

DIGITAL PHOTOGRAMMETRY FOR LAND REGISTRATION IN DEVELOPING COUNTRIES (Focused on Azerbaijan Case)



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Introduction

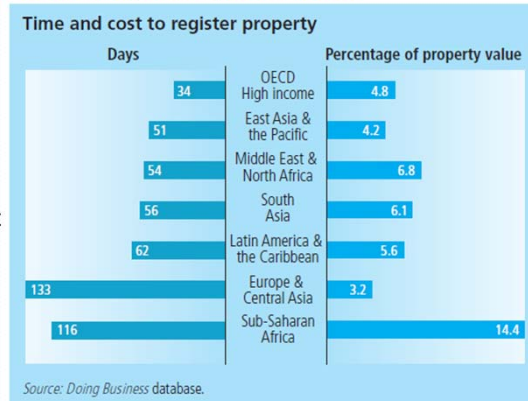
- **Research question**
 - Low Land Registration Rate(not covered by cadastre maps)
 - Affordable and Acceptable Cadastral Survey Method
- **Outline of research**
 - Identification of Land Parcel Boundaries using Digital Photogrammetric method
- **Research method**
 - Comparison of Aerial survey data and Reference map
- **Research data**
 - The Zira (settlement) , on the Absheron Peninsula, in the Republic of Azerbaijan

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Introduction

Harder to register in poor countries

- **Research question**
 - *The Property registries record legal ownership,*
 - *The Cadastre records physical characteristics and identifies boundaries.*
- One of the obstacles to economic growth



*. Doing Business(WB, 2005, 2011)

- **Low Land Registration Rate(not covered by cadastre maps)**
- **Affordable and Acceptable Cadastral Survey Method**

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Introduction

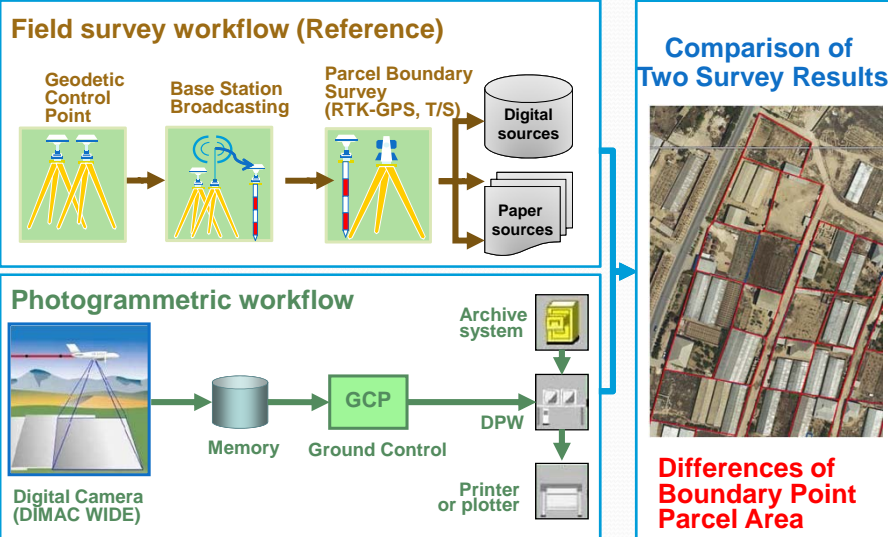


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Research design and methods



- Comparison of Aerial survey data and Reference map



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Research Data



- **Zira testfield**
 - End of Absheron Peninsula, Azerbaijan
- **Area : approx 10km²**
- **Test Area : A**
- **Test Area : B**



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Field Survey Workflow

- **Test Field A : RTK-GPS**
- **Test Field B : T/S with laptop**



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Photogrammetric Workflow



- Cessna 402B
 - Cessna/ USA
 - Tale Number : TC-CAY
 - 2 Piston Engines
 - Capacity : 2 pilots, Camera Operator
Plane Technician
- DiMAC WIDE
 - DiMAC Systems/ Belgium
 - Lenz: 70mm
 - Image Output : 13,800 X 8,900 Pixels
 - Focal Length: 80.3767 mm
 - Pixel Size: 6.8 x 6.8 μm
 - Radiometric Resolution : 16 bits per color channel

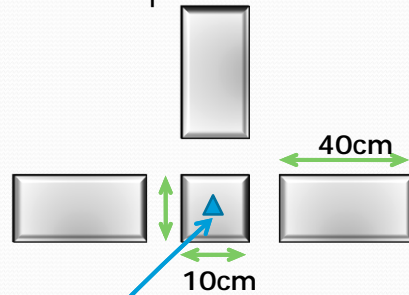



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Aerial Target



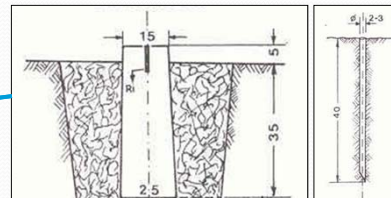
- Every Aerial Target pre-marked before the flight.
- Size and Shape



Pavement



Agricultural Field



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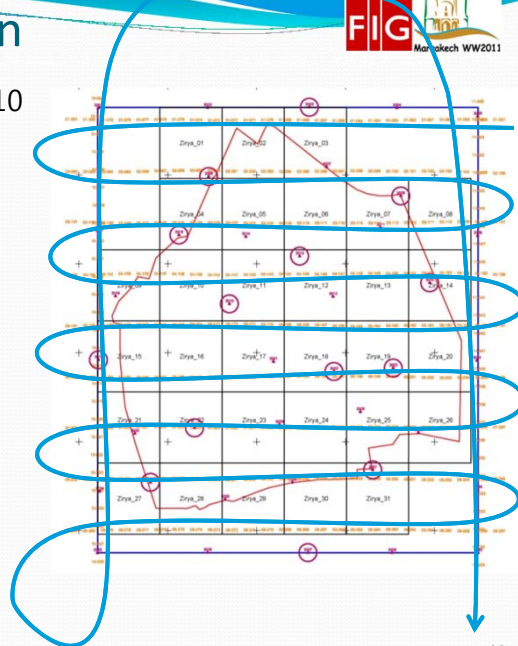
Flight Specification



- 12:30 ~13:30 / 1st. Jun. 2010
- GSD: 10.37cm
- Flight Height: 1,220m
- Num of Exposures : 281
- Num of Strips: 11
- Forward Overlap: 69%
- Side Overlap: 45%

$$\begin{aligned} \text{GSD} &= \text{Pixel Size} (\mu\text{m}) \times \text{Scale} \\ &= 6.8 \mu\text{m} \times (1,220 / 0.08) \\ &= 10.37\text{cm} \end{aligned}$$

- GSD (Ground Sampling Distance)
- Scale = Flight / Focal Length



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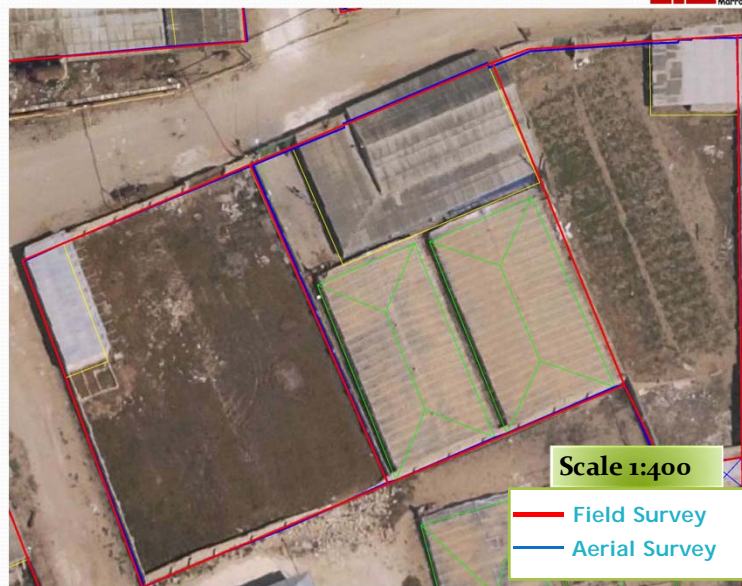
Aerial Triangulation (AT)



Check Point ID	GEODETIC COORDINATES			AERIAL TRIANGULATION COORDINATES			DIFFERENCE		
	X	Y	Z	X	Y	Z	dx	dy	dz
3003	439591.982	4471762.858	18.665	439592.019	4471762.888	18.658	-0.037	-0.03	0.007
3006	438459.211	4470983.368	2.922	438459.221	4470983.356	2.89	-0.010	0.012	0.032
3008	440620.241	4470764.352	8.687	440620.244	4470764.357	8.793	-0.003	-0.005	-0.106
3010	440945.497	4469787.239	-15.317	440945.484	4469787.269	-15.383	0.013	-0.030	0.066
3013	439482.562	4470087.680	0.056	439482.541	4470087.699	0.052	0.021	-0.019	0.004
3015	438692.403	4469550.241	-2.666	438692.434	4469550.240	-2.709	-0.031	0.001	0.043
3016	438124.802	4470325.431	-0.385	438124.81	4470325.384	-0.352	-0.008	0.047	-0.033
3019	437219.548	4468920.092	-9.467	437219.592	4468920.026	-9.522	-0.044	0.066	0.055
3022	439868.389	4468789.839	-9.611	439868.356	4468789.834	-9.658	0.033	0.005	0.047
3023	440535.495	4468828.605	-16.601	440535.513	4468828.625	-16.501	-0.018	-0.020	-0.100
3027	440304.369	4467681.606	-20.628	440304.359	4467681.622	-20.723	0.010	-0.016	0.095
3031	438300.492	4468155.415	-12.877	438300.468	4468155.441	-13.011	0.024	-0.026	0.134
3033	437803.906	4467542.553	-14.415	437803.916	4467542.533	-14.392	-0.010	0.020	-0.023
3037	439575.526	4466751.580	-23.272	439575.461	4466751.553	-23.288	0.065	0.027	0.016
RMSE / Sigma nut: 1.8 micron							0.029	0.029	0.067

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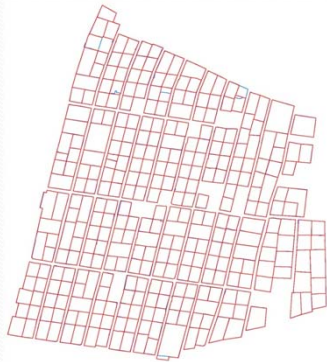
Results of Cadastral mapping



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Results of Cadastral mapping

Test Field 1



Test Field 2



Blue Line : Field Survey
Red Line : Aerial Survey

Classification	Test Field 1		Test Field 2	
	Boundary	Parcel	Boundary	Parcel
Field Survey	876 points	328 parcels	3,548 points	425 parcels
Aerial Survey	3,272 points	323 parcels	6,190 points	386 parcels

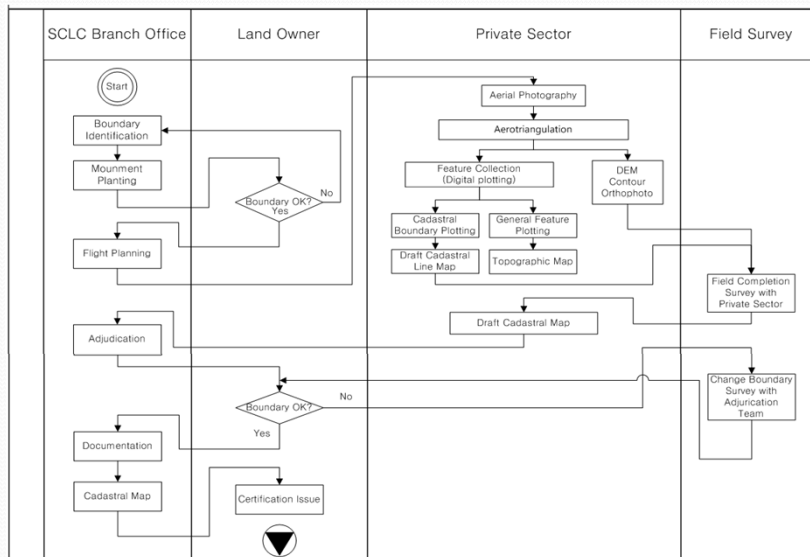
Comparison of 2 cadastral maps

Classification	Test Field 1		Test Field 2	
	Boundary	Parcel	Boundary	Parcel
Regional Characteristics	newly built residential area make up generally straight, uniform walls and distinctly demarcated		old town, narrow and winding road relatively indistinctly demarcated	
Coincidence rate (within a 2% parcel -area difference)	96%	89%	82%	71%
Accuracy	RMSE_x	RMSE_y	RMSE_x	RMSE_y
	0.12m	0.14m	0.19m	0.21m

*. ASPRS Standard for planimetric feature coordinate accuracy requirement for target scale 1/1,000 as limiting RMSE_x or RMSE_y 0.25m.

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Proposed Land Registration Process




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Conclusion and Remarks

- **Affordable Survey Method**
 - Test Field 1 : Aerial survey method would be one of the most reasonable way to register the land in developing countries (fast, easy and inexpensive)
 - Test Field 2 : suggests the land registration method through the field survey with GPS or T/S.
- **Institutional Arrangement needed**

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Thank you for your attention
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Sukeran
Q&A

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