of all from a technical aspect there is a risk of damaging or losing the data as a result of expanding the database model. In this particular case the database is Oracle supplemented with the Spatial Data

Engine (SDE) from ESRI which ensures the geometry of cadastral parcel, and standards which are defined by OGC consortium. The next step that is required is to perform automatic comparisons between the databases to identify all possible errors or mismatches that the databases have. For instance: in graphics exist lots that do not exist on administrative database, numbering of the structures in different order in graphic and in different order in the administrative database, and certain area in graphics that differs from the area in administrative database. According to Blixt (2008) in Sweden also the same approach was applied to identify the inconsistencies. To correct these errors, archive research was made for each cadastral parcel. Having identified these inconsistencies between two databases mostly in common attributes next challenge is to complete and correct them. The correction and completion of these inconsistencies and errors is done to accomplish the condition that is needed before introducing the data into one database i.e. to have consistent data.

The problem that arises is on making consistent the area and on the decision of choosing which of these areas should be considered as master area, the graphical or legal one. This issue involves discussions between surveyors and lawyers who in this particular case had same opinion. The decision made was to have just one area and that is the area calculated from the cadastral map. This means that all areas in land title certificate must be changed to correspond with the graphics, as the tolerance in deviations is zero. This type of problems also were mentioned in the report by Eurogeographics et al. (2012) that merging the information from land registers and cadastral maps is not an easy task as legal valid differences can exist between the extent of property rights and cadastral parcel. In addition, Harvey (2006) also argues that the agreement between land registers and cadastral maps is rarely perfect.

As problematic are considered the differences in area on digital cadastral maps which were produced indirectly through digitizing process. According to the comparative reports collected it was identified that the differences on area are bigger in cadastral municipalities where a Real Estate Cadastre has been established through analogue cadastral maps, which later were digitized (Table 5). The causes of these differences are due to the conversion method applied for adjudication, human errors on calculating the area with old instruments in paper-based maps, as well as the accuracy of the instrument.

The problem does not arise because the old maps were digitized. The differences arise as a result of converting the old land certificates (possessory list) to new land title certificate without checking if the area from the former certificate corresponds to the geo-referenced and digitized map (or even a map that was not yet digitized). In the old land certificates the areas were calculated from hard copy maps using analogue instruments called planimeters with limited accuracy. Furthermore, the differences in area depend on the scale of the cadastral maps. In analogue cadastral maps, which later were digitized and vectorized, with scale 1:1000 the differences are smaller than in maps with scale 1:2500.

Contrary to this, for cadastral municipalities where Real Estate Cadastre has been established through sophisticated technologies (total station, GPS, photogrammetry) where the cadastral map was produced directly in digital format the differences in area are insignificant and are not considered as problematic at all. The cause of the differences in this case is due to the rounding of the coordinates in two decimals (in centimetres) in Mac-Edit, which is the graphical database i.e. before introduction in Mac-Edit the graphics were maintained in file system such as Cad and Micro Station file system where the coordinates were not determined with fix decimals.

The area on administrative database or land title document is not always bigger than the area in the graphics. Regarding the inspections made between graphical and administrative databases resulted that the area in land title

document in some cases is higher, and in some other cases is smaller than the area calculated from the graphics.

6.4. Strategies employed to resolve the problem and accepted alternative

The graphical data overruled the administrative ones. It was mentioned that as master area that the project follows is the one calculated from the graphics. If we refer to the main concepts of land registration and cadastre defined by Zevenbergen (2002) in Chapter 1, Figure 1 shows that the size of the cadastral parcel should be determined by the boundaries of the cadastral parcel. This shows that the area is only one component of a closed figure i.e. the boundaries of a cadastral parcel.

The project of merging the administrative and graphical databases started together with changes in the Law on Real Estate Cadastre in April, 2013. From the changes in Law on Real Estate Cadastre, was adopted the Regulation on Cadastre Maps and Maps of Infrastructure Objects by steering board of AREC. In this regulation in Article 57 was specified that '*the area of the cadastral parcel shall be calculated with an algorithm, after forming of the topological structure, on the basis of the coordinates of the points'* (The Agency for Real Estate Cadastre, 2013) i.e. the same area should be presented in land title certificate.

However, on the Law on Real Estate Cadastre but as well in the Regulation permitted deviation on area from graphical database and administrative database is determined with the formula $\triangle P = 0.0007 * M * \sqrt{P}$ *(where M is the module of the DCM scale and P is the area of the parcel).* The following strategy was implied with the new changes: (1) If the differences in area are smaller than $\triangle P$, the agency changes the area ex-officio without informing the lot owner thereof (Table 5, in green). (2) If the differences are higher than permitted deviations in this case the owner is informed about the change but as well the reasons of the change and stating that the boundaries of the land are not changed (see Table 5, in red). In the second case before undertaking the decision a deep inspection are done in archive data to find the reasons of that change (section 4.4.1). In cases where the old maps are damaged or difficult to identify the boundaries, the actual state on the field will be surveyed. Also in the second case the landowner is entitled to fill complain in the administrative court. Part of the strategy is also the campaigns in media where the citizens are informed on what the agency is working on.

Presenting two types of area, graphical and legal, in a land title document was not accepted as strategy. According to the interviewees this strategy was not accepted because there still will be inconsistencies, on area between two components as well as the space for manipulation is present. To leave the situation as it is and graphical database to be used just for administrative purposes such as numbering of cadastral lots, also was not accepted because of the reasons mentioned above.

The applied strategy showed satisfactory results. According to the information retrieved from the interviewees in territory of Republic of Macedonia 80% of digital cadastral maps are produced indirectly through scanning and digitizing process, and 20% of maps were directly produced in digital format. The former ones in the merging process are seen as problematic because of huge differences in area comparing with land title certificates (Table 5).

In Macedonia, in total are 1912 cadastral municipalities. From the period July 2013 - October 2014, more than 46% have been merged. From these merged cadastral municipalities resulted that more 70% of the lots belong to the accepted deviations. Which deviations are in right proportion with the size of the cadastral parcel i.e. the size of the lot is bigger accepted deviations are bigger.

6.5. Challenges that can occur after merging the databases

In long term, after merging process is finished, parties are legally 'winners' or 'losers'. The term legally 'winners' or 'losers' is used to clarify that the boundaries of the cadastral parcel won't be changed i.e. legal area to correspond with area calculated from graphics. But a comparison between land title document before and after merging can cause new challenges or problems after merging process is done. This is because the land title document is used in all events such as on transfer on land rights, determining the value of land, taxation, mortgage, and privatization as well as for inheritance (Appendix: 3).

The new challenges or problems that can occur are in cases where the area from land title documents has been decreased or increased. In cases where the area has been decreased the problems can occur on sale/purchase transactions where the value of land is based mostly on its area i.e. the purchaser pays the owner for a certain area, after the transaction new land title of the purchaser measures smaller area (Example: 5, section 4.6). Furthermore, another problem can occur if a respective lot has previously registered a mortgage with certain area and after resulted that the area is smaller (Example: 7).

In cases where the area has been increased the problems may occur with other laws and regulation which are linked to the land title certificate. For instance, privatization of certain lot, with certain legal area, whose boundaries never have been changed, with the merging process the lot turn to measure more. The area privatized will measure the one before merging process, whereas the remaining area can cause additional challenges with other institutions. Since the lot owner has not changed the boundaries of his lot, he will ask for a right on whole, probably the owner has to buy out the remaining area from the state (Example: 6).

These three examples show that the change of area in land title certificate can open further challenges such as person-person in cases of full transfer ownership (while merging process is on-going), and person-institution, in this case with the banks (in cases of registered mortgage) and with municipalities or ministries (in case of privatizing land). These examples indicate that cadastral procedures (such as privatization) that have started with land title certificate before merging and/or are still in active process will have mismatch in areas with other legal acts defined by other institutions.

6.6. Citizens' reaction

Changes in area imply fluctuation regarding the citizens' trust in the cadastral system. Changing the area from land title document to correspond with the graphical ones, involves initial negative reaction. The reaction of ten interviewed citizens is different. Most of them claimed that they will refer to agency for further explanation to understand how the change occurred, whereas very few of them supposed that their area has been decreased by claiming that will request the area that they had. On the question whether they are ready to accept this change if such a change happens to their land, most of them claimed that the changes will be accepted only if the area is determined with the boundaries on the spot. According to the interviewees from the agency, most of the citizens left convinced that the boundaries of cadastral parcel have not been changed.

Complaints by the citizens can take place in the administrative court. To complain in the administrative court was part of the strategy (if differences are bigger than ΔP) to overcome the inconsistencies. Parties that cannot be convinced that the boundaries of the cadastral parcel have not been changed or the difference in land title certificate before and after merging the databases is possible to file complain in the court.

6.7. Co-operation between public and private sector

The effects on external system start with improvements on corporation between public and private sector.

The efficiency of purchasing cadastral data and preparing surveying reports has been increased. This involves the private surveying and notaries companies electronically to purchase (online payment) cadastral official data from the Agency, both graphical and administrative. All this is done in few minutes. This is done through the E-Cad Counter application where the purchase of graphical data is as a result of merging the databases.
In addition, this includes the reduced time that is needed to prepare the surveying report (includes both graphical and administrative changes) since the data are consistent. The Mac-Edit software is used for preparation of surveying report, which allows processing of the files from the E-Cad Counter, and afterwards retrieval of this changed data into the electronic cadastre.

Transparency is increased and chances for manipulation are reduced. This new system will deny automatically the new cases (submitted to the agency) that are not worked-out properly by the private surveying companies. This is also in relation with Eurogeographics et al. (2012) vision, that combining the national information from land registration and cadastre will create added value such as transparent and accessible data.

Agency will issue continuously complete and correct data. This is due to the fact that inconsistencies between the administrative and graphical data are corrected. This also has effect on improving the corporation between public and private sector as in many cases private surveying companies have paid for incorrect or out-dated graphical data.

6.8. Cadastral procedures

The effects of merging the databases are even more significant on the internal and external workflows of the cadastral procedures of transferring land rights especially on cadastral procedures where a modification in both administrative and graphical part is needed. External workflows refer to the steps that need to be carried out by the citizens to undertake new cases of transferring land rights. Internal workflows are workflows inside the agency to perform the updating process for new cases received from notary and/or private surveying companies.

External workflow of subdivision process is simplified. The subdivision process starts with application to the private surveying company by the agreed parties. The surveying company purchase all needed data online to perform the subdivision, to prepare the surveying report, and to check it automatically is whether is well prepared. If it is correct is submitted electronically to the agency. To the customer is issued a unique code of the case. Afterwards the customer goes to notary with this code in order to conclude the contract for subdivision. The notary uploads the surveying report and prepares a deed according to data in the report. After been signed the contract, the notary forwards it in the digital form to the agency. The notary shall inform the customer that the procedure is finished.

All this can happen without going the parties to the cadastre, or linking private surveying companies and notaries with paper-based documentation that was needed to be transported. Furthermore, this new system approach will avoid the process of subdivision to be repeated as is checked in advance whether is worked out properly especially by the private surveying companies.

Citizens satisfied regarding the new workflow of subdivision. Regarding this issue opinions of ten citizens were collected. The citizens claimed that this will be in their favour, will save time and avoid queues at the counters.

External workflow of full transfer ownership remained the same as they were before merging. This is due to the fact that full transfer of ownership procedures do not require cadastral map to be submitted. The process of

workflow remained the same. The purchaser and seller go to the notary declare their intentions and identify the respective real estate. Notary is authorized to enter E-Cad counter and provide land title certificate needed for preparation of the deed. After the deed is signed by contractual parties the deed is electronically submitted to the Agency.

Internal workflow updating graphical and administrative part is drastically simplified. This includes efficient and effective updates in both parts. In one step both graphical and administrative parts will be updated. The workflow process is one single and while it lasts involves a legal expert and a surveyor who visually checks the new case received by the private surveying companies.

6.9. Quality of data

The new system approach provides data of higher quality and up-to-date information. The elimination of inconsistencies and errors between the administrative and graphical, and having one database leads to data of higher quality. The system provides up-to-date information regarding the official data that the Agency has. This is in relation with the two main functions of the cadastral system defined by van Oosterom et al. (2006) who claim that two main functions of every cadastral system are to keep the content of land registers and cadastral maps up-to-date based on legal transactions and to provide information on this registration.

6.10. Positive and negative (internal and external) effects of the cadastral system as a result of merging the administrative and graphical databases

This section aims to classify and justify the effects of the cadastral system defined above, that arise as a result of merging the administrative and graphical databases. The classification of the effects is done into positive and negative effects.

Positive effects

1. *The new system approach provides data of higher quality and up-to-date information.* This is because the elimination of inconsistencies and errors between the administrative and graphical databases.

2. *Transparency is increased and chances for manipulation are reduced* - This new system will deny the new cases (submitted to the agency) that are not worked-out properly. Topological and alphanumerical inspections are done in each submission of new case. Agency continuously will issue complete and correct data which is different from the old system where the payment was done and the agency issued incorrect, inconsistent, and out-dated data.

3. *The efficiency of purchasing cadastral data and preparing surveying reports has been increased* – With the new system integrated cadastral data are purchased online in few minutes. Before, private surveying companies had to purchase graphical data in person to the agency, or through online application to the Agency where purchased data were returned back by the employee in the agency. The new system enables to increase preparation of surveying report because of the consistent data that the new system provides.

4. *External workflow of subdivision process is simplified* – parties have to refer only to the private surveying company and notary. All the documentations will be submitted electronically to the agency. The surveying report is checked in advance whether is worked out properly. This will lead citizens to not undertake the process of subdivision twice.

5. *Citizens satisfied regarding the new workflow of subdivision* – time will be saved and queues at the counters will be avoided. Citizens do not have to link three institutions anymore such as surveying company-notary-agency.

6. *External workflow of full transfer ownership remained the same as it was before merging* – just the land title document and the deed from the notary are required. Even the databases are merged there is not a need of submitting land title document with cadastral map, as the workflows inside are different for different processes.

7. *Efficient and Effective internal updates* - In one step both graphical and administrative parts will be updated. The system automatically reflects the attributes of subdivided parcel in land title document. Before merging, the process of subdivision involved two updates manually by lawyers and surveyors.

Negative effects

1. *Legally 'winners' and 'losers', possibility of new problems after merging process* - this is due to the fact that the area in land title document for some parties will be increased and for some other will be decreased i.e. to corresponds with the area in graphics. In cases where the area has been decreased the problems can occur on sale/purchase transactions where the value of land is based mostly on its area. Many laws and regulations are linked with the content of land title document that in long term can cause new challenges.

2. *Changes in area imply fluctuation regarding the citizens' trust in the cadastral system* – the initial reaction is negative. The citizens require further explanation and convince that the boundaries of the cadastral parcel have not been changed.

3. *Complaints by the citizens can take place in the administrative court*.- in cases where the area in land title document have been drastically decreased, and parties that cannot be convinced that the boundaries have not been changed, complains in the court are possible. This was part of the strategy where unsatisfied parties are entitled to fill complaints. This means that the Agency predicts that such complaints may occur.

7. CONCLUSIONS AND RECOMMENDATIONS

7.1. Conclusions

This research explored the positive and negative (internal and external) effects of the cadastral system as a result of merging the administrative and cadastral spatial database. In order to achieve this main objective, three sub objectives were set: A) *To define and classify the concept of merging,* B) *To analyse and identify the main challenges and problems that occur during the process of merging*, and C) *To analyse the impact of the new system approach on cadastral procedures and services.*

For the first sub objective two research questions were posed.

Research question A(1) sought to find what theories exist on merging and how it can be defined. Based on the organization and business administration literature, merging was defined as statutory alliance where one organization is absorbed or acquired by another organization. Unlike this, there were still other views on merging which claimed that merging of two organizations is not merely the combination of two operations under one management authority, successful merging should combine diverse processes, systems, and organizational structures. The combination of these two definitions covered three main aspects of each cadastral system such as organizational, legal, and technical in relation with merging of land registration and cadastre.

Research question A(2) sought to classify merging regarding land registration and cadastre considering three main aspects of the cadastral system. The answer of this research question was addressed in Chapter 2. The classification and definition of merging regarding land registration and cadastre, was done in three classes *Fully Merged, Merged, and Partly Merged.* The first classification, *Fully Merged* covered all three aspects: there is only one organization which performs the functions of land registration and cadastre; one public register where registration of owners, land rights, and land data, is legal only if it is registered in that register; there is only one database including graphical and administrative information, and the data are consistent. The second one, *Merged*, differs from the first one in the technical aspect. There are two databases administrative and graphical which are linked through interface and/or application and inconsistencies are applicable. Third classification was *Partly Merged.* Here just the organizational aspect is covered. The attributes between land registers and cadastral maps are ambiguously defined, and technically there are two databases with no linkage between them.

For the second sub objective three research questions were posed.

Research question B(1) sought to identify the main reasons of carrying out the project of merging the administrative and cadastral spatial databases in Macedonia. The main reasons were: inconsistent and inaccurate data on common attributes (id of parcel, id of building, area) between administrative and graphical databases, the inability to monitor the graphical component, and manipulations in cadastral procedures. Furthermore, these inconsistencies contributed the agency to issue inaccurate and inconsistent data which affected other actors to incorrectly perform their work.

Research question B(2) sought to identify the main challenges and problems during the process of merging administrative and graphical databases. Main challenges were to make consistent the information from both databases such as: missing properties or parcels in graphical database which exist in the administrative one, numbering of the structures in different order in graphical database and in different order in the administrative database, and certain area in graphical database that differs from the area in

administrative database. A key problem was on making consistent the differences in area that exist between two databases. The differences in area were present in digital cadastral maps which were produced indirectly through digitizing and vectorizing process. As master area was chosen the area calculated from the cadastral map.

Research question B(3) sought to understand employed and accepted strategies to resolve the problems. The accepted strategy starts with some changes in law where explicitly was mentioned that area calculated from the graphics should be considered as master one. In the law was also specified the permitted deviations with the formula $\Delta P = 0.0007*M*\sqrt{P}$ *(where M is the module of the DCM scale and P is the area of the parcel).* If the differences in area were smaller than ΔP, the agency changes the area without informing the lot owner. Unlike this if the differences are higher than permitted deviations in this case the owner is informed about the change but as well the reasons of the change and stating that the boundaries of the land are not changed. In the latter case, inspections are done in archive to find the reasons of the difference, and also the landowner is entitled to make complain in the administrative court. As employed strategies were to leave the situation as it is, that means still to be used the formula that allows deviations, or to define two types of areas graphical and legal one in land certificate. These strategies were not accepted as the main aim of the project is to have consistent data.

For the last sub objective three research questions were posed.

Research question C(1) sought to identify how does the new system approach affect the cooperation between public and private sector. As a result of merging the administrative and graphical databases the cooperation between public and private has been enlarged. The efficiency of purchasing cadastral data and preparing surveying reports has been increased. There is E-Cad Counter system from where can be purchased online administrative and graphical data as well as Mac-Edit software which is used for preparation of surveying reports and submitting electronically to the agency. Transparency is increased and chances for manipulation are reduced. The surveying reports which are not worked properly will be denied automatically by the system. Agency will issue continuously complete and correct data.

Research question C(2) sought to identify how does the new system affect the internal and external workflows of transferring land rights. Internal workflow updating graphical and administrative part is extremely simplified in one step the changes take place in the administrative and graphical part. Surveyors and Lawyers inside the Agency just visually check the surveying report by the agency. The external workflow of subdivision is simplified too. Parties have to refer only to the private surveying company and notary. All the documentations will be submitted electronically to the agency. The external workflow of subdivision procedure remains the same, only the deed from notary is required.

Research question C(3) sought to answer the question whether this new system approach will provide data of higher quality. The system provides data of higher quality and up-to-date information regarding the content of land registers and cadastral maps.

Main Research Objective:

The main objective of this study was to identify the positive and negative (internal and external) effects of the cadastral system as a result of merging the administrative and graphical database into one. The positive and negative effects of the cadastral system as a result of one defined database were derived from the methodology used for this research as well as from the study object that was chosen.

Positive effects	Negative effects
1. The new system approach provides data of higher quality and up-to-date information *2. Transparency is increased and chances for manipulation are reduced* *3. The efficiency of purchasing cadastral data and preparing surveying reports has been increased* *4. External workflow of subdivision process is simplified* *5. Citizens satisfied regarding the new workflow of subdivision* *6. External workflow of full transfer ownership remained the same as it was before merging* *7. Efficient and Effective internal updates*	*1. Legally 'winners' and 'losers', possibility of new problems after merging process* *2. Changes in area imply fluctuation regarding the citizens' trust in the cadastral system* *3. Complaints by the citizens can take place in the administrative court*

7.2. Recommendations

For further research

The method used to answer the first sub objective (A) was based on literature review and desk study. In order to support these findings on the cadastral systems it is useful to perform additional interviews with key informants of the agencies of the considered countries. This way the findings will be better conceptualized since they will be based on two types of sources that will provide added information on the findings.

The empirical data collection in this research was based on triangulation principle using semi-structured interviews, grey literature, datasets, and direct observations. The findings indicate that this approach is relevant to answer the main objective of this research. However, in addition to the professionals who were interviewed, the study considered also 10 citizens as one specific group of interviewees. For further research, it will be more useful to increase the number of respondents aside the professionals to enable an appropriate definition of the extent to which the new system approach adversely affects the citizens' trust regarding the agency.

The main objective of this research was achieved through research questions posed under the sub objectives. Based on this, a classification of positive and negative effects was made. The findings regarding the positive effects are considered from the perspective of a centralized administrative and graphical database. Further research should investigate how separate cadastral databases can be upgraded to yield positive effects similar to that of a merged administrative and graphical database.

The study object of this research was the cadastral system of Macedonia. The Macedonian case was different from the other reviewed cadastral systems because of the operational tasks, which are performed by the private sector. For further research it is recommended to analyse and identify what kind of effects on cadastral procedures can be derived in different study object where private sector is not part of the cadastral system.

For countries that will tend to merge databases

For countries that will tend to undertake the process of merging the administrative and graphical database it is recommended: Firstly, to make analyses before undertaking this process. With carried analyses will be identified the extent of inconsistencies between two database. Secondly, it is recommended to define through legislations which of common attributes will be considered as legal.

For Macedonia / AREC

For practitioners in Macedonia it is recommended to improve the undertaken campaign as citizens require further explanations regarding the changes in area. It is recommended AREC to organize different type of campaign such as 'open days' with citizens.

Merging of administrative and graphical led to eliminate inconsistencies and provide up-to-date information regarding the official recorded data that the Agency has. However, it is recommended to analyse to what extent the recorded data fits to the actual state.

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APPENDICES

APPENDIX 1: List of respondents

Resp.	Position	Background	Organization	Location	Date of interview	Type
1	Management position	Lawyer	Agency For Real Estate Cadastre of Republic of Macedonia	Skopje	17.10.2014	Recorded
2		Surveyor		Skopje	20.10.2014	Email Communication
3		Surveyor		Skopje	02.10.2014	Recorded
4	Key Informants (Involved in the project of merging the databases)	Surveyor		Skopje	03.10.2014	Recorded
5		Surveyor		Shtip	13.10.2014	Recorded
6		Lawyer		Skopje	03.10.2014	Recorded
7		Lawyer		Skopje	09.10.2014	Recorded
8		IT		Skopje	01.10.2014	Recorded
9		IT		Skopje	02.10.2014	Recorded
10	Heads of Private Surveying Companies	Surveyor	Katastar-Pro	Gostivar	18.10.2014	Notes
11		Surveyor	Geoplan	Tetovo	10.10.2014	Notes
12	University Professors	Surveyor	Faculty of Civil Engineering - Department of Geodesy	Skopje	22.10.2014	Recorded
13		Surveyor	Faculty of Civil Engineering - Department of Geodesy	Skopje	14.10.2014	Recorded
14-23	Citizens	n/a	n/a	Tetovo	23.10.2014	Filled by citizens

APPENDIX 2: Interview questions

A) Interview with people in Management Position

1. How the data are organized, both its administrative part and its graphical part, prior to merging the data into one database?
2. Which attribute, datum contained in the cadastral parcel is also part of the legal document, of the land title certificate?
3. Which is the legal valid information, regarding these common attributes?
4. Which were the problems you encountered in the previous system that underlie the present merging these two databases into one database?
5. How does the inconsistency of data between these two databases affect the cadastral procedures?
6. Do you think that the difference between these two sources of data may have led to some sorts of manipulations?
7. Do you think that various adjudication methods applied had to a certain extent brought about the occurrence of this differences?
8. Which cadastral procedures were electronically performed and submitted to the Agency before merging the databases?
9. Which cadastral procedures were in paper form submitted to the Agency?
10. Which are the positive effects that you expect from this new system?
11. Do you expect emergence of some problems related to this new system?
12. Lastly, is there anything very important that you would like to say and I have not raised is as an issue?

B) Interview with Surveyors/Lawyers

1. Which is the major objective of merging the administrative and graphical databases?
2. Which problems have you encountered in the process of merging the administrative and graphical databases?
3. Which area is the master area you follow, the one calculated from the cadastre lot, or the area registered in the legal document?
4. Prior to merging, will there be any permitted tolerance, or the match administrative data: graphical data must be 1:1?
5. Is the area in the alphanumerical database always bigger than the one in the graphical database?
6. Which are the other problems in the merging process, apart from the area?
7. Do you think that various adjudication methods applied had to a certain extent brought about the occurrence of this differences?
8. Do you think that it is conversion that contributes to these problems?
9. As a surveyor/lawyer, what is your opinion, which is more correct to change, the area from the land title certificate or from the cadastral map?
10. Could you name, list some of the strategies you applied in order to overcome these differences?
11. Was there another strategy that was not accepted, that was totally different from this one?
12. Based on which regulation or law is the change or areas introduced into the land title document?
13. Do you think that this change will affect the citizens' rights regarding registration and their trust in the Agency? Don't you think it can appreciably shake the citizens' trust in the Agency?
14. Lastly is there anything of significance that was not covered by my questions?

C) Interview with IT

1. Which is the major objective of merging attributive and graphical databases?
2. Which standards were used for creation of this new database?
3. How do you identify the differences between the common attributes of the two databases, for instance, the number of the cadastre lot and the area?
4. Which difficulties did you encounter in the process of merging these two bases, due to their differences?
5. Have you worked out a new software or application for the cadastre procedures and conditions, as a result of merging the two databases?
6. Where will be data be provided from, will there be separate application?
6.1. In which format will these products be submitted to the private sector?
7. Regarding the new system, which will be the main difference in the process of subdivision or other sort of modification of the cadastral parcel?
7.1. Regarding the internal process of updating, can we reconfirm that, unlike the past when updating had to go in two steps, now only one step of updating will be sufficient?
8. Will that be performed automatically or manually, meaning, there will be two officers in the Agency updating the alphanumeric and then the graphic part?
9. What about the external aspect, what are the customers expected to do and what will be different from this change?
10. Who will inform the customer of completion of the updating, the agency or notary?
11. If there is no modification in the piece of land, is the notary public obliged to send to you the documents for the lot, or the contract only?
12. When the surveyor wants to divide a lot, does the system provide automatic numbering of the lot and automatic placing of the divided areas into the new land title certificates?
13. In your opinion, will this project raise the quality of the data issued?
14. Does this new system mean that we shall have at any time updated data?
15. Lastly is there anything of significance that was not covered by my questions?

D) Interview with Heads of Private Surveying Companies

1. What kind of software and/or application are you using from the Agency?
2. Which type of data do you mostly purchase from the Agency?
3. Do you encounter inconsistent data from the lot geometry and the land title certificate?
4. Which are the difficulties encountered when preparing the surveying reports, and which arise from these inconsistencies between the data from the graphical part and from the land title certificate?
5. In your opinion, do you think that having consistent data both in the administrative and the graphical part means better efficiency in your work, in your operation?
6. In which form do ultimate users, the clients, get your final product, which they are supposed to submit to the cadastre?
7. In your opinion, which is the advantage offered by the new electronic system, with respect to the private surveying companies.
8. Does this new system enable provision of data of better quality?

E) Interview with University Professors

1. Were you, as a university professor, a member of the team preparing the new project for merging alphanumerical and graphical data into one single database?
2. What is your opinion about this project on merging the administrative and graphical databases into one single database?
3. Can we say that the main reason for merging were the differences in the common attributes present in both databases?
4. Do you think that changes in the area in the land title certificate, done in order to match the data from land title certificate with that in the cadastral maps may give birth to disputes and disagreements?
5. Do you think that the project will contribute to people's losing their trust in the Agency?
6. Having in mind private surveying companies, do you believe that this project will lead to standardization in the work of the private surveying companies?
7. Will existence of consistent data put an end to all the possible manipulations?
8. In your opinion, which area should be considered as master area, the administrative one or the area calculated from the cadastral map?
9. Do you think that the Agency should launch a campaign in order to inform the citizens better of the process going on, explaining clearly the issue to the concerned parties?
10. Is there anything you would like to add about the project itself?

F) Interview with Citizens

1) What would be your reaction if the area of your cadastre parcel was changed in the land title document due to matching its area to the on-the-spot surveyed data?
2) Would you be ready to accept this change of the lot area in the land title document?
3) What is your opinion about the fact that in case of any sort of a cadastre procedure, you as a customer need to go to the private surveying company or a notary public only, and the surveying report or the purchase/sale document will be electronically submitted to the Agency?
4) Do you believe this way things would be better for you? In which way would it be better?

APPENDIX 3: Land Title Certificate

Digital signature
Time stamp

РЕПУБЛИКА МАКЕДОНИЈА
АГЕНЦИЈА ЗА КАТАСТАР НА НЕДВИЖНОСТИ
1105-880/2015 од 14.01.2015 14:56:55

Податоци за сертификатот на АКН на Р. Македонија
Издаден на: Elektronski salter
Издавач: KIBS Certificate Services CA
Сериски број: 26 88 e1 cf
Валиден до: 16.10.2015
Датум и час на потпишување: 14.01.2015 во 14:57:13
Документот е дигитално потпишан и е правно валиден

1105-880/2015

ИМОТЕН ЛИСТ број: 4622

Data about title holder

ЛИСТ А: ПОДАТОЦИ ЗА НОСИТЕЛОТ НА ПРАВОТО НА СОПСТВЕНОСТ

Ред. бр.	ЕМБГ / ЕМБС	Име и презиме / Назив	Адреса / Седиште	Дел на недвижност	Правен основ на запишување	Бр. на пред. по кој е извршено запишување	Датум и час на запишување
1	***		М.БАФТИЈАРИ 91, ТЕТОВО	1/1		50 / 10	04.03.2010

Data about cadastral parcel and

ЛИСТ Б: ПОДАТОЦИ ЗА ЗЕМЈИШТЕТО (КАТАСТАРСКА ПАРЦЕЛА) И ЗА ПРАВОТО НА СОПСТВЕНОСТ

Број на катастарска парцела		Викано место/улица	Катастарска		Површина во м2	Сопственост / сосопственост / заедничка сопственост	Право преземено при конверзија на податоците од стариот ел.систем	Бр. на евид. лист	Бр. на пред. по кој е извршено запишување	Датум и час на запишување
основен	дел		култура	класа						
8475		ГРАД	50000	1	94		831		69 / 10	31.03.2010
8475		ГРАД	50000	2	35		831		69 / 10	31.03.2010
8475		ГРАД	50000	3	10		831		69 / 10	31.03.2010
8475		ГРАД	70000		281		831		69 / 10	31.03.2010

Data about registered apartments

ЛИСТ В: ПОДАТОЦИ ЗА ЗГРАДИ, ПОСЕБНИ ДЕЛОВИ ОД ЗГРАДИ И ДРУГИ ОБЈЕКТИ И ЗА ПРАВОТО НА СОПСТВЕНОСТ

Број на катастарска парцела		Адреса (улица и куќен број на зграда)	Бр. на зграда/друг објект	Ном. на зг. и друг об.	Намена на згр. преземена при конверзија на податоците од стариот ел.систем	Влез/Кат/Број на посебен/заеднички дел од зграда			Намена на посебен/заеднички дел од зграда	Внатрешна површина во м2	Отворена површина во м2	Волумен во м3	Сопственост / сосопственост / заедничка сопственост	Право преземено при конверзија на податоците од стариот ел.систем	Бр. на евид. лист	Бр. на пред. по кој е извршено запишување	Датум и час на запишување
основен	дел					Влез	Кат	Број									
8475	0	УЛ.ГОСТИВАРСКА БР.26	1		ПОМОШНИ ПРОСТОРИИ	1	ПО	1		14				831		50 / 10	04.03.2010
8475	0	УЛ.ГОСТИВАРСКА БР.26	1		СТАМБЕНА ЗГРАДА - СТАН	1	ПР	1		63				831		50 / 10	04.03.2010

Г.Промени на други стварни права и други права чие запишување е утврдено со закон, прибележување на факти од влијание за недвижностите и предбележување

Г11.ДРУГИ СТВАРНИ ПРАВА преземени од стариот електронски систем (ХИПОТЕКА, РЕАЛЕН ТОВАР, СЛУЖБЕНОСТИ И ИНТАБУЛАЦИЈА)

Број на катастарска парцела		Бр. на зграда	Влез/Кат/Број на посебен дел од зграда			Намена на посебен дел од зграда	Внатрешна површина во м2	Опис	Број на предмет по кој е извршено запишување	Датум и час на запишување
основен	дел		Влез	Кат	Број			
8475	0	1	1	ПО	1		14	ЗАСНОВАНА ХИПОТЕКА ОД ПРВ РЕД НА ДЕН 10.06.2010Г. ВО 15 Ч. ВРЗ ОСНОВА НА НОТАРСКИ АКТ ОДУ 206/2010 ОД 10.06.2010 (ИЗВРШНА ИСПРАВА) ОД НОТАР СНЕЖАНА Г.- БИДОЕСКА ВО КОРИСТ НА ИЗВОЗНА И КРЕДИТНА БАНКА АД СКОПЈЕ ЗА ИЗНОС ОД 25.000,00 ЕУР.	0 / 2010	10.06.2010 00:00:00

Registered mortgage in apartment

Легенда на внесени шифри и кратенки:

Шифра	Опис
ПОМОШНИ ПРОСТОРИИ	
СТАМБЕНА ЗГРАДА - СТАН	
831	ПРАВО НА СОПСТВЕНОСТ
50000	ПОД ЗГРАДА
70000	ДВОР

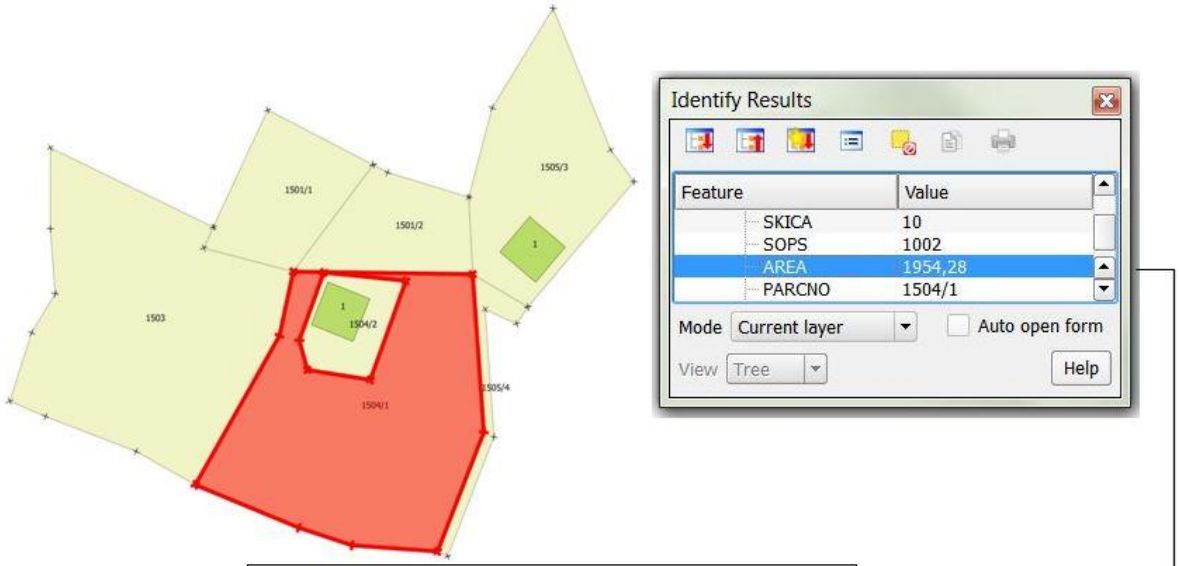
Тип	Опис
Извод	Дел од содржината на имотниот лист за избраните парцели или згради

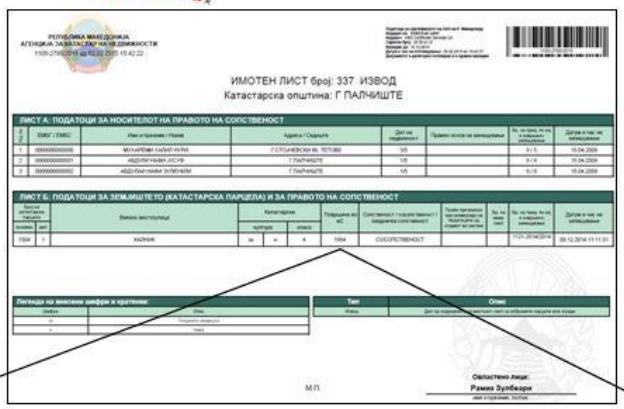
М.П.

Овластено лице:

име и презиме, потпис

APPENDIX 4: Sample data – before and after merging the databases.





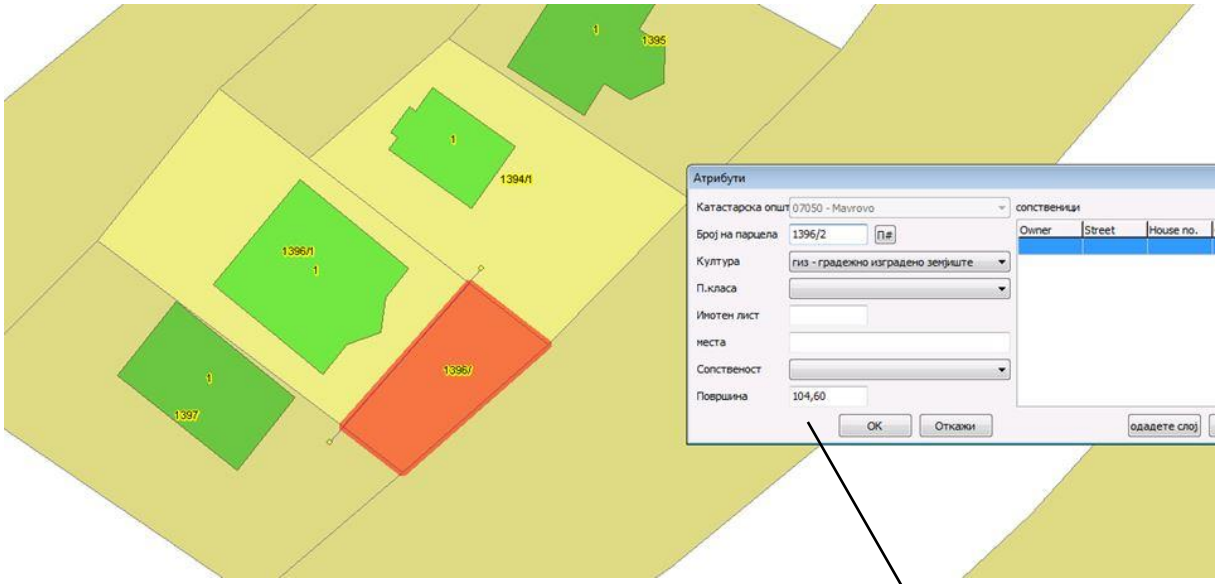
Before

Катастарска			Површина во м2
култура		класа	
	11000	4	1944

After

Катастарска			Површина во м2
култура		класа	
33	н	4	1954

APPENDIX 5: Process of subdivision using Mac-Edit software and automatic changes in the administrative part



Парцела (нова состојба)

Пар.	Пар.д.	Кат. одд.	Кат. опш.	Бр. на пар.	ИЛ	Тип	Намена	Површина	
3	5	7 - ГОСТИВАР	МАВРОВО	1396/2	2244		гиз	104.6	
2	4	7 - ГОСТИВАР	МАВРОВО	1396/1	2244		зпз	124.46	
2	3	7 - ГОСТИВАР	МАВРОВО	1396/1	2244		гиз	252.69	