3D Cadastre Modelling in Russia

G2G10/RF/9/1

Inception report

Version

0.3

Auteur(s)

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3D Cadastre Modelling

Inception report

Responsible for the assignment

Rik Wouters, Kadaster International

Status

0.3

Distribution

Project team, FCC Zemlya, Rosreestr

Version history

Version	Date	Author(s)	Remarks
0.1	22 June 2010	Louisa J.M. Jansen	Template
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1.0	14 July 2010	Rik Wouters	Various textual amandments

Review history

Version	Date	Reviewer	Remarks

Table of Contents

Summary

Project title:	**3D Cadastre Modelling in Russia (G2G10/RF/9/1)**
Counterpart:	Ministry of Economic Development of the Russian Federation
Beneficiaries:	Federal Service for State Registration, Cadastre and Mapping (Rosreestr)
Executing agency:	Netherlands' Cadastre, Land Registry and Mapping Agency (Kadaster) in consortium with: - Delft University of Technology (TUD) - Grontmij Nederland B.V. - Royal Haskoning B.V.
Budget:	EUR 300,000
Duration:	24 months
Starting date:	1 May 2010
Objectives:	Introduction of a 3D cadastre modelling in Russia. The aim of this project is to provide guidance in the development of a prototype and to create favourable (legal and institutional) conditions for the introduction of 3D cadastre modelling in Russia.
Main results:	1. Legal framework and organisation of 3D-cadastre data collection, storage and distribution in the Netherlands studied and comparison made with the Russian situation; 2. 3D cadastral model for data generation, storage and distribution developed; 3. Prototype (and access portal) developed and tested on objects of a pilot region; 4. Strategy and action plan for proper institutional embedding by legal and organisational adjustments prepared and (partially) implemented to guide the long-term development of 3D cadastre in Russia; and 5. Training programme developed.

List of abbreviations

DTM	Digital Terrain Model
EVD	Agency for International Business and Co-operation (of the Dutch Ministry of Economic Affairs)
FCC	Federal Cadastral Centre (of the Russian Federation)
GIS	Geographic Information System
G2G	Government to Government co-operation
IT	Information Technology
Kadaster	Netherlands' Cadastre, Land Registry and Mapping Agency (Independent public service of the Ministry of Housing, Spatial Planning and Environment)
LADM	Land Administration Domain Model
MDA	Model Driven Architecture
PAC	Project Advisory Committee
Rosreestr	Federal Service for State Registration, Cadastre and Mapping (of the Russian Federation)
TUD	Delft University of Technology, The Netherlands

1 General information

1.1 Institutional setting

The *Federal Service for State Registration, Cadastre and Cartography* (Rosreestr) was established by merging three government agencies: Rosregistratsia, Rosnedvizhimost and Roskartografia (Government Decree of 1 June 2009, No. 457). With this merger a single organisation responsible for all tasks related to the registration of rights, recording of parcels (cadastral map) and geodetic and (topographic) mapping was created. Rosreestr has about 6,500 offices and 60,000 staff members. Since the start of the Russian Federation approximately 80 million parcels have been registered together with associated rights and restrictions (responsibilities) and the involved parties (persons). Rosreestr falls under the authority of the **Ministry of Economic Development of the Russian Federation** (Deputy Minister Igor Manylov) being the project counterpart.

The **Federal Cadastre Centre** (FCC) **"Zemlya"** is a state unitary enterprise. The Centre is the main organisation in development of the State land cadastre automated system. FCC Zemlya realises scientific and technical maintenance of the implemented information technologies and software, and provides and supports its operation. FCC Zemlya is the Project Coordinator for the G2G project.

The **Netherlands' Cadastre, Land Registry and Mapping Agency** (called in short Kadaster) manages the country's largest parcel based real estate information system, consisting of the register of conveyance deeds, the cadastral register, the cadastral map and the register of measurements of parcel boundaries. The registration includes the registration of condominium, including the physical description of the condominium rights. Kadaster is an independent public agency at national level. The independent status means that Kadaster has its own financial, personnel and marketing management and that the political responsibility of the **Minister of Housing, Spatial Planning and the Environment**, under which Kadaster resorts, is limited. The operations of Kadaster are fully covered by the tariffs that are levied for the services that Kadaster renders to its clients.

Delft University of Technology (TUD) is renowned for the research conducted in the fields of 3D cadastre and Information Technology (IT). Since over 10 years research is done top-level.

Two engineering companies with ample experience in several GIS and IT projects in the Netherlands as well as abroad, i.e. **Grontmij Nederland B.V.** and **Royal Haskoning B.V.**, will be involved in the pilot area and prototype development.

The institutional setting comprises public-private-partnership.

1.2 Analysis of the current situation

1.2.1 Situation as found during the inception phase

The current parcel system is 2D polygon based, implying that the boundary between two neighbouring parcels is repeated (redundancy). The database contains the full history of the polygon since its creation. There are regional differences in the contents of the cadastral map, for example in some areas government parcels are included, while in others they are not (yet) included. The coverage is not yet complete. The scale differs for pragmatic reasons from 1:2,000 in urban areas up to 1:10,000 in rural areas. Because of the size of the Russian Federation several coordinate reference systems are used for accurate coordinates on cadastral maps (3 degree zones). In each region, special local coordinate systems are used for cadastral purposes. There are rules to avoid overlap between parcels. The survey plans needed for the registration of new parcels are made by commercial companies.

Data maintenance is executed by the cadastre offices and data is managed in the databases of a number of regional offices (compared to the Netherlands this may mean that a region is larger and sometimes also the number of inhabitants). The software used countrywide comprises: Oracle 9, ArcGIS and Panoramia including the Russian coordinate transformations. Currently every three months data is copied to a central server for online web access to countrywide data (based on MapInfo's MapExtreme). From 2011 onwards it is foreseen that the updating will be executed on a daily basis resulting in real-time data.

There is a strong vision and drive in the Russian Federation towards a 3D cadastre. This is a realistic vision insofar that 3D will be used where needed: complex buildings, or other types of constructions, and subsurface networks (e.g., cables and pipelines). To realise a 3D cadastre many aspects need to be investigated such as laws and regulations, organisation of workflow and procedures, and the technology needed for implementation.

Applicable laws and articles to 3D cadastre modelling are:

- Federal Law '*On State Cadastre for Real Estate*', Article 1;
- Civil Code, Article 130;
- Land Code, Article 11.1; and
- Urban Development Code, Article 1.

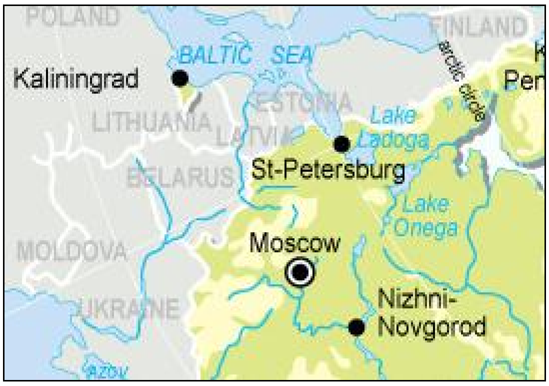
The cadastre law in the Russian Federation is quite generic: it neither explicitly mentions 3D, nor does it prohibit 3D volumetric parcels for registration. Currently subsurface networks (e.g., pipelines and cables) are not part of the cadastral registration. However, in a future 3D cadastre they should be considered for inclusion. If such objects are included than they should be treated as single objects and not subdivided according to the surface parcels.

1.2.2 Project pilot area

Contrary to what was mentioned in the General Project Plan, not the Murmansk Oblast but **Nizhegorodskaya Oblast** has been selected as pilot region in this project. It is located about 450 km east of Moscow (Figure 1.2.1). The territorial division of Rosreestr of Nizhegorodskaya Oblast (approximate size of 77,000 km^{2,} or nearly twice the size of the Netherlands, with 3,5 million inhabitants) will be actively involved in the project, as well as the **Nizhny Novgorod City Administration** (with 1,9 million inhabitants in the capital). There are 1,200 staff members of Rosreestr in Nizhegorodskaya Oblast. This office will provide the local data needed for the pilot. Three representatives were involved in the discussions on the project results, activities, and planning during the inception mission in Moscow.

Figure 1.2.1 Map of location of Nizhny Novgorod (a) and map of Nizhegorodskaya Oblast (b)

(a)



(b)

1.2.3 Project purpose

The project long-term objective is: introduction of a 3D cadastre in Russia. The aim of this project is to provide guidance in the development of a prototype and to create favourable (legal and institutional) conditions for the introduction of 3D cadastre modelling in Russia.

More specifically, a prototype will be developed for the registration and retrieval of 3D cadastral objects from the pilot area Nizhegorodskaya Oblast. This prototype will be implemented in the Rosreestr office in Nizhegorodskaya Oblast.

1.2.4 Results

The results as mentioned in the General Project Plan have remained unchanged. These results are:

1. Legal framework and organisation of 3D-cadastre data collection, storage and distribution in the Netherlands studied and comparison made with the Russian situation;
2. 3D cadastral model for data generation, storage and distribution developed;

3. Prototype (and access portal) developed and tested on objects of a pilot region;
4. Strategy and action plan for proper institutional embedding by legal and organisational adjustments prepared and (partially) implemented to guide the long-term development of 3D cadastre in Russia;
5. Training programme developed.

1.2.5 Findings of the inception phase

A number of observations concerning the legal, institutional and technical aspects can be made.

<u>Legal observations</u>
Emphasis has been put on the legislative aspects of 3D cadastre modelling. This was already clear from the General Project Plan. However, it was repeated by Mr Victor Kislov as being a key issue despite the fact that the current legislation being generic might be sufficient for 3D object registration. Further investigation in the current legislation and regulations will be made.

<u>Institutional observations</u>
Though the legal aspects and the development of the prototype are important, attention will be paid to institutional and organisational aspect. What will be the impact of a 3D-cadastre in the skills, the processes and the way of working. Also a question as to what extend 3D cadastre will be implemented is interesting.

<u>Technical observations</u>
The title of the project emphasizes the modelling aspect. Several statements made during the inception mission underlined this aspect. In the Model Driven Architecture (MDA) this is appropriate as the model is the starting point for database storage, exchange format, interactive query and edit environments.

The registration of legal objects, i.e. cadastral parcels with associated rights, and their physical counterparts, i.e. buildings or tunnels, result in two different but related data sets that can be accessed via the spatial information infrastructure. This is already true in 2D, but even more so in 3D. By showing some physical objects for reference purposes, the location and size of the legal objects will be clearer.

When a new 3D parcel is to be registered, after all required legal and spatial source documents have been properly prepared and submitted, the 3D parcel should be visualised and checked for correctness, including the fact that it should not overlap with any other registered 3 D parcel. This check is important for consistency and quality. However, it also implies that there should be an environment that contains the georeferenced 3D representation of the earlier registered 3D parcels. Thus, a 3D cadastre environment is needed and not just a register of source documents.

1.3 Sustainability of project results

During the inception phase the availability of funds from the Russian federal budget for the involvement of local specialists, necessary equipment and works in the pilot region was discussed and agreed upon with the Russian beneficiary and counterpart. The involvement of the Russian counterpart is at about the same level, both in number of days and fields of expertise.

From the Dutch side there should be regular contact with the city of Groningen, Nordconnect, and interested Dutch companies in order to make this G2G project complementary to the current activities in the field of spatial planning and infrastructure development in Murmansk region.

In the inception report, resulting from the Inception phase, Kadaster should present its view on the sustainability of the project in a separate paragraph and should elaborate on activities which will be undertaken to strengthen the sustainability after the project will have ended.

2 Detailed work plan

The detailed work plan was elaborated during the first two days of the inception mission (see Annex A). The results and activities were presented by Mr Tikhonov at the Inception Seminar (see Annex B for full programme and lists of participants) to representatives of all relevant institutions as well as the Russian private sector (e.g., OOO Data+).

2.1 Project approach

The project aims at the establishment of knowledge and understanding with respect to the 3D-cadastre model. Basically the project concentrates on the adequacy of the legal framework, the elaboration on a elaborated 3D cadastre model and the testing of such model in a pilot project.

In order to obtain a sustainable result we have planned a series of activities and formats to achieve this goal.

The basic work packages are based on the results to be achieved as formulated in section 1.2.2. They are elaborated to some extend in 2.2, but will be further detailed during the inception phase. In essence the 3D Cadastre conditions are studied in the present situation: legal framework, cadastre model, and cadastre data. The specific needs will be studied and discussed with relevant stakeholders.
Based on the needs analysis the outline for the pilot system will be designed.

The formats aim principally on the transfer of knowledge and the sharing of best practices from experiences in the Netherlands and Europe. The mostly used formats are workshops, study tours and training. Furthermore the Dutch team will study relevant information and will comment and advice on the observations and or will give additional technical assistance. The latter format will be used more when elementary knowhow is lacking.

2.2 Results and detailed activities

In the next table the activities are listed and described.

Project result(s):	Expected activities + format:
0. Inception	0.1 Preparation of inception Result: programme, materials 0.2 Inception mission Result: inception report
1. Legal framework and organisation of 3D-cadastre data collection, storage and distribution in	1.1. To study legal framework for 3D-cadastre modelling in the Netherlands and other countries. To compare with the kindred Russian legal framework (consultations, the exchange of information about legislations of the Russian Federation, the Netherlands and other countries, a working visit of experts for drafting recommendations on the Russian legislation).

the Netherlands studied and comparison made with the Russian situation;	Result: Report on legal framework for Russia 1.2. To study the organisation of 3D-cadastre data collection, storage and distribution in the Netherlands: stakeholders, their interaction; the distribution of rights to information resources and the distribution of responsibilities for their management; financial flows; types of services; the contents, validity, actuality and format of collected and delivered data; existing restrictions on specific cadastral data and restriction control; standards used for 3D-cadastre data generation, collection and delivering. To compare with the situation in Russia (reciprocal working visits of experts, the training of Russian specialists, consultations). Result: Report on the organisation of 3D-cadastre Study tour for 8 staff and 5 days. Training (comb 2.1) 1.3. To prepare a comparative overview on the situation in Russia, the Netherlands and other countries. Result: Report on the 3D-cadastre
2. 3D-cadastral model for data generation, storage and distribution developed	2.1. To study technologies and technical solutions for the representation of 3D-cadastre information (a mechanism for the generation and delivery of this information) in Russia. To compare with international analogues. (a working visit of Russian specialists to the Netherlands, the training of Russian specialists). Result: Report on the basic concept 3D in Russia Study tour for 8 staff and 5 days. Training (comb 1.2) 2.2. To study how 3D is defined in the ISO Land Administration Domain Model and how this can be fitted to the Russian requirements. Result: Report technical design 2.3. To study technologies and technical solutions for the description of 3D-cadasre objects and data distribution in the Netherlands. To compare with international analogues (a working visit of Russian specialists to the Netherlands, the training of Russian specialists). Result: Report technical design Study tour (optional not budgeted!) 2.4. To define 3D-cadastre objects in Russia. To formulate principles of 3D cadastre using international experience. Result: Report on the 3D objects 2.5. To develop models for selected 3D-cadastre objects (a working visit of Dutch experts, consultations) Result: Report on 3D-models
3. Prototype (and access portal) developed and tested on objects of a pilot region	3.1 Set up Requirements for the designing of the prototype and the pilot, including required data, technical platform, hardware etc. Result: report on requirements 3.2 To collect, analyse and upload necessary information about objects of a pilot region to the data base.

	Result: dataset with object 3.3 To develop a system's prototype and test it on objects of a pilot region, to process data. Result: Prototype system 3D-cadastre 3.4 To design a portal for access of users to results of 3D cadastre. Result: portal for access of 3D-data 3.5 To implement the pilot and to carry out an evaluation. Result: Report on evaluation of pilot and specifically to the prototype
4. Strategy and action plan for proper institutional embedding by legal and organisational adjustments prepared and (partially) implemented to guide the long-term development of 3D cadastre in Russia;	4.1 To prepare proposals on the organisation of 3D-cadastre data generation, storage and distribution on the basis of the integration of information obtained during the project and prototype testing (consultations). Result: Report on the data logistics wrt 3D 4.2 To prepare proposals on improvement in the Russian legal framework (consultations). Result: proposal improvement legal framework
5. Training program developed an staff trained	5.1 To set up training for curriculum for internal training in Rosreestr also applicable for the university Result: Report Training cv Training materials 5.2 To train staff from Rosreestr concerning 3D: concepts, techniques, applications and the like Result: training to 12 staff members in RF
6. Completion	6.1 Preparation of seminar Result: Seminar programme materials 6.2 Seminar for max 25-30 participants for 1 day. Result: Final seminar in Nizhny Novgorod
7. Project management	7.1 Overall project management 7.2 Participation PAC-meetings

In a series of annexes further details and considerations are provided. Considerations for the 3D model to be developed are provided in Annex C, pilot area activities are described in Annex D. The outline architecture, registration and retrieval components, as well as boundary conditions are described in Annex E. Use cases and key requirements are outlined in the same annex.

2.3 Resources plan

In the next table the resources are presented for both the NL- and the RF-team.

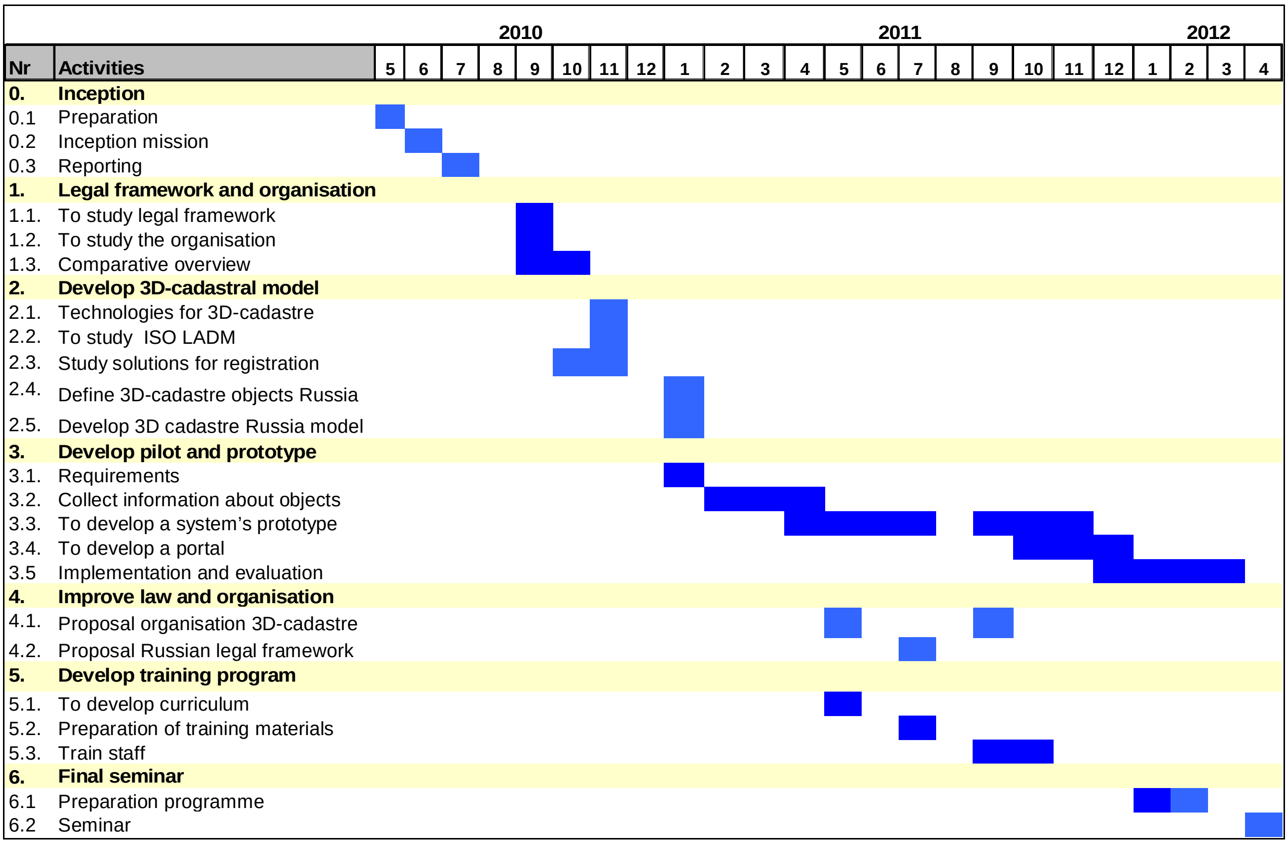
	Activities	Actors	Deliverables	Days NL	Days RF
0.	**Inception**		**1 missie**	**32**	**12**
0.1.	inception mission	team		28	10
0.2.	preparation inception report	Rik Wouters		4	2
1.	**Legal framework and organisation of 3D-cadastre data collection, storage and distribution**		**1 missies**	**24**	**12**
1.1.	To study legal framework	Hendrik Ploeger		8	5
1.2.	To study the organisation of 3D-cadastre	Jantien Stoter/Chrit Lemmen		10	4
1.3.	Comparative overview on the situation in Russia, the Netherlands and other countries	Peter van Oosterom/Chrit Lemmen		6	3
2.	**Development of as model for 3D-cadastral model for data generation, storage and distribution**		**2 missies**	**30**	**25**
2.1.	To study technologies and technical solutions for the representation of 3D-cadastre information	Peter van Oosterom/Sisi Zlatanova		7	6
2.2.	To study how 3D is defined in the ISO Land Administration Domain Model and how this can be fitted to the Russian requirements	Chrit Lemmen		5	4
2.3.	Study of technologies and technical solutions for the description of 3D-cadastre	Sisi Zlatanova		8	5
2.4.	To define 3D-cadastre objects in Russia. To formulate principles of 3D cadastre using international experience	Hendrik Ploeger/Peter van Oosterom		4	5
2.5.	To develop a 3D cadastral model for Russia based on obtained results and insights	Peter van Oosterom/Jantien Stoter		6	5
3.	**Development of a prototype**		**2 missies**	**67**	**45**
3.1.	Requirements of the prototype and portal	Boudewijn/Andreas/Jantien Stoter		5	5
3.2.	To collect, analyse and upload necessary information about objects of a pilot region to the data base	Andreas Hoogeveen		8	20
3.3.	To develop a system's prototype and test it on objects of a pilot region, to process data	Grontmij/Haskoning/Marian de Vries		32	10
3.4.	To develop a portal for access of users to results of 3D cadastre	Boudewijn Spiering		17	5
3.5	Implementation and evaluation	Andreas Hoogeveen		5	5
4.	**Improvement of legal framework**		**0 missie**	**12**	**6**
4.1.	Proposals on the organisation of 3D-cadastre data generation, storage and distribution	Andreas Hoogeveen/Chrit Lemmen		8	4
4.2.	Proposals on improvement in the Russian legal framework	Hendrik Ploeger		4	2
5.	**Development of a training program**		**1 missie**	**14**	**8**
5.1.	To develop curriculum + materials	Chrit Lemmen/Peter Oosterom		1	1
5.2	To prepare training materials	Jantien Stoter/Chrit lemmen		7	5
5.3	Train trainers	Peter v Oosterom/Chrit Lemmen		6	2
6.	**Final seminar**		**1 missie**	**8**	**6**
6.1.	Prepare programme	Chrit Lemmen/Peter Oosterom		1	1
6.2	seminar	Jantien Stoter/Chrit lemmen		7	5
6.	**Management**		**1 missie**	**30**	**20**
7.1.	Overall Management	Rik Wouters/louisa Jansen		24	20
7.2	PAC-meeting	Rik Wouters		6	
	Total			**217**	**134**

2.4 Time plan

In the schema below the timing of the various activities is indicated. The total elapsed time is 2 years including the inception period. The activities are carried out as much as possible sequentially. Though activities under result 1 and 2 might show quite some overlap both in time and content.

The time interval for the pilot/prototype phase is about 15 months. This is considered as a short, but as we can see now a sufficient period of time.

Figure: Gantt chart of project activities



2.5 Assumptions and risks

2.5.1 Assumptions

For the realisation of all project results the total budget is rather tight. Close monitoring of the expenditure of the budget will be essential and, whenever needed, timely adjustments will be made in terms of human resources and/or days to be spent.

On the Russian side Rosreestr headquarters, Rosreestr in Nizhny Novgorod and FCC Zemlya will be involved and on the Dutch side Kadaster, Grontmij Nederland B.V., Royal Haskoning B.V. and TUD. Because of the many different organisations involved it will be important to assign clear roles and responsibilities in the inception phase in order to prevent incompatibilities at a later stage of the project.

In order to prevent any miscommunication, it is assumed that communication between all institutions involved will be efficient using modern technologies (e.g., teleconferencing or conference calls). In this manner the limited moments of direct contact in the missions will be overcome and frequent exchange and continued support (e.g., to Nizhny Novgorod) can be guaranteed.

For the implementation of the project the timely availability of the Russian and Dutch experts of the involved organisations will be a key issue.

Concerning the pilot area the following assumptions can be made: the colleagues from the Nizhny Novgorod Rosreestr office provide data related to (1) 2D parcels including the legal attributes, (2) 3D objects in a format suitable for downloading in the prototype and (3) reference maps of which a Digital Terrain Model (DTM) is available. The team receives full cooperation from (IT) staff for implementation of the two increments of the prototype. Requirements for the pilot area data to be collected by Rosreestr in Nizhny Novgorod are needed at an early stage, so that Rosreestr will have enough time to collect the data according to these requirements.

Concerning the prototype the following assumptions can be made:

1. The success of the prototype will very much depend on the 3D visualization and navigation functionality. Existing tools will be used to provide this functionality and these tools have to be selected before the start of the construction phase (there is no budget to experiment with several different tools). Therefore, selecting a wrong tool will have a negative influence on the project results.
2. Because of possible time pressure there is a risk that requirements on the pilot data will be specified before the 3D cadastral model and the system architecture are properly designed. If these requirements do not fit the optimal 3D cadastral model and/or the system architecture, more time is needed to design and build the prototype or to recollect or convert the pilot data.

2.5.2 Risks

For the execution of the pilot, one of the biggest risks is the possibility of the unavailability of suitable data. Especially the 3D cadastral objects are essential, as well as the DTM. If such a situation occurs the following mitigating measures can be taken:

1. If no suitable 3D objects are available, Rosreestr can use existing 2D objects and convert them to 3D objects. The project team is able to provide advice on this task. Other sources for obtaining 3D data might also be identified. In Google Earth, several 3D buildings are present for the city of Nizhny Novgorod. If all these sources do not lead to suitable 3D objects, ‘dummy’ objects could be used. If this would occur it would be far from ideal because the added value of the pilot area would be very limited.

2. A DTM is necessary for projecting the 2D information (including parcels and reference maps, if applicable) onto the earth surface. This, in its turn, is needed for the visualisation in the portal. The resolution and accuracy of the DTM must be optimal, but if no detailed DTM is available some satellite imagery (of relative low resolution) could be used that is publicly available.

Another risk is the lack of interest with important stakeholders. This can lead to not enough participants in the pilot and especially in the workshop. In that case, the pilot will not give enough insight in the benefits of 3D cadastre in the pilot area. To prevent this from happening, (at least) two measures can be taken. First there is the careful selection of the stakeholders. Only those stakeholders are to be selected that have a real interest in cooperating in the pilot. The second measure is to ensure that the activities during the pilot (and especially during the workshop) are very relevant and add real value for the stakeholders.

3 Project organisation and implementation

3.1 Counterpart and beneficiary

The roles of the Russian partners in the project are shared by:

- Rosreestr (Headquarters): general project management, legal aspects in cadastre and registration, IT aspects;
- FCC Zemlya: project coordination, modelling, GIS, prototype development;
- The Moscow Aerogeodetic Enterprise: geodetic aspects, cartographic support;
- The Rosreestr Office in Nizhegorodskaya Oblast: support to activities in the pilot region, the providing of data on the pilot region, prototype development; and
- OOO Data+: web technology, portal development.

It is suggested that the involvement of the Russian partners in the international context is stimulated as this would provide optimal chances to learn and share knowledge and expertise related to:

- 3D Cadastre developments: ISO TC211 (with the Russian Federation being a P-member);
- Land Administration Domain Model (LADM, ISO DIS 19152); and
- FIG Commission 3 and 7 joint working group 2010-2014 on 3D cadastres.

3.2 Netherlands' partner organisations

The roles of the Dutch partners in the project are:

- Kadaster (project management, knowledge cadastral work flow) with the following persons:
    - Rik Wouters: overall project management
    - Veliko Penkov: project leader and translator
    - Christiaan Lemmen: cadastre and LADM
    - Louisa Jansen: general support.
- TU Delft (theory and technology) with the following persons:
    - Hendrik Ploeger: legal aspects
    - Jantien Stoter: 3D Cadastre processes
    - Sisi Zlatanova: 3D registration formats (CityGML, BIM/IFC)
    - Marian de Vries: 3D web visualization
    - Peter van Oosterom: modelling 3D Cadastre Russia, database aspects
- Grontmij (creating prototype) with the following person:
    - Boudewijn Spiering: GIS and IT expert for development prototype; and
- Haskoning (realisation pilot) with the following person:
    - Andreas Hoogeveen: GIS expert for realisation pilot area activities.

Based upon the findings during project implementation, additional input or adjustments in the team may be considered necessary. For this purpose the project partners have a range of experts available. Changes in the composition of the team will be communicated through the Project Leader to the beneficiaries. Changes in the composition of the FCC Zemlya team should also be communicated to the Project Leader.

3.3 Project Advisory Committee

The Project Advisory Committee (PAC) comprises the following seven persons representing the different institutions:

- Ms J.F.H. (Joyce) Ten Holter representing NL EVD International (chair);
- Mr H.J. (Rik) Wouters representing Kadaster (secretary);
- Mr V.I.P (Veliko) Penkov representing Kadaster (project leader);
- Mr V.A. (Vladimir) Yatskiy representing the Ministry of Economic Development (counterpart);
- Mr V.S. (Victor) Kislov representing Rosreestr (beneficiary);
- Mr V.V. (Vladimir) Tikhonov representing FCC Zemlya (project coordinator); and
- Mr R. (Richard) Roemers representing the Netherlands' Embassy in Moscow.

4 Financials

4.1 Budget

The total budget for the project is 300.000€.

4.2 Breakdown of costs

The following budget breakdown in percentages is based on the general work plan and the budget as it is prepared after the inception mission:

Inception phase	13% of budget
Project result 1	20% of budget
Project result 2	22% of budget
Project result 3	24% of budget
Project result 4	4% of budget
Project result 5	6% of budget
Completion phase	4% of budget
Project management	7% of budget

ANNEXES

Annex A – Programme Kadaster team Inception Mission

Moscow 20 – 25 June 2010

Flights Schedule

RIK WOUTERS, PETRUS VAN OOSTEROM, BOUDEWIJN SPIERING, LOUISA JANSEN, ANDREAS HOOGEVEEN

AMSTERDAM – MOSCOW	SU 230	20JUN	13:10 - 18:25
MOSCOW – AMSTERDAM	SU 403	24JUN	18:00 - 19:25

VELIKO PENKOV

SOFIA – MOSCOW	SU 172	20JUN	10:50 - 15:45
MOSCOW – SOFIA	SU 425	25JUN	19:55 - 21:55

Hotel

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PHONE	**++7 (495) 627-17-77**

Mobile phone numbers:

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VELIKO PENKOV (VP):	+359 888 709699

Sunday 20 June

Time	Activity	Participants	Location	Remarks
18:25	*ARRIVAL*	*Rik Wouters*	Sheremetyevo Arpt (SVO)	
18:25	*ARRIVAL*	*Petrus van Oosterom*	Sheremetyevo Arpt (SVO)	
18:25	*ARRIVAL*	*Boudewijn Spiering*	Sheremetyevo Arpt (SVO)	
18:25	*ARRIVAL*	*Louisa Jansen*	Sheremetyevo Arpt (SVO)	

18:25	*ARRIVAL*	*Andreas Hoogeveen*	Sheremetyevo Arpt (SVO)	
15:45	*ARRIVAL*	*Veliko Penkov*	Sheremetyevo Arpt (SVO)	

Monday 21 June

Time	Activity	Participants	Location	Remarks
09:15 – 10:15	Introduction	RF team, NL team	FCC Zemlya	personal Introduction ; discussion programme; discussion on seminar
10:15 – 11:45	Project Discussion (Cadastre experts)	RF team, NL team	FCC Zemlya	Relevant expert RF-side
11:45 – 12:30	Project Discussion (legal aspects)	RF team, NL team	FCC Zemlya	
12:30 – 13:30	Lunch break		FCC Zemlya	
13:30 – 14:30	Project Discussion (stakeholders)	RF team, NL team	FCC Zemlya	
14:30 – 16:00	Project Discussion (pilot)	RF team, NL team	FCC Zemlya	
16:00 – 18:00	Wrap up first day	NL team	FCC Zemlya	Preparing materials for Thursday wrap up

Tuesday 22 June

Time	Activity	Participants	Location	Remarks
09:00 – 11:00	Project Discussion (Cadastre experts)	RF team, NL team	FCC Zemlya	Relevant expert RF-side
11:00 – 12:30	Project Discussion (to be decided)	RF team, NL team	FCC Zemlya	
12:30 – 13:30	Lunch break			
13:30 – 17:00	Preparation for seminar and wrap up meeting	NL team	FCC Zemlya	Option for extra meeting with RF-experts

Wednesday 23 June

Time	Activity	Participants	Location	Remarks
09:00 – 09:30	Registration	See Programme	Kazakhstan Embassy Hotel	According to agreed Programme
09:30 – 13:30	Inception Seminar 3D Cadastre Modelling in	See Programme	Kazakhstan Embassy Hotel	According to agreed Programme

	Russia – Morning session			
13:30 – 14:30	Lunch break			
14:30 – 18:00	Inception Seminar 3D Cadastre Modelling in Russia – Afternoon session	See Programme	Kazakhstan Embassy Hotel	According to agreed Programme

Thursday 24 June

Time	Activity	Participants	Location	Remarks
10:00 – 12:30	Wrap up and marking next steps	RF team, NL team	FCC Zemlya	
12:30 – 13:30	Lunch break			
13:30 – 15:00	Wrap up and marking next steps	RF team, NL team	FCC Zemlya	
18:00	*DEPARTURE*	*NL-team (5 persons)*	Sheremetyevo Arpt (SVO)	

Friday 25 June

Time	Activity	Participants	Location	Remarks
19:55	*DEPARTURE*	*Veliko Penkov*	Sheremetyevo Arpt (SVO)	

Annex B – Programme seminar

RUSSIAN-DUTCH INCEPTION SEMINAR 3D-CADASTRE MODELLING IN RUSSIA

Moscow – 23 June 2010

Residence of the Embassy of the Republic of Kazakhstan in the Russian Federation, Chistoprudny Boul. 3, Moscow

09.00-09.30	Registration	
09.30-09.40	Opening. Presentation of the programme and participants	V.V.Tikhonov – Chief of the International Projects Division, FCC “Zemlya”; Project Coordinator
09.40-109.50	Welcome (Ministry of Economic Development of the Russian Federation)	Mr Yatskiy – Deputy Director, Real Estate Department
09.50-10.00	Welcome (Netherlands’ Embassy in Moscow)	Richard Roemers – Deputy Head of the Economic and Commercial Section
10.00-10.10	Welcome (Kadaster)	Rik Wouters - Manager, Netherlands’ Kadaster
10.10-10.25	Welcome (from the pilot region)	Irina V. Berdnikova – Head of Rosreestr Office in Nizhegorodskaya Oblast
10.25-10.40	Welcome (Rosreestr)	V.S. Kislov – Deputy Head
10.40-11.00	Coffee break	
11.00-11.50	The presentation of the joint project ‘3D-Cadastre Modelling in Russia’	V.V.Tikhonov – Chief of the International Projects Division, FCC “Zemlya”; Project Coordinator
11.50-12.30	Institutional aspects of 3D cadastre	Louisa Jansen – Senior Geodetic Advisor, Kadaster
12.30-13.30	The state-of-the-art of 3D cadastre in the Netherlands	Peter van Oosterom – Professor GIS Technology, TU Delft Netherlands
13.30-14.30	Lunch	
14.30-15.30	Background for the development of 3D cadastre in Russia	D.A. Malinovsky – Deputy Chief, Dept. Of Control and Methodological Support to Rights Registration and Cadastre, Rosreestr
15.30-15.50	Presentation on Kadaster and project activities: modelling, best practices	Rik Wouters – Manager Netherlands’ Kadaster
15.50-16.15	Coffee break	
16.15-16.35	Presentation on TU Delft and project activities 3D cadastre: organisation, legal framework, modelling	Peter van Oosterom – Professor GIS Technology, TU Delft
16.35-16.55	Presentation of company and GIS-related topics	Andreas Hoogeveen – GIS-Consultant, Royal Haskoning
16.55-17.15	Presentation of company and GIS-related topics	Boudewijn Spiering – Advisor GIS and ITC, Grontmij Nederland
17.15-17.45	Discussion on presented reports	
17.45-18.00	Concluding words. Closing	V.V.Tikhonov – Chief of the International Projects Division, FCC “Zemlya”; Project Coordinator

RUSSIAN-DUTCH INCEPTION SEMINAR

3D-CADASTRE MODELLING IN RUSSIA
List of participants
Moscow – June 23, 2010

Ministry of Economic Development of the Russian Federation
1. Vladimir Alexandrovich YATSKIY – Deputy Director, Real Estate Department
2. Dmitry Nikolaevich MINAKOV – Chief of the Division of the Coordination of Information and Technological Support to Cadastre and State Registration of Rights

Federal Service for State Registration, Cadastre and Mapping (Rosreestr)
1. Victor Stepanovich KISLOV – Deputy Head
2. Alexandr Vladimirovich STEPANOV – Chief of the Department of Planning, Organisation and Control
3. Dmitry Anatolyevich MALINOVSKY – Deputy Chief of the Department of Control and Methodological Support in Rights Registration and Cadastre
4. Sergey Nikolaevich PANKOV – Chief of the Division of the Development of Information Systems and Technologies
5. Olga Mikhailovna BORONENKO – Deputy Chief of the International Division; Department of Planning, Organisation and Control

Pilot region – Nizhegorodskaya Oblast
1. Sergey Nikolaevich ANISIMOV – Deputy Minister of State Property and Land Resources
2. Irina Victorovna BERDNIKOVA – Head of the Rosreestr Office in Nizhegorodskaya Oblast
3. Vasily Mikhailovich ROMANOV – Deputy Head of the Rosreestr Office in Nizhegorodskaya Oblast

Federal Cadastral Centre “Zemlya”
1. Vladimir Vasilyevich TIKHONOV – Chief of the International Projects Division
2. Natalia Mikhailovna VANDYSHEVA – Chief of the Spatial Data Division
3. Modest Modestovich YAKUBOVICH – Deputy Chief of the International Projects Division
4. Natalia Ignatyevna SEVOSTYANOVA – Project Manager, International Projects Division
5. Tatiana Alexandrovna KULAKOVA – Chief Specialist, International Projects Division

Moscow Aerogeodetical Enterprise
1. Nikolay Konstantinovich KAZEEV – Interim Chief Engineer

OOO Data+
1. Gennady Pavlovich RADIONOV – Technical Director

Kadastrer International, The Netherlands
1. Rik WOUTERS – Regional Manager
2. Veliko PENKOV – Senior Geodetical Advisor
3. Peter VAN OOSTEROM – Professor GIS Technology, TU Delft
4. Louisa JANSEN – Senior Geodetic Advisor, Kadaster
5. Andreas HOOGEVEEN – GIS-Consultant, Royal Haskoning
6. Boudewijn SPIERING – Advisor GIS and ITC, Grontmij Nederland B.V.

The Netherlands Embassy in Russia
1. Richard ROEMERS – First Secretary, Economic Affairs Section

Annex C – Considerations for the 3D model to be developed

Scope and legal aspects

There are a number of 3D cadastre options, which need to be investigated in more detail, and the result will define the scope of the future 3D Cadastre:

1. What are the types of 3D cadastral objects that need to be registered? Are these always related to (future) constructions (e.g., buildings, pipelines, tunnels, etc.) as is the case in Norway and Sweden or could it be any part of the 3D space, both airspace or in the subsurface as is the case in Queensland (Australia)?

2. In case of (subsurface) infrastructure objects, such as long tunnels (for roads, metro, train), pipelines, cables: should these be divided based on the surface parcels (as in Queensland, Australia) or treated as one cadastral object (as in Sweden). In case of subdivision, note that to all parts rights (and parties) should be associated.

3. For the representation (and initial registration) of a 3D cadastral object, is the legal space specified by its own coordinates in a shared reference system (as the practice for 2D in most countries) or is it specified by refereeing to existing topographic objects/boundaries (as in the 'British' style of a cadastre) .

Alternative models to be investigated

The basis of the Russian 3D Cadastre model could be formed by the Land Administration Domain Model (LADM). However, LADM is still allowing many options and these should be investigated. Below a range of options for a 3D cadastre model:

1. *Minimalistic 3D cadastre*: do not consider cables, pipelines and (rail)roads as real estate objects (and do not register them in the cadastre), this eliminates the majority of subsurface objects. For apartment buildings: make them available via layers (by clicking on a symbol on 2D map/floor plans as in Spain), this takes care for the majority of above surface objects. For all other 3D objects add a symbol to the 2D map and refer the spatial source document (and other tricks to make the situation 'clear'). Advantage: easy to implement. Drawback: the minority of 3D exception cases (non layered apartments or pipelines and cables) may give the majority of problems.

2. *Topographic 3D cadastre*: do not create own geometry for the legal objects, but define the legal objects by referring to (boundaries) of physical objects (topography, including pipelines and cables). Advantage: when a reliable 3D topographic data set is available, this can also form the basis of the 3D Cadastre. Drawbacks: This implies that a legal object can only exist if there is a topographic counterpart to refer to. The topographic 3D cadastre is non-consistent with the design principle of the current 2D cadastre.

3. *Polyhedral Legal 3D cadastre*: 3D volume parcels have their own geometry, similar as in the current 2D database (via polygons). However, this time the geometry is represented by a polyhedron (volume bound by flat faces). Advantages: relatively easy implementable with current technology (database, GIS/CAD), and

similar to polygon approach in 2D. Drawbacks: no topology structure (for better quality guarantees) and no curved faces.

4. *Non-polyhedral Legal 3D cadastre*: similar to the previous model alternative, but now allowing curved faces, such as cylinder and spherical patches (which can be the result of buffers) of even more complicated curved surfaces, including NURBS. Advantage: more type of 3D shapes can be registered (as needed in Queensland, because the law and regulations do not enforce restrictions on the geometry types). Drawbacks: no so easily implemented with current technology and also still no topology structure.

5. *Topological Legal 3D cadastre*: 3D volume parcels are described by a topological structure based on nodes, edges, faces and volume primitives. It is assumed that, and most useful when, the 3D objects are to be considered a partition of space. That is, the 3D objects have touching neighbours on all sides: Advantages: no redundancy in storing the boundaries, good quality control (no overlap and gaps). Drawbacks: less well supported by current technology and also not consistent with the current polygon parcel approach in the 2D Russian cadastre.

Technology options for the pilot

In order to enable easier incorporation by the Russian Cadastre, software architecture solutions are preferred to be in line with the current environment of the Russian Cadastre. Therefore the first technology options to be considered are Oracle 11 spatial (supporting polyhedrons) and ArcGIS. However, if during the lifetime of the project it becomes clear that this will give too many limitations for the prototype and pilot than other technology options will be explored. In this context cooperation with the ongoing 3D NL pilot in the Netherlands will be very beneficial (as many software vendors, government organisations, engineering firms and research organisations are participating and bring in their knowledge).

Annex D – Pilot area activities

The goals of the pilot area activities are twofold:

1. *Testing of the prototype*: does the prototype work, and is it possible to implement it within the client's setting, and does the prototype perform as anticipated?
2. *Obtaining experience*: stakeholders (within and outside of Rosreestr and FCC Zemlya) know the implications of 3D cadastre with hands on experience.

Below the activities related to the pilot are described in more detail.

<u>Data analysis and collection</u>
Two approaches to the data analysis and data collection will be applied. On the one hand, a list of required data for modelling the 3D objects in the correct way will be established; on the other hand, a quick inventory of data readily available in the pilot area will be made.

Based on the data requirements, formulated during the design of the prototype, a data analysis will be executed. This analysis focuses on the suitability of the available data for usage in the prototype, both from a quality point of view and an accessibility point of view. In other words, the data have to be fine enough, and the data are accessible by the prototype (e.g., by uploading or copying files). In close cooperation with Rosreestr and FCC Zemlya, it will be established how many objects and how large an area will be deemed sufficient for a thorough assessment of the system.

If the appropriate data are available, the data collection can commence. Depending on the format of the data source, files are transferred to the team developing the prototype or (web)services are made available. The data will be stored in the project archives and used during the development of the prototype. If no suitable data is available, dummy data will be used during the development phases.

Two kinds of information are distinguished: (1) the actual 3D objects, and (2) the reference data. Both will be used during the development of the prototype.

<u>Pilot activities during the building of the prototype</u>
The building of the prototype will entail two increments, or reiterations, in order to be able to test the functionality and component performance.

Increment 1
The first version of the prototype has very limited functionality and is particularly aimed at the technical testing of the selected technologies and components. To this end, the prototype will be installed on a computer in the office of Rosreestr in Nizhny Novgorod. The available data (see paragraph 6.5.1) will only be used during development, and will not be present in the prototype. Part of the testing is to load data into the prototype.

After the installation of the prototype, the registration and retrieval of 3D objects will be tested. To this end, some of the available 3D objects will be imported in the prototype and the objects will be stored in the database using the data model. The back office components of the prototype will perform these operations. The data is available in the portal, so the other parts of the processes (selecting and visualising 3D objects) can be tested.

During testing, small changes to the software or implementation protocols may be made. The testing will be performed in close cooperation with IT staff of Rosreestr.

Mission:

- Implement first prototype in the Nizhny Novgorod Rosreestr office; and
- Prepare activities for second increment.

Increment 2

The second version of the prototype has more functionality and is more user-friendly than the first version. The new prototype will also be installed in Nizhny Novgorod. Again, the registration and retrieval of 3D objects will be tested. In this case, more objects will be used for loading into the prototype.

After the loading of the objects, stakeholders will be involved in using the prototype in use cases, which mimic real life situations. This ensures that possible future users of the system gain insight in possibilities of the loading, storing, selecting and visualising 3D cadastre objects. The outcome of this activity leads to recommendations for the next phases of the project. For the involvement of stakeholders, project team members organise a workshop. In advance, a selection of relevant stakeholders will be made.

Mission:

- Implement second version of prototype in the Nizhny Novgorod Rosreestr office; and
- Prepare, lead and report on the workshop in Nizhny Novgorod.

<u>Results</u>

Two results of the pilot are equally important. The first is the gained knowledge within the project team of the technical, organisational and legal implications of an information system as it is implemented in the pilot area. The second result is the experiences of the stakeholders with the prototype and the 3D data. This will be the basis for further activities in the next project phases.

<u>Organisation of the pilot</u>

The pilot and the prototype are closely related and the activities for both components of the project have to be carried out in first-rate coordination.

The data analysis and collection will be carried out by the project team. Members of the project team will question some employees of the local Rosreestr office to make an inventory of relevant data. Based on this information, the data will be requested and Rosreestr will send the data to the team.

The first increment will be carried out by the technicians that are familiar with the prototype. During the building of the prototype will de decided which project partner will take the lead in building and implementing the prototype. The implementation during the second increment will be carried out by the same staff. The workshop will be prepared by the team, in close cooperation with the local staff from Rosreestr.

The organisation of the pilot will be planned in more detail during the upcoming phases of the project.

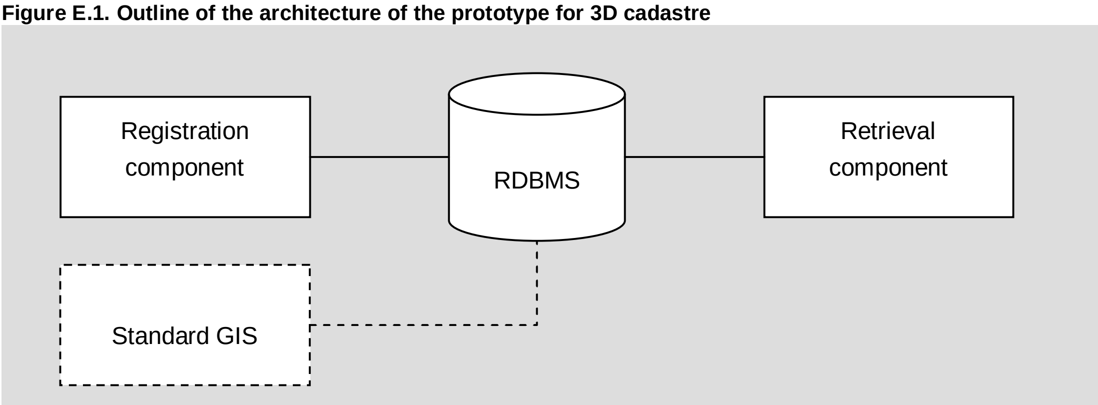
Annex E – Prototype 3D cadastre

The Prototype will have two main components (see figure E.1):

- *Registration component* (back office) for loading and storing new 3D cadastral objects;
- *Retrieval component* (portal) for selecting the 3D cadastral objects and visualising them together with reference maps.

Data will be stored in a relational database management system (RDBMS), which could offer the possibility to access the data in a standard GIS.

Figure E.1. Outline of the architecture of the prototype for 3D cadastre



<u>Registration component</u>
The registration component can be a desktop application. The formats for importing new 3D cadastral objects into the registration component will have to be determined and specified (e.g. CityGML, DXF, XML).

For storing the data, Oracle 11 Spatial will be considered as first option because:

- Oracle 11 Spatial supports storage and spatial querying of 3D objects (i.e. polyhedrons);
- Oracle Spatial is available for Rosreestr and for the software development team.

The registration component will not have map visualisation and navigation functionality. But the aim is to use GIS standards to store the data, so that it can be visualised or even edited in a standard GIS-application such as ArcGIS 10. It is expected that this will be easier to realise for 2D or 2,5D data than for 3D data. The 2D or 2,5D cadastral map will be made available as a reference map in a separate layer, so it can be displayed in the map of the retrieval component.

<u>Retrieval component</u>
The map visualisation and navigation functionality of the retrieval component will be served in a web browser. For map configuration functionality of the retrieval component a desktop application is possible. For all this functionality, existing tools will be used. Therefore, the functionality of the retrieval component will depend on the available functionality of the chosen tool(s).

ArcGIS Server is considered as one of the options because it is available for Rosreestr and for the software development team.

Boundary conditions

- The software development process for the prototype will be more or less iterative according to the *Unified Process* method (see http://en.wikipedia.org/wiki/Unified_Process). The following phases and iterations are distinguished:
  - Inception: 1 iteration;
  - Elaboration: 2 iterations;
  - Construction: 2 iterations;
  - Transition: 2 iterations.
- Following test-data from the pilot area will be available for the software development team for internal testing of the prototype (formats will be defined within the project):
  - 3D cadastral objects including legal data;
  - 2D or 2.5 D cadastral parcels;
  - Digital terrain model;
  - Reference maps (topographic objects in 2D, 2,5D or 3D, Imagery);
- Both components of the prototype including existing tools must run in the ICT environment of Rosreestr in Nizhny Novgorod and in the ICT environment of the software development team.
- The English language will be used for all communication, including documentation and user-interface of the prototype.

Use cases and key requirements

The main functionality of the prototype is described as use case diagrams (UML). To prioritize the functionality, the *MoSCoW* method is used:

- M: MUST have;
- S: SHOULD have this if at all possible;
- C: COULD have this if it does not affect anything else;
- W: WON'T have this time but WOULD like in the future.

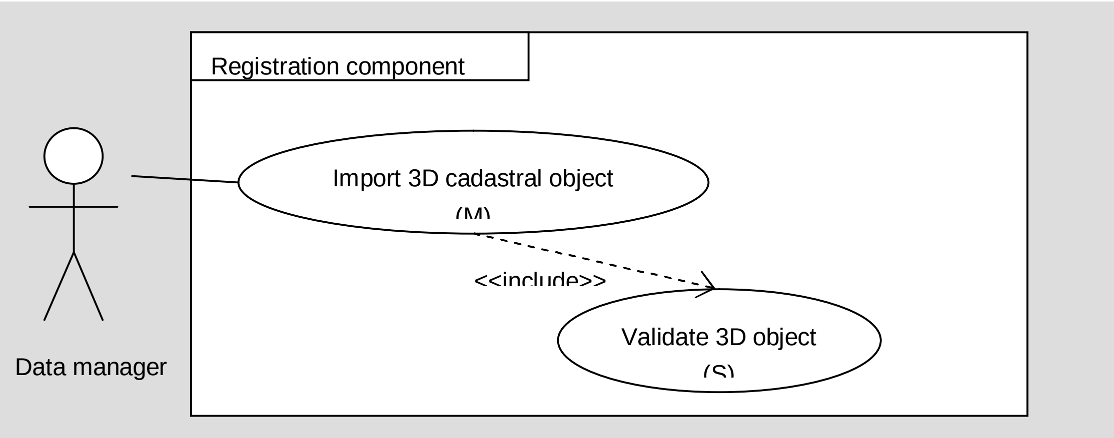
The M-functionality should be implemented in iteration 1 and the S-functionality should be implemented in iteration 2 (if at all possible). The key requirements are defined by M-functionality. For S-functionality which can not be implemented within this project, a workaround should be available.

Registration component

The use case diagram of figure E.2 shows the M- and S- functionality of the registration component. This functionality will be used by the *Data manager*, who is responsible for the available data in the prototype.

The use case *Validate 3D object* is relevant to keep the dataset of 3D objects consistent.
Because 3D cadastral objects will be modelled undependably as Polyhedrons, the validation should include the check for overlap with other 3D cadastral objects.

Figure E.2. UML use case diagram showing the basic use cases of the registration component



C-functionality of the registration component:

- Import multiple 3D cadastral objects;
- Delete 3D cadastral objects;
- GIS functionality from a standard GIS application such as ArcGIS:
  - Display an navigate through 3D cadastral map;
  - Adding/removing reference maps;
  - Selecting object(s) and showing its attributes;
  - Administrative and spatial editing.

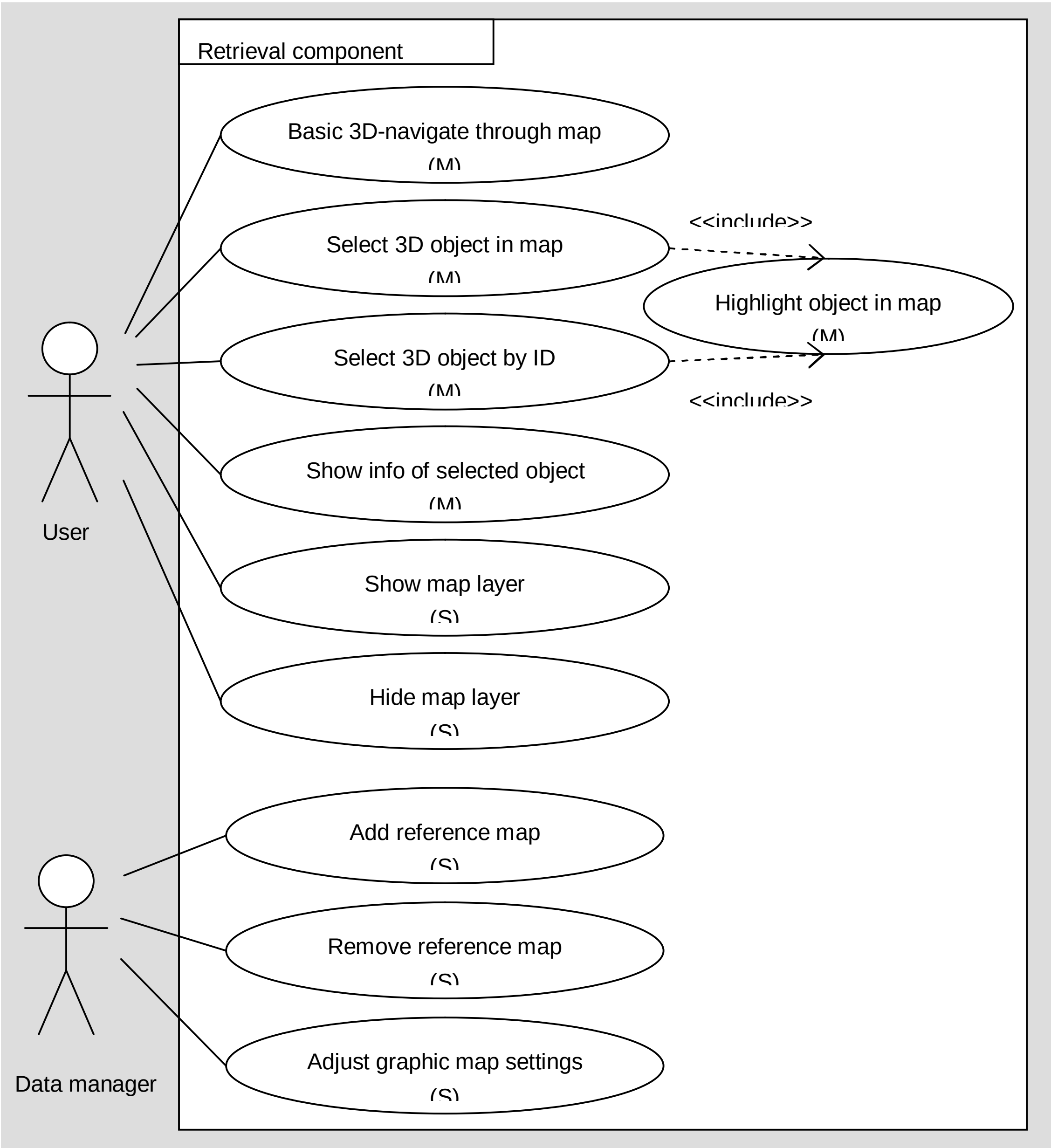
W-functionality of the registration component:

- Storing history;
- Import 2D or 2,5D cadastral objects;
- Taylor-made editing functions.

Retrieval component

The use case diagram of figure E.3 shows the M- and S- functionality of the of the retrieval component. The *User* will have access to the functionality in a web browser. The *Data manager* is responsible for the data and its appearance in the web browser. The Data manager will also have access to the User functionality (to keep the diagram clear, no lines are drawn from the Data manager to the use cases of the User). The Data manager functionality will be available in a desktop application or a web browser.

Figure E.3. UML use case diagram showing the basic use cases of the retrieval component



C-functionality of the retrieval component (using existing standard tools):

- More advanced map navigation functions;
- Display the map in multiple windows in different perspective;
- Show or hide legend;
- Adjust graphic presentation of a map layer;
- Adjust order of map layers.

W-functionality of the retrieval component:

- Taylor-made C-functionality;
- History- functionality;
- Editing functionality;
- Authorisation mechanism;
- More advanced selection functions;
- Report functionality;
- Print functionality;
- Adjusting screen lay-out.

Other requirements

- Both components of the prototype including existing tools must run in the ICT environment of Rosreestr in Nizhny Novgorod.
- The complete software development process has to be well documented in the English language.
- The user-interface of the prototype will be in the Russian language.