



SCHOOL OF RURAL, SURVEYING
AND GEOINFORMATICS ENGINEERING
NATIONAL TECHNICAL UNIVERSITY OF ATHENS



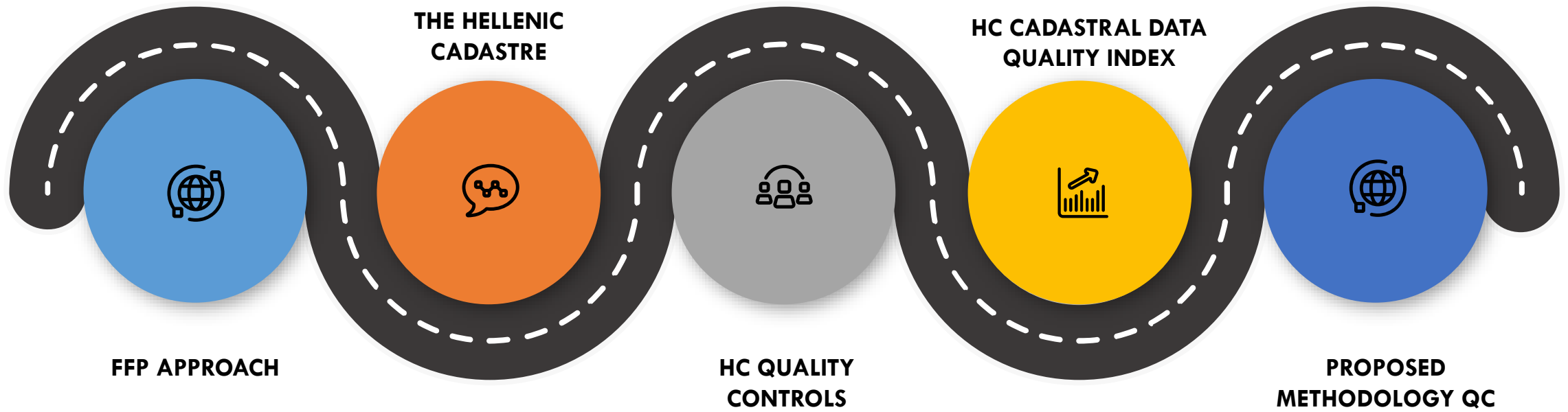
Time to discuss improving the quality of crowdsourced cadastral surveys

Konstantinos Apostolopoulos, Assistant Lecturer, Msc, Phd Student

Chryssy Potsiou, Professor, FIG Honorary President

Ioannis Kavvadas, Msc, Head of Internal Audit Unit, Hellenic Cadastre





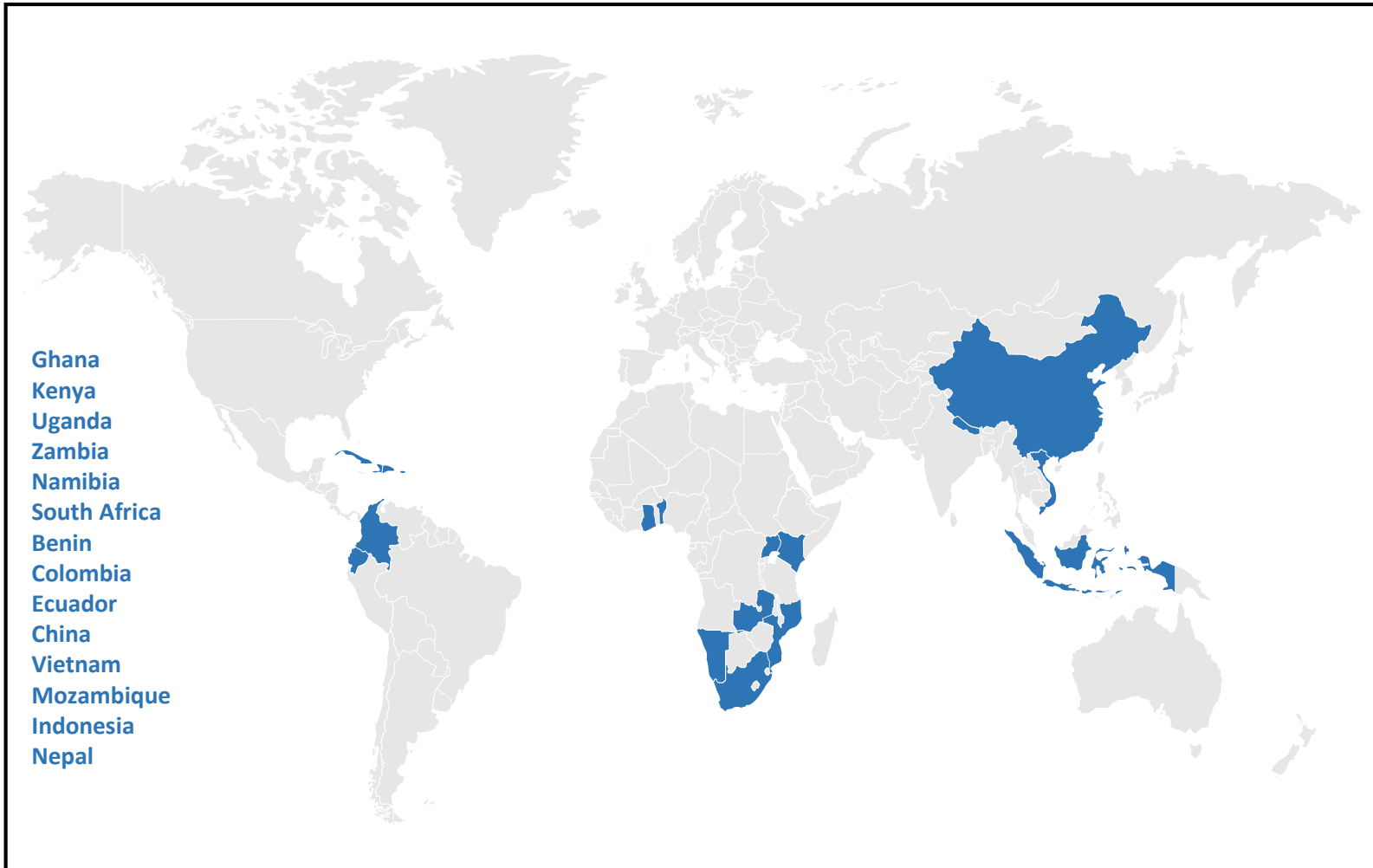


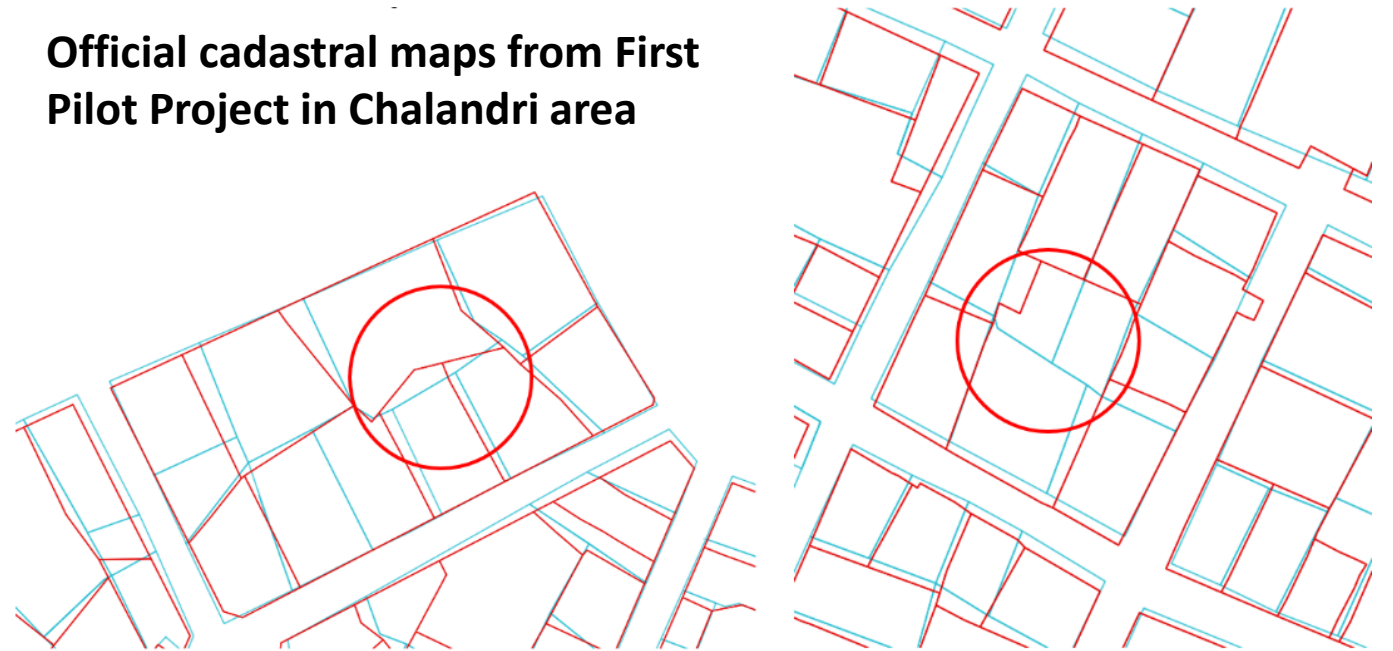
Figure: Sample of current FFPLA projects. (Source: Enemark et al., 2021)



- 79 out of 571 (14% of the total land parcels) =>not accepted.
- Average accuracy deviation => 0.58 m
- Maximum accuracy deviation =>1.77 m

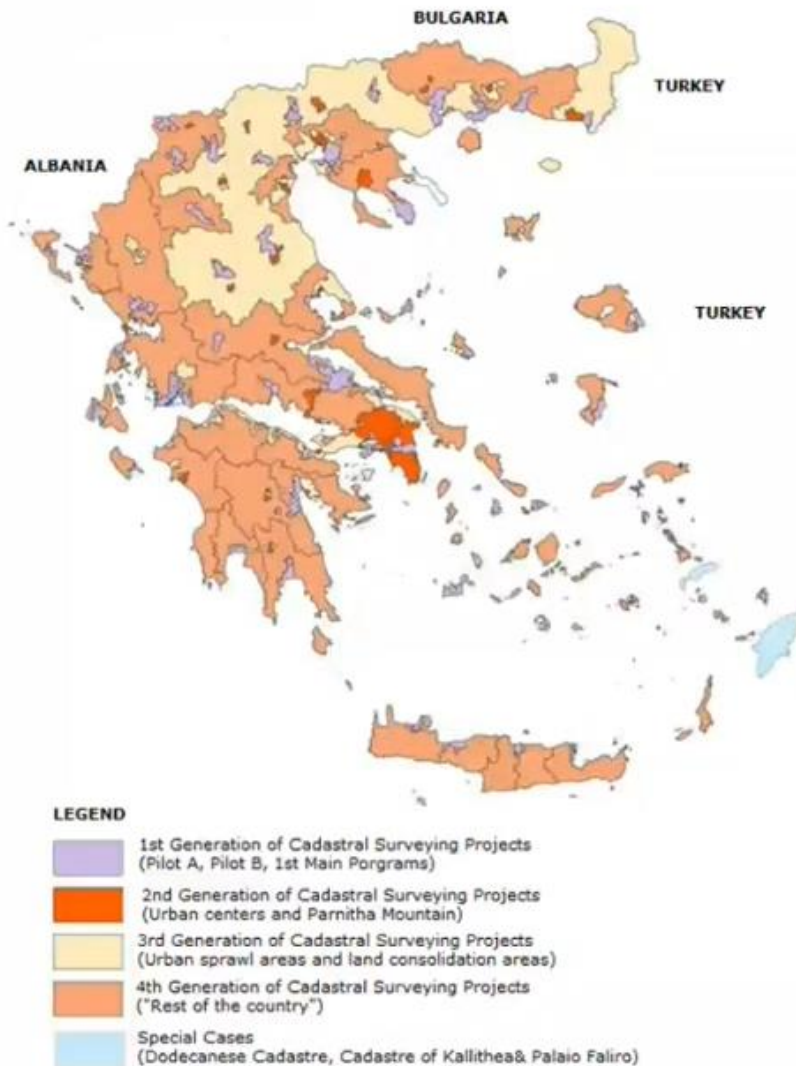
Apostolopoulos, K.; Potsiou, C. How to Improve Quality of Crowdsourced Cadastral Surveys. Land 2022, 11, 1642. <https://doi.org/10.3390/land11101642>

Official cadastral maps from First Pilot Project in Chalandri area



Main elements affecting the geometric accuracy of the crowdsourced cadastral maps

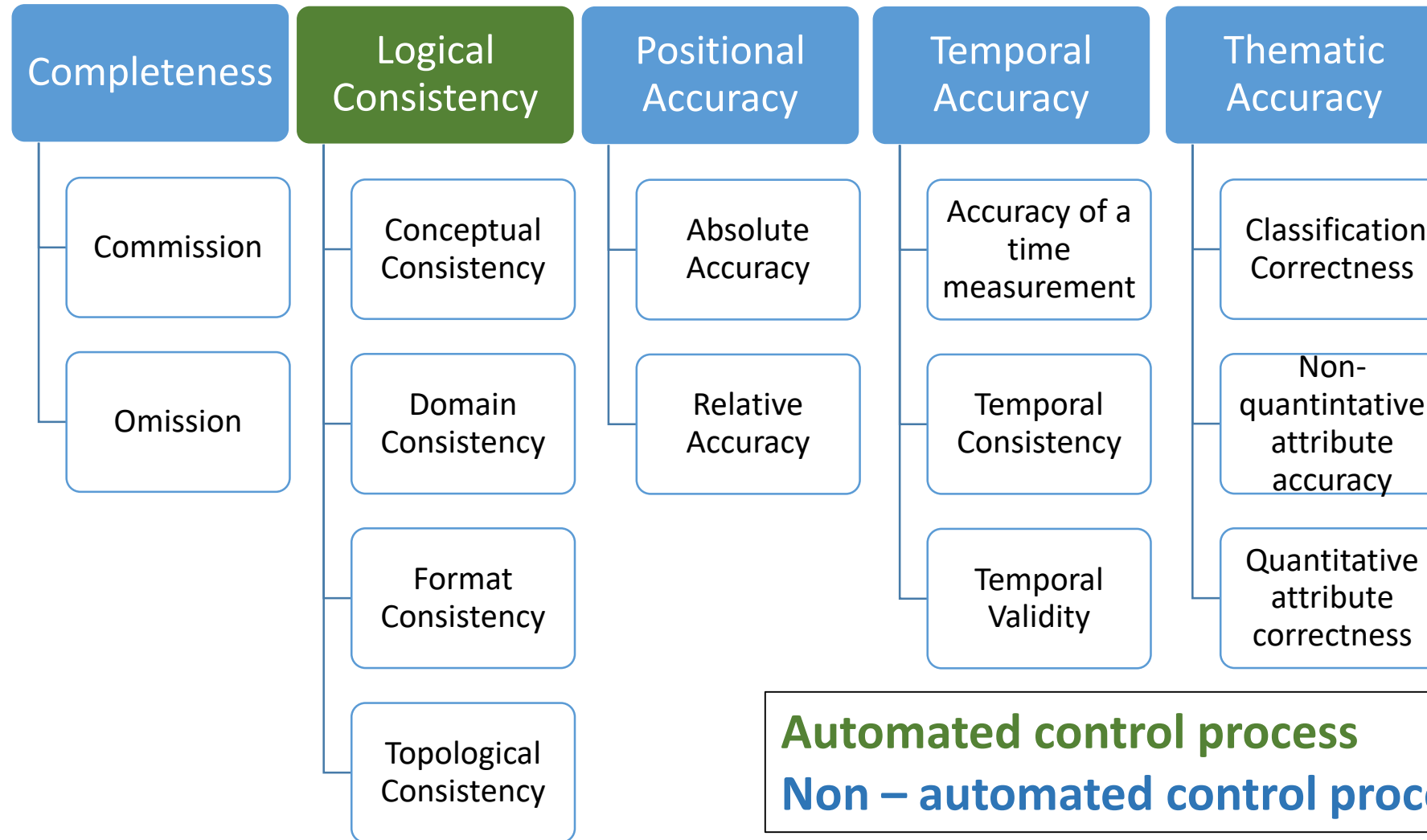
- the quality and accuracy of the used basemap (orthophoto or aerial photo, OpenStreetMap, etc)
- the ability and perception of the user/volunteer/non-professional to identify correctly the boundary points
- the complexity of the property shapes
- whether trees or vegetation hide some boundary points on the basemap used
=> use of an additional GPS antennae is important.



Final deliverables (5) – Intermediate deliverables (4)














- The General Project Quality Plan - Timetable
- Cadastral study area boundaries
- Compilation of the advanced preliminary cadastral basemap
- Submission of 50% of the digital cadastral database (*following the declaration submission phase*)
- Submission of the whole digital cadastral database (*following the declaration submission phase*) (*Draft cadastral map*)
- Final submission of the whole digital cadastral database (*following the declaration submission phase*)
- *Submission of objections/ corrections*
- Submission of final revised cadastral database
- Initial registration of the cadastral database

Quality controls of cadastral database based on **ISO 19157:2013**



Automated control process

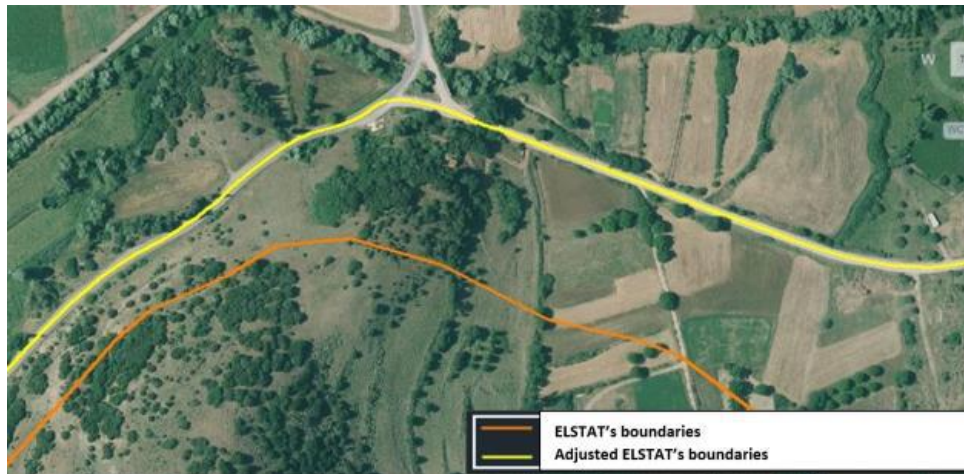
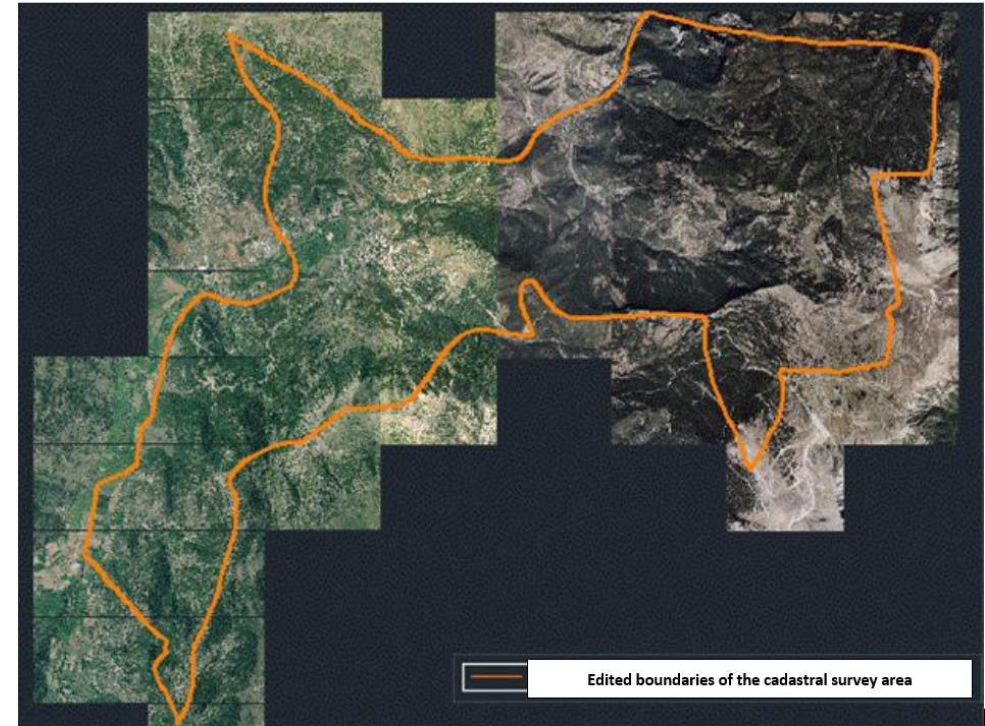
Non – automated control process - Sample testing

	Quality control of deliverables
Thematic data	Data uploading 
	Legal inspection 
	Technical inspection 
Spatial data	Parcel boundaries correctness based on the delineated boundaries of the properties as shown on orthoimages 
	Implementation correctness of topographical diagrams 
	Implementation correctness of bounding parcels within administrative acts 
	Cadastral parcels area compatibility (area in cadastral data vs area in deeds) 
	The ability to detect non-localized properties 
	Possible errors on parcel boundaries using neighboring parcels 
	Geometric accuracy of spatial data with field measurements 
Thematic & Spatial data	Completeness of deliverable, structure and content correctness 
	Correlation of spatial data with corresponding thematic data 
	Quality indicator of cadastral data 

 Completeness
  Logical Consistency
  Positional Accuracy
  Temporal Accuracy
  Thematic Accuracy

Carried out controls on:

- Deliverable's completeness and structure
- Delineation of administrative boundaries
- Delineation of pre-existing cadastral maps boundaries (*land distributions, land consolidations, city plans etc.*)
- Delineation of urban area boundaries
- Deliverable's digital files integrity
- Technical report correctness



Specified QCs regarding implementing correctness

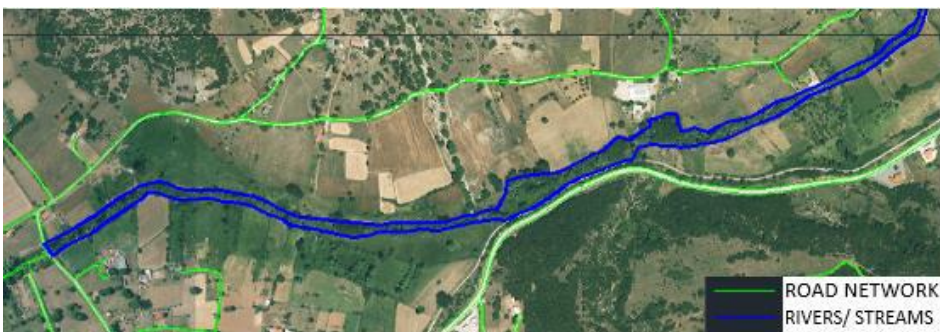
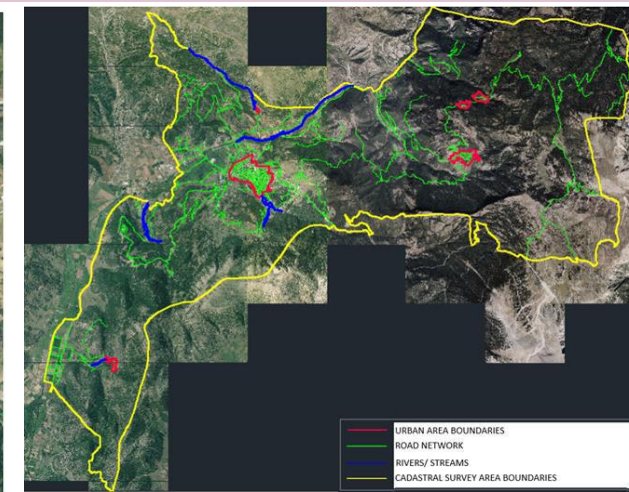
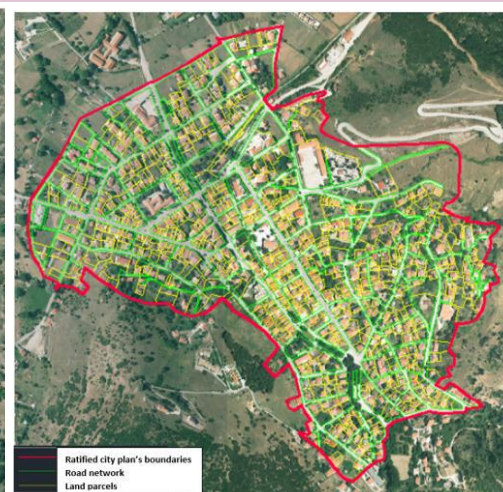
1. Administrative acts at the municipalities boundaries
2. Basemap for identifying cases that intersect structures
3. Geodetic reference system
4. Boundaries of neighbouring areas with cadastre in operation
5. Boundaries of neighbouring areas under cadastral survey
6. Conceptual consistency and domain correctness
7. Topological consistency

Automated control process

Non – automated control process - Sample testing

Carried out controls on:

- Deliverable's completeness and structure
- Identification with the cadastral study area boundaries deliverable
- cadastral units and sectors delineation
- Land parcels coverage completeness
- Cadastral number coverage completeness
- Road network and POI completeness
- Descriptive data table completeness
- Deliverable's digital files integrity
- Technical report correctness



Automated control process

Non – automated control process - Sample testing

Specified QCs regarding implementing correctness

1. Geodetic reference system
2. Cadastral units and sectors delineation
3. Conceptual consistency
4. Format and domain consistency
5. Topological consistency
6. Correlation correctness
7. Data range correctness

Regarding completeness

8. Land parcel coverage
9. Cadastral number coverage
10. Road network
11. Points of Interest
12. Descriptive data

Integration of descriptive data in the Cadastral database

1st stage: Structural database controls

2nd stage: Prohibitive register controls (*e.g. completion of mandatory fields, compatible data range*)

3rd stage: Prohibited combination controls (*e.g. Combined controls between registers, key uniqueness*)

QC per controlled entity	
Rights	69
Properties	69
Right holders	72

Remote procedure by the contractor

Categorization of errors

Definitely wrong registers

Possibly wrong registers

Incorrect

Possibly incorrect

Unrelated entities

Authentication error

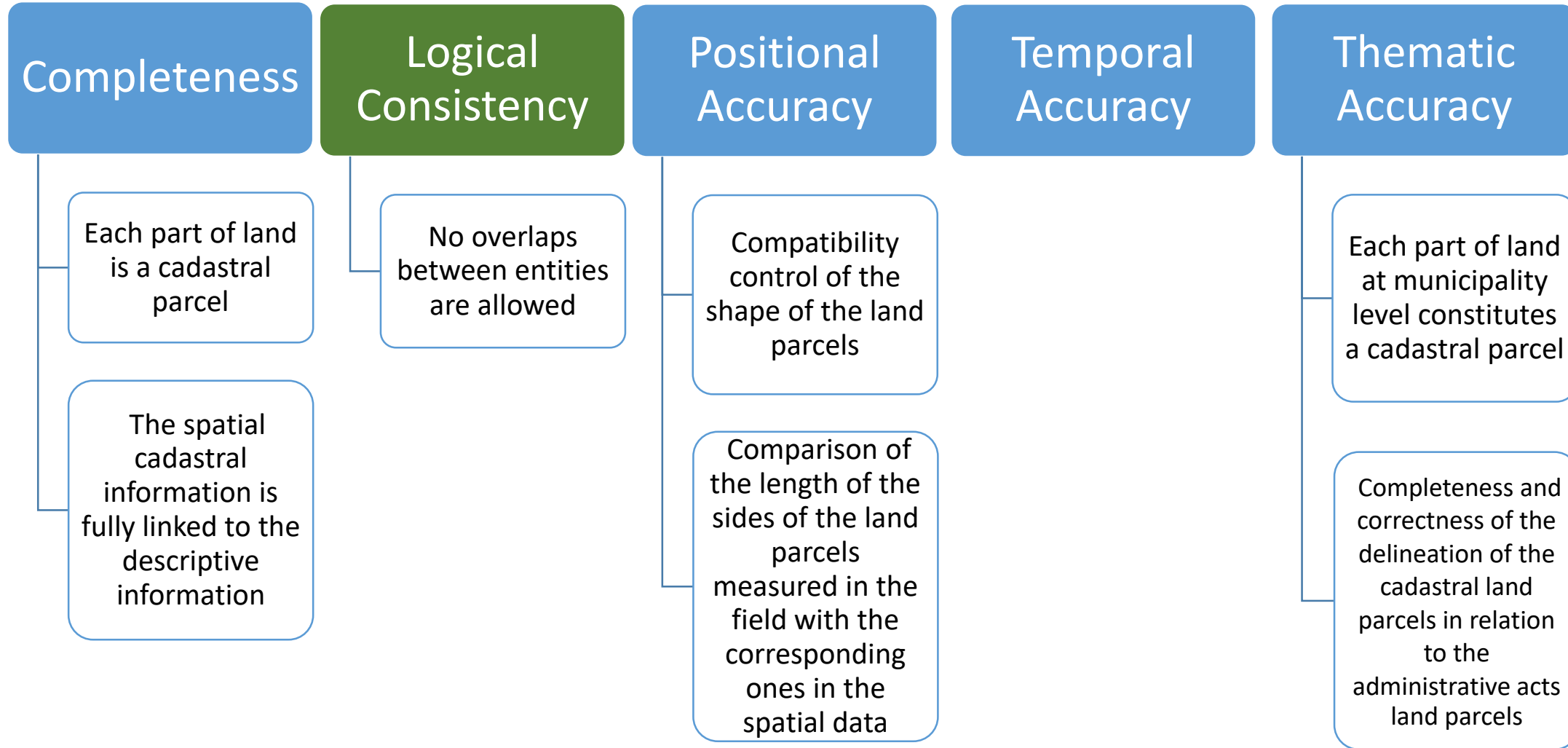
Authentication error

Right holder

Right holder

Multiple registers

Job ID	Μοδέλι	Υποβολή	Επανάληψη	Κατάσταση	Έναρξη	Λήξη
1502	ΚΤ-15	ΠΑΡΑΔΟΣΗ 35%	1	ΦΟΡΤΩΣΗ ΔΕΔΟΜΕΝΩΝ ΕΠΙΤΥΧΗΣ	24/4/2012 2:40 μμ	24/4/2012 3:16 μμ
27	ΚΤ-08	ΠΑΡΑΔΟΣΗ 35%	7	ΦΟΡΤΩΣΗ ΔΕΔΟΜΕΝΩΝ ΕΠΙΤΥΧΗΣ	5/8/2010 10:14 ημ	5/8/2010 10:47 ημ
221	ΚΤ-09	ΠΑΡΑΔΟΣΗ 35%	6	ΦΟΡΤΩΣΗ ΔΕΔΟΜΕΝΩΝ ΕΠΙΤΥΧΗΣ	10/9/2010 3:38 μμ	10/9/2010 3:52 μμ
124	ΚΤ-20	ΠΑΡΑΔΟΣΗ 35%	7	ΦΟΡΤΩΣΗ ΔΕΔΟΜΕΝΩΝ ΕΠΙΤΥΧΗΣ	29/7/2010 12:41 μμ	29/7/2010 12:58 μμ
1243	ΚΤ-09	ΔΟΚΙΜΑΣΤΙΚΗ ΥΠΟΒΟΛΗ Α...	4	ΦΟΡΤΩΣΗ ΔΕΔΟΜΕΝΩΝ ΕΠΙΤΥΧΗΣ	5/8/2011 2:49 μμ	5/8/2011 3:28 μμ
1483	ΚΤ-15	ΔΟΚΙΜΑΣΤΙΚΗ ΥΠΟΒΟΛΗ Α...	3	ΦΟΡΤΩΣΗ ΔΕΔΟΜΕΝΩΝ ΕΠΙΤΥΧΗΣ	19/3/2012 1:56 μμ	19/3/2012 2:11 μμ
321	ΚΤ-16	ΔΟΚΙΜΑΣΤΙΚΗ ΥΠΟΒΟΛΗ Α...	3	ΦΟΡΤΩΣΗ ΔΕΔΟΜΕΝΩΝ ΕΠΙΤΥΧΗΣ	16/11/2010 10:33 ...	16/11/2010 11:03 ...
1082	ΚΤ-18	ΑΝΑΡΤΗΣΗ	8	ΦΟΡΤΩΣΗ ΔΕΔΟΜΕΝΩΝ ΕΠΙΤΥΧΗΣ	15/6/2011 4:14 μμ	15/6/2011 4:50 μμ
1443	ΚΤ-09	ΑΝΑΡΤΗΣΗ	35	ΦΟΡΤΩΣΗ ΔΕΔΟΜΕΝΩΝ ΕΠΙΤΥΧΗΣ	28/12/2011 11:48 ...	28/12/2011 12:36 ...
1322	ΚΤ-08	ΑΝΑΡΤΗΣΗ	9	ΦΟΡΤΩΣΗ ΔΕΔΟΜΕΝΩΝ ΕΠΙΤΥΧΗΣ	13/9/2011 8:53 ημ	13/9/2011 10:09 ημ
1022	ΚΤ-16	ΑΝΑΡΤΗΣΗ	10	ΦΟΡΤΩΣΗ ΔΕΔΟΜΕΝΩΝ ΕΠΙΤΥΧΗΣ	10/6/2011 6:43 μμ	10/6/2011 7:30 μμ



Automated control process
Non – automated control process - Sample testing

Sample control based on ISO 2859-2

Quality Requirement: Correctness of cadastral database
Quality measure: Number of non-compliant properties
Reporting data: Documents and spatial data collected during the cadastral survey
Sampling method: Non – automated control process

Previous cadastral surveys (mainly urban areas)

Whole digital cadastral database
 AQL=> 5%
 Final revised cadastral database
 AQL => 3%

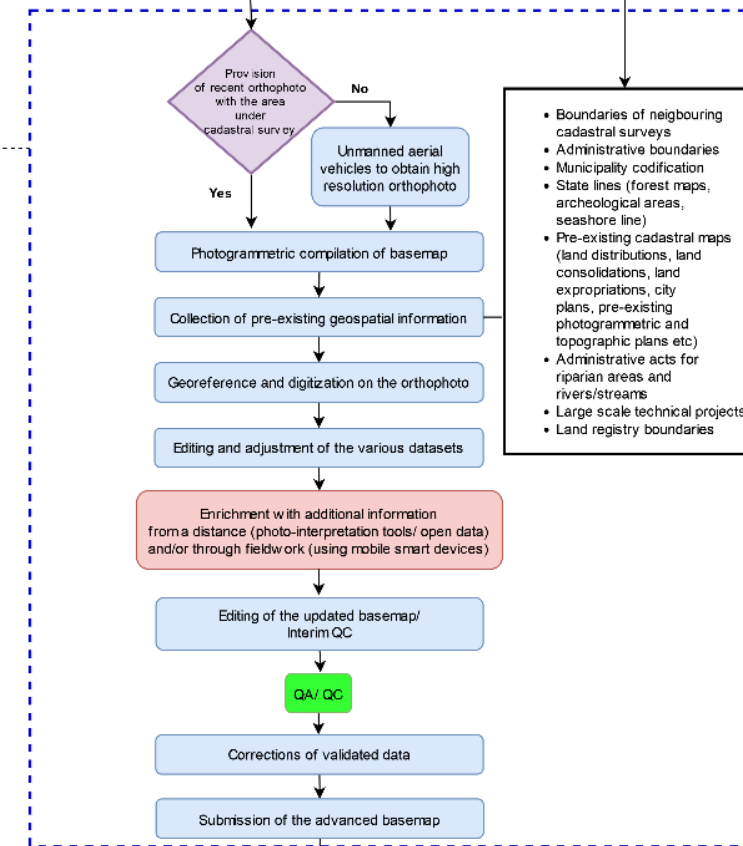
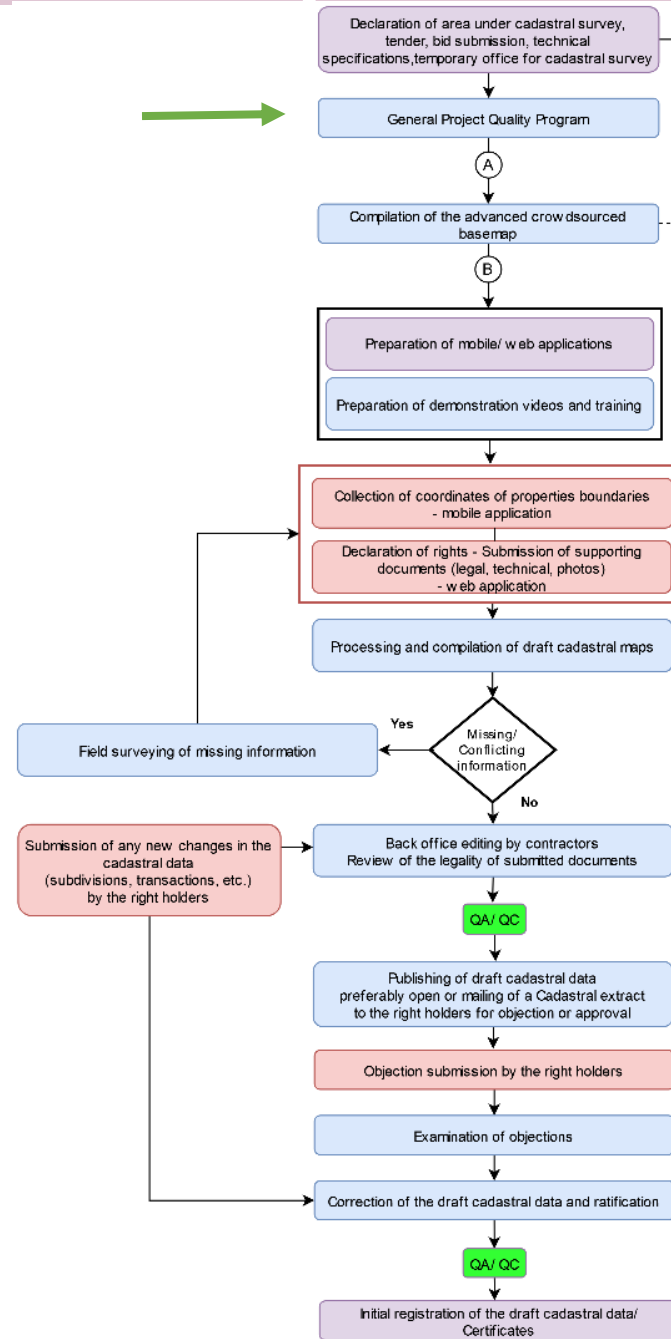
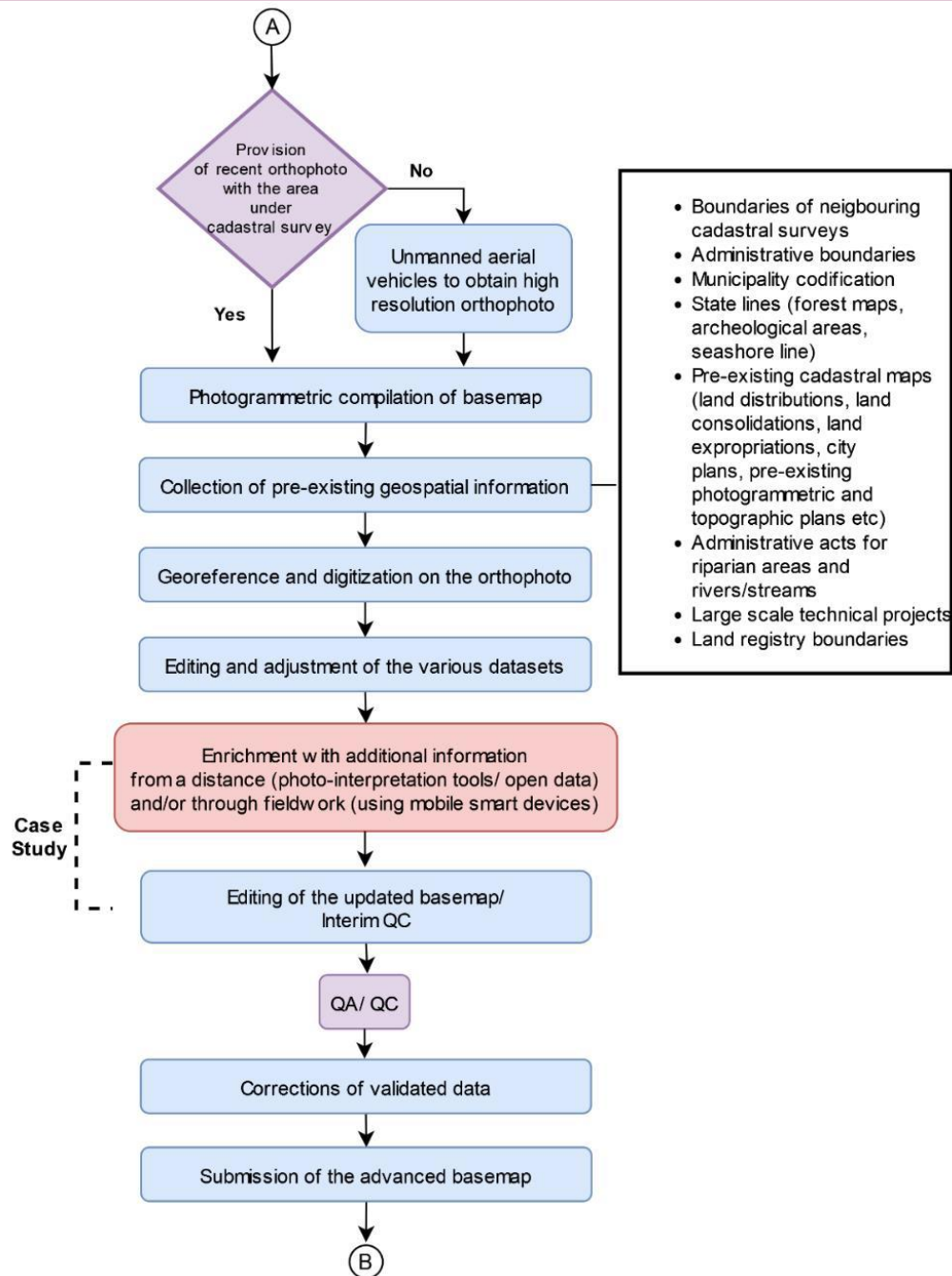
Current cadastral surveys (mainly rural areas)

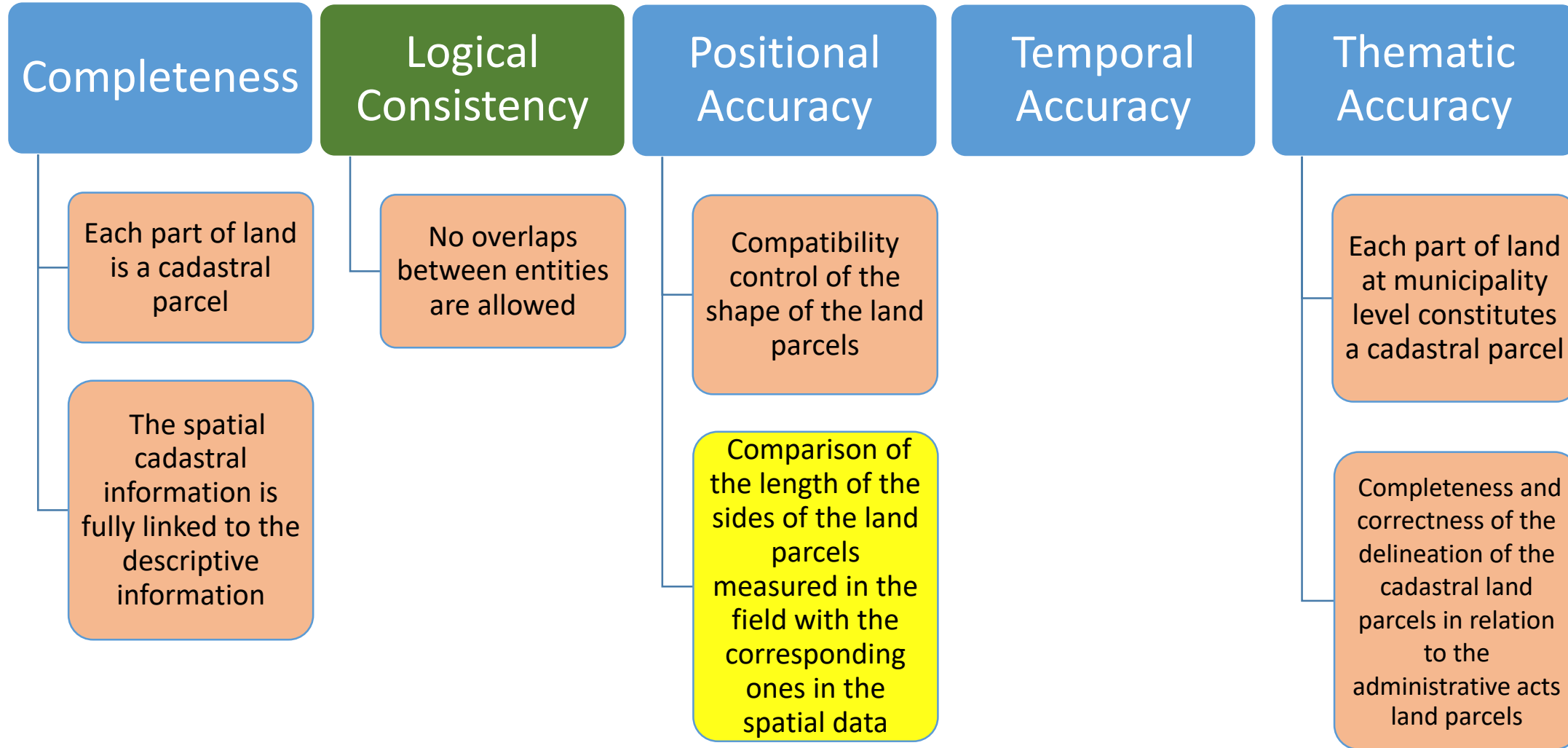
Whole digital cadastral database
 AQL=> 7%
 Final revised cadastral database
 AQL => 5%

Sample		Accuracy quality level								
		0.5	0.8	1.25	2.0	3.15	5.0	8.0	12.5	20
16 – 25	n	-	-	-	-	-	25	17	13	9
	Ac	-	-	-	-	-	0	0	0	0
26 – 50	n	-	-	-	50	50	28	22	15	10
	Ac	-	-	-	0	0	0	0	0	0
51 – 90	n	-	-	90	50	44	34	24	16	10
	Ac	-	-	0	0	0	0	0	0	0
91 – 150	n	-	150	90	80	55	38	26	18	13
	Ac	-	0	0	0	0	0	0	0	0
151 – 280	n	200	170	130	95	65	42	28	20	20
	Ac	0	0	0	0	0	0	0	0	1
281 – 500	n	280	220	155	105	80	50	32	32	20
	Ac	0	0	0	0	0	0	0	1	1
501 –1.200	n	380	255	170	125	125	80	50	32	32
	Ac	0	0	0	0	1	1	1	1	3
1.201 – 3.200	n	430	280	200	200	125	125	80	50	50
	Ac	0	0	0	1	1	3	3	3	5
3.201 – 10.000	n	450	315	315	200	200	200	125	80	80
	Ac	0	0	1	1	3	5	5	5	10
10.001 – 35.000	n	500	500	315	315	315	315	200	125	125
	Ac	0	1	1	3	5	10	10	10	18
35.001 – 150.000	n	800	500	500	500	500	500	315	200	125
	Ac	1	1	3	5	10	18	18	18	18
150.001 – 500.000	n	800	800	800	800	800	500	315	200	125
	Ac	1	3	5	10	18	18	18	18	18
> 500.000	n	1.250	1.250	1.250	1.250	800	500	315	200	125
	Ac	3	5	10	18	18	18	18	18	18

200	Number of examined properties
18	

Deliverable (mainly rural areas)	LQ
Whole digital cadastral database	20.0
Final revised cadastral database	12.5





1st QA/QC takes place following the compilation of the advanced basemap

2nd QA/QC takes place following the declaration submission phase

3rd QA/QC takes place following the objection's submission phase.

Intermediate and final QA/QC



Depending on the availability of funds and the particular situation of each project

Research on the compilation procedure of the Hellenic cadastral project has proved that intermediate QA/QC are crucial for the final accuracy of the cadastral survey

Percentage of 'objections' submitted by beneficiaries



17.5% => 3.4%



Future research:

- Modelling of cadastral data maintenance and updating procedure using crowdsourced methodology and necessary QC
- Especially for the maintenance and updating of urban areas where changes in the use of land are not recorded systematically

Thank you for your attention!!

