Master Thesis

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zum Thema

„Scope of Cadastre Reconstruction in the Republic of Kosovo“

with an Outlook to the Land Administration Domain Model

vorgelegt von

Dipl.-Ing. (FH) Alexander Schmidt
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Declaration

Hiermit erkläre ich, dass ich die vorliegende Arbeit selbständig angefertigt habe. Es wurden nur die in der Arbeit ausdrücklich benannten Quellen und Hilfsmittel benutzt. Wörtlich oder sinngemäß übernommenes Gedankengut habe ich als solches kenntlich gemacht.

Meißen, 29.06.2011

Ort, Datum

Unterschrift

(Alexander Schmidt)

Kurzfassung

In dieser Arbeit wird die Notwendigkeit der Katasterrekonstruktion anhand der Situation in der Republik Kosovo dargestellt und diskutiert. Nach einem kurzen Blick in die wechselhafte Geschichte dieses Landes und der Entwicklung des Rechtssystems werden einige Beispiele aktueller Katasterdaten vorgestellt. Anhand dieser Daten werden Modelle zur Datenrekonstruktion beschrieben und diskutiert. Abschließend wird ein Prozessablauf zur Datenrekonstruktion vorgeschlagen.

Weiterhin werden die vorhandenen Systeme zur Speicherung der Kataster- und Registrierungsdaten vorgestellt. Diese werden mit der neuesten Entwicklung des Land Administration Domain Models (LADM) verglichen. Die Historie des LADM wird kurz vorgestellt mit einem kleinen Ausblick auf die weitere Entwicklung.

Abstract

In this thesis, the necessity of reconstruction of cadastral data is presented and discussed based on the situation in the Republic of Kosovo.

After a brief look into the historical development of this region, some examples of actual cadastral data are presented. Based on these data, models used for data reconstruction are described and discussed. At the end, a process for data reconstruction is proposed.

Furthermore, the existing systems for storing of the cadastral and registration data are presented. These are compared with the latest development of the Land Administration Domain Model (LADM). The history of LADM is briefly presented with a preview of the future development.

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Acronyms

(alb: text)	Albanian translation of preceding English term, e.g. KCA (alb: AKK).
(eng: text)	English translation of preceding term in original language,
AKK	→ KCA
BCC	Building Cadastre Construction
BMZ	Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung Federal Ministry for Economic Cooperation and Development
CCDM	Core Cadastral Domain Model
CD	Committee Draft
CR	Cadastre Reconstruction
CZ	Cadastral Zone
DIS	Draft International Standard
EULEX	European Union Rule of Law Mission in Kosovo
FAO	Food and Agriculture Organization of the United Nations
FDIS	Final Draft International Standard
FIG	Fédération Internationale des Géomètres (eng: International Federation of Surveyors)
FLOSS	Free and Libre Open Source Software
FLOSS SOLA	FLOSS Solutions for Open Land Administration
FRYREF30	Federal Republic of Yugoslavia Reference System, defining in 1924
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH (eng: German International Cooperation) (since 1st January 2011; precursor organisations: DED, GTZ, InWent)

GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH (eng: German Technical Cooperation) (up to 31st December 2010; afterwards GIZ)
INSPIRE	Infrastructure for Spatial Information in Europe
IPRR (alb: RDPP)	Immovable Property Rights Register (alb: Rregjistri I Drejtes se Prones te Palujtshme)
IS/TS	International Standard
ISO/TC 211	International Organization for Standardization / Technical Committee 211 (Standardization in the field of digital geographic information)
ITF	Interlis Transfer Format
KCA (alb: AKK)	Kosovo Cadastral Agency (Agjencia Kadastrale e Kosovës)
KCID	Kosovo Cadastral Interim Database
KCLIS (alb: SIKTK)	Kosovo Cadastre and Land Information System (alb: Sistemi i Infromacioneve Kadastrale te Tokes ne Kosove)
KCSP	Kosovo Cadastre Support Programme
KLA (alb: UÇK)	Kosovo Liberation Army (alb: Ushtria Çlirimtare e Kosovës)
KOSOVAREF01	Kosovo References System, defining in 2001
LA	Land Administration
LADM	Land Administration Domain Model
MAPL	→ MLGA
MCO	Municipal Cadastral Office
MESP (alb: MMPH)	Ministry of Environment and Spatial Planning (alb: Ministria e Mjedisit dhe Planifikimit Hapsinore)
MLGA (alb: MAPL)	Ministry of Local Government Administration (alb: Ministria e Administrimi te Pushtetit Lokal)
MMPH	→ MESP
OGC	Open Geospatial Consortium
OICRF	Office International du Cadastre et du Régime Foncier (eng: Permanent Institution of the International Federation of Surveyors)
RDPP	→ IPRR
SIGIT	Sistema de Gestion Intergral de Tierras

SIKTK	→ KCLIS
UÇK	→ KLA
UN	United Nations
UNECE	United Nations Economic Commission for Europe
UNMIK	United Nations Interim Administration Mission in Kosovo
UNOSEK	United Nations Office of the Special Envoy for Kosovo
USAID	
WB	The World Bank

1 Introduction

1.1 Motivation

The availability and timeliness of digital cadastral and registration data is a decisive basis for the quality and transparency of decisions in the administration, politics and economy. Securing of land ownership, planning of infrastructure provision and addressing of locations or points are preconditions for economic and political development of a country. The economic development of their country depends not only on their own economic conditions but also from those in neighbouring countries. In an increasingly integrated Europe, this is a non-negligible aspect. Not only the economy is growing together, the spatial data are more and more to be correlated.

To meet these requirements, the cadastral and registration data have to be kept up to date and consistent. Because of the collapse Republic of Yugoslavia and the further fragmentation, the situation of the cadastral and registration data in the Republic of Kosovo is not just refer to as well.

Important steps towards digital data storage have been taken and are being taken for several years. Now it remains the last discrepancies between the data to correct. Through a variety of professional assignments in the Republic of Kosovo the author of this master thesis got a deep to very deep insight into the enhanced land-registration system of Kosovo. By identifying more and more information, a kind of detective instinct was aroused. This was even with the rash, to carry out the master's thesis in this area.

1.2 Theory (Hypothesis)

Based on the above-mentioned problems, the following assumptions will be introduced:

+ The cadastral administration lacks a clear plan for consolidation of cadastral data
+ The existing regulations lacks a unified approach to cadastre reconstruction

+ The data transfer of graphical data into an electronic, combined cadastre and registration system is not yet fully established. One such a system can be created based on ISO/TC 211 19152 (DIS).

1.3 Expected Results

The results of the work carried out in the context of this thesis shall be a basic concept for further tasks in the field of cadastre reconstruction. The result namely should be a process with description of the steps to undertake cadastre reconstruction and/or preparation tasks for support cadastre reconstruction.

1.4 Issues Not Covered

The realisation and implementation of the derived methodology should be done in the closest future. It is not part of the thesis to analyse the results of the implementation/realisation on the spot. However, the methodology should be tested under real situations in the field of cadastre (reconstruction) in the Republic of Kosovo. Then it will be shown if the first version of the methodology is practicably and useful.

It should also be mentioned, that there is no system or methodology (in this field) which can be used “as it is” from the start. Furthermore, improvements must be made on the requirements of each new case of cadastre reconstruction.

1.5 Audience

This thesis addresses anybody who would like or is required to undertake cadastre reconstruction in Kosovo or in another country of the world. The thesis provides on one hand a prototype of a possible methodology for systematic cadastre reconstruction.

On the other hand, the existing and future data models for combined storing of cadastral, registration, and other data will be explained and discussed.

1.6 Structure of Thesis

Following this chapter, the closest history of Kosovo is described in chapter two. The description starts with the socialistic time, over the war at the end of the last century, and ends with the foundation of a new Republic.

In chapter 3 an overview of the legal framework is given. A cadastre especially a real estate cadastre is closely linked with the registry of property of the spatial units described in the cadastre. The overview will start with the historical framework – Albanian Customary Rights – goes over the interim legal framework and comes to the actual legal framework.

Chapter 4 lists all the used material for the analyses as well as the course of investigations.

Possible reasons for cadastre reconstruction mentioned in Chapter 5. Whereas the cadastre maintenance is described in Chapter 6. Chapter 7 shows possibilities of consolidation of cadastral data. In Chapter 8 data models of existing and to be developed data storages are described. Findings and an outlook are discussed in Chapter 9.

Figure 1 shows a graphical representation of the structure in a cadastre conformal way.

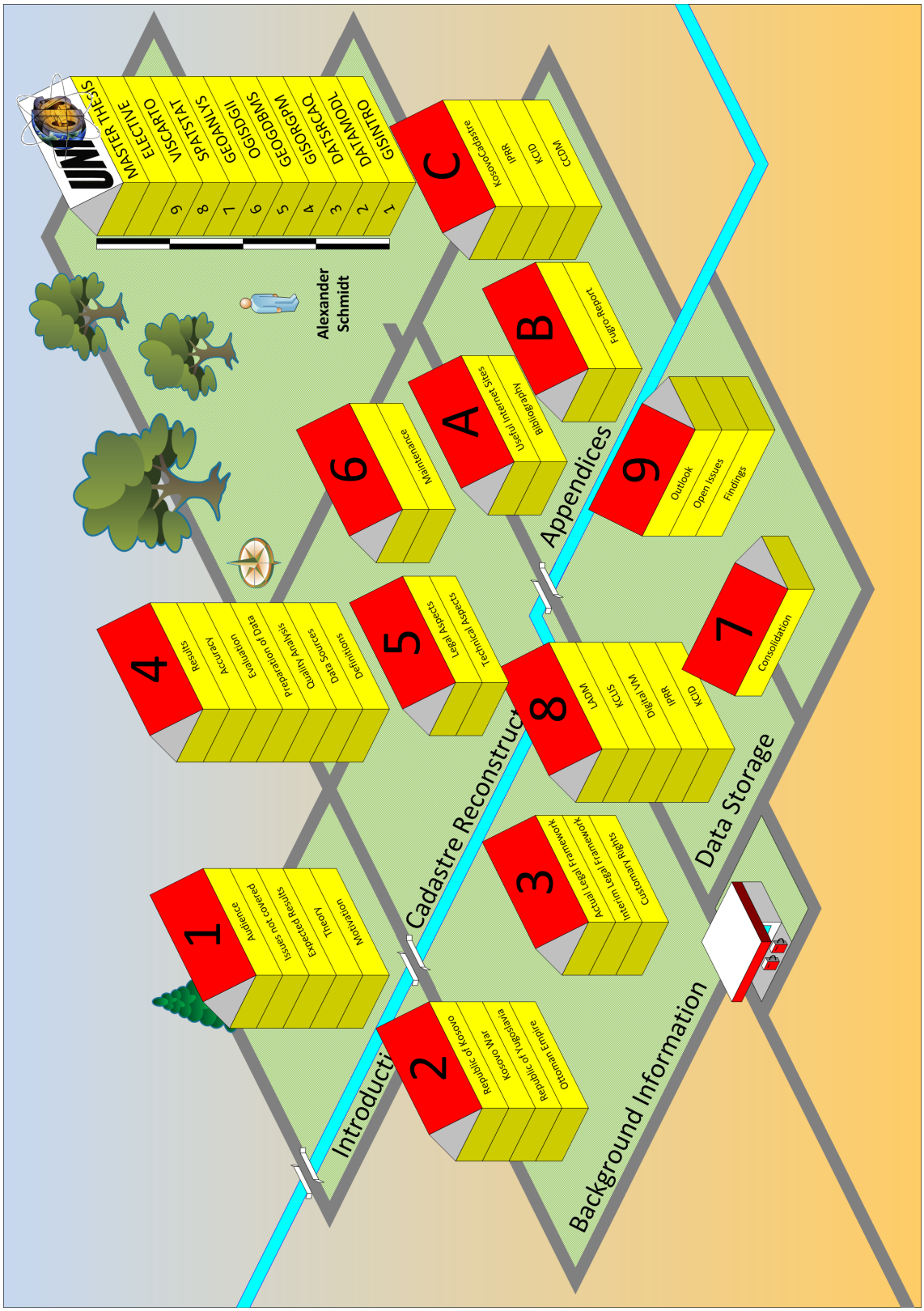


Figure 1: Structure of Master Thesis

I Background Information

2 History of Kosovo

For a better understanding of the topics of this thesis, a brief look into the history of the country, today known as Kosovo, is necessary.

2.1 Ottoman Empire

In the 14th and 15th century, this south-east part of Europe was occupied by the ottomans and was part of the ottoman empire, also known as osmanic or osmanian empire, till the beginning of the 20th century.

During this time, culture, economics and religion were strongly influenced by the new leaders. The Islam became the predominant religion there, pushing back the christian and orthodox faith.

Although there were several migration movements within this time by serbs, albanian and other peoples of surrounding areas, there was never a tendency to create an independent state there by one of these ethnic groups.

2.2 Federal Republic of Yugoslavia

After World War 1 and the end of the Austrian kingdom, a new kingdom was founded in the southeast of Europe as the kingdom of the Serbs, Croats and Slovenes. During World War 2, this part of Europe was invaded by the axis powers (Germans, Italians and others). After World War 2, this country was known as Republic of Yugoslavia. In the 90s of the last century, this Republic broke up into several independent states in a several years long process.

2.3 The Kosovo War 1999

The Kosovo War was two sequential armed conflicts in Kosovo. The first one was an armed conflict between the KLA (Kosovo Liberation Army), better known under the Albanian wording UÇK, and the police of the Republic of Yugoslavia. It took place between January 1998 and March 1999. The main purpose was a fight for the independence of Kosovo.

The second, so-called intergovernmental phase of the conflict began on 24 March 1999 and ended on 10 June 1999. During this time, NATO air attacks were made on the entire territory of the Yugoslav republic of Serbia, were continued in the military conflicts between the Yugoslav armed forces and the rebels.

2.4 The Republic of Kosovo

After the break-up of the former Republic of Yugoslavia and the following battles in this region, there was a tendency within the international organization of states to support the wishes for the creation of a new state in south-east Europe, dividing the region into Serbs and Albanians. After a several years long international discussion, the Republic of Kosovo was founded in 2008.

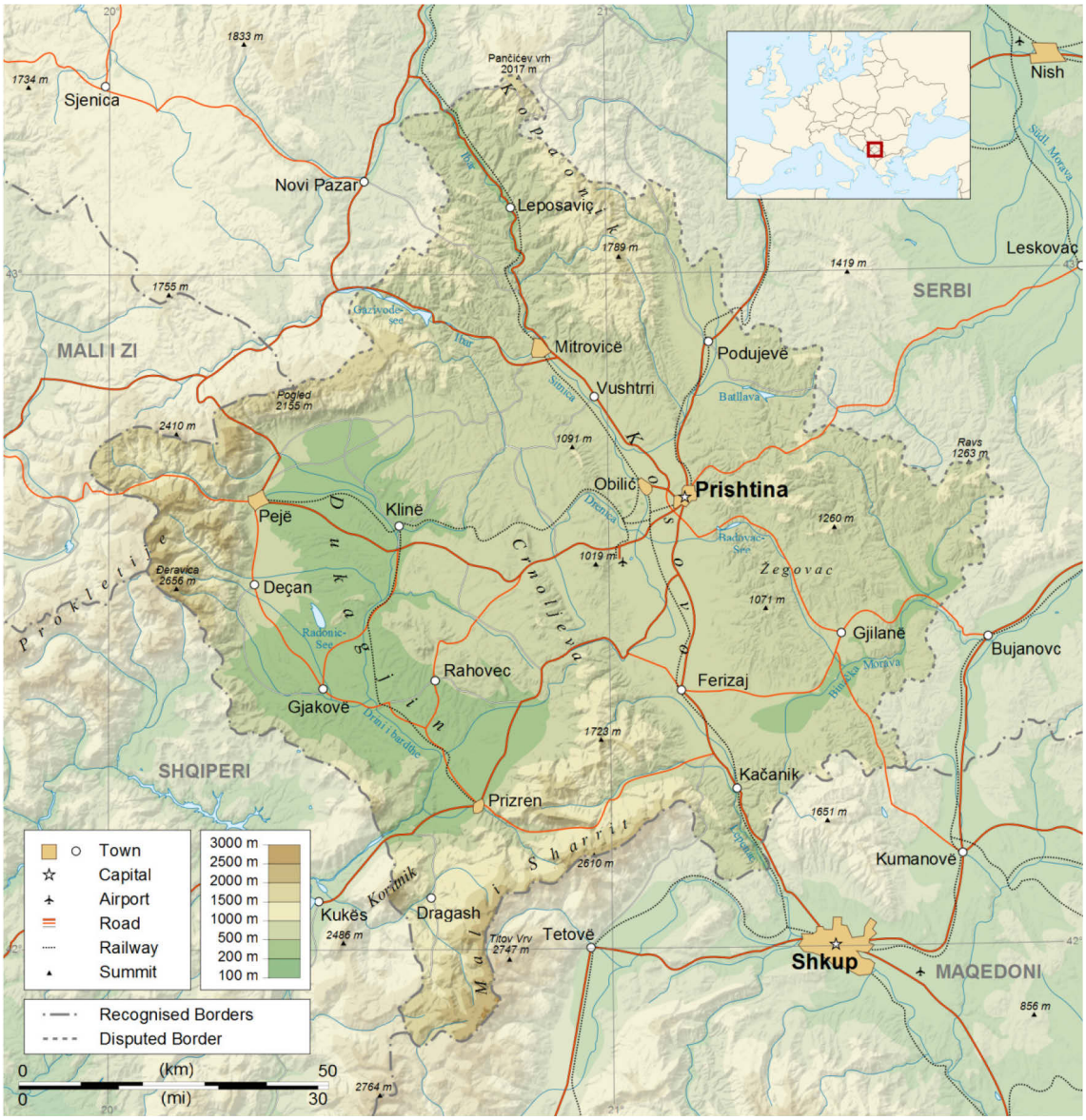


Figure 2: Map of the Republic of Kosovo [1]

[1] Source: http://commons.wikimedia.org/wiki/File:Kosovo_map-al.svg?uselang=de (Author: Wikimedia-User Sémhur; little changes by A. Schmidt)

3 Legal Framework

3.1 Historical – Albanian Customary Rights

Most of the inhabitants of Kosovo call themselves not as Kosovars, but as Albanians in Kosovo. For this reason, it appears necessary to look at the traditional laws of Albania. These traditional laws have been summarised and published in the Kanun around the beginning of the 19th century:

> *The heartland of the Kanun is Dukagjin, i.e. the highlands of Lezha, Mirdita, Shala, Shosi and Nikaj-Merturi and the Dukagjin level in today's western Kosova. Lekë Dukagjini (1410-1481), after which the Kanun is called, remains a little known, a mystery person to be a prince and companion of the Albanian national hero Skanderbeg (1405-1468) was. Whether he put together the Kanun or he simply gave his name can not be determined.*
>
> *[...]*
>
> *The Kanun of Lekë Dukagjini was first used by the in Janjeva, south of Prishtina in Kosova, born Franciscan Father Shtjefën Gjeçovi or Gjeçov (1874-1929) systematically recorded and published.*[2] *(Elsie, 2001)*

The Kanun provides a whole chapter for boundaries (see Dukagjini et al., 1989, chapter 13). The important paragraphs are given below:

[2] Citation in original language: »*Das Kernland des Kanun ist Dukagjin, d. h. das Hochland von Lezha, Mirdita, Shala, Shosi und Nikaj-Merturi, sowie die Dukagjin-Ebene im heutigen westlichen Kosova. Lekë Dukagjini (1410-1481), nach dem der Kanun genannt wird, bleibt eine wenig bekannte, schleierhafte Person, die ein Fürst und Weggefährte des albanischen Nationalhelden Skanderbegs (1405-1468) gewesen sein soll. Ob er den Kanun zusammenstellte oder ihm lediglich seinen Namen gab, ist nicht zu ermitteln.* […] *Der Kanun des Lekë Dukagjini wurde zuerst von dem in Janjeva, südlich von Prishtina in Kosova, geborenen Franziskanerpater Shtjefën Gjeçovi bzw. Gjeçov (1874-1929) systematisch erfaßt und veröffentlicht.*«

Chapter Thirteen – Boundaries

LVII – 'Land Boundaries are not Movable'

§ 238. *The boundary is constructed with large, towering rocks thrust into the earth and exposed above it. An aged tree may also serve as a boundary.*

'The boundary stone has witnesses behind it.'

§ 239. *The boundary stone has witnesses around it. These six or twelve small rocks which are buried in the earth around the boundary stone.*

§ 240. *When boundaries are fixed, aside from households concerned, there must also be present Elders of the village, Elders of the Banner, and as many young people and children as possible from the villages of the district, so that the boundary will be retained in memory.*

§ 241. *Every tract of land, whether field or meadow, garden or vineyard, small forest or copse, woodland or pasture or house grounds, village, Banner, or house – all are divided by boundaries.*

§ 242. *'Once boundaries are fixed, they are never moved again.'*

§ 243. *In the view of the Kanun, the bones of the dead and the boundary stone are equal. To move a boundary is like moving the bones of the dead.*

§ 244. *Someone who wishes to set a boundary or restore a forgotten one must take and bear on his shoulder a rock and a clod of earth, and leading the two households, or the two villages, or the two Banners, must fix the new boundary or indicate the traces of the old boundaries.*

§ 247. *When the oath of weight is taken (i.e. the weight of the boundary stone on the shoulder), no one may move the boundary.*

§ 250. *If someone moves the boundary in order to cause discord between one household and another, or one village and another, or one Banner and another, instigated by promises of reward or seeking such, he will be punished with dishonor and will also bear the cost of the damage that he caused by creating this discord.*

§ 251. *If a murder results from the mischief relating to the moved boundary, the person who caused the mischief must be fined 100 sheep and one ox, and is executed by the village.*

Especially § 251 shows the importance of boundaries and possibly follow-ups.

> *The death penalty is carried out collectively by the village or the banner, usually by shooting. In this case, death remains unpunished, "the blood is lost" (shkon gjakhupës). The collective killing [...] is the* ***most serious offenses such as*** *[...]* ***an unwarranted shift of property boundaries****, [...] (§§ 17, 62,* ***251****, 1125, 1194). [Emphasis by the author]* [3] *(Elsie, 2001, pp. xxiv-xxv)*

[3] Citation in original language: »*Die Todesstrafe wird kollektiv durch das Dorf bzw. das Banner, meist durch Erschießen, vollstreckt. In diesem Falle bleibt der Tod ungerächt; ‚das Blut geht verloren' (shkon gjakhupës).*

LVIII – 'The boundary Does Not Twist'

§ 252. *In order to avoid any misunderstandings, the boundary does not twist and turn or zig-zag, but must go in a straight line.*

LIX – The Boundary Won with Blood

§ 253. *If a person enters within someone else's boundaries without knowing that it is private property, and if no one stops him or calls out to tell him that he has trespassed, even if he does some damage and is brought to account, he is not liable for the damage he has done, but only for having trespassed.*

§ 254. *If, because of the boundaries, clashes occur between brothers, cousins, clans, or villages, and a hundred people are killed, even though destruction occurs, the boundaries are not moved. The pledges of the Elders must settle the matter.*

§ 255. *If the murder occurs at the time of setting the boundaries, or if the murder takes place among herdsmen in the mountains, caused by a conflict over the boundaries of the pasture in the mountain or valley, then discussions are broken off. "He demanded from me the pasture-rent, and I turned the iron [i.e. the rifle] and the trigger on him." A cairn is raised there over the murdered man, and it remains the boundary point.*

§ 256. *The stones of the cairn remain a boundary forever.*

§ 257. *In the event that two people kill each other, shot for shot, at somewhat of a distance from each other, the boundary of one area remains the cairn of the one, and the boundary of another area, the cairn of the other.*

§ 258. *The place between the two boundaries remains the property of the two areas.*

§ 259. *If the man who is shot does not die immediately, but is able to move, the place to which he goes, staggering, and dies, even beyond another border, wherever he enters, falls, and, weary from his wound, dies, there the cairn is built. That cairn remains as a border, even if it is on someone else's property.*

§ 260. *The property remains to that village and Banner to which the murdered man belonged, he who urged himself on, and there is no man who would dare move the cairn that remains as a boundary, since it was won with blood and a broken skull.*

§ 261. *This right exists only for a murder because of a boundary and not for any other murder.*

Die kollektive Tötung […] steht auf besonders schwere Delikte wie […] einer ungerechtfertigten Verschiebung von Grundstücksgrenzen, […] (§§ 17, 62, 251, 1125, 1194).«

Chapter Fifteen – Trade

LXXVI – Definition of Trade

§ 452. *The Kanun defines trade as buying and selling, either without conditions, i.e. in a cut-and-dried manner, or with conditions, before witnesses, or else with earnest-money.*

§ 453. *Earnest-money is one grosh (in coin), which is given before the article bought is acquired.*

§ 454. *"The earnest-money makes the item yours, but you must pay the balance."*

§ 455. *Whether you have given one or a hundred grosh, you are the owner of the item secured by deposit.*

§ 456. *"Once the earnest-money has been taken, it is not returned."*

§ 461. *If the seller denies that he received earnest-money and the buyer has no witness, the Kanun requires the seller to take an oath. If he takes the oath, the buyer loses his earnest-money.*

LXXVI –Trade in Land

§ 464. *Before the sale of any land or a turn at irrigation water or at the mill, the cousins, brotherhood, and clan of the seller must be informed.*

§ 465. *"The neighbor buys the land of his neighbor, if it is not bought by the cousins, brotherhood, or clan."*

§ 466. *If no relatives or neighbors buy the land, the owner is free to sell it to anyone in the village.*

§ 467. *If no one in the village buys the land, then he is free to sell it to any buyer.*

Note:

In our mountains, it almost never happens that any land or a mill or a turn at irrigation water is sold outside the village. If the cousins, clan, and neighbors make no effort to buy the land, mill, or turn at irrigation water, it is sold and resold within the village, in order to prevent an outsider from buying it and entering the community.

§ 468. *If someone has sold land, a mill, or water rights without having informed his cousins, the brotherhood, the dan, or his neighbors, the transaction is illegal, according to the Kanun.*

§ 469. *The relatives have the right to make this transaction invalid.*

§ 470. *The buyer may not dispute the matter when he is told that he bought illegally, but he must take back his money.*

§ 471. *If the buyer says that he questioned the seller before buying the land, and the latter affirmed and swore as to its legality, the seller is fined according to the gravity of the crime, but the land transaction is nevertheless illegal and must be invalidated.*

§ 472. A brother and close cousins pay 100 grosh less for land than the brotherhood and clan, which are futher removed. (In Dukagjin, Shale, Shosh, etc., a close relative pays 500 grosh less than a distant one.)

§ 473. Land sold conditionally: If I sell you land today, but tomorrow you decide to resell it, you may not sell it to anyone else without offering it to me again.

§ 474. This condition is binding on the buyer, and he may not sell to anyone else without offering it to the first seller.

§ 475. If land is sold without the aforementioned condition, the buyer is then free to sell it whenever he likes.

§ 476. At the sale of land, a mill, or water rights, it is the custom to drink raki.[4]

§ 477. The raki *must be provided by the purchaser.*

LXXIX – Prices Set by the Kanun

§ 484. According to the Kanun:

1. *A building site for a house costs 500 grosh.*
2. *A piece of land that yields 100 grosh profit costs 500 grosh: "100 grosh profit-500 grosh in land."*
3. *An acre of land: according to its quality, plus the cost of liquidating any debts.*

Even if these »laws« are not legally valid laws, they have always been a certain model of character. Many people (especially the younger generation who have lived through the war) are interested in the history of their ancestors. The reading of the Kanun is even today, or perhaps because of, a part of the repertoire of reading and the subsequent and essential discussing.

[4] »***Rakia*** *(also* ***Rakija*** *or* ***Raki*** *or* ***Rachiu****) is an alcoholic beverage that is produced by distillation of fermented fruit; it is a popular beverage throughout the Balkans. Its alcohol content is normally 40% ABV, but home-produced rakia can be stronger (typically 50% to 60%). Prepečenica is double-distilled rakia which has an alcohol content that may exceed 60%. […] In Albania, rakia can be made out of grapes (mostly in mild climate regions) or out of plum (and sometimes out of mulberry) in colder climate areas. Plum and grape rakia are sometimes mixed with other ingredients, such as herbs, honey, sour cherries and walnuts, after distillation.* « (Wikipedia, 2011)

3.2 Interim Legal Framework

3.2.1 Ahtisaari

In March 2007 Martti Ahtisaari sent his proposal about the situation in Kosovo to the UN Security Council (UN Security Council, 2007a). It is the report of the Special Envoy of the Secretary-General on Kosovo's future status. The main items of the report are highlight below:

+ *Recommendation: Kosovo's status should be independence, supervised by the international community*
+ *Reintegration into Serbia is not a viable option*
+ *Continued international administration is not sustainable*
+ *Independence with international supervision is the only viable option*

3.2.2 UNMIK Legislation (1999 – 2008)

Between 1999 and 2008 UNMIK promulgated different laws. Below, laws regarding cadastre are mentioned:

+ Kosovo Assembly Law No. 2003/25 on Cadastre
+ Administrative Instruction No. MPS 2004/08 (22 September 2004) on the implementation of the Law on Cadastre
+ Regulation No. 2004/4 (18 February 2004) on the Promulgation of the Law on Cadastre adopted by the Assembly of Kosovo
+ Kosovo Assembly Law No. 02/L-96 on Amendments and Additions to the Law on Cadastre
+ Regulation No. 2007/32 (16 November 2007) on the Promulgation of the Law on Amendments and Addtions to the Law on Cadastre adopted by the Assembly of Kosovo
+ Law No. 02/L-96 (26 January 2007) on Amendments and Additions to Law No. 2003/25 on Cadastre

Actually, a new version of the Law on Cadastre is on the Parliament for review and acceptance. This new version will give more power to the commission in place for regulating cadastre reconstructions.

3.3 Actual Legal Framework

The legal framework for cadastre reconstruction is based on:

+ Laws
+ Administrative Instructions
+ Guidelines
+ Terms of References for executive companies

3.3.1 Laws

Number	Description
2009/03-L-154	Law on Property and other Real Rights

3.3.2 Administrative Instructions

The following table gives an overview of the actual Administrative Instructions (AI):

Table 1: Overview of Administrative Instructions

Number	Description
MESP 2010/01	on Responsibilities of CR and BCC Commissions
MPS 2007/04	for Licensing of Geodesy Companies and the Geodesists
MPS 2006/09	Determination of Taxes for Products and Services offered by Kosovo Cadastral Agency
AKK 2006/01	on application of Law on Establishment of Immovable Property Rights Register No. 2002/5, 2003/13 on Determination of Payment Level for Finished Payment on Registration of Immovable Property Rights
MPS 2004/08	on the Establishment of the Law on Cadastre

Number	Description
MPS 2004/03	on the Implementation of the Law on the Establishment of an Immovable Property Rights Register
AKK 2004/01	on Implementation of the Law on Establishment of an Immovable Property Rights Register No. 2002/5, 2003/13 regarding Procedures and Official Applications for Registration

3.3.3 Guidelines

The following table gives an overview of the actual Guidelines (GL):

Table 2: Overview of Guidelines

Number	Description
KCA 2009/01	for Registration of Buildings and Parts of Buildings (replaces KCA 2007/01)
~~KCA 2007/01~~	~~for Registration of Buildings and Parts of Buildings~~
KCA 2005/11	for Quality Control of Vectorized Data
KCA 2005/10	Vectorization of Surface Ceiling
KCA 2005/09	Vectorization of Parcels in GeoMedia/GeosPro
KCA 2005/08	for Georeferencing of Maps
KCA 2005/04	for the 3rd Order and Local Reference Network
KCA 2005/03	for Maintenance of Cadastral Information
KCA 2005/02	for Handling of Area Differences
KCA 2005/01	Reconstruction of Cadastral Information

II Cadastre Reconstruction

4 Cadastral Data

4.1 Definitions

Cadastre »*A Cadastre is normally a parcel based, and up-to-date land information system containing a record of interests in land (e.g. rights, restrictions and responsibilities). It usually includes a geometric description of land parcels linked to other records describing the nature of the interests, the ownership or control of those interests, and often the value of the parcel and its improvements. It may be established for fiscal purposes (e.g. valuation and equitable taxation), legal purposes (conveyance), to assist in the management of land and land use (e.g. for planning and other administrative purposes), and enables sustainable development and environmental protection.*« (FIG, 1995)

Maintenance of Cadastre All official acts of the land authority for the establishment, continuation and renewal of the cadastre.

Renewal of the cadastre is renewal of components of the cadastre in order to match always the requirements of it.

Cadastre Reconstruction to (re-)establish the cadastre and/or update the cadastre with missing documentation caused by different reasons.

To have a complete cadastre, the requirements on cadastral data are as follows

The data must be:

+ complete,
+ correct,
+ accurate, and
+ reliable
+ actual
+ comprehensive

This shall apply in:

+ Completeness is more important than accuracy
+ Accuracy will improved step by step
+ Errors must be removed-up from the date of knowing

4.2 Data Sources

The following is a short description (presentation) of the results of quality analyses, which the author of this thesis undertook during consultancy work for the GTZ Landmanagement / Cadastre Project Kosovo in 2009 (stage 1). At this point, only a few examples and results of the investigations will be presented (see Schindler et al., 2009 and Schmidt, 2009).

Later on, the possibility were given to the author to undertake further investigations in three additional MCOs in 2011 (stage 2). Up to now, the results of the investigations during stage 2 were nowhere presented in written form.

4.2.1 Location

The cadastral data of the following Municipal Cadastral Offices (MCOs) were analysed:

- Stage 1 (2009)
  - + Ferizaj,
  - + Istog, and
  - + Peja
- Stage 2 (2011)
  - + Pristina
  - + Mitrovica
  - + Hani i Elezit

Figure 3 shows the location of the selected MCOs, stage 1 (yellow) and stage 2 (green) in the Republic of Kosovo.

Figure 3: Selected MCOs for Quality Analysis

4.2.2 Available Data

For the quality analyses, the following materials were used:

- + Digital Orthophoto Maps (DOM)
- + scanned and georeferenced maps in digital format
- + digital Vector Maps (VM), derived from the scanned maps
- + Registration information out of Kosovo Cadastral Interim Database (KCID) and Immovable Property Rights Register (IPRR); partly as printout and partly in digital format as Excel-sheets
- + analogue cadastral maps
- + analogue sketches, partly additionally with update cases (example see Figure 4)
- + protocols of tachometric measurements (example see Figure 5)

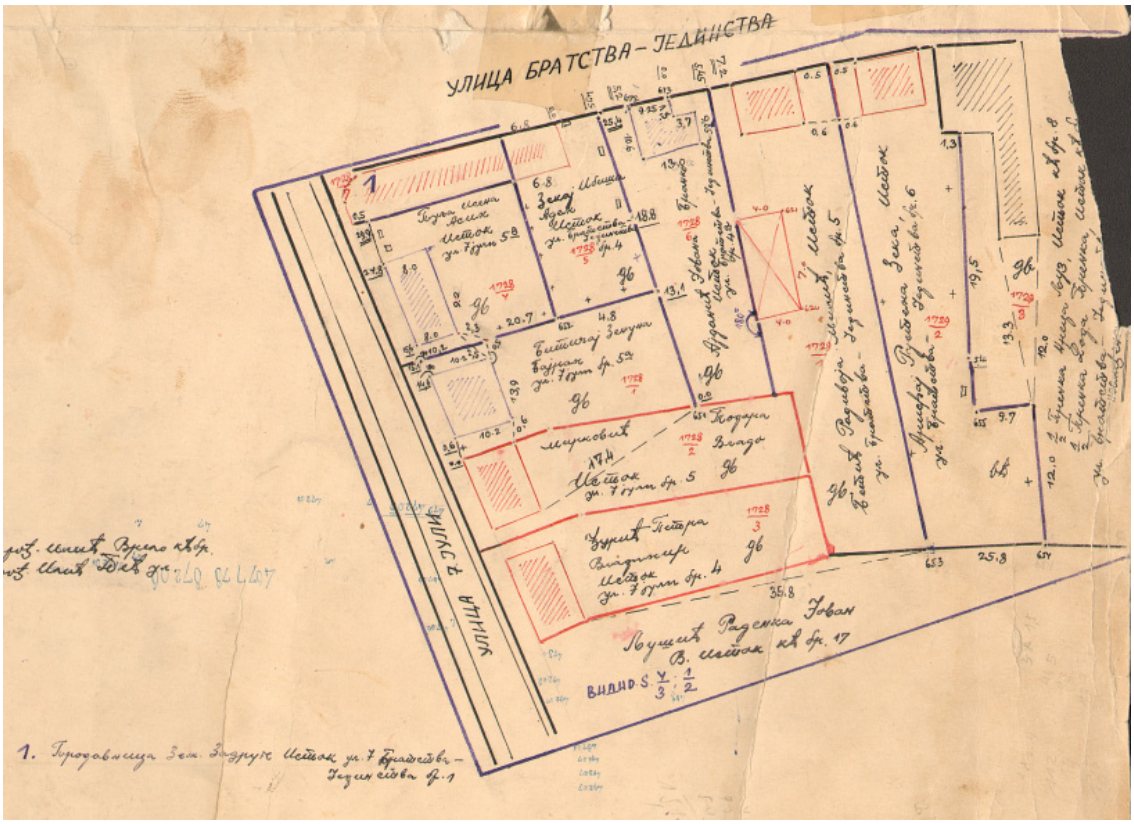
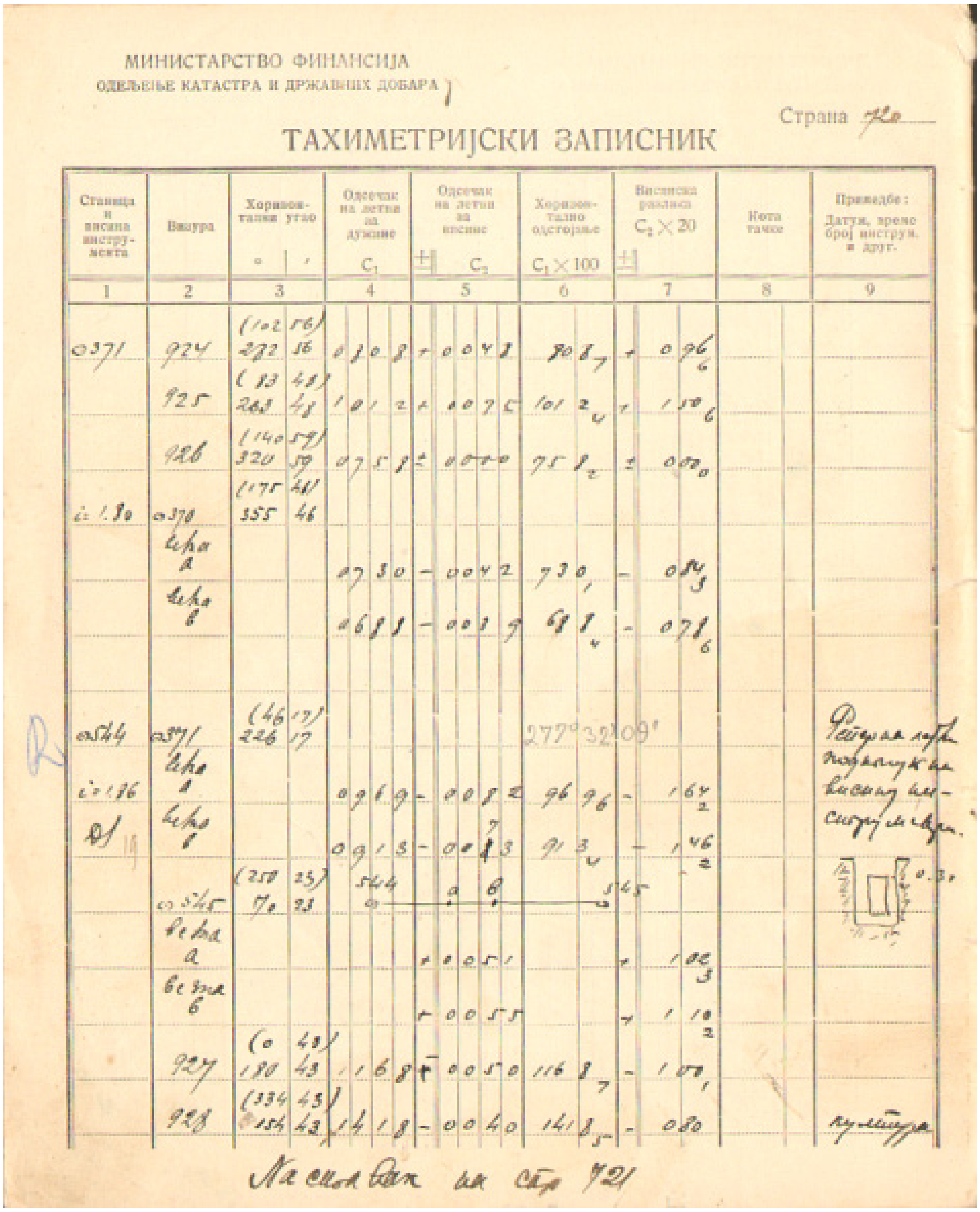


Figure 4: Example of analogue sketch


МИНИСТАРСТВО ФИНАНСИЈА
ОДЕЉЕЊЕ КАТАСТРА И ДРЖАВНИХ ДОБАРА

Страна

ТАХИМЕТРИЈСКИ ЗАПИСНИК

Станица и висина инстру-мента	Визура	Хоризон-тални угао ° ′	Одсечак на летви за дужине C_1	Одсечак на летви за висине ± C_2	Хоризон-тално одстојање $C_1 \times 100$	Висинска разлика $C_2 \times 20$ ±	Кота тачке	Примедбе: Датум, време број инструм. и друг.
1	2	3	4	5	6	7	8	9

Figure 5: Example of tachometric protocol (1933)

Table 3 gives an overview about the provided materials for the quality analyses.

Table 3: Provided documents for analyses

	graphical info					textual info	
	DOM	VM	Maps	Sketches	Origin Measure-ments	KCID	IPRR
Ferizaj	KCA	KCA (shp)	1954, M 1:2,500, KOSOVAREF01, KCA				
			1974,M 1:2,500, FRYREF30, MCO				
					2009 (surveying)	MCO (printout)	KCA (Excel)
Istog	KCA	KCA (shp)	1933, M 1:1,000, analogue, MCO 1933, M 1:2,500 KOSOVAREF01, KCA	1933, MCO	1933, MCO (coord.)		
			1954, M 1:2,500, KOSOVAREF01, KCA		1955, MCO (coord.)		
			1955, M 1:1,000, analogue, MCO	1955, MCO	1955-1983 (coord.)		
					2009 (surveying)	MCO (printout)	KCA (Excel)
Peja	KCA	KCA (shp)	1932, M 1:2,500, KOSOVAREF01, KCA				
				2003, MCO	2003, MCO (coord.)		
			2008, M 1:2,500, analogue, MCO			MCO (printout)	KCA (Excel)

During investigations in the MCOs of stage 2 (2011), several type of documents were located which were not known up to now.

E.g. at the MCO in Mitrovica, documentation about update cases were located. Figure 6 shows an example of such an update case. The case is dated 1998. This is very close to the Kosovo War. The situation of the plot is based on a cadastral map. Up to now, it was not possible to check if the original cadastral map, which was used for this sketch, is still available in the MCO.

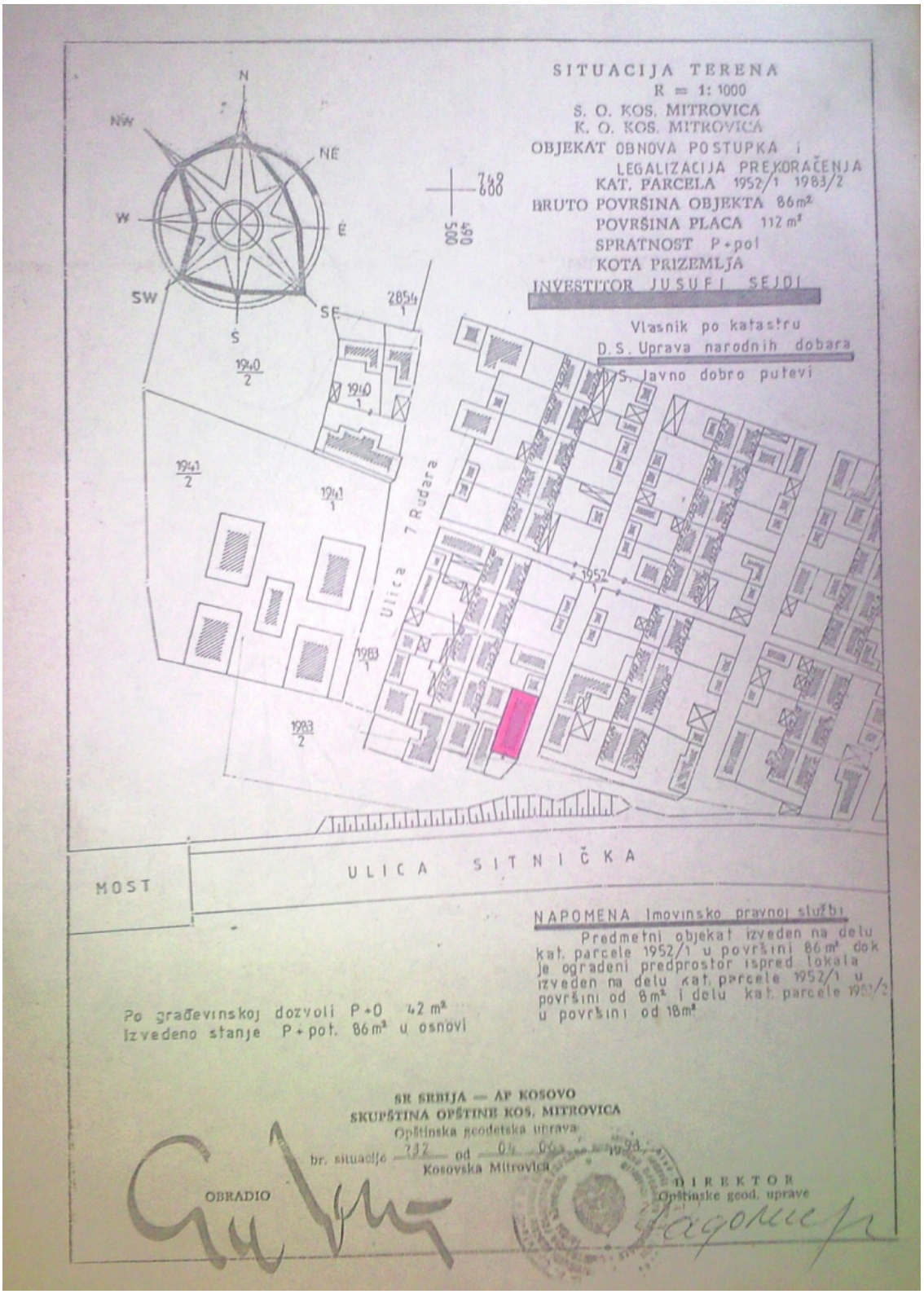


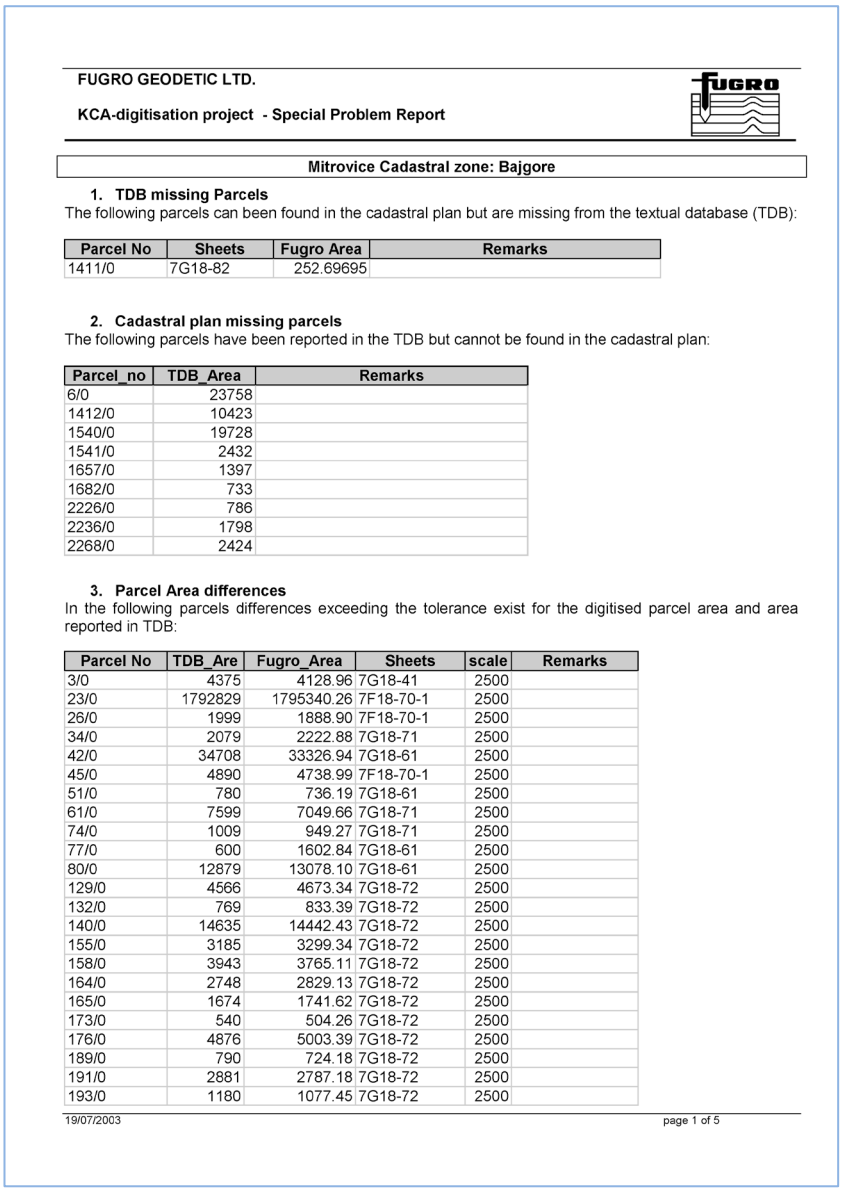
Figure 6: Example of update case

Source: Photo: Salih Ahmetaj

Furthermore, the existence of the so-called »Fugro-Reports« are proven. These reports gives information about problems during and after the digitisation (vectorisation) of the before scanned (by KCA) cadastral maps. Figure 7 shows the first page of such a report. An example of a complete »Fugro-Report« is given in appendix B.

The main parts of the reports are:

+ Missing parcels in textual DB (= parcel(s) exist(s) only in cadastral maps)
+ Missing parcels in cadastral plans (= parcel(s) exist(s) only in textual DB)
+ Parcel area differences (= differences between area in textual DB and area of vectorised parcel)
+ Parcels without or unclear number



FUGRO GEODETIC LTD.

KCA-digitisation project - Special Problem Report

Mitrovice Cadastral zone: Bajgore

1. TDB missing Parcels

The following parcels can been found in the cadastral plan but are missing from the textual database (TDB):

Parcel No	Sheets	Fugro Area	Remarks
1411/0	7G18-82	252.69695	

2. Cadastral plan missing parcels

The following parcels have been reported in the TDB but cannot be found in the cadastral plan:

Parcel_no	TDB_Area	Remarks
6/0	23758	
1412/0	10423	
1540/0	19728	
1541/0	2432	
1657/0	1397	
1682/0	733	
2226/0	786	
2236/0	1798	
2268/0	2424	

3. Parcel Area differences

In the following parcels differences exceeding the tolerance exist for the digitised parcel area and area reported in TDB:

Parcel No	TDB_Are	Fugro_Area	Sheets	scale	Remarks
3/0	4375	4128.96	7G18-41	2500	
23/0	1792829	1795340.26	7F18-70-1	2500	
26/0	1999	1888.90	7F18-70-1	2500	
34/0	2079	2222.88	7G18-71	2500	
42/0	34708	33326.94	7G18-61	2500	
45/0	4890	4738.99	7F18-70-1	2500	
51/0	780	736.19	7G18-61	2500	
61/0	7599	7049.66	7G18-71	2500	
74/0	1009	949.27	7G18-71	2500	
77/0	600	1602.84	7G18-61	2500	
80/0	12879	13078.10	7G18-61	2500	
129/0	4566	4673.34	7G18-72	2500	
132/0	769	833.39	7G18-72	2500	
140/0	14635	14442.43	7G18-72	2500	
155/0	3185	3299.34	7G18-72	2500	
158/0	3943	3765.11	7G18-72	2500	
164/0	2748	2829.13	7G18-72	2500	
165/0	1674	1741.62	7G18-72	2500	
173/0	540	504.26	7G18-72	2500	
176/0	4876	5003.39	7G18-72	2500	
189/0	790	724.18	7G18-72	2500	
191/0	2881	2787.18	7G18-72	2500	
193/0	1180	1077.45	7G18-72	2500	

19/07/2003 page 1 of 5

Figure 7: Example of »Fugro-Report«

4.2.3 Collect existing data and processing status

During timely different visits in the MCOs, more and more data were collected. Digital data were copied on a memory stick. Analogue data, e.g. old cadastral maps were scanned with a portable A3 scanner. Furthermore, investigations took place whether different copies and versions at different times of graphical documentation (maps, sketches) are available.

4.3 Method of Quality Analysis

At first, it was planned to undertake the analysis separately in two parts. Part one for analysing the cadastral data (graphical & numerical) and part two for the registration data (textual).

For both, a course of actions was prepared (see Figure 8 and Figure 9).

During the work it stated out, that it will be better to mix both analyses for more efficiency. Results from the cadastral analysis were mixed with results from the registration analysis and vice versa.

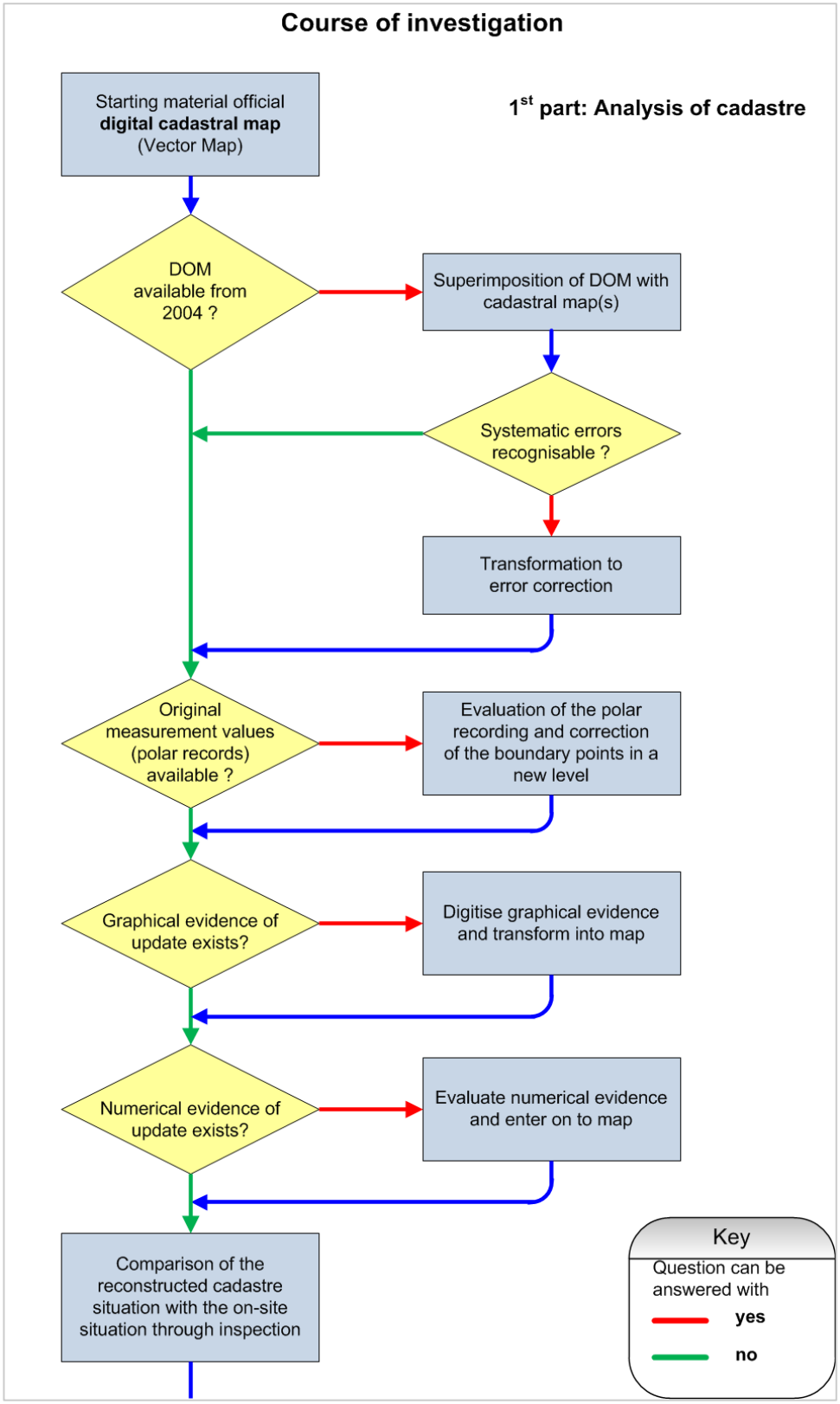


Figure 8: Course of investogation (part 1)

Source: Revised version (original: Schindler et al., 2009); basic idea: G. Schindler; graphical Design: A. Schmidt

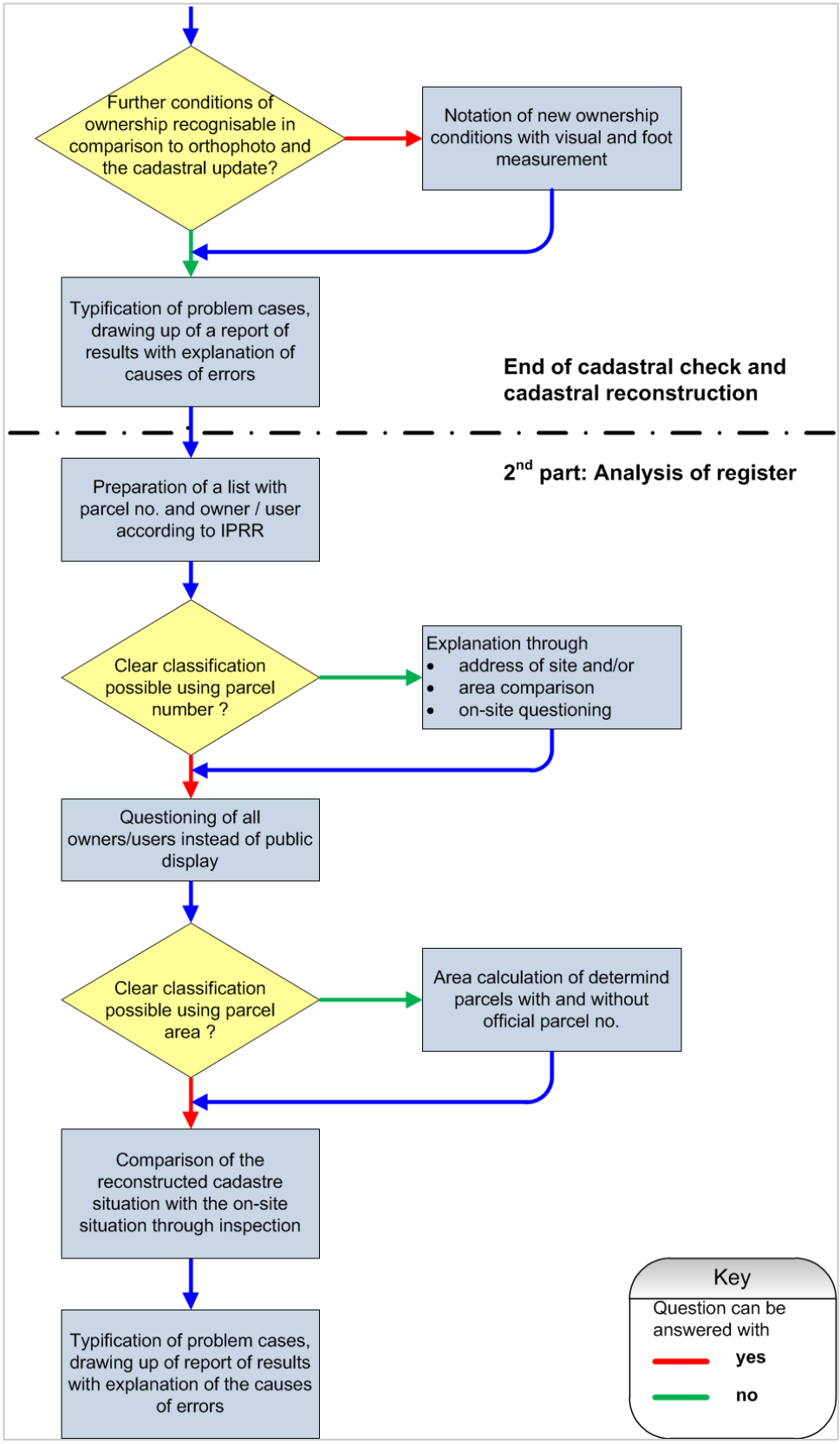


Figure 9: Course of investogation (part 2)

Source: Revised version (original: Schindler et al., 2009); basic idea: G. Schindler; graphical Design: A. Schmidt

4.4 Preparation of Data

Regarding the type of data, some preparation tasks were necessary. Some of the data in the MCOs are only available in analogue format. These data were converted into digital format.

4.4.1 Analogue Maps

Areas of investigations on an analogue map are not bigger than a paper in A3 format. The areas of interest in the analogue maps were scanned with a normal scanner in A3-format. It was not necessary to merge different scans into one.

After scanning of parts of the maps, the derived data were georeferenced using the digital maps in spatial reference system KOSOVAREF01. For georeferencing, identical and distinctive points were located in both maps.

4.4.2 Digital maps in FRYREF30

Some cadastral maps are available in the old reference system FRYREF30. For the analyses of these maps, they were newly georeferenced into KOSOVAREF01. For this, identical and distinctive points were located in both kinds of maps.

4.4.3 Digital maps in KOSOVAREF01

Digital cadastral maps are available in KOSOVAREF01. These maps are the officially maps and they were used as they are. The digital vector maps were derived from them.

4.4.4 Geodetic Reference systems

In the Republic of Kosovo different geodetic reference systems were used. In the period of 1924 to 2001, maps are based on the FRYREF30 reference system. Since 2001, maps and cadastral surveying are based on KOSOVAREF01. Table 4 gives an overview of the parameters of both reference systems.

Table 4: Geodetic Reference Systems in Kosovo

	FRYREF 30	KOSOVAREF 01
Projection	Gauß-Krüger	Transverse Mercator
Central Meridian	21° East	21°East
Latitude of Origin	0°	0°
False Easting	500,000 m	7,500,000 m
False Northing	0	0
Scale Factor	0.9999	0.9999
Linear Unit	Meter	Meter
Geodetic Datum	Hermannskogel	ETRS 1989
Prime Meridian	0°	0°
Spheroid	Bessel 1841	IUGG Ellipsoid GRS 80
Projection zone	7	7
Width of the Zone	3°	3°

4.5 Evaluation of existing cadastral Data

Even at the beginning of the evaluations turned out that, separate examination of graphical cadastral data and registry data is particularly not effective. A combined analysis of the documents brought a significant increase in effectiveness and information content.

The graphical information were compared with the alpha-numeric data in relation to:

+ Presence or completeness of the documents
  - Number of parcels in the graphical evidences
  - Number of parcels in the textual evidences
  - Number of parcels that are not recorded (documented) in the registries, but exists in the locality
+ Examine the possibilities and conditions for a possible cadastre reconstruction

During the analyses, special attention was paid to consider all copies and versions of the cadastral maps. During the evaluations of cadastral documents issues raised, which could not be answered by the existing data. For this reason, the proposed schedule (see Figure 8 and Figure 9) was changed. The locations were not taken only in appearances, as envisaged in the course of investigation, but there were also carried out additional surveying.

4.6 Accuracy of existing Data

4.6.1 Coordinate Differences

The digital vector maps were derived from existing analogue ones. In 2001 KCA started a project for scanning, georeferencing, and vectorisation of analogue maps.

In the following example the VM were compared with the map (1954), map (1974) and the surveying results from 2009. Out of the VM the boundary points were derived. The results are shown in Figure 10. A visual comparison with the map (1954) shows that the boundary point in the south of the parcel is represented by two points (point no. 5 and no. 6), which are more or less equal. For the further analyses, point no. 6 will not be considered. Besides this, two points are missing in the VM. These are marked in red colour and labelled with no. 22 and no. 23 (shown in Figure 11).

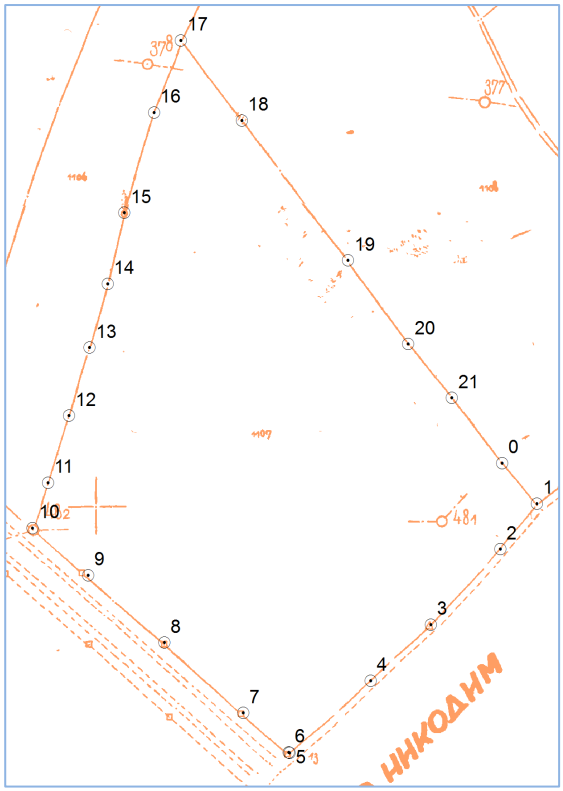


Figure 10: Map (1954) with boundary points (black) derived from VM

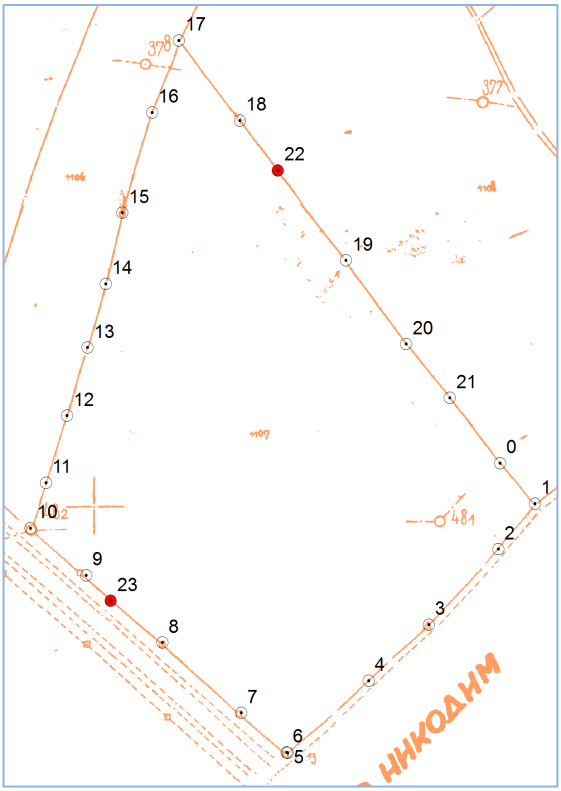


Figure 11: Map (1954) with boundary points (black) derived from VM and missing boundary points (red)

Table 5 shows the coordinate differences between the VM and the map from 1954 respectively the surveying from 2009.

Table 5: Coordinate Differences between VM and Map 1954 respectively Survey 2009

Point No.	Difference in [m] between VM and	
	Map 1954	Survey 2009
0	0.68	
1	0.55	1.90
3	1.17	2.94
4		2.21
5	0.99	1.78
7	1.11	
8	0.71	
9	3.02	
10	0.68	1.63
11	0.75	
12	1.09	
13	1.29	
14	0.43	
15	0.61	1.91
16	0.11	
17	0.53	3.66
18	0.42	
19	0.19	2.49
20	0.54	1.44
21	0.22	
22		1.74

The graphical representation of the coordinate differences are shown in Figure 12.

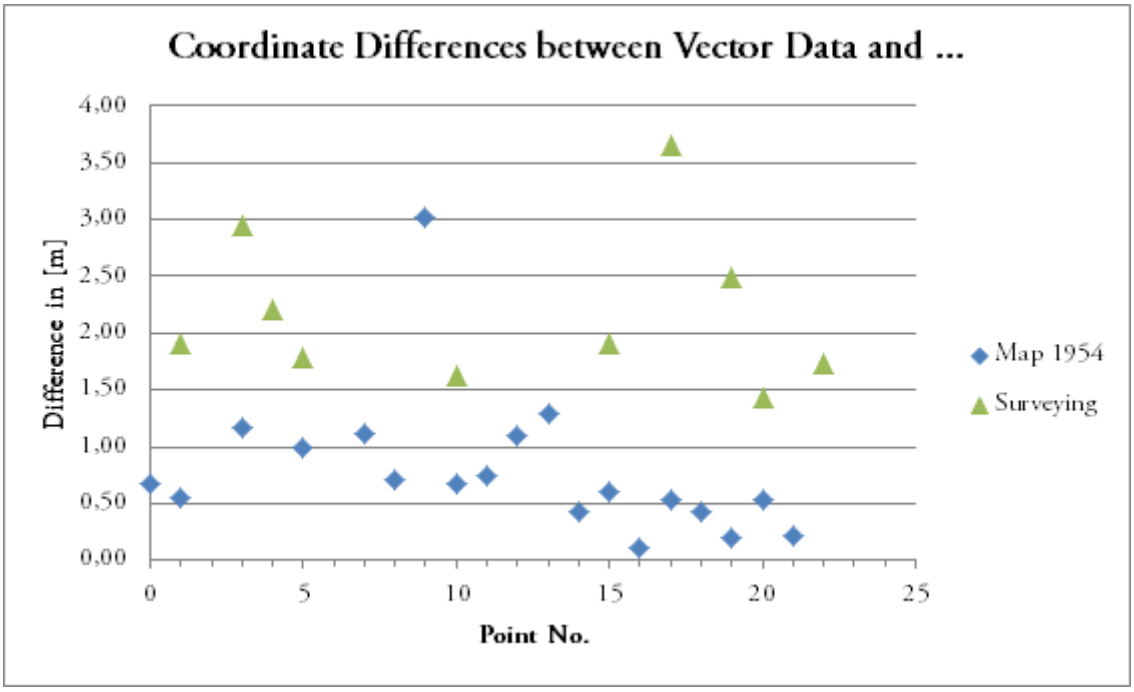


Figure 12: Coordinate Differences between VM and Map 1954 respectively Survey 2009 in graphical representation

The coordinate differences between the VM and the map from 1954 are in an area up to 1.50 m, except point no. 9 that has a difference of 3 meters. The coordinate differences between the digital VM and the surveying of 2009 are located in a span between 1.5 m and 3.0 m, except point no. 17 that has a difference of more than 3.6 m.

However, it must not go unmentioned that a population of 19 points is not a sufficient quantity and basis to derive statistically reliable statements.

4.6.2 Map and Errors

The digital vector maps were derived from digital raster maps, they, in turn, were derived from existing analogue maps. That means the accuracy of the digital vector data is influenced by different factors (Scheuring, 1995, p. 86 ff.).

Baisc formula for the Propagation of uncertainty according to Gauß:

$$\sigma_{total} = \sqrt[2]{{\sigma_1}^2 + {\sigma_2}^2 + \cdots + {\sigma_n}^2}$$

The factors are:

Scale independent influences of errors		
σ_{net}	$= 10\ cm$	Precision of point determination of basic surveying (fixpoints of reference networks)
σ_{sur}	$= 20\ cm$	Precision of point determination through surveying with e.g. tape, theodolite (1933)
σ_{photo}	$= 40\ cm$	Precision of point determination through stereo photogrammetry methods (1954, 1974)

Scale dependent influences of errors		
σ_{cart}	$= 0.2\ mm$	Precision of manual mapping
σ_{map}	$= 0.2\ mm$	Changes of the map material through ageing, air humidity, temperature, and using the map over decades in daily business
σ_{scan}	$= 0.1\ mm$	Precision of the scanning procedure
σ_{geo}	$= 0.1\ mm$	Precision of georeferencing of the map; Transformation on the ground with at least 4 identical map points (e.g. 4 Parameter-Helmert-Transformation)
σ_{vec}	$= 0.1\ mm$	Precision of the vectorisation process

For cadastral maps based on surveying determination:

$$\sigma_{total,S} = \sqrt[2]{{\sigma_{net}}^2 + {\sigma_{sur}}^2 + SD^2\left({\sigma_{cart}}^2 + {\sigma_{map}}^2 + {\sigma_{scan}}^2 + {\sigma_{geo}}^2 + {\sigma_{vec}}^2\right)}$$

$$= \sqrt[2]{(10^2 + 20^2)cm^2 + SD^2(0.2^2 + 0.2^2 + 0.1^2 + 0.1^2 + 0.1^2)mm^2}$$

$$= \sqrt[2]{500\ cm^2 + SD^2 * 0.11\ mm^2} = \sqrt[2]{500 + SD^2 * 0.0011}\ cm$$

with SD as Scale Denominator of the map

For cadastral maps based on stereo photogrammetric determination:

$$\sigma_{total,P} = \sqrt[2]{{\sigma_{net}}^2 + {\sigma_{photo}}^2 + SD^2\left({\sigma_{cart}}^2 + {\sigma_{map}}^2 + {\sigma_{scan}}^2 + {\sigma_{geo}}^2 + {\sigma_{vec}}^2\right)}$$

$$= \sqrt[2]{(10^2 + 40^2)cm^2 + SD^2(0.2^2 + 0.2^2 + 0.1^2 + 0.1^2 + 0.1^2)mm^2}$$

$$= \sqrt[2]{1700\ cm^2 + SD^2 * 0.11\ mm^2} = \sqrt[2]{1700 + SD^2 * 0.0011}\ cm$$

with SD as Scale Denominator of the map

For different Scale Dominators SD and differentiation of determination method the values for σ are listed in Table 6.

Table 6: Average point errors

	SD		
σ_{total}	500	1,000	2,500
Surveying	0.28 m	0.40 m	0.86 m
Photo	0.44 m	0.53 m	0.93 m

According to the normal (or Gaussian) distribution, the accuracy of point location will be for

68.27 % of all points $0 < d \leq \sigma$

27.18 % of all points $\sigma < d \leq 2\sigma$

4.28 % of all points $2\sigma < d \leq 3\sigma$

0.27 % of all points $> 3\sigma$

with d as coordinate difference.

Most of the analogue cadastral maps are in scale 1:2,500 and based on stereo photogrammetric determination. In this, $\sigma = 0.93\ m$.

Regarding to the elaborated value for $\sigma = 0.93\ m$, the accuracy of point location will be for

68.27 % of all points $0 < d \leq 0.93\ m$

27.18 % of all points $0.93\ m < d \leq 1.86\ m$

4.28 % of all points $1.86\ m < d \leq 2.79\ m$

0.27 % of all points $d > 2.79\ m$

with d as coordinate difference.

The distribution of the coordinate differences between the VM and the map from 1954, as presented in Table 5, is:

13	of 19 points (= 68.4 %)	are in the range of	$d \leq 0.93\ m$
5	of 19 points (= 26.3 %)	are in the range of	$0.93\ m < d \leq 1.86\ m$
0	of 19 points (= 0.0 %)	are in the range of	$1.86\ m < d \leq 2.79\ m$
1	of 19 points (= 5.3 %)	are in the range of	$d > 2.79\ m$

with d as coordinate difference.

That means, except of one point (point no. 9), the coordinate differences are normal distributed. However, it should not go unmentioned again that a population of 19 points is not a sufficient quantity and basis to derive statistically reliable statements.

4.7 Results of Quality Analyses

First, it must be mentioned that the situation regarding the availability of data is completely different in each MCO. The following results are based on the investigations at the mentioned MCOs (stage 1 and stage 2). These results can differ from investigations at other MCOs, then the mentioned ones.

The worst case which is known is the MCO of Prizren. Most of the cadastral data, eg. cadastral maps, registration information, have been heavily damaged or even destroyed by a fire on 29th October 2007 (Demirkol et al., 2011).

The digital vector maps were derived from analogue maps. That means that the accuracy of the point cannot be better than the accuracy of the analogue maps. In addition, the location of boundary points (derived out of the digital vector map) are not in every case coincident with the location of boundary points which are present on analogue maps.

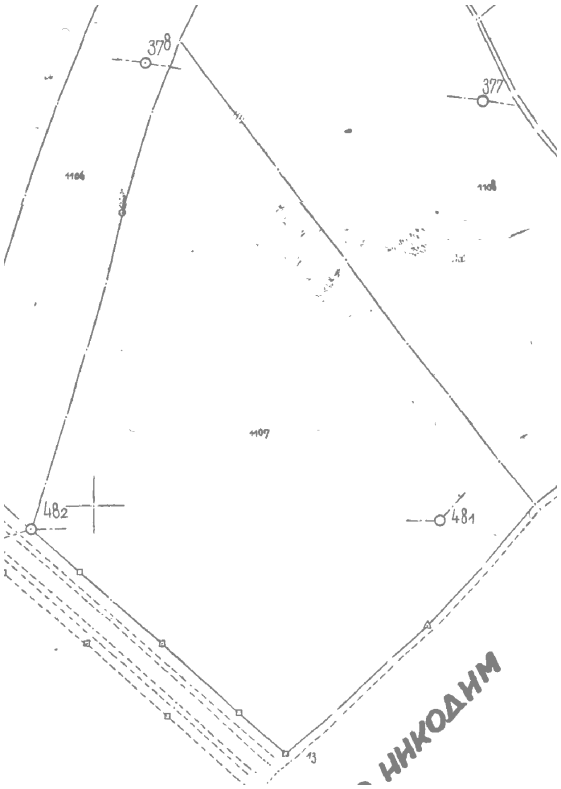


Figure 13: Ferizaj: Cadastral map from 1954

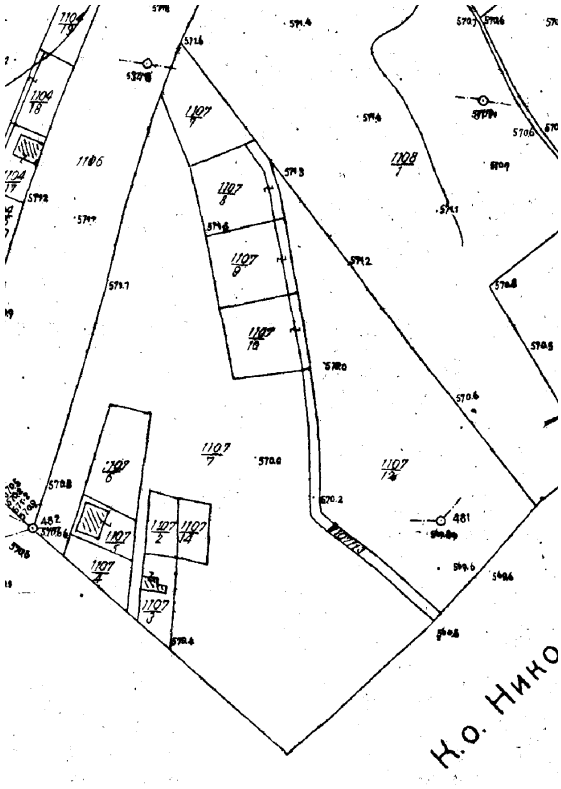


Figure 14: Ferizaj: Cadastral map from 1974

(For better view of the parcels, the isolines were removed partly)

Figure 13 shows a part of a cadastral map from 1954. Figure 14 shows the same location on a map from 1974. The content of both maps are different.

In Figure 15 and Figure 16 a digital orthophotos map (DOM) were used to compare the more or less actual situation in the field with the cadastral maps from 1954 respectively 1974.

Figure 17 is an additional map with more information content than the maps froam 1954 or 1974. The data of this map cannot be determined.

Figure 15: Ferizaj: DOM superimposed with cadastral map from 1954 (yellow)

Figure 16: Ferizaj: DOM superimposed with cadastral map from 1974 (yellow)

Figure 17: Ferizaj: Cadastral map, 19xx (n.d.)

The figures below show the actual data in different systems. The first one is the digital vector data in the electronic system. It is separated from the registration information in IPRR. The second is an actual analogue map from 19?? (correct date cannot be determined). It must be produced after the period from 1974. The map is superimposed with the cadastral map from 1974 (in blue colour). The third figure represents the actual situation on site. This is also superimposed with the cadastral map from 1974 (in blue colour). It is a result of surveying the parcels and interviewing the inhabitants of the parcels.

① Vector data (= same content as Map 1954)

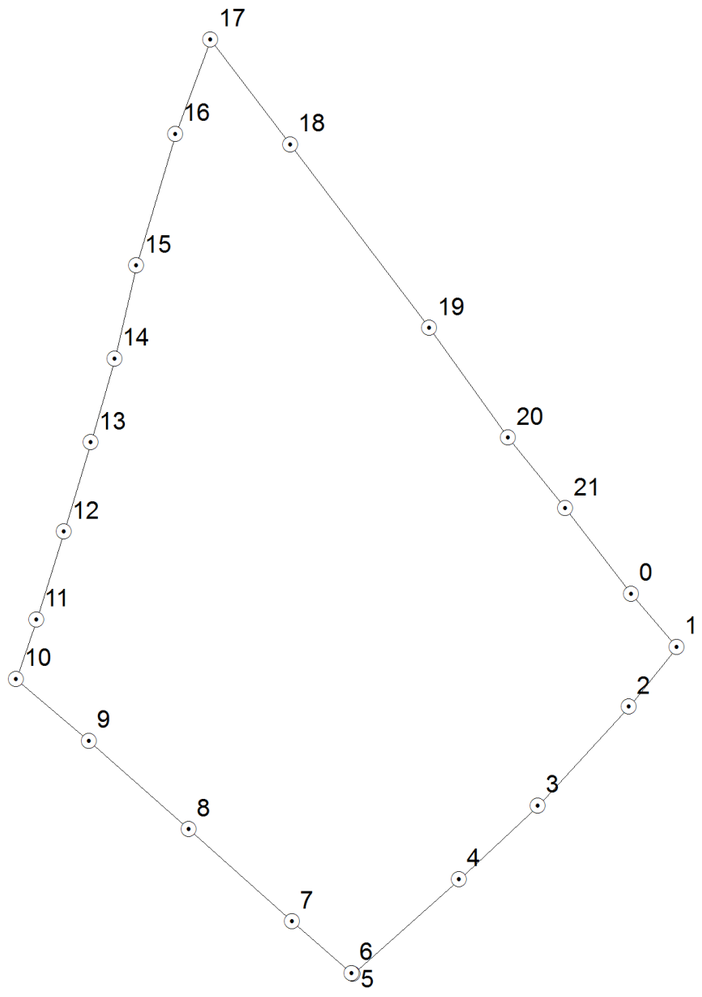


Figure 18: Ferizaj: Vector data (2006)

② "newest" available map (19xx) which is still in use in the Cadastral Office

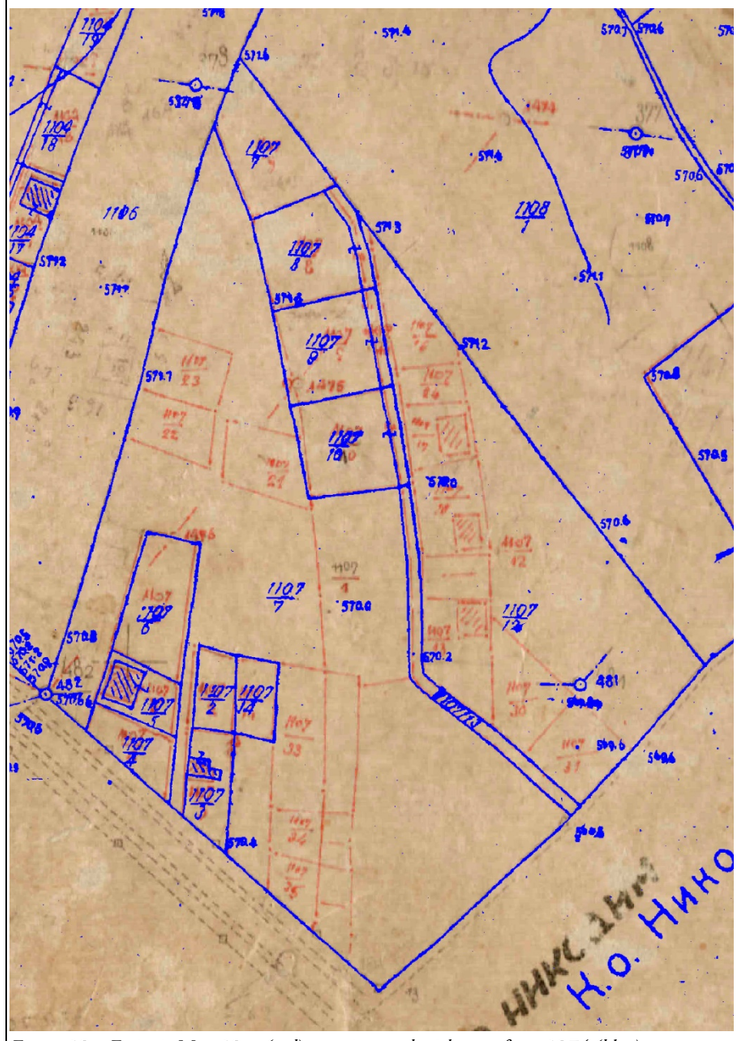


Figure 19: Ferizaj: Map 19xx (red) superimposed with map from 1974 (blue)

③ Actual situation (Surveying results from 2009)

Figure 20: Ferizaj: Actual situation (surveying results from 2009) superimposed with map from 1974 (blue)

The following Figure 21 gives an impression of the usage of two different copies of the same map sheet. Updates were sometimes mapped in copy A and sometimes in copy B.

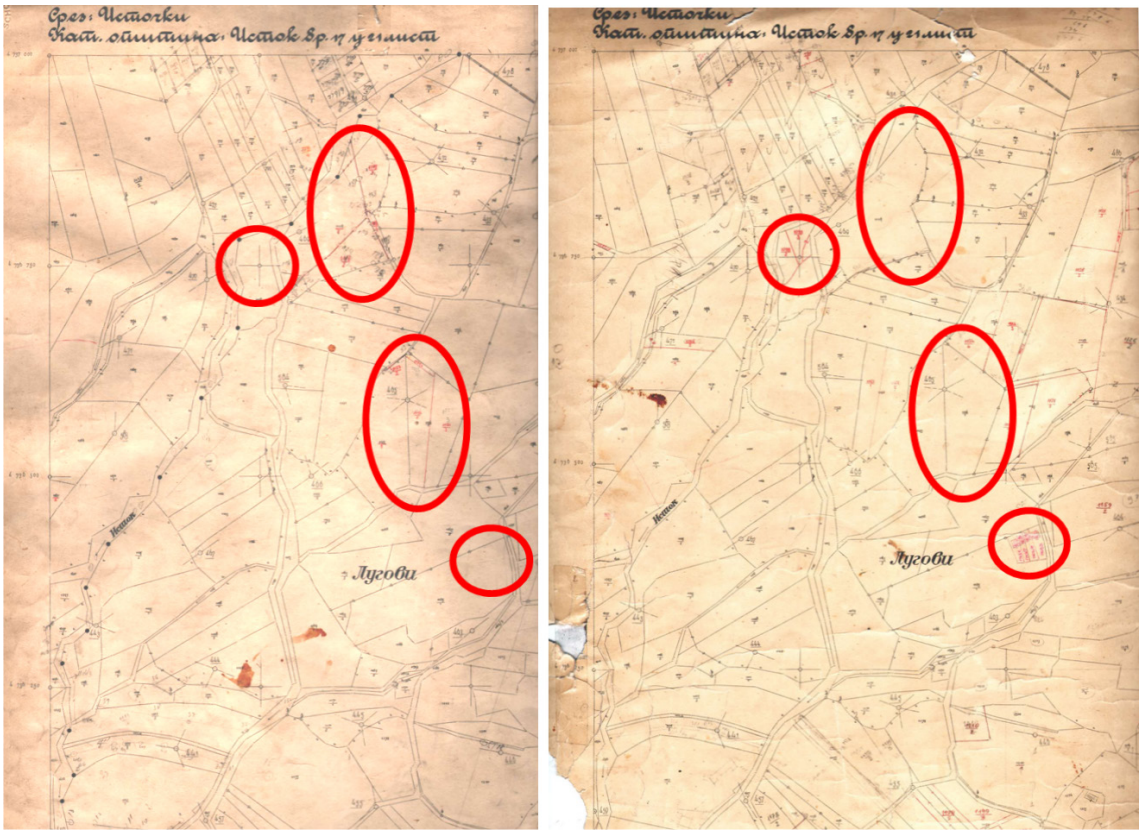


Figure 21: MCO Istog – Example oft wo different copies oft he same map sheet

5 Reasons for Cadastre Reconstruction

The Governments of Sweden, Switzerland and Norway, UNMIK and UNCHS (Habitat) financed the Kosovo Cadastre Support Programme (KCSP). Development of a well-functioning real property land market is one of the main objective. Restoring the cadastral information and make it available in digital format is one of the main priorities of the programme (Valstad, 2001).

In November 2000, KCA was established, because of UNMIK Administrative Direction No. 2000/14 of 7th June 2000 (Valstad, 2001). With this, the long way of cadastre reconstruction begun.

The central question for Cadastre Reconstruction in Kosovo is:

WHO owns WHICH spatial unit and WHERE it is located?

With spatial unit as, e.g. parcel, building or part of a building.

Reasons for cadastre reconstruction are based on technical respectively legal aspects.

5.1 Technical Aspects

During the war (cf. chapter 2.3 – The Kosovo War) the cadastral documentation were brought to Pristina for selection. Selected documents were transferred to Belgrade; unselected documents remained in Pristina. After the war, the remaining documents were transferred back to the competent MCOs (Matarova, 2011).

Reasons for the technical lacks are different. Up to now the following lacks are known:

+ Maps with updates of the period up to 1999 were brought to Serbia

+ Sometimes the MCOs delivered out-dated maps to KCA for scanning and vectorisation
+ Updates were mapped in different copies of the same map sheet. E.g. surveyor 1 uses copy A of the map and surveyor 2 uses copy B of the same map.
+ Non unified update handling. Sometimes updates were generated with various software applications. These changes were not entered into the analogue maps. In case of computer damages the information will be lost.
+ Shape and/or size of parcels were changed between neighbours (→ moving of boundaries).

5.2 Legal Aspects

Reasons for the technical lacks are different. Up to now the following lacks are known:

+ Registrations were carried out without updating the cadastral map
+ Land parcels were sold of without registration of the new owners.
+ Selling/Buying contracts were made in spoken form (see § 452 of the Kanun). A contract in written form is not necessary. Can also be done by the use of witnesses.
+ Inheritance cases have not been registered.

6 Practice

Maintenance of Cadastre

Figure 22 gives a comprehensive overview of the ideal procedure for subdividing a parcel.

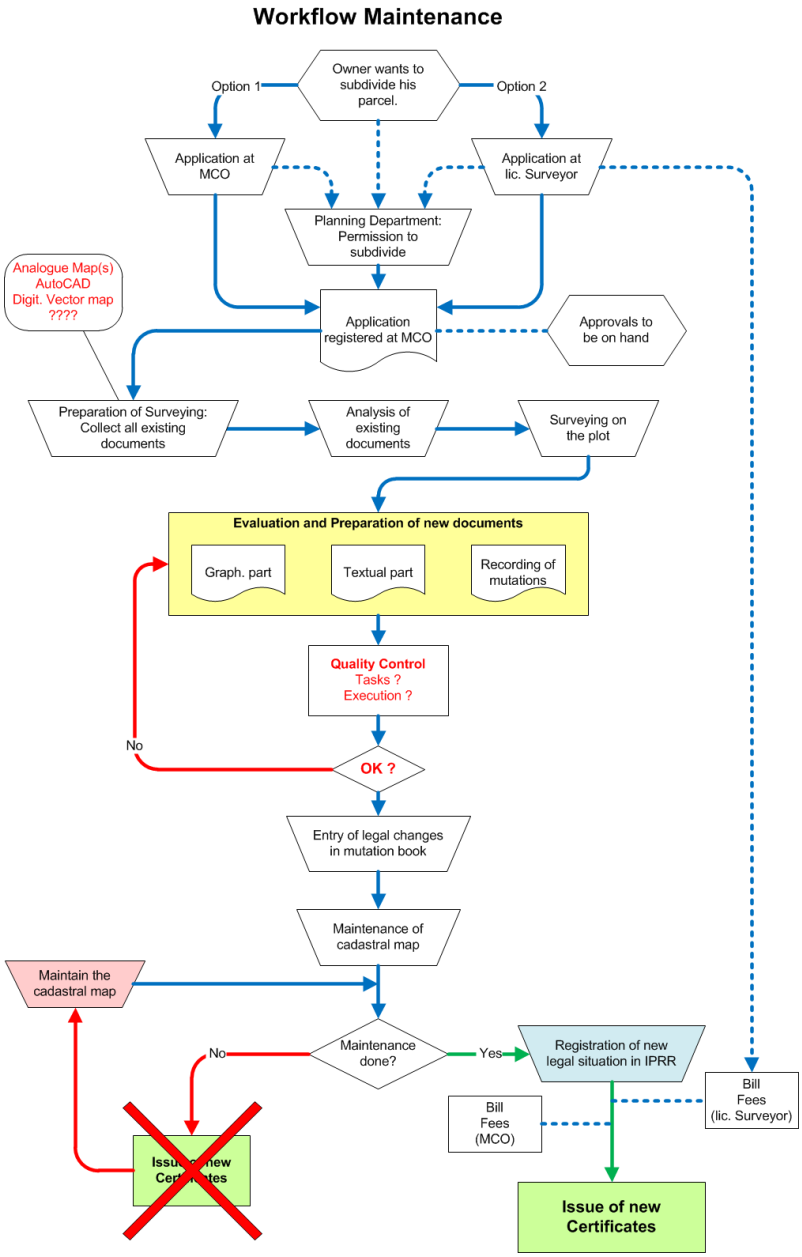


Figure 22: Workflow Maintenance – Subdividing of parcel

The work in a cadastral office is influenced by the four seasons. Especially the work of the field teams. During wintertime, normally no fieldwork is undertaken. Only office work will be done. In summertime, it is the opposite. Fieldwork is on-going and preferred whilst office work is reduced to an absolute minimum.

This line of action causes problems at the process *Maintenance of cadastral map*. In summertime the registration and issue of new certificates will be done. But the maintenance of the cadastral maps will be shifted to wintertime. When it is wintertime, the tasks to enter the changes in the cadastral maps are »forgotten«. This means, Figure 22 has to be changed to show the reality. Changes are shown in Figure 23.

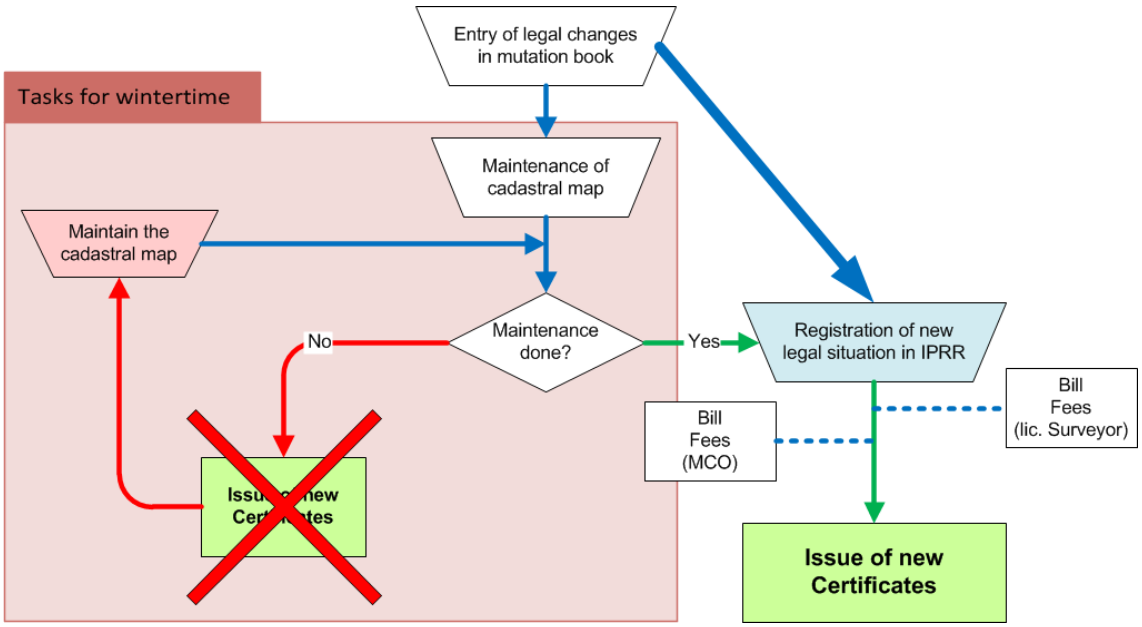


Figure 23: »Forgotten« tasks for wintertime

The result is, after the entry of legal changes in the mutation book, the workflow is going in a straight line to register the new situation and issuing new certificates (symbolised with strong blue arrow). However, the maintenance of the cadastral map is not on the spot. This causes discrepancies between the textual part (register) and the graphical part (cadastre). The cadastre has to be reconstructed to be in accordance with the legal part.

III Data Storage

7 Consolidation of graphical and textual Cadastral Data

Out of the results of the analyses a first workflow for consolidation of graphical and textual Cadastral Data were derived. The figure should be self-explained, so no additional explanations are given here.

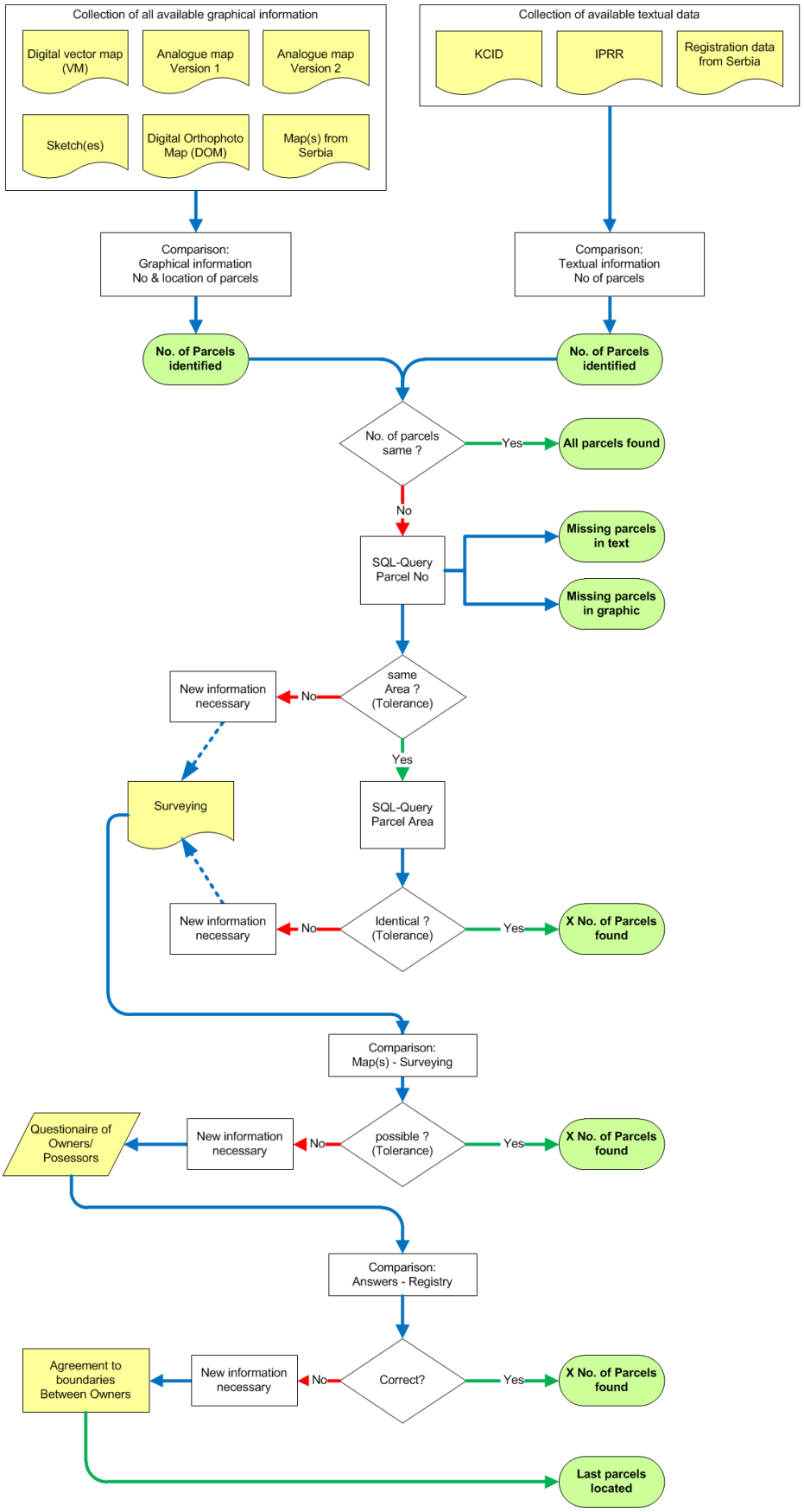


Figure 24: Workflow of Consolidation of Data

The above mentioned *SQL-Query – Parcel No* can be done by the following statements. These statements are based on MS Access. Therefore it is necessary to UNION the LEFT JOIN with the RIGHT JOIN.

```
SELECT TEXT.IPRR_ID, TEXT.Name_Last, TEXT.Name_First, TEXT.Name_Fathers,
TEXT.OwnerPartScale, TEXT.OwnerPartNominator, TEXT.Area AS IPRR_Area,
GRAPHIC.Immovablep, GRAPHIC.Area AS GRAPHIC_Area, GRAPHIC.Explanation
FROM IPRR LEFT JOIN GRAPHIC
ON IPRR.[IPRR_ID] = GRAPHIC.[Immovablep]
UNION
SELECT IPRR.IPRR_ID, IPRR.Name_Last, IPRR.Name_First, IPRR.Name_Fathers,
IPRR.OwnerPartScale, IPRR.OwnerPartNominator, IPRR.Area AS IPRR_Area,
GRAPHIC.Immovablep, GRAPHIC.Area AS GRAPHIC_Area, GRAPHIC.Explanation
FROM IPRR RIGHT JOIN GRAPHIC
ON IPRR.[IPRR_ID] = GRAPHIC.[Immovablep]
ORDER BY IPRR_ID;
```

Listing 1: SQL-Statement for comparison of Parcel No from textual and graphical data

When the parcel.id in the SQL-Query is replaced with the parcel.area, the SQL-Query will be according to the *SQL-Query – Parcel Area* in the workflow.

8 Data Models

8.1 Textual Data – KCID

The Kosovo Cadastral Interim Database (KCID) is a textual database for storing information about parcels and the responsible owners/ possessors. It was built out of available punch cards. The information of the DB is based on surveying and aerial photogrammetry from 1931 – 1935 and 1951 – 1985. The first version of the DB was a simple read-only DB in MS-Access format. Version 2 was a read-write DB developed in Visual Basic and Access. This version was updated through maintenance and entering of information provided by the public. Old information is stored in a separate table of the database (Valstad, 2001).

KCID DBs are still in use in the MCOs. The DBs are only for information purposes in use. Maintenance of the DBs is not allowed.

A technical documentation about KCID does not exist or was (for this Thesis) not available. Therefore, the database model was reverse engineered out of a still existing and in use database. This DB represents the Cadastral Zone of Vushtri and was made available by the MCO Mitrovica.

Figure 25 shows the database schema of the example of a KCID DB. At this, the example is a DB of the above-mentioned version 2. For a more readable version please refer to appendix C.2, where the schema is shown in bigger size.

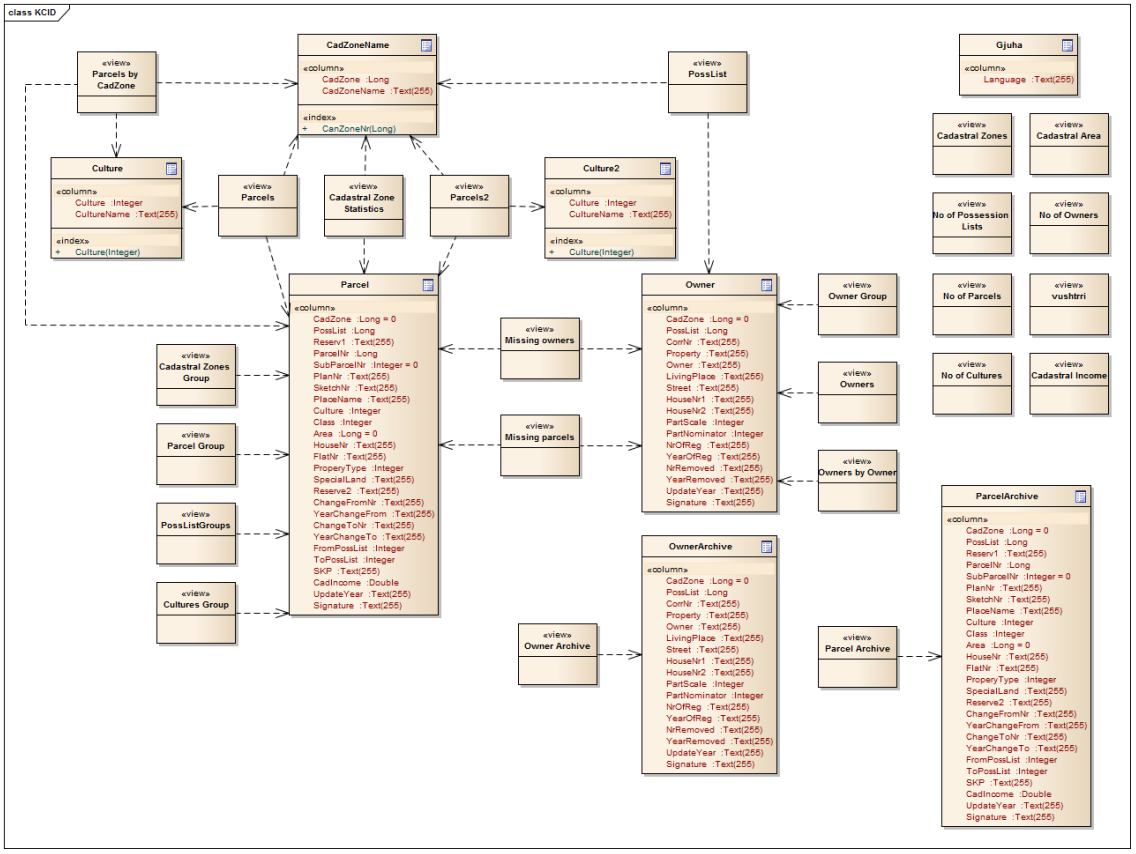


Figure 25: Derived database model of KCID database (MS Access)

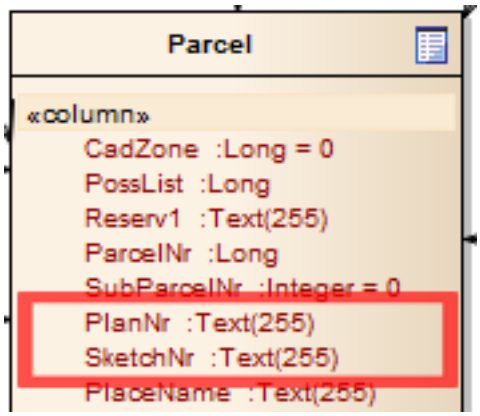


Figure 26: Extract of table »Parcel«

In the table **Parcel**, information about graphical update cases (*PlanNr* and *SketchNr*) are stored (in the figure beside marked in red colour). This is an indicator for possibly existing graphical information about the parcel and their history.

The same attributes exist also in the table **ParcelArchive**.

History of a parcel is the evidence about the creation and / or changes of parcels. Therefore, it is a basic element of a functional and trustworthy cadastre system.

8.2 Textual Data – IPRR

According to the Law on Cadastre (UNMIK - Assembly of Kosovo, 2003), KCA had to establish an Immovable Property Rights Register (IPRR). IPRR is the follow-up of KCID. It is centralised installed on KCA server(s). Most of the MCOs have access to the databases via a connection over the government network.

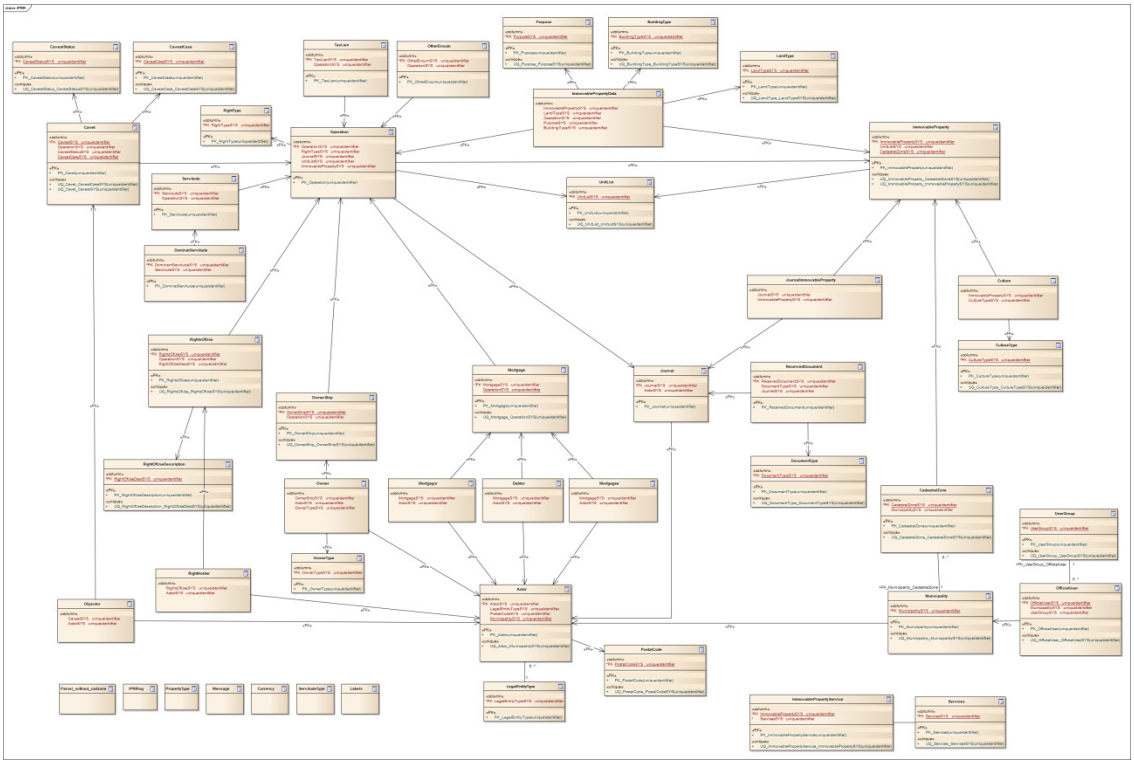


Figure 27: Derived database model of IPRR database (SQL Server)

8.3 Graphical Data – Digital Vector Map

The digital vector maps were organised with GeoMedia and GeosPro. Basis for this is a data model in Interlis-1 notation. The name is *KosovoCadastre.ili*. The complete content of the model is given in appendix C.4

The following is an extract of the model file. It shows the content of two tables *ParcelRegister* and *Parcel*. According to chapter 3.1 – Historical – Albanian Customary Rights, bound-

aries must go in a straight line. The data model of the graphical data stated that arcs in a boundary are allowed. (KCA, 2004)

```
TABLE ParcelRegister =
   ParcelRegisterID: TEXT*12;       !! CONTRACT NUMBER
   Description: TEXT*30;
   Perimeter: OPTIONAL SURFACE WITH (STRAIGHTS, ARCS) VERTEX LCoord
              WITHOUT OVERLAPS > 0.500;
   ParcelState : State;
   Date1: DATE;                     !! Data Record Date
   Date2: OPTIONAL DATE;            !! Registration Date
   Date3: OPTIONAL DATE;            !! End Date
IDENT
   ParcelRegisterID;
END ParcelRegister;

TABLE Parcel =
   ParcelObject: -> ParcelRegister;
   ParcelID: TEXT*30;
   ParcLegalReli: LegalReliability;
   Type: (Parcel, Encumbrance);
IDENT
   ParcelID;
END Parcel;
```

Listing 2: Tables »ParcelRegister« and »Parcel« in Interlis-1 Notation

With the UML/Interlis Editor[5] the complete model were analysed and converted into a graphical representation in UML notation. The representation of the class *Parcel* is shown in Figure 28. Not all diagrams can be shown here.

[5] Source: http://interlis.ch/interlis2/docs23/umleditor-3.2.0.zip

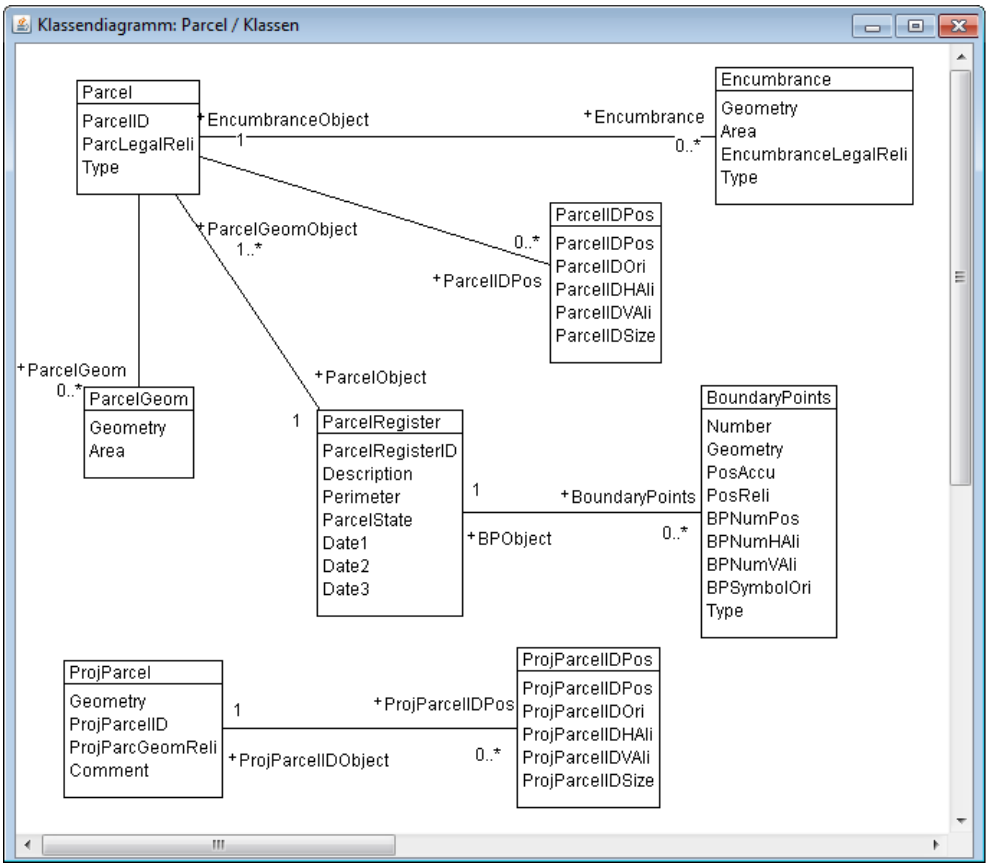


Figure 28: KosovoCadastre – Package: Parcel

The complete model consists out of the following packages (Figure 29).

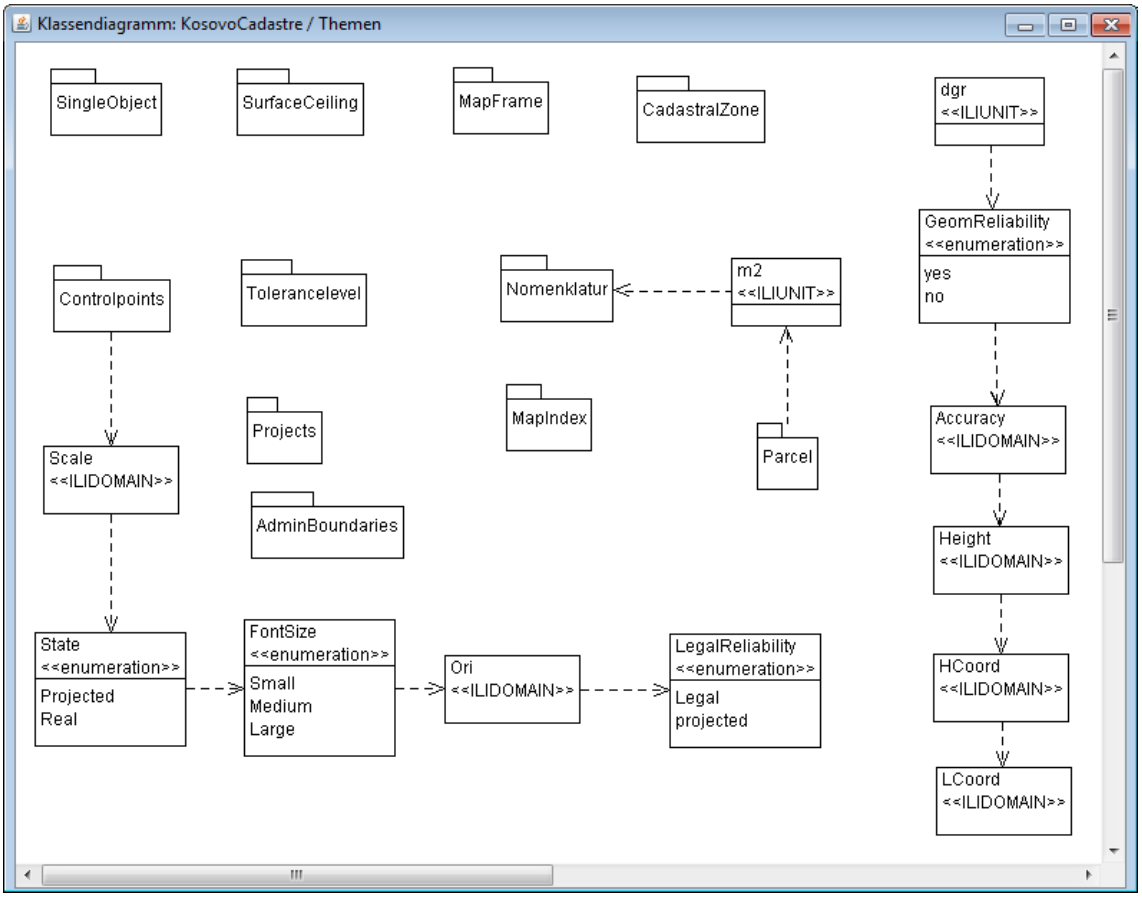


Figure 29: KosovoCadastre – all packages

For the cadastre reconstruction also the package *SurfaceCeiling* is important. Especially the class *ProjectedSurface*. Parcels which are not yet registered will be stored within this class.

The package is shown in Figure 30.

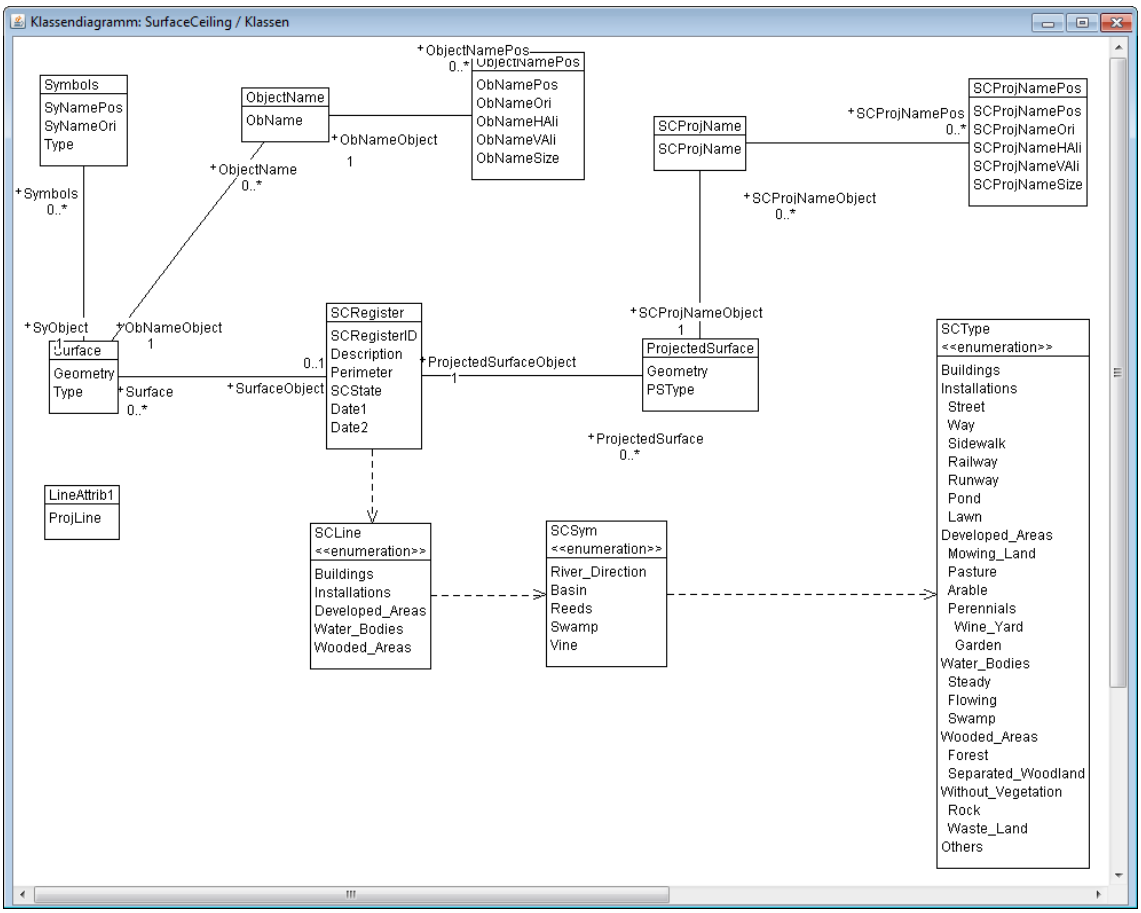


Figure 30: KosovoCadastre – Package SurfaceCeiling

8.4 Graphical Data – KCLIS

Up to now, the cadastre and the registration are handled in two different and separately systems. In view of NSDI and Land Administration it is necessary to combine both systems. Therefore the Kosovo Cadastre Land Information System (KCLIS) was developed. Actual the development for the textual part of the system is finished. Missing is the part for the graphical database. Figure 31 gives an overview of the proposed conceptual data model for the graphical part of KCLIS (a more detailed version of the concept was not available).

The main goals of the graphical system are:

+ appropriately integration of registration data (textual) and cadastral data (mainly graphical)
+ improvements during maintaining the data (registration and cadastral) at the same time
+ simplification of data transfer (import & export functionality)
  → better support of the private sector (licensed surveyors)
+ establish the linkage between the data in one unified system

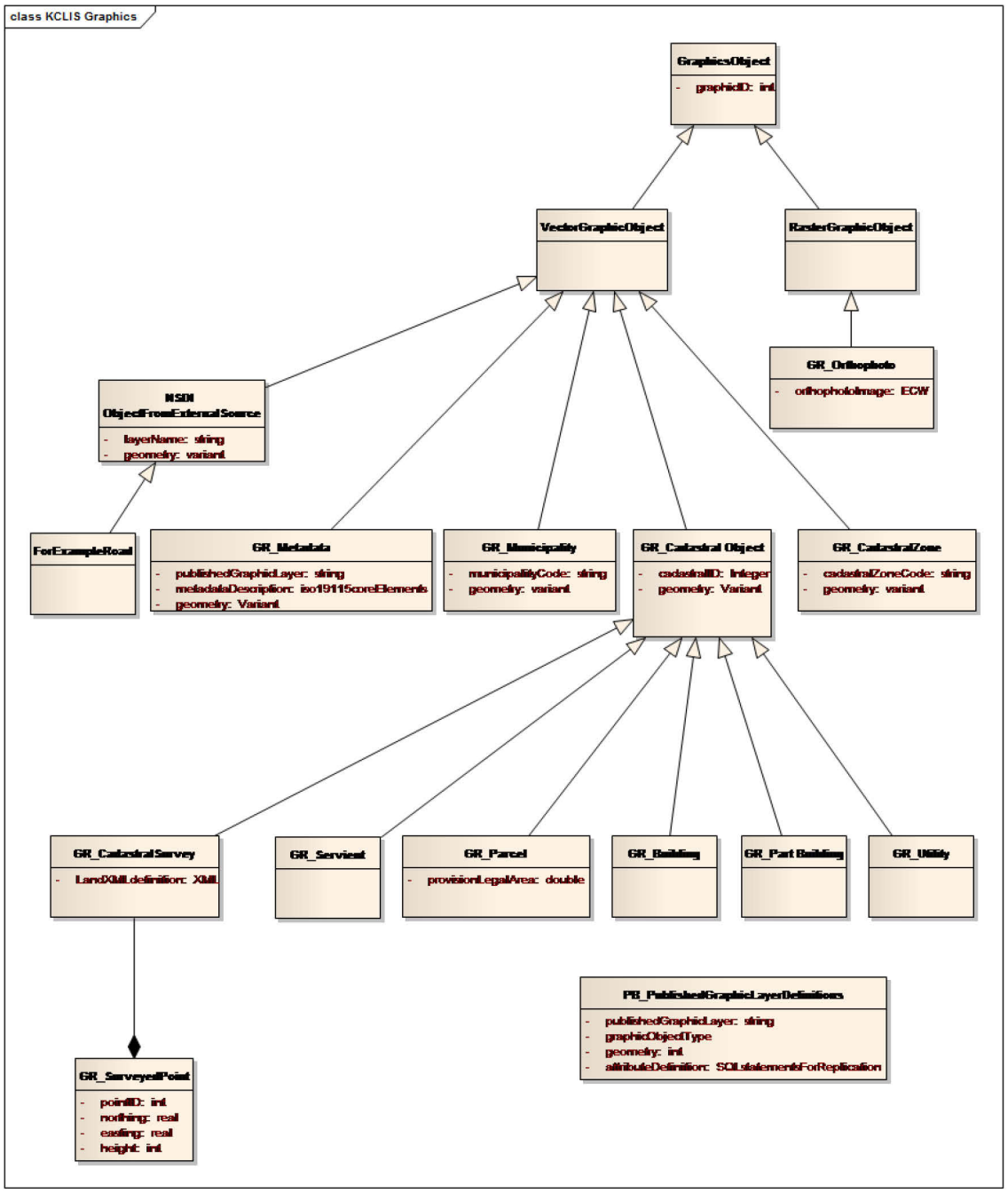


Figure 31: Proposed KCLIS Graphic Conceptual Data Model

Source: KCLIS Graphics Specification (version 1.8, 28/10/2010) (KCA, 2010)

8.5 Land Administration Domain Model (LADM)

»The Land Administration Domain Model (LADM) is a conceptual schema, and not a data product specification (in the sense of ISO 19131 Data Product Specification).« (ISO/DIS, 2011, p. vii)

The main goals of the model are described furthermore in the ISO/DIS as follows:

> *»LADM provides a reference model which will serve two goals:*
> - *to provide an extensible basis for the development and refinement of efficient and effective land administration systems, based on a Model Driven Architecture (MDA), and*
> - *to enable involved parties, both within one country and between different countries, to communicate, based on the shared vocabulary (that is, an ontology), implied by the model.«* (ISO/DIS, 2011, p. vii)

Furthermore in the DIS the considerations are mentioned:

> *»Four considerations during the design of the model were:*
> - *it should cover the common aspects of land administration all over the world;*
> - *it should be based on the conceptual framework of 'Cadastre 2014' of the International Federation of Surveyors (FIG) (KAUFMANN and STEUDLER, 1998; see Bibliography, and www.fig.net/cadastre2014/);*
> - *it should be as simple as possible in order to be useful in practice;*
> - *the geospatial aspects follow the ISO/TC 211 conceptual model.«* (ISO/DIS, 2011, p. vii)

8.5.1 History and Outlook of LADM

van Oosterom et al. (2006) and Lemmen et al. (2011) give an overview about the history and development of the LADM. They describe the conceptual framework of *Cadastre 2014* (Kaufmann & Steudler, 1998) as the starting point for the Core Cadastral Domain Model (CCDM) development.

The timely development and the improvements from the CCDM to the LADM are shown comprehensively in Table 7 (cf. Lemmen et al., 2011).

Table 7: Development of LADM

Version	Date	Presented at
	Improvements	
0.1 (CCDM) *Core Cadastral Domain Model*	2002, September 2002, November	OGC meeting, Noordwijk, The Netherlands. COST Workshop, Delft, The Netherlands (van Oosterom & Lemmen, 2002).
	• initial version of the CCDM	
0.2 (CCDM) *Paris'03*	2003, March 2003, April	Workshop on Cadastral Data Modelling at the ICT in Enschede (van Oosterom & Lemmen, 2003). FIG Working Week, Paris, France (Lemmen & van Oosterom, 2003).
0.3 (CCDM) *Brno'03*	2003, September 2004, April 2004, November	Digital Earth, Brno, Czech Republic (Lemmen et al., 2003). EULIS Seminar on "Land Information Systems and the Real Estate Industry", Lund, Sweden (Lemmen et al., 2004). Expert Group Meeting on Secure Land Tenure, Nairobi, Kenya (van der Molen & Lemmen, 2004).
	• multipurpose cadastre • 3D extensions • refinements • CCDM is organised into several packages	
0.4 (CCDM) *Bamberg'04*	2004, December	Bamberg, Germany (van Oosterom et al., 2004).
	• attention to system boundary	
0.5 (CCDM) *Cairo'05*	2005, April	FIG Working Week, Cairo, Egypt (Lemmen et al., 2005).
	• improvements on legal, administrative side • 100% compliant with the OGC and ISO/TC 211 standards • submitted to ISO/TC 211	

Version	Date	Presented at
	Improvements	
0.6 (CCDM) *Moscow'05*	2005, October	UN-HABITAT Expert Group Meeting, Moscow, Russian Federation (van Oosterom & Lemmen, 2006).
	2006, March	FIG Regional Conference, Accra, Ghana (Augustinus et al., 2006).
	• all valid comments from the ISO/TC 211 submission have been addressed • class »Building« was added to the model, to better explain the relationship between rights and restrictions • for better explanation the role of »PartOfParcel« was added	
	2006,	(van Oosterom et al., 2006).
	• 1st Presentation of the whole model (the whole model consists out of 3 main figures)	
1.0 (CCDM)	2006, October	FIG Congress, Munich, Germany (Lemmen & van Oosterom, 2006).
	• »Version 1.0 of the FIG Core Cadastral Domain Model«	
ISO/TC 211 19152 Geographic information – Land Administration Domain Model (**LADM**)	2008, May [6]	New project (Stage 20.20): ISO 19152 Geographic information – Land Administration Domain Model (LADM) at the ISO/TC 211 (ISO/TC 211 Plenary, 2008).
	2009, July	Published as CD – Committee Draft
	2011, January [7]	Published as DIS – Draft International Standard ISO/TC 211 19152 (ISO/TC 211 Plenary, 2010).
	2012, January [8]	Publication planned as FDIS – Final Draft International Standard (ISO/TC 211 Plenary, 2011).
	2012, July [9]	Publication planned as IS/TS – International Standard (ISO/TC 211 Plenary, 2011).

[6] ISO/TC 211 Resolution 414, 2008-05-29/30 »Registration of new projects«

[7] ISO/TC 211 Resolution 500, 2010-05-28 »Registration of ISO/CD 19152, Geographic information — Land Administration Domain Model (LADM), as DIS«

[8] according ISO/TC 211 Resolution 556, 2011-05-26/27 »Adjustment of target dates of the ISO/TC 211 programme of work«

[9] according ISO/TC 211 Resolution 556, 2011-05-26/27 »Adjustment of target dates of the ISO/TC 211 programme of work«

8.5.2 Graphical Representation of LADM

The LADM consist of four basic packages related to

+ parties (people and organisations)
+ basic administrative units, rights, responsibilities, and restrictions (ownership rights)
+ spatial units (parcels, buildings and utility networks)
+ spatial sources (surveying), and spatial representations (geometry and topology)

Figure 32 shows the overview of the packages with the classes.

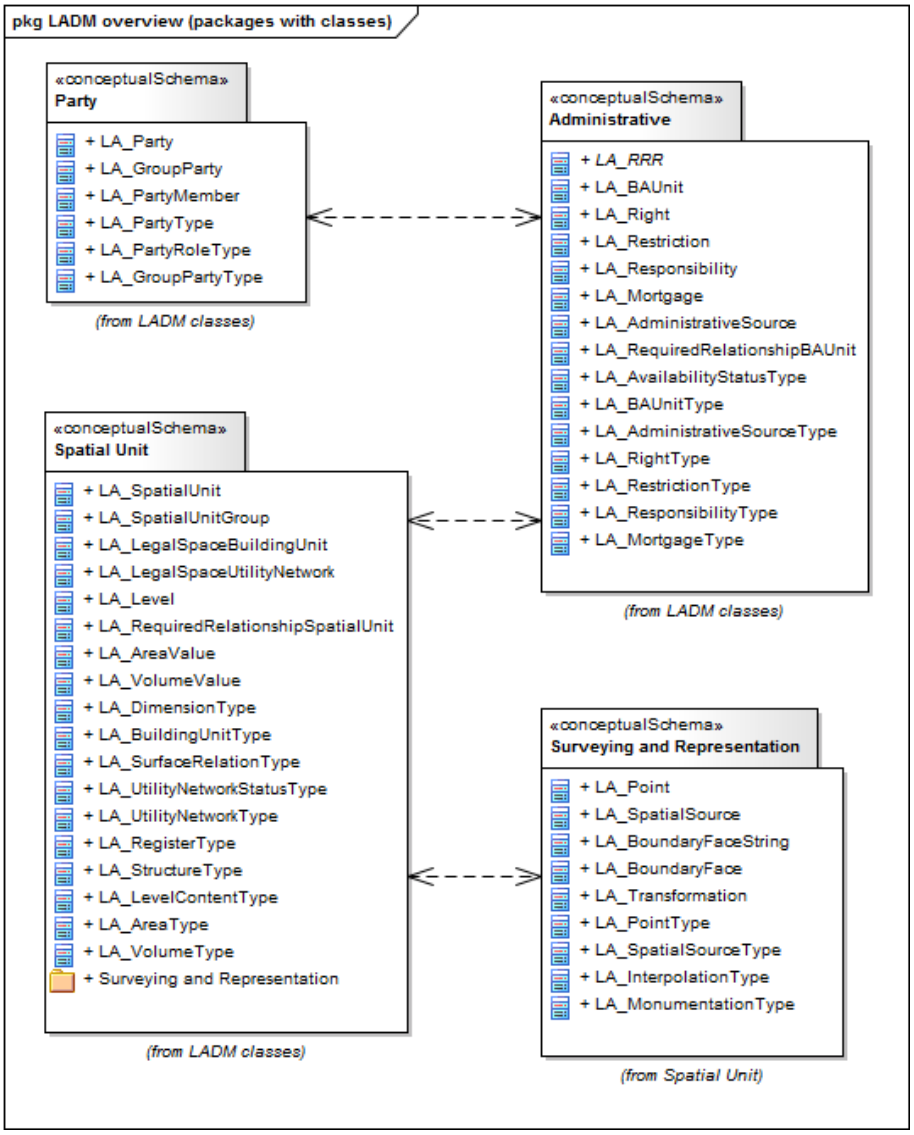


Figure 32: LADM overview (packages with classes) [10] *(ISO TC211, 2011)*

[10] Source: http://www.isotc211.org/hmmg/EArchitect/2011/SingleEAP/ISO%20TC211%202011-06-16.eap
(Path inside the Enterprise Architect File: \ISO 19152-All\ISO 19152:2012 Land Administration Domain Model (LADM)\LADM\Figures Main Text\LADM overview (packages with classes)

In the following figures, the four packages are presented with their attributes, constraints, operations, and code lists.[11]

8.5.2.1 Party Package

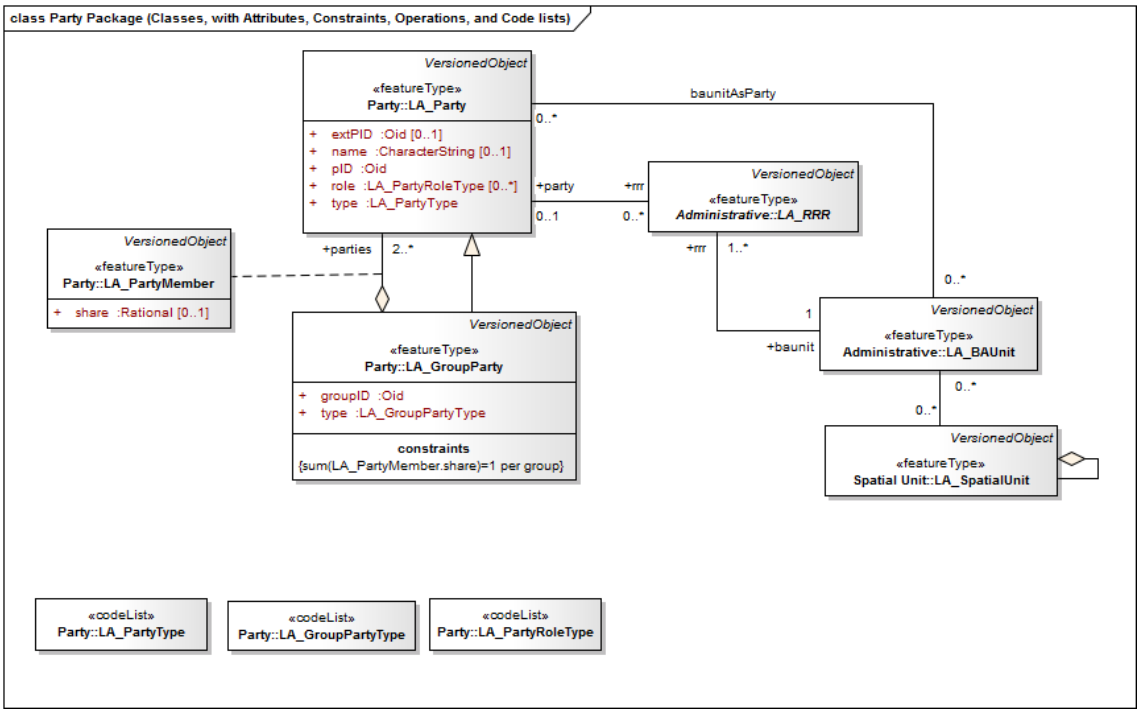


Figure 33: Class – Party package (ISO TC211, 2011)

[11] Source: http://www.isotc211.org/hmmg/EArchitect/2011/SingleEAP/ISO%20TC211%202011-06-16.eap
(Path inside the Enterprise Architect File: \ISO 19152-All\ISO 19152:2012 Land Administration Domain Model (LADM)\LADM\Figures Main Text\...

8.5.2.2 Administrative Package

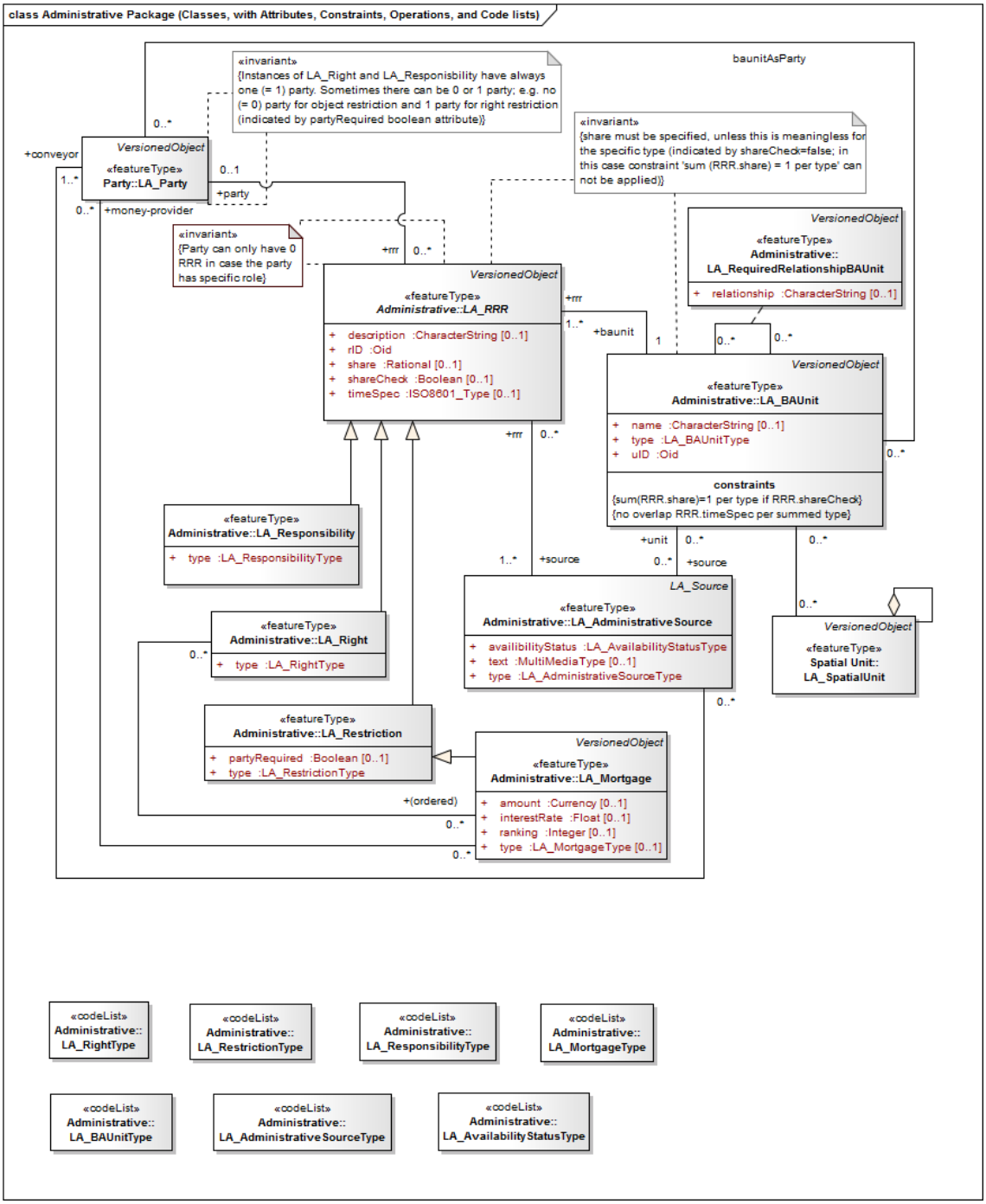


Figure 34: Class – Administrative package (ISO TC211, 2011)

8.5.2.3 Spatial Unit Package

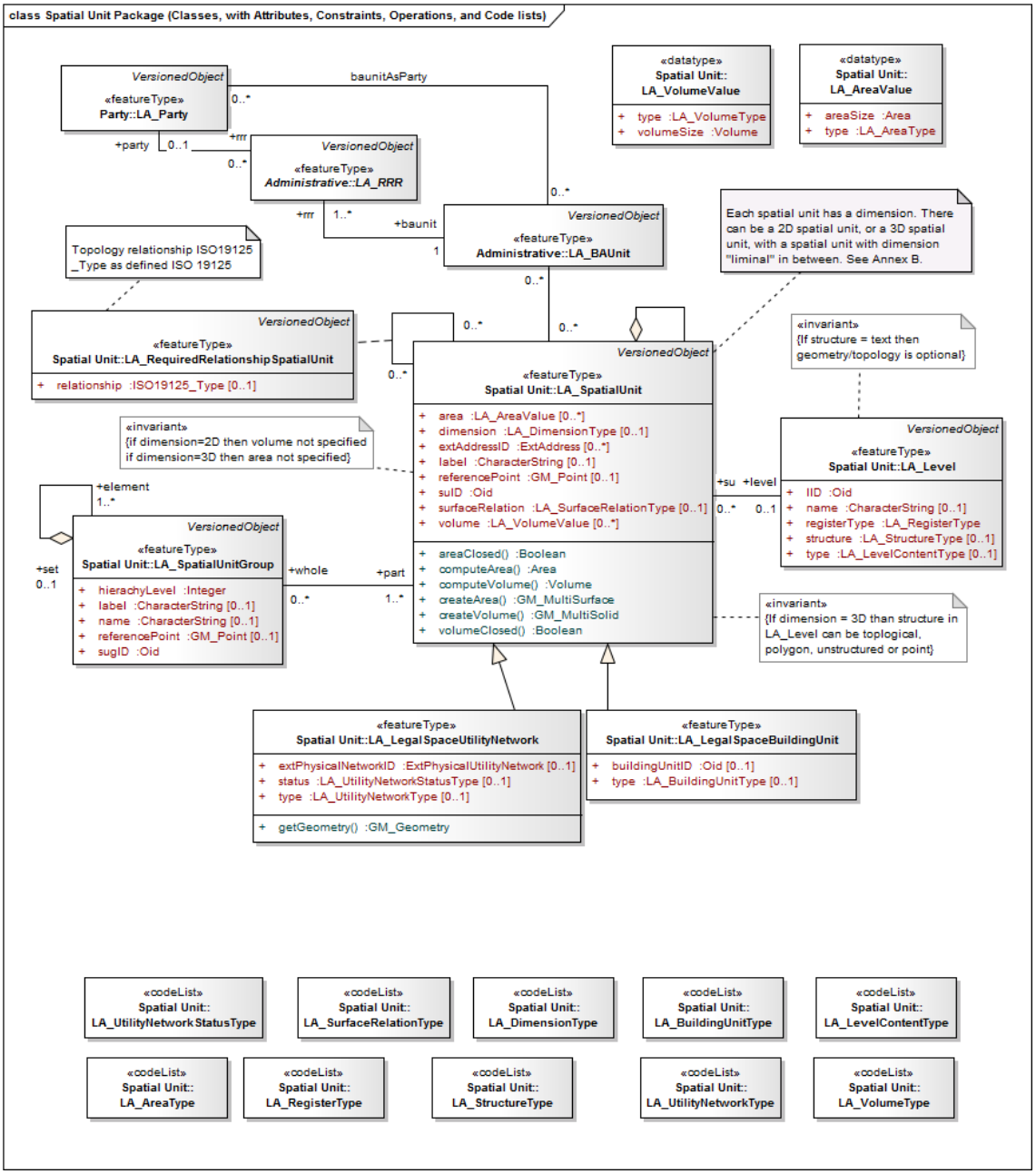


Figure 35: Class – Spatial Unit package (ISO TC211, 2011)

8.5.2.4 Surveying and Representation Subpackage

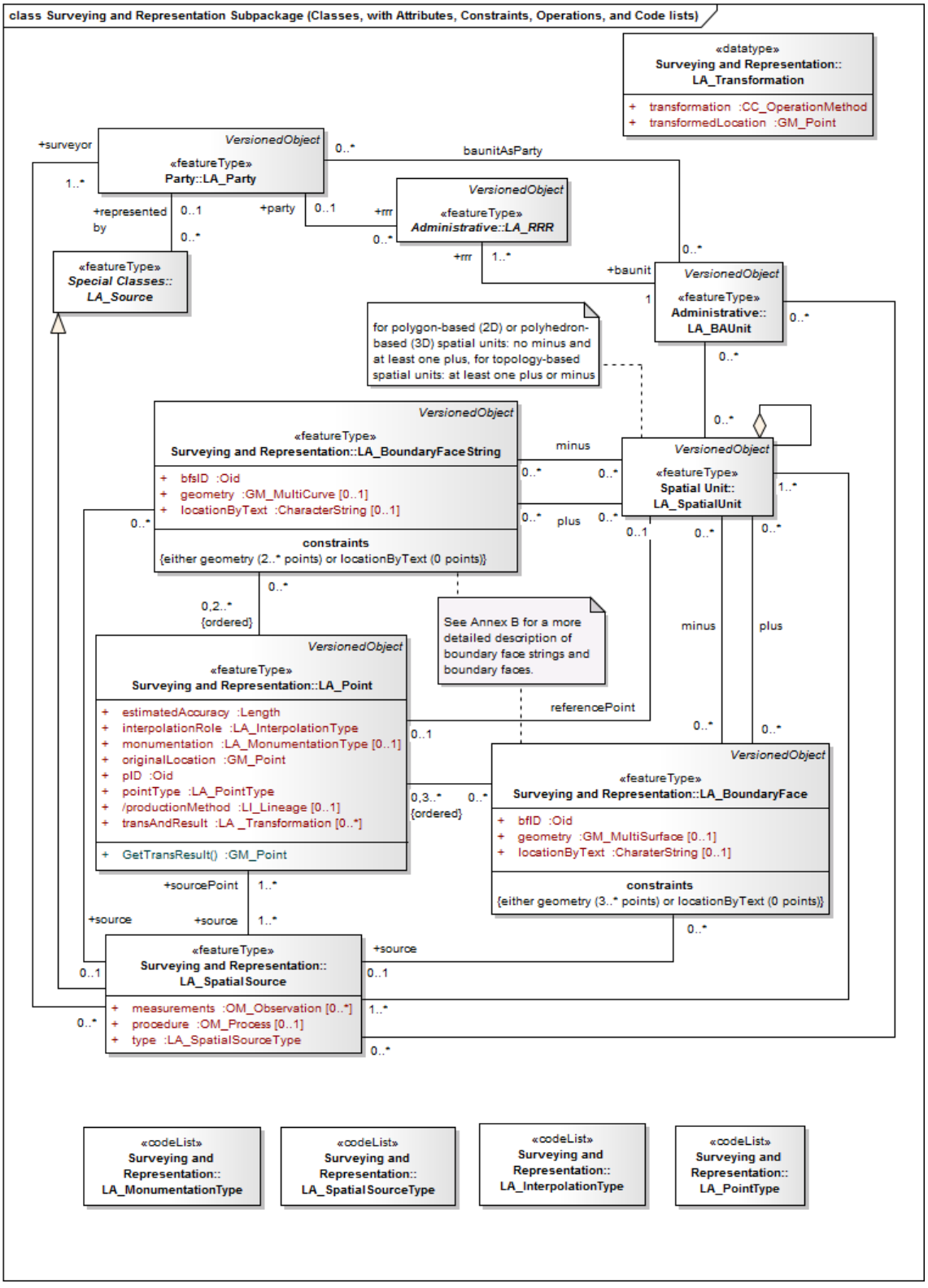


Figure 36: Class – Surveying and Representation subpackage (ISO TC211, 2011)

8.5.3 Registration Systems based on LADM

The LADM influenced the development of different systems for Land Administration. Here are two examples where the system is based on the LADM and developed on Open Source Technology.

8.5.3.1 FLOSS SOLA

»**Solutions for Open Land Administration (SOLA) Project** is an open source software system that aims to make computerised cadastre and registration systems more affordable and more sustainable in developing countries.« [12]

> *»Started in June 2010, SOLA is a 3 year trust fund project funded by the Government of Finland. Through the development and re-use of open source software, it aims to make computerised cadastre and registration systems more affordable and more sustainable in developing countries. Three countries (Samoa, Nepal and Ghana) have been identified for pilot implementation of the software.*
>
> *Open-source meansthat, unlike proprietary software, developers have access to software's "engine", which can be freely modified and adjusted. Open-source solutions are typically more flexible and adaptable to local cadastre and registration practices and languages than proprietary software. Over time it is expected that the community of land administration agencies using SOLA will increase. As land administration agencies complete further software development to customize, extend and enhance SOLA, it will be seen not only as a low cost software solution but also a way of adopting international best practice in the fields of cadastre and registration.«* [13]

[12] Source: http://www.flossola.org/

[13] Source: http://www.flossola.org/about

8.5.3.2 SIGIT

Sistema de Gestion Intergral de Tierras (SIGIT) is an EU supported development. The pilot implementation will be in one municipality in Guatemala and three municipalities in Honduras. The pilot implementation will be ready by end of June 2011.

Some facts about SIGIT [14]:

+ Multiuser and business process oriented
+ Support of History and Transaction
+ 100 % web user interface
+ 100 % Open Source technology programmed

[14] Source: Presentation of 8th June 2011, distributed by C. Lemmen on 21st June 2011 for the World Bank ECA E-Learning session "Open Source Software in Land Administration" June 21, 2011 at 8:30am EST

9 Conclusion

9.1 Findings

To fulfil the principles of the cadastre (under German point of view), it is essential, to use all the available documentation for the cadastre reconstruction. Only then, the confidence in the cadastre and registration will be established and can be maintained.

Cadastre Reconstruction is necessary. It is the basis for registration of property. The question is only, which accuracy is necessary. It must not be specially emphasizes that the reliability of cadastre and registration is beyond all question. A spatial unit, e.g. parcel, can only be registered in case, the cadastre is the documented evidence of the spatial unit.

The Republic of Kosovo has 1301 Cadastral Zones. All zones have to be reconstructed. The work will not end. Nevertheless, this means not that cadastre reconstruction will use the next years completely. There are other items that must be done in a timely frame. The reconstruction of the cadastre must be done as fast as possible to guarantee the reliability of Land Administration in Kosovo for the future of the Republic and their inhabitants.

9.2 Open Issues

The graphical part of the KCLIS is still not developed. There are only some proposals for the implementation. The LADM have the possibilities to fulfil all actual requirements. Also the sketches of update cases can be stored regarding the LADM. Such a system is still not established.

9.3 Outlook

The next steps in implementing the presented method would find the practical implementation in a test area or one of its soon performed cadastre reconstruction. Previously, a database for the identification of existing cadastral data has to be created to collect the relevant data. This is not only a valuable aid during a CR, but also for the daily work of professionals in the KCA and the MCOs. Moreover, this will be a building block towards a service-oriented Land Administration system. In addition, the economic development of the country will be influenced positively.

IV Appendices

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A.2 Useful Internet Sites

Keyword	Description & URL
FLOSS SOLA	*»Solutions for Open Land Administration (SOLA) Project is an open source software system that aims to make computerised cadastre and registration systems more affordable and more sustainable in developing countries.«* *Source: http://www.flossola.org*
Interlis	*»The tool to describe, integrate and coordinate geodata«* *Source: http://interlis.ch/index_e.htm* *»In 1991 "INTERLIS - A Data Exchange Mechanism for Land-Information-Systems" was first published. This mechanism consists of a conceptual description language and a transfer format which in particular takes into account spatially related data (shortly geodata), thus permitting compatibility among various systems and long-term availability, i.e. depositing in archives and documentation of data.«* *Source: http://interlis.ch/general/historique_e.php*
OICRF	***» Welcome to OICRF*** *OICRF – the International Office for Cadastre and Land Records - is one of the permanent bodies of the International Federation of Surveyors (FIG). OICRF serves as a documentation and study centre for land administration and is charged with the following tasks:* • *collecting and systematically filing and indexing all documentation material relating to existing cadastres and land registration systems,* • *conducting comparative studies of this material and publishing the results,* • *providing information and advice on all cadastres and land registration systems to all interested persons and institutions for the purposes of study or to help countries wishing to set up a cadastre or land registration system or improve an existing system,* • *maintaining the documentation system on a daily basis.* ***A digital Land Administration library*** *OICRF maintains a digital library that currently contains approximately 6,000 publications, which include things such as conference documents, magazine articles and reports on land administration. All of the available documents and the most recent publications can be accessed electronically at www.oicrf.org and downloaded in PDF format.* *The website includes a function that enables users to search for publications and documents by 'Title' or 'Author' or on the basis of an 'Abstract' or 'Keyword'. A 'Language'-based search is also possible. Users can also trace documents linked to a certain event, such as papers linked to a specific conference or seminar. […]«* Source: http://www.oicrf.org/oicrf_organization.html

B »Fugro-Report«

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Mitrovice Cadastral zone: Bajgore

1. TDB missing Parcels

The following parcels can been found in the cadastral plan but are missing from the textual database (TDB):

Parcel No	Sheets	Fugro Area	Remarks
1411/0	7G18-82	252.69695	

2. Cadastral plan missing parcels

The following parcels have been reported in the TDB but cannot be found in the cadastral plan:

Parcel_no	TDB_Area	Remarks
6/0	23758	
1412/0	10423	
1540/0	19728	
1541/0	2432	
1657/0	1397	
1682/0	733	
2226/0	786	
2236/0	1798	
2268/0	2424	

3. Parcel Area differences

In the following parcels differences exceeding the tolerance exist for the digitised parcel area and area reported in TDB:

Parcel No	TDB_Are	Fugro_Area	Sheets	scale	Remarks
3/0	4375	4128.96	7G18-41	2500	
23/0	1792829	1795340.26	7F18-70-1	2500	
26/0	1999	1888.90	7F18-70-1	2500	
34/0	2079	2222.88	7G18-71	2500	
42/0	34708	33326.94	7G18-61	2500	
45/0	4890	4738.99	7F18-70-1	2500	
51/0	780	736.19	7G18-61	2500	
61/0	7599	7049.66	7G18-71	2500	
74/0	1009	949.27	7G18-71	2500	
77/0	600	1602.84	7G18-61	2500	
80/0	12879	13078.10	7G18-61	2500	
129/0	4566	4673.34	7G18-72	2500	
132/0	769	833.39	7G18-72	2500	
140/0	14635	14442.43	7G18-72	2500	
155/0	3185	3299.34	7G18-72	2500	
158/0	3943	3765.11	7G18-72	2500	
164/0	2748	2829.13	7G18-72	2500	
165/0	1674	1741.62	7G18-72	2500	
173/0	540	504.26	7G18-72	2500	
176/0	4876	5003.39	7G18-72	2500	
189/0	790	724.18	7G18-72	2500	
191/0	2881	2787.18	7G18-72	2500	
193/0	1180	1077.45	7G18-72	2500	

Figure 37: Example of »Fugro-Report« (page 1/5)

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194/0	700	810.67	7G18-72	2500	
209/0	700	655.92	7G18-72	2500	
222/0	371	333.33	7G18-72	2500	
235/0	4084	3841.65	7G18-72	2500	
238/0	170	143.25	7G18-72	2500	
247/0	150	124.74	7G18-72	2500	
248/0	2342	2213.98	7G18-82	2500	
267/0	870	918.66	7G18-71	2500	
269/0	6101	5971.51	7G18-72	2500	
275/0	2103	2022.95	7G18-71	2500	
279/0	1787	1897.81	7G18-71	2500	
321/0	4498	4390.24	7G18-71	2500	
350/0	4853	2327.64	7G18-71	2500	
361/0	686	3180.80	7G18-71	2500	
382/0	2035	1932.22	7G18-71	2500	
387/0	5752	5590.66	7G18-71	2500	
408/0	274	248.04	7G18-71	2500	
452/0	481	725.84	7G18-71	2500	
469/0	1426	1366.44	7G18-71	2500	
483/0	17373	17076.50	7G18-71	2500	
486/0	851	958.01	7G18-71	2500	
492/0	4543	4404.11	7G18-71	2500	
494/0	8467	8325.77	7G18-71	2500	
505/0	1900	1966.31	7G18-71	2500	
511/0	3946	4074.15	7G18-71	2500	
523/0	564	524.25	7F18-80-1	2500	
524/0	130	101.94	7F18-80-1	2500	
527/0	1626	1736.29	7F18-80-1	2500	
541/0	2600	2693.20	7F18-80-1	2500	
557/0	9280	9534.97	7G18-71	2500	
559/0	344733	345677.83	7G18-71	2500	
566/0	7923	8080.39	7G18-71	2500	
568/0	4117	3099.65	7G18-81	2500	
569/0	45685	40525.72	7F18-90-1	2500	
570/0	186299	191164.84	7F18-90-1	2500	
573/0	4671	4782.55	7G18-81	2500	
580/0	225	199.08	7F18-90-1	2500	
648/0	3181	3052.16	7F18-90-1	2500	
661/0	613	650.51	7F18-90-1	2500	
670/0	3766	3864.10	7F18-90-1	2500	
671/0	1803	1872.48	7F18-90-1	2500	
702/0	592	455.30	7F18-90-1	2500	
712/0	845	928.24	7F18-90-1	2500	
745/0	288	260.77	7F18-90-1	2500	
750/0	755	711.11	7F18-90-1	2500	
751/0	527	396.72	7F18-90-1	2500	
752/0	1020	1077.49	7F18-90-1	2500	
789/0	1232	1145.08	7G18-81	2500	
820/0	5347	5197.32	7G18-81	2500	
835/0	1322	1243.19	7G18-81	2500	

Figure 38: Example of »Fugro-Report« (page 2/5)

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838/0	1473	1539.87	7G18-71	2500	
856/2	1931	1833.37	7G18-81	2500	
873/0	45238	44621.90	7G18-81	2500	
879/0	191	263.57	7G18-81	2500	
880/0	511	423.27	7G18-81	2500	
951/0	5611	5755.94	7G18-81	2500	
995/0	2518	2826.71	7G18-81	2500	
1008/0	120	139.68	7G18-81	2500	
1054/0	5118	5235.46	7G18-81	2500	
1064/0	724	767.63	7G18-81	2500	
1077/0	7148	7298.76	7G18-81	2500	
1110/0	314	354.23	7G18-81	2500	
1179/0	4691	4538.95	7G18-82	2500	
1180/0	7144	7310.63	7G18-81	2500	
1192/0	2258	2349.80	7G18-81	2500	
1195/0	1883	1750.06	7G18-81	2500	
1258/0	1452	1389.31	7G18-82	2500	
1326/0	30264	30533.20	7G18-82	2500	
1332/0	101173	101698.32	7G18-82	2500	
1336/0	13022	12827.99	7G18-82	2500	
1378/0	506	470.86	7G18-82	2500	
1379/0	3387	3482.91	7G18-82	2500	
1389/0	218	195.14	7G18-72	2500	
1391/0	2145	2239.99	7G18-72	2500	
1394/0	799	872.94	7G18-72	2500	
1429/0	535	592.68	7G18-82	2500	
1446/0	371	338.05	7G18-82	2500	
1448/0	12505	12780.32	7G18-82	2500	
1453/0	4217	4352.78	7G18-82	2500	
1462/0	17439	17663.19	7G18-92	2500	
1463/0	72	136.30	7G18-92	2500	
1464/0	149	53.96	7G18-92	2500	
1468/0	2090	2012.05	7G18-92	2500	
1494/0	741	811.15	7G18-91	2500	
1496/0	3054	3179.27	7G18-91	2500	
1504/0	4079	4318.03	7G18-92	2500	
1506/0	430	393.94	7G18-92	2500	
1516/0	3728	3600.98	7G18-91	2500	
1518/0	5414	5271.04	7G18-92	2500	
1519/0	4575	4464.52	7G18-92	2500	
1527/0	4783	4663.28	7G18-92	2500	
1528/0	7758	7625.05	7G18-92	2500	
1549/0	4046	4193.35	7G17-1	2500	
1555/0	12545	12731.15	7G17-1	2500	
1561/0	3973	3832.38	7G18-91	2500	
1567/0	18571	18775.68	7G18-91	2500	
1568/0	1874	1943.38	7G18-91	2500	
1570/0	21948	22301.24	7G18-91	2500	
1571/0	20752	19962.32	7G18-91	2500	
1576/0	2522	2611.64	7G18-91	2500	

Figure 39: Example of »Fugro-Report« (page 3/5)

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1578/0	2871	3013.10	7G18-91	2500	
1583/0	16428	16700.06	7G18-91	2500	
1616/0	3169	3508.38	7G18-91	2500	
1624/0	732	825.09	7G18-91	2500	
1662/0	40235	39818.45	7G18-91	2500	
1668/0	7711	7545.71	7G18-91	2500	
1670/0	9253	9058.15	7G18-91	2500	
1671/0	9353	9202.26	7G18-91	2500	
1685/0	880	935.59	7G18-91	2500	
1715/0	3979	3721.68	7G18-91	2500	
1728/0	2738	2658.63	7G18-91	2500	
1771/0	7862	7659.00	7G18-91	2500	
1772/0	4001	4249.55	7G18-91	2500	
1794/0	2459	2572.08	7G18-91	2500	
1800/0	10156	3036.68	7G18-91	2500	
1801/0	2999	10144.29	7G18-91	2500	
1811/0	3721	3838.09	7G18-91	2500	
1822/0	2602	2718.44	7G18-91	2500	
1853/0	310	282.66	7G18-91	2500	
1860/0	189	161.10	7G18-91	2500	
1884/0	1611	1687.57	7G18-91	2500	
1899/0	5433	5603.26	7G18-91	2500	
1928/0	3724	3580.44	7G18-91	2500	
1943/0	17425	17079.73	7G18-91	2500	
1948/0	6572	6718.56	7G17-1	2500	
1969/0	5002	5115.01	7G18-91	2500	
1987/0	280	177.52	7G18-91	2500	
2007/0	3021	2929.13	7G18-91	2500	
2015/0	3281	3091.35	7G18-91	2500	
2021/0	11761	11576.25	7G18-91	2500	
2053/1	4723	5234.34	7G18-91	2500	
2053/2	213	769.89	7G18-91	2500	
2062/0	3637	3729.33	7G18-91	2500	
2066/0	2199	2125.82	7G18-91	2500	
2070/0	8494	8640.60	7G18-91	2500	
2091/0	245	221.08	7G18-91	2500	
2120/0	8227	8374.46	7F18-100	2500	
2216/0	1239	1306.98	7G17-1	2500	
2296/0	18978	19260.33	7G17-2	2500	
2301/0	4861	4742.59	7G17-2	2500	
2323/0	12721	12439.60	7G18-51	2500	
2324/0	12274	11920.43	7G18-71	2500	
2325/0	10109	9861.30	7F18-90-1	2500	
2328/0	4772	4502.89	7G18-82	2500	
2330/0	13849	14324.76	7F18-100	2500	
2331/0	10499	9857.09	7G18-82	2500	
2332/0	12515	12113.02	7G18-92	2500	
2333/0	16175	15668.63	7G18-81	2500	
2334/0	8670	8446.23	7G18-82	2500	
2340/0	1316	1467.39	7G17-2	2500	

Figure 40: Example of »Fugro-Report« (page 4/5)

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4. Parcel without number/Unclear number

The following parcels in the cadastral plan do not have a parcel number/Unclear number:

Fugro Parcel No	Fugro Area	sheet	Remarks
9001	1379.67895	71208001_7G18-91	
9002	2402.5289	71208001_7G17-1	
9003	1761.75315	71208001_7G17-1	
9004	10467.3729	71208001_7G18-82	
9005	23850.41765	71208001_7G18-51	
9006	22212.8145	71208001_7G17-1	
9007	719.36985	71208001_7G18-81	
9008	33597.1701	71208001_7G18-71	

Figure 41: Example of »Fugro-Report« (page 5/5)

C Data(base) Models

C.1 Core Cadastral Domain Model

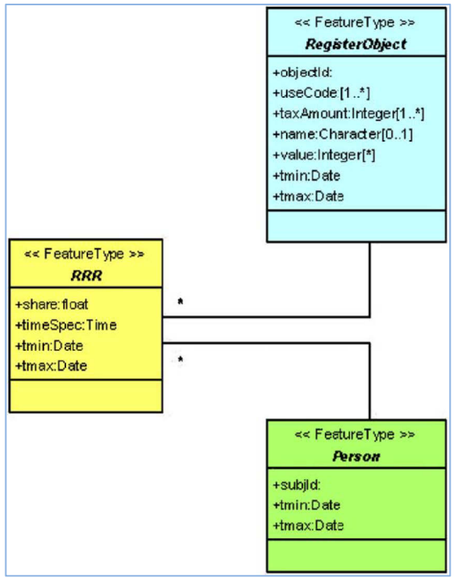

Figure 42: Core of the CCDM: Person, RRR (Right, Restriction, Responsibility) and RegisterObject.

Source: Fig. 1 from (van Oosterom et al., 2006)

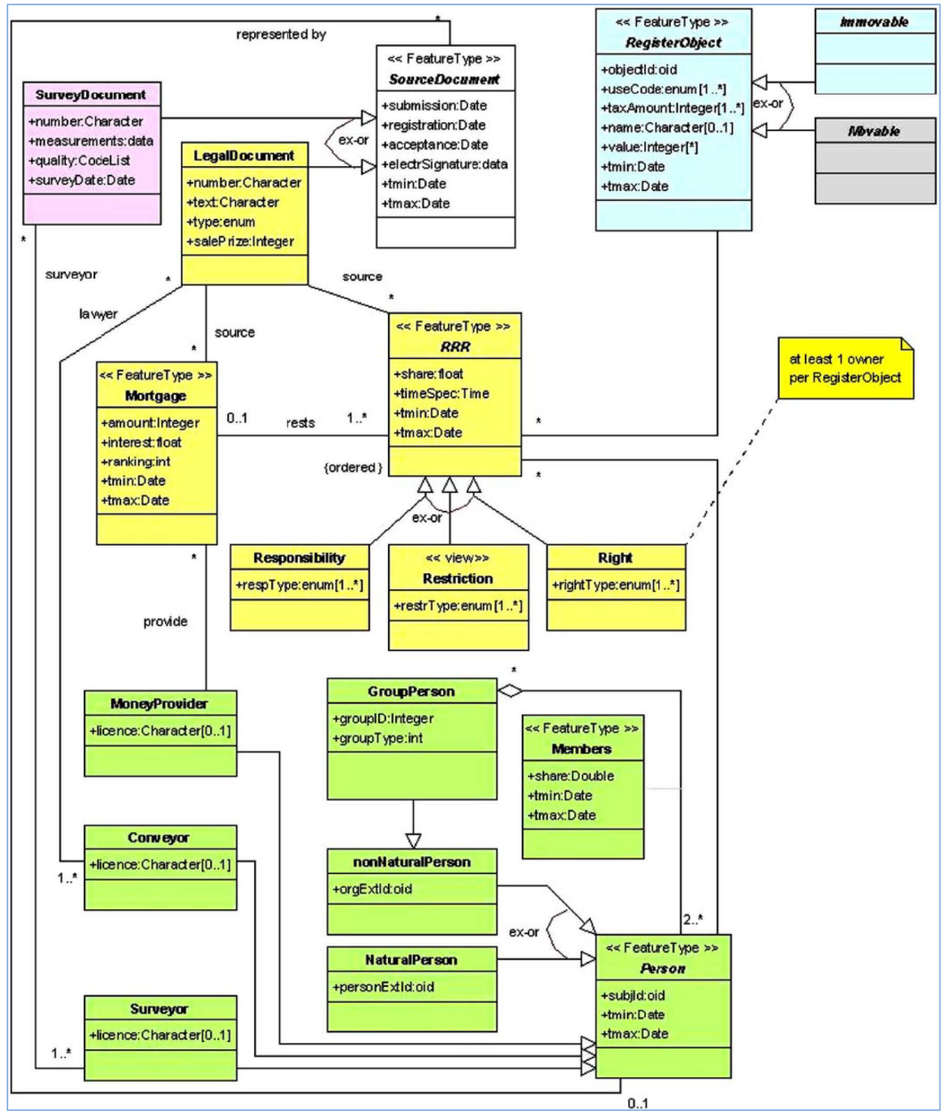

Figure 43: The legal/administrative and person classes together

Source: Fig. 11 from (van Oosterom et al., 2006)

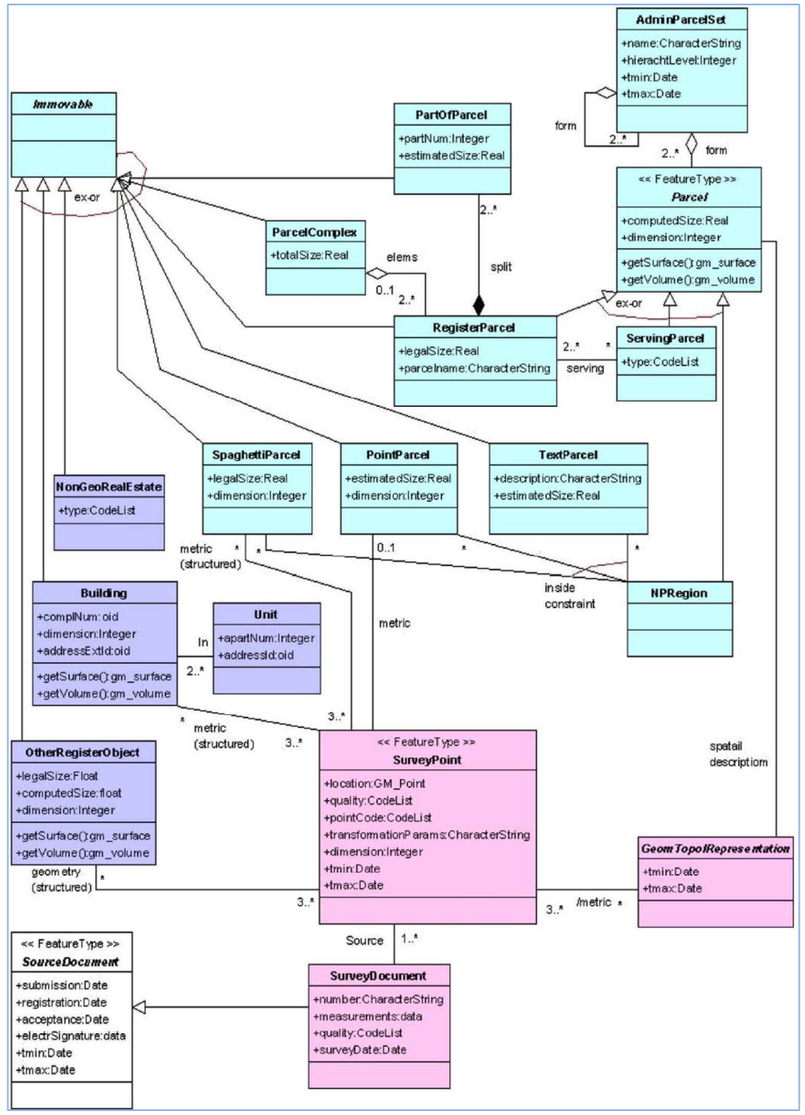

Figure 44: The different types of Immovable object classes together

Source: Fig. 12 from (van Oosterom et al., 2006)

C.2 Database model of KCID

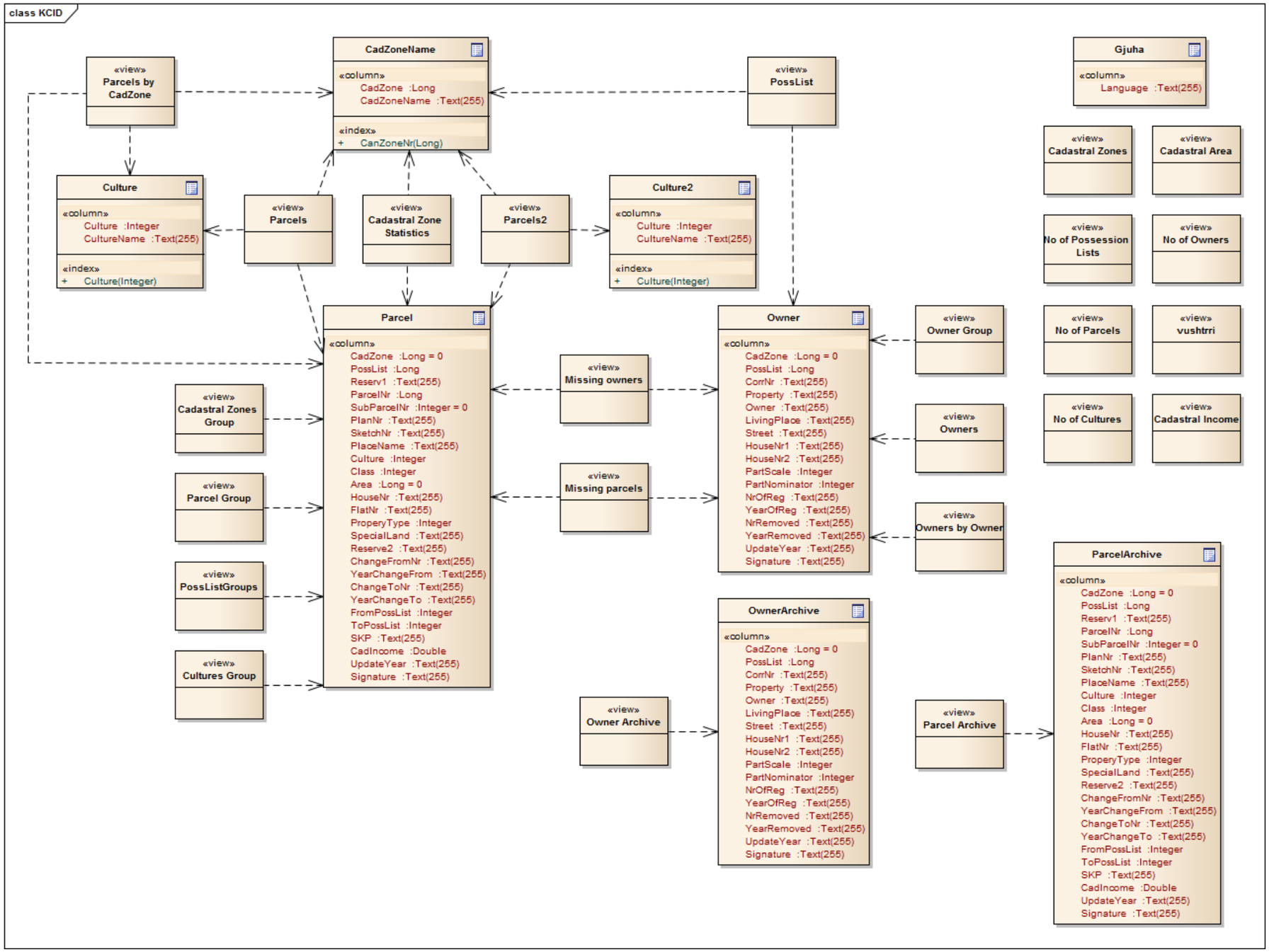

Figure 45: Derived database model of KCID database (MS Access) (bigger size)

C.3 Database model of IPRR

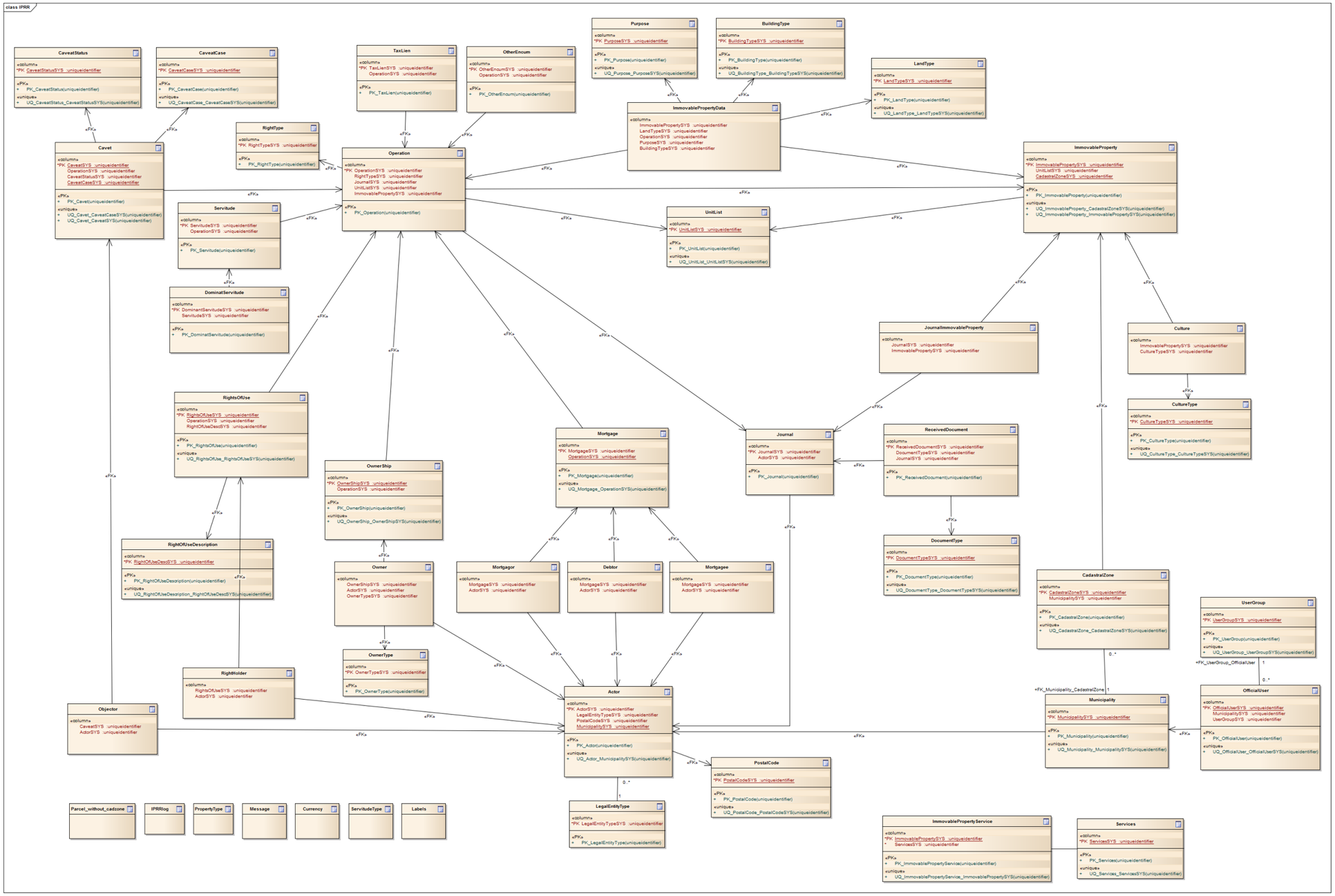

Figure 46: Derived database model of IPRR database (SQL Server) (bigger size)

C.4 Kosovo Cadastre

Table 8: KosovoCadastre.ili (in Interlis-1 model file notation)

```
TRANSFER KosovoCadastre;                                    !! Version 04-02-27

MODEL KosovoCadastre

   DOMAIN
      LCoord = COORD2  7399900.000   4629900.000
                       7585100.000   4800100.000;
      HCoord = COORD3  7399900.000   4629900.000      0.000
                       7585100.000   4800100.000   3000.000;
      Height = DIM1  0.000  3000.000;
      Accuracy = [0.0 .. 1000.0];                           !! in cm
      GeomReliability = (yes, no);
      LegalReliability = (Legal, projected);
      Ori = DEGREES 0.0 360.0;
      FontSize = (Small, Medium, Large);
      State = (Projected, Real);
      Scale = [1..1000000];

!!_____________________________________________________________________________
   TOPIC Controlpoints =

      TABLE CPRegister =
         CPRegisterID: TEXT*12;                             !! Contract Number
         Description: TEXT*30;
         Perimeter: OPTIONAL SURFACE WITH (STRAIGHTS, ARCS) VERTEX LCoord
                    WITHOUT OVERLAPS > 0.500;
         Date1: DATE;                                       !! Data Record Date
         Date2: OPTIONAL DATE;                              !! End Date
      IDENT
         CPRegisterID;
      END CPRegister;

      TABLE ControlPoints =
         CPObject: -> CPRegister;
         Number: TEXT*12;                                   !! Assigned by KCA
         Geometry: LCoord;
         HeightGeom: Height;
         PosAccu: Accuracy;
         PosReli: GeomReliability;
         HeightAccu: Accuracy;
         HeightReli: GeomReliability;
         CPNumPos: LCoord;
         CPNumOri: OPTIONAL Ori;                            !! Default: 90.0
         CPNumHAli: OPTIONAL HALIGNMENT;                    !! Default: Left
         CPNumVAli: OPTIONAL VALIGNMENT;                    !! Default: Base
         CPSymbolOri: OPTIONAL Ori;                         !! Default: 0.0
         Type:(CP1_KCA,
               CP2_KCA,
               CP3_Monument,
               CP3_Bolt,
               CP3_Cross,
               CP3_Pipe,
               CP3_Not_Marked,
               CP3_Highpoint);
```

```
      IDENT
         Number;
         Geometry;
      END ControlPoints;

      TABLE FormerPoints =
         FPObject: OPTIONAL -> CPRegister;
         Number: TEXT*12;
         Geometry: LCoord;
         HeightGeom: OPTIONAL Height;
         PosAccu: OPTIONAL Accuracy;
         PosReli: OPTIONAL GeomReliability;
         HeightAccu: OPTIONAL Accuracy;
         HeightReli: OPTIONAL GeomReliability;
         FPNumPos: LCoord;
         FPNumOri: OPTIONAL Ori;                        !! Default: 90.0
         FPNumHAli: OPTIONAL HALIGNMENT;                !! Default: Left
         FPNumVAli: OPTIONAL VALIGNMENT;                !! Default: Base
         FPSymbolOri: OPTIONAL Ori;                     !! Default: 0.0
         Type:(FPPos,
               FPLev,
               FPPhoto);
      IDENT
         Number;
         Geometry;
      END FormerPoints;

    END Controlpoints.

!!_____________________________________________________________________________

   TOPIC SurfaceCeiling =

      DOMAIN
         SCType = (Buildings,
                   Installations
                                    (Street,
                                     Way,
                                     Sidewalk,
                                     Railway,
                                     Runway,
                                     Pond,
                                     Lawn),
                   Developed_Areas
                                    (Mowing_Land,
                                     Pasture,
                                     Arable,
                                     Perennials
                      (Wine_Yard,
                       Garden)),
                   Water_Bodies
                    (Steady,
                                     Flowing,
                                     Swamp),
                   Wooded_Areas
                    (Forest,
                                     Separated_Woodland),
                   Without_Vegetation
                                    (Rock,
```

```
                  Waste_Land),
               Others);

         SCSym = (River_Direction,
                  Basin,
                  Reeds,
                  Swamp,
                  Vine);

   SCLine = (Buildings,
             Installations,
             Developed_Areas,
             Water_Bodies,
             Wooded_Areas);

OPTIONAL TABLE SCRegister =
   SCRegisterID: TEXT*12;                        !! CONTRACT NUMBER
   Description: TEXT*30;
   Perimeter: OPTIONAL SURFACE WITH (STRAIGHTS, ARCS) VERTEX LCoord
              WITHOUT OVERLAPS > 0.500;
   SCState: State;
   Date1: DATE;                                  !! Data Record Date
   Date2: OPTIONAL DATE;                         !! End Date
IDENT
   SCRegisterID;
END SCRegister;

TABLE Surface =
   SurfaceObject: OPTIONAL -> SCRegister // if SCState=Real //;
   Geometry: AREA WITH (STRAIGHTS, ARCS) VERTEX LCoord
             WITHOUT OVERLAPS > 0.050;
   Type: SCType;
NO IDENT
END Surface;

TABLE ObjectName =
   ObNameObject: -> Surface;
   ObName: TEXT*30;
NO IDENT
END ObjectName;

TABLE ObjectNamePos =
   ObNameObject: -> ObjectName;
   ObNamePos: LCoord // As a rule within surface //;
   ObNameOri: Ori;                               !! Default: 90.0
   ObNameHAli: OPTIONAL HALIGNMENT;              !! Default: Center
   ObNameVAli: OPTIONAL VALIGNMENT;              !! Default: Half
   ObNameSize: FontSize;                         !! Default: Small
NO IDENT
END ObjectNamePos;

TABLE Symbols =
   SyObject: -> Surface;
   SyNamePos: LCoord // As a rule within surface //;
   SyNameOri: Ori;
   Type: SCSym;
NO IDENT
END Symbols;
```

```
      OPTIONAL TABLE ProjectedSurface =
         ProjectedSurfaceObject: -> SCRegister //if
SCState=Projected/Under_Construction//;
         Geometry: SURFACE WITH (STRAIGHTS, ARCS) VERTEX LCoord
                   LINEATTR =
                   ProjLine: OPTIONAL (Buildings,
                                                              Installations,
                                                              Developed_Areas,
                                       Water_Bodies,
                                                              Wooded_Areas);
                   END;
         PSType: SCType;
      NO IDENT
      END ProjectedSurface;

      OPTIONAL TABLE SCProjName =
         SCProjNameObject: -> ProjectedSurface;
         SCProjName: TEXT*30;
      NO IDENT
      END SCProjName;

      OPTIONAL TABLE SCProjNamePos =
         SCProjNameObject: -> SCProjName;
         SCProjNamePos: LCoord // As a rule within surface //;
         SCProjNameOri: Ori;
         SCProjNameHAli: OPTIONAL HALIGNMENT;          !! Default: Center
         SCProjNameVAli: OPTIONAL VALIGNMENT;          !! Default: Half
         SCProjNameSize: FontSize;                     !! Default: Small
      NO IDENT
      END SCProjNamePos;

   END SurfaceCeiling.

!!_____________________________________________________________________________

   TOPIC SingleObject =

      DOMAIN
         SOType = (Underground_Construction,
                                 Separate_Building_Part,
                   Important_Step,
                                 Tunnel_Underground_Passage,
                                 Bridge,
                                 Well,
                   Reservoir,
                                 Pillar,
                                 Stand,
                                 Tower,
                                 Chimney,
                                 Monument,
                   Mast_Antenna,
                                 Sightseeing_Tower,
                                 Coastal_Protection_Wall,
                   Landslide_Retention_Wall,
                                 Platform,
                                 Basement,
                   Ruin_Archeological_Object,
                                 Single_Rock,
                   Narrow_Strip_of_Perennials,
```

```
                              Streamlet,
                              Narrow_Path,
                  High_Voltage_Air_Cable,
                              Pressure_Pipeline,
                              Cable_Cart,
                  Ski_Lift,
                              Ferry,
                              Cave_Entrance,
                              Track,
                              Axis,
                              Important_Tree,
                  Spring,
                              Terminal,
                              Others);

    SPType = (Buildings,
                        Waters,
                        Edge_of_the_forest,
              Roadside,
              Other_landmarks,
              Axis,
              Milestone,
              Important_tree,
              Pylon_AerialMast,
              LevP_with_Text,
              LevP_without_Text);

     OPTIONAL TABLE SORegister =
        SORegisterID: TEXT*12;                          !! CONTRACT NUMBER
        Description: TEXT*30;
        Perimeter: OPTIONAL SURFACE WITH (STRAIGHTS, ARCS) VERTEX LCoord
                   WITHOUT OVERLAPS > 0.500;
        SOState: State;
        Date1: DATE;                                    !! Data Record Date
        Date2: OPTIONAL DATE;                           !! End Date
     IDENT
        SORegisterID;
     END SORegister;

     TABLE SObject =
        SObject: OPTIONAL -> SORegister;
        Type: SOType;
     NO IDENT
     END SObject;

     TABLE SObjectName =
        SONameObject: -> SObject;
        SOName: OPTIONAL TEXT*30;
     NO IDENT
     END SObjectName;

     TABLE SONamePos =
        SONameObject: -> SObjectName;
        SONamePos: LCoord;
        SONameOri: OPTIONAL Ori;                        !! Default: 90.0
        SONameHAli: OPTIONAL HALIGNMENT;                !! Default: Center
        SONameVAli: OPTIONAL VALIGNMENT;                !! Default: Half
        SONameSize: FontSize;                           !! Default: Small
     NO IDENT
```

```
      END SONamePos;

      TABLE SurfaceFeature =
         SFObject: -> SObject;
         Geometry: SURFACE WITH (STRAIGHTS, ARCS) VERTEX LCoord
                   WITHOUT OVERLAPS > 0.050;
      NO IDENT
      END SurfaceFeature;

      TABLE LinearFeature =
         LFObject: -> SObject;
         Geometry: POLYLINE WITH (STRAIGHTS, ARCS) VERTEX LCoord;
      NO IDENT
      END LinearFeature;

      TABLE PointFeature =
         PFObject: -> SObject;
         Geometry: LCoord;
         PFSymbolOri: Ori;                              !! Default: 0.0
      NO IDENT
      END PointFeature;

      TABLE SinglePoints =
         SPObject: OPTIONAL -> SORegister;
         Number: OPTIONAL TEXT*12;
         Geometry: LCoord;
         HeightGeom: OPTIONAL Height;
         PosAccu: OPTIONAL Accuracy;
         PosReli: OPTIONAL GeomReliability;
         HeightAccu: OPTIONAL Accuracy;
         HeightReli: OPTIONAL GeomReliability;
         Type: SPType;
         SPNumPos: LCoord;
         SPNumHAli: OPTIONAL HALIGNMENT;
         SPNumVAli: OPTIONAL VALIGNMENT;
         SPSymbolOri: OPTIONAL Ori;
      IDENT
         Geometry;
      END SinglePoints;

   END SingleObject.

!!------------------------------------------------------------------------------

   TOPIC Nomenklatur=

      OPTIONAL TABLE NomRegister =
         NomRegisterID: TEXT*12;                        !! CONTRACT NUMBER
         Description: TEXT*30;
         Perimeter: OPTIONAL SURFACE WITH (STRAIGHTS, ARCS) VERTEX LCoord
                    WITHOUT OVERLAPS > 0.500;
         Date1: DATE;                                   !! Data Record Date
         Date2: OPTIONAL DATE;                          !! End Date
      IDENT
         NomRegisterID;
      END NomRegister;

      TABLE Localname=
         LocObject: OPTIONAL -> NomRegister;
```

```
         LocName: TEXT*30;
         Geometry: OPTIONAL SURFACE WITH (STRAIGHTS, ARCS) VERTEX LCoord
                   WITHOUT OVERLAPS > 0.050;
         LocNamePos: LCoord;
         LocNameOri: Ori;                                  !! Default: 90.0
         LocNameHAli: HALIGNMENT;                          !! Default: Center
         LocNameVAli: VALIGNMENT;                          !! Default: Half
         LocNameSize: FontSize;                            !! Default: Medium
      NO IDENT
      END Localname;

   END Nomenklatur.

!!_____________________________________________________________________________

   TOPIC Parcel =

      TABLE ParcelRegister =
         ParcelRegisterID: TEXT*12;                        !! CONTRACT NUMBER
         Description: TEXT*30;
         Perimeter: OPTIONAL SURFACE WITH (STRAIGHTS, ARCS) VERTEX LCoord
                    WITHOUT OVERLAPS > 0.500;
         ParcelState : State;
         Date1: DATE;                                      !! Data Record Date
         Date2: OPTIONAL DATE;                             !! Registration Date
         Date3: OPTIONAL DATE;                             !! End Date
      IDENT
         ParcelRegisterID;
      END ParcelRegister;

      TABLE BoundaryPoints =
         BPObject: -> ParcelRegister;
         Number: TEXT*12;
         Geometry: LCoord;
         PosAccu: Accuracy;
         PosReli: GeomReliability;
         BPNumPos: LCoord;
         BPNumHAli: OPTIONAL HALIGNMENT;                   !! Default: Left
         BPNumVAli: OPTIONAL VALIGNMENT;                   !! Default: Base
         BPSymbolOri: OPTIONAL Ori;                        !! Default: 90.0
         Type: (Monument,
                Bolt,
                Cross,
                PlasticPeg,
                Not_marked,
                Peg,
                Pipe);
      IDENT
         Geometry;
      END BoundaryPoints;

      TABLE Parcel =
         ParcelObject: -> ParcelRegister;
         ParcelID: TEXT*30;
         ParcLegalReli: LegalReliability;
         Type: (Parcel, Encumbrance);
      IDENT
         ParcelID;
      END Parcel;
```

```
      TABLE ParcelIDPos =
         ParcelIDObject: -> Parcel;
         ParcelIDPos: LCoord // As a rule within Parcel //;
         ParcelIDOri: OPTIONAL Ori;                    !! Default: 90.0
         ParcelIDHAli: OPTIONAL HALIGNMENT;            !! Default: Center
         ParcelIDVAli: OPTIONAL VALIGNMENT;            !! Default: Half
         ParcelIDSize: FontSize;                       !! Default: Medium
      NO IDENT
      END ParcelIDPos;

      TABLE ParcelGeom =
         ParcelGeomObject: -> Parcel;
         Geometry: AREA WITH (STRAIGHTS, ARCS) VERTEX LCoord
                   WITHOUT OVERLAPS > 0.050;           !! According to Documents
         Area: OPTIONAL DIM2 1 999999999;
      NO IDENT
      END ParcelGeom;

      OPTIONAL TABLE Encumbrance =
         EncumbranceObject: -> Parcel;                 !! If Encumbrance=Yes
         Geometry: SURFACE WITH (STRAIGHTS, ARCS) VERTEX LCoord
                   WITHOUT OVERLAPS > 0.050;           !! According to Documents
         Area: OPTIONAL DIM2 1 999999999;
         EncumbranceLegalReli : LegalReliability;
         Type: (Parcel, Encumbrance);
      NO IDENT
      END Encumbrance;

      TABLE ProjParcel =
         Geometry: SURFACE WITH (STRAIGHTS, ARCS) VERTEX LCoord
                   WITHOUT OVERLAPS > 0.050;
         ProjParcelID: OPTIONAL TEXT*12;
         ProjParcGeomReli: GeomReliability;
         Comment: OPTIONAL TEXT*30;
      NO IDENT
      END ProjParcel;

      TABLE ProjParcelIDPos =
         ProjParcelIDObject: -> ProjParcel;
         ProjParcelIDPos: LCoord // As a rule within Parcel //;
         ProjParcelIDOri: OPTIONAL Ori;                !! Default: 90.0
         ProjParcelIDHAli: OPTIONAL HALIGNMENT;        !! Default: Center
         ProjParcelIDVAli: OPTIONAL VALIGNMENT;        !! Default: Half
         ProjParcelIDSize: FontSize;                   !! Default: Medium
      NO IDENT
      END ProjParcelIDPos;

   END Parcel.

!!------------------------------------------------------------------------------

   TOPIC CadastralZone =

      OPTIONAL TABLE CadRegister =
         CadRegisterID: TEXT*12;                       !! CONTRACT NUMBER
         Description: TEXT*30;
         Perimeter: OPTIONAL SURFACE WITH (STRAIGHTS, ARCS) VERTEX LCoord
                    WITHOUT OVERLAPS > 0.500;
```

```
         Date1: DATE;                                    !! Data Record Date
         Date2: OPTIONAL DATE;                           !! End Date
      IDENT
         CadRegisterID;
      END CadRegister;

      TABLE CadZone =
         CadObject: OPTIONAL -> CadRegister;
         CadID: TEXT*12;
         CadName: TEXT*30;
         Geometry: AREA WITH (STRAIGHTS, ARCS) VERTEX LCoord
                   WITHOUT OVERLAPS > 0.050;
         CadZoneLegalReli: LegalReliability;
      IDENT
         CadID;
      END CadZone;

      TABLE CadIDPos =
         CadIDObject: -> CadZone;
         CadIDPos: LCoord // As a rule within surface//;
         CadIDOri: OPTIONAL Ori;                         !! Default: 90.0
         CadIDHAli: OPTIONAL HALIGNMENT;                 !! Default: Center
         CadIDVAli: OPTIONAL VALIGNMENT;                 !! Default: Half
         CadIDSize: OPTIONAL FontSize;                   !! Default: Large
      NO IDENT
      END CadIDPos;

      TABLE CadNamePos =
         CadNameObject: -> CadZone;
         CadNamePos: LCoord // As a rule within surface//;
         CadNameOri: OPTIONAL Ori;                       !! Default: 90.0
         CadNameHAli: OPTIONAL HALIGNMENT;               !! Default: Center
         CadNameVAli: OPTIONAL VALIGNMENT;               !! Default: Half
         CadNameSize: OPTIONAL FontSize;                 !! Default: Large
      NO IDENT
      END CadNamePos;

      OPTIONAL TABLE ProjCadZone =
         PCadObject: -> CadZone;
         Geometry: POLYLINE WITH (STRAIGHTS, ARCS) VERTEX LCoord
                   WITHOUT OVERLAPS > 0.050;
         Comment: OPTIONAL TEXT*30;
      NO IDENT
      END ProjCadZone;

   END CadastralZone.

!!_____________________________________________________________________________

   TOPIC AdminBoundaries =

      TABLE ABoundary =
         Geometry: POLYLINE WITH (STRAIGHTS, ARCS) VERTEX LCoord;
         Type: (CadastralDistrict,
                              Municipality,
                              Region,
                              Authonomy);
      NO IDENT
      END ABoundary;
```

```
   END AdminBoundaries.

!!_____________________________________________________________________________

   TOPIC Tolerancelevel =

      TABLE TLBoundary =
         TLID: TEXT*12;
         Geometry: AREA WITH (STRAIGHTS, ARCS) VERTEX LCoord
           WITHOUT OVERLAPS > 0.050;
         Type: (Town,
                              Country,
                              Mountain);
      IDENT
         TLID;
      END TLBoundary;

   END Tolerancelevel.

!!_____________________________________________________________________________

   TOPIC Projects =

      TABLE Project =
         ProjectID: TEXT*12;
         ProjectName: TEXT*30;
         Type: (Buildings,
                Roads,
                Singleobjects,
                Parcels,
                Others);
      NO IDENT
      END Project;

      TABLE ProjectIDPos =
     ProjectIDObject: -> Project;
     ProjectIDPos: LCoord // As a rule within surface//;
         ProjectIDOri: OPTIONAL Ori;                    !! Default: 90.0
         ProjectIDHAli: OPTIONAL HALIGNMENT;            !! Default: Center
         ProjectIDVAli: OPTIONAL VALIGNMENT;            !! Default: Half
         ProjectIDSize: OPTIONAL FontSize;              !! Default: Small
      NO IDENT
      END ProjectIDPos;

      TABLE ProjectNamePos =
         ProjectNameObject: -> Project;
         ProjectNamePos: LCoord // As a rule within surface//;
         ProjectNameOri: OPTIONAL Ori;                  !! Default: 90.0
         ProjectNameHAli: OPTIONAL HALIGNMENT;          !! Default: Center
         ProjectNameVAli: OPTIONAL VALIGNMENT;          !! Default: Half
         ProjectNameSize: OPTIONAL FontSize;            !! Default: Small
      NO IDENT
      END ProjectNamePos;

      TABLE SurfaceFeature =
         SFObject: -> Project;
         Geometry: SURFACE WITH (STRAIGHTS, ARCS) VERTEX LCoord
                   WITHOUT OVERLAPS > 0.050;
```

```
      NO IDENT
      END SurfaceFeature;

      TABLE LinearFeature =
         LFObject: -> Project;
         Geometry: POLYLINE WITH (STRAIGHTS, ARCS) VERTEX LCoord;
      NO IDENT
      END LinearFeature;

      TABLE PointFeature =
         PFObject: -> Project;
         Geometry: LCoord;
         PFSymbolOri: Ori;                              !! Default: 0.0
      NO IDENT
      END PointFeature;

      TABLE ProjectPoints =
         Number: OPTIONAL TEXT*12;
         Geometry: LCoord;
         HeightGeom: OPTIONAL Height;
         PosAccu: OPTIONAL Accuracy;
         PosReli: OPTIONAL GeomReliability;
         HeightAccu: OPTIONAL Accuracy;
         HeightReli: OPTIONAL GeomReliability;
         PPNumPos: LCoord;
         PPNumHAli: OPTIONAL HALIGNMENT;                   !! Default: Center
         PPNumVAli: OPTIONAL VALIGNMENT;                !! Default: Half
         PPSymbolOri: OPTIONAL Ori;                     !! Default: 90.0
         Type: (LevP_with_Text,
                LevP_without_Text,
                Building,
                Boundary,
                Axis,
                Others);
      IDENT
         Geometry;
      END ProjectPoints;

   END Projects.

!!_____________________________________________________________________________

   TOPIC MapIndex =

      TABLE Map =
         MapID: TEXT*20;
         MapType: Scale;
         Date: OPTIONAL DATE;
      IDENT
         MapID;
      END Map;

      TABLE MapGeom =
         MapGeomObject: -> Map;
         Geometry: AREA WITH (STRAIGHTS, ARCS) VERTEX LCoord
                   WITHOUT OVERLAPS > 0.050;
      NO IDENT
      END MapGeom;
```

```
      TABLE MapIDPos =
         MapIDObject: -> Map;
         MapIDPos: LCoord;
         MapIDOri: OPTIONAL Ori;                          !! Default: 90.0
         MapIDHAli: OPTIONAL HALIGNMENT;                  !! Default: Center
         MapIDVAli: OPTIONAL VALIGNMENT;                  !! Default: Half
         MapIDSize: FontSize;
      NO IDENT
      END MapIDPos;

   END MapIndex.

!!_____________________________________________________________________________

   TOPIC MapFrame =

      DOMAIN
         TextType = (MapID,
                                      Sakrebulo,
                                      Surveyor_Executor,
                                      Date,
                                      Map_Tolerance,
                     Digital_Scale,
                                      Coordinate_Value,
                                      Neibouring_Sakrebulo,
                     Neiboring_Map,
                                      Coord_Sys_Info,
                                      Legend);
         LegendFill = (Mowing_Land,
                                        Pasture, Arable,
                                        Wine_Yard,
                                        Garden,
                       Tea_Plantation,
                                        Flow_Direction,
                                        Woodland,
                                        Rock,
                       Land_Slide,
                                        Landfill,
                                        Glacier,
                                        Swamp,
                                        Revine,
                       Cliff);                            !! Same as SCFill
         LegendSymbol = (Coord_Cross
                                              (Coord_Cross,
                                               Network_Cross,
                                               Network_Mark),
                         North_Arrow,
                                             Well,
                                             Reservoir,
                                             Monument,
                                             Mast_Antenna,
                         Ruin_Archeological_Object,
                                             Ferry,
                         Important_Tree);                 !! Same as SOSymbol
         LineType = (Coordinate_Line, Others);

      TABLE FrameInfo =
         MapNumber: TEXT*20;
         Sakrebulo: TEXT*30;
```

```
         Date: DATE;
         MapScale: Scale;
      IDENT
         MapNumber;
      END FrameInfo;

      TABLE MapText =
         MapTextObject: -> FrameInfo;
         Text: TEXT*30;
         Type: TextType;
      NO IDENT
      END MapText;

      TABLE MapTextPos =
         MapTextPosObject: -> MapText;
         MapText: TEXT*30;
         MapType: TextType;
         MapTextPos: LCoord // As a rule within geometry //;
         MapTextOri: OPTIONAL Ori;                    !! Default: 90.0
         MapTextHAli: OPTIONAL HALIGNMENT;            !! Default: Center
         MapTextVAli: OPTIONAL VALIGNMENT;            !! Default: Half
         MapTextSize: FontSize;
         Comment: OPTIONAL TEXT*30;
      NO IDENT
      END MapTextPos;

!!      TABLE MapGraphics =
!!         Object: -> FrameInfo;
!!         Geometry1: OPTIONAL POLYLINE WITH (STRAIGHTS) VERTEX LCoord;
!!         MGLineType: OPTIONAL LineType;
!!         Geometry2: OPTIONAL AREA WITH (STRAIGHTS, ARCS) VERTEX LCoord;
!!         MGFillType: OPTIONAL LegendFill;
!!      NO IDENT
!!      END MapGraphics;

      TABLE MapSymbolPos =
         MapSymbolObject: OPTIONAL -> FrameInfo;
         MapSymbolPos: OPTIONAL LCoord // As a rule Next to the Text //;
         MapSymbolOri: OPTIONAL Ori;
         MapSymbolSize: FontSize;
      NO IDENT
      END MapSymbolPos;

   END MapFrame.

!!_____________________________________________________________________________

END KosovoCadastre.

FORMAT FIX WITH LINESIZE = 75, TIDSIZE = 10;

CODE
   BLANK = DEFAULT, UNDEFINED = DEFAULT, CONTINUE = DEFAULT;
   TID = I32;
END.
```