New Surveying Metodologies for the Cartographical Updating of Cadastral Maps and Archives

Piero PANUNZI and Fiorenzo GUARALDA, Italy

SUMMARY

During the 2004, a new procedure regarding the updating acts processing (subdivision and different types of lots) of cadastral lands will be adopted using the system “PREGEO 8”.
This System provides for the use of GPS, and for the subsequent introduction and adaptation of digital map and for the first time it will be also the altimetrical surveying.

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1. INTRODUCTION

In 2003, the Italian Land Agency carries out a substantial change in the management and in the updating of cadastral cartography:

Outer technicians will have the possibility to update archives, as well as to consult them.

The Fulfilment of this extreme change, make a better computarization of the updating procedure necessary, and it represents also the opportunity to renew and to modernize both operational procedures and surveying metodologies.

Absolute innovations are:
- Numeration of all paper maps;
- New surveying metodologies.

2. THE DIGITAL MAP

In order to update maps through a standardized and rapid metodology, and trasmissibile through data, it was necessary to pass from old**,** traditional and beloved"canapine"- hamps – (paper maps deriving from original papers and updated manually) to digital maps.

This operation was not simple. Infact, actually only 120.000 paper maps, representing all national Land, are available in vector format, while the remaining, 200.000, is available in "Raster" format, and for a small percentage the sole available support is just paper.

For the management of this new cadastral system, the administration office is equipped with a data processing system called "WEGIS 2000". This system, a real GIS, is able to manage vector and "raster" data at different levels, combining them with taxable data of parcels. In this way, it can provide for all information, necessary for both consultation and updating.

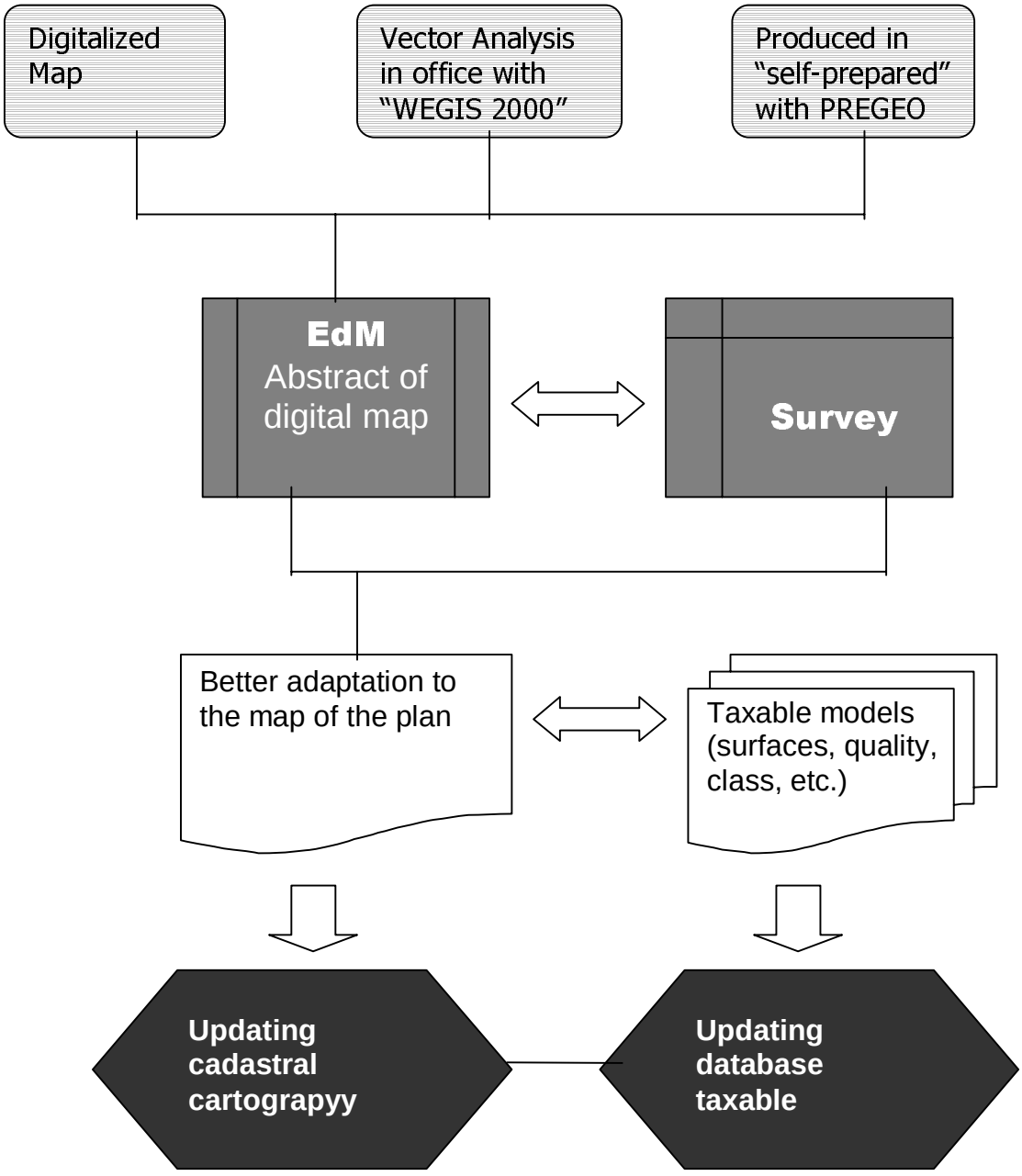
The objective is to arrive, as soon as possibile, to a vector cartogrophy, easy to read, to export on other CAD and GIS applications, to update with new altimetrical elements and, above all, that can be immediatly updated with new publications when an outer technician will give a cartographical updating.

To achieve the above mentioned objective, maps must be updated in a vector way. So, for this reason, each part of maps, which will be submitted to a cartographical updating, must respect the following procedure. First it will be submitted to a vector processing, then it will be updated. The vectorial analysis of "RASTER" parcels can be fulfilled whether by a

cadastral operator, through WEGIS 2002, or by an other techician interested in the cartographical updating, through "PREGEO" software.

The above mentioned software, distributed to the external users by the Ministry of Finance free, gives to the technicians the possibility to elaborate the measurements mapped in the field, to control them and to draw up an "Updating Proposal", to update the map with the new vectors deriving from this work.

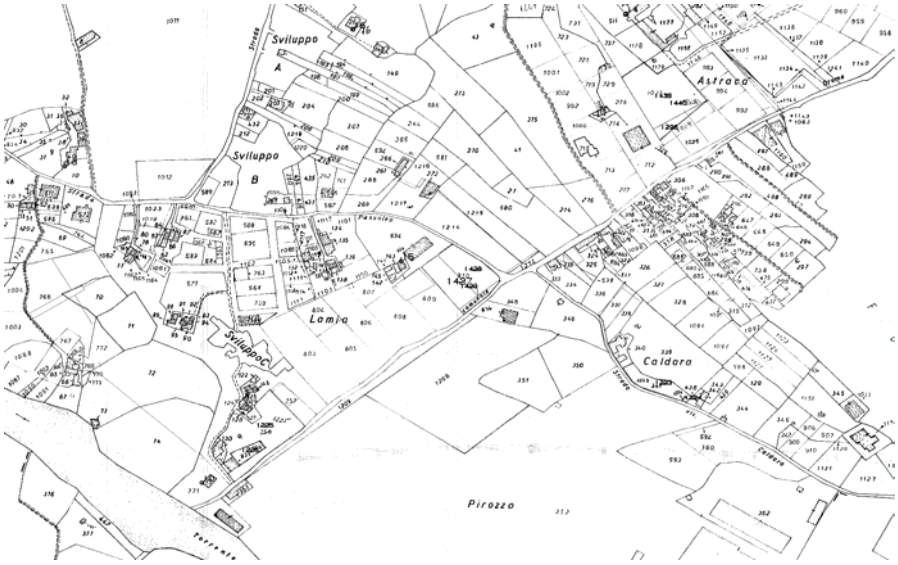
The updating procedure of the map becomes, in this way, automatic, and develops in the following stages:



3. ABSTRACT OF MAP

As what said above, the "Abstract of digital Map" (EdM) is the instrument from which, as the years go by, derive all vector maps, and it is the one used by external professionals for updating the maps.

It is issued by the Land register on magnetic support and is trasmitted in a telematic way. It consists of an image (format PNG) of the portion of the map in question, in suitable scale in A4 or A3 format, and of a file ASCII (expansion EMP), containing almost all necessary information for the cartographic updating.



0|28112002|0|I725|00240|1427|RC|PUB|RMOSVS54S05H224M|5203719986960|
8|1%|-95280.659|-10708.455|
8|2%|-95288.445|-10717.983|
8|3%|-95293.379|-10723.585|
8|4%|-95338.241|-10687.395|
8|5%|-95323.573|-10670.184|
8|PF10/0240/I725|-95522.573|-10929.092|75|SPIG OVEST FABBR|52|I725,00240,10|19-11-2002|2002/252860|
8|PF12/0240/I725|-95439|-10460|438|SPIG S-E FABBR|10|I725,99990,0|04-01-1988|IMPIANTO|
8|PF13/0240/I725|-95239.515|-10447.412|296|PUNTO FIDUCIALE INDISPONIBILE VICINO AL PF05/25 VEDI TIPO N.2630/91|32|I725,00250,4|28-03-1990|TIPO 90/451|
8|PF14/0240/I725|-95019.432|-10535.429|283|SPIG. OVEST FABBR.|52|I725,00240,14|03-10-2002|2002/210330|
8|PF15/0240/I725|-95288.58|-10740.828|144|SPIG NORD FABBR|52|I725,00240,15|11-03-2002|2002/51011|
8|PF16/0240/I725|-95043.928|-10788.353|26|SPIG SUD FABBR|52|I725,00240,16|11-06-1997|1997/6351|
8|PF18/0240/I725|-95187.256|-11060.493|40|SPIG. SUD FABBR.|52|I725,00240,18|28-07-1998|1998/8097|
7|6|1%|2%|3%|4%|5%|1%|NC|1427|1427|1221.222|
6|PARTICELLA|1427|02|ULIVETO |1284|1221.222|4.31|7.96|
6|DISTANZA|PF14/0240/I725|PF10/0240/I725|638.111|0.014|1997836|
6|DISTANZA|PF14/0240/I725|PF10/0240/I725|637.595|0.141|199316002|
6|INQUADRAMENTO|-95015.8115225881|-11119.2389503838|0.5081669691|-94465.2970000003|-

File Ascii (EMP)

This file contains the following geometrical and taxable information of the surveying object:
Line 0
Date, number of progr., municipal district, sheet, parcels, office, operator, operator CF, code of control;
Line 8 vertix particel
Vertix polygon, north coordinate, east coordinate;
Line 8 PF organisation
PF name, north coordinate, east coordinate, reliability, comment;
Line 8 altimetrical organisation
Name point, altitude, reliability, comment;
Line 7
Number of vertices, list of vertices, kind of line, parcel, main parcel, surface; *(the identification of the parcel can be followed by the signales + and/or – to identify external, internal, bounderies or seamed buildings).*
Line 6 parcel description
Identification type of line, parcel, class, quality, taxable surface, cartographical surface , R.A., R.D.
Line 6 PF distance (measured)
Identification type of line, PF 1, PF 2, distance, SQM, updating art;
Line 6 "georeferenziazione"

Identification, north vertix, north ovest abstract, east vertix, north west abstract, dimension pixel-metres, north center rotation, east center rotation, rotation angles.

4. NEW SURVEYING METODOLOGIES

The necessity of the shift to digital maps determined the demand of new software of data processing.
This demand brought to the introduction of GPS and of altimetrical information within the cadastral of topographical work.
The above mentioned methodologies were considered superfluous for the normal cadastral practice (surveys of modest areas and maps without any references to the altitude), but the spreading of satellite instrumentation and the desire of a three-dimensional cadastre encouraged the General Administration to effect this qualitative leap, to coincide with the computer based updating of digital cartography.

- Use of GPS.
  The coming of new procedures brought to a regulation on the use of GPS (an instrument about complete positioning through radio-signales, received from a constellation of satellites), for the execution of all foreseen cartographical updatings. For obtaining a complete survey it is possible to use both single or double frequency instruments and methods of static surveying (not very well advisable for the long time of acquisition of points), kinematics and RTK.

4.1 Estimated Resctrictions for GPS Measures

Type of instrument	Static modality	Kinematical modality	RTK
Single frequency	≤ 15.000 m	≤ 1.000 m	---
Double frequency	>15.000 m	≤ 15.000 m	≤ 15.000 m

- Altimetrical information

  For the relative accomplishment, see law 17.08.1941, n. 1043 and Ministerial Decree 2.01.1998, n. 28. We talk about altrimetical information because, currently, we know the altitude of only few PF. Infact, the professional man will limit himself to measure the difference of level between PF and, at least, one point of the object in question. All this implies that each PF has identified the altimetrical point of reference, to which refer the measure of difference of level. If this point was not identified, the professional man, who used that confidentional point first, has to decide this reference and has to present a monographic file to the land register, following an attached model of the new regulation

- New types of line

  The new surveying metodologies, the altimetrical information and the updating proposal have determined the necessity of other type of lines, that are able to describe the new information.
  Different type of lines are plans of an ASII file, explainable from the cadastral software through the metrical and taxable data processing.

The information about a GPS base are contained in a type of line 1 and in a type of line 6, that follows the first one. As we are talking about geometric coordinates of the station expressed in metres, the values X,Y and Z (distance from the centre of the earth) will have 6 numbers before the comma (millions of metres).

agenzia del Territorio

Punto fiduciale PF 01/0010/E041 Attendibilità: 52

Ufficio provinciale di: REGGIO DI CALABRIA

Comune: GIOIA TAURO Sezione: Fg: 0010 All.: Part.: 274

Riferimento planimetrico

SPIGO CENTRALE REC

Coordinate piane

Cassini-Soldner Gauss - Boaga

X: -75050.170 Nord:

Y: +44135.050 Est:

Orig: Fuso:

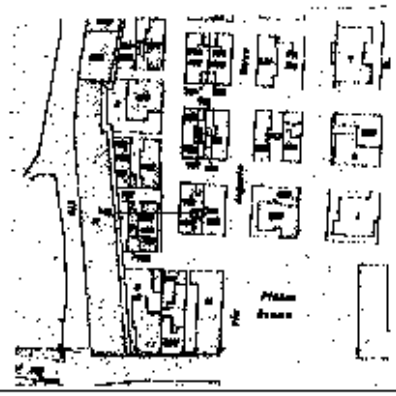
Riferimento altimetrico

Quota s.l.m. Att.:

Coordinate/quota riservate all'Ufficio

Fotografia o schizzo prospettico

Estratto di mappa Scala 1: 2000



Particolari

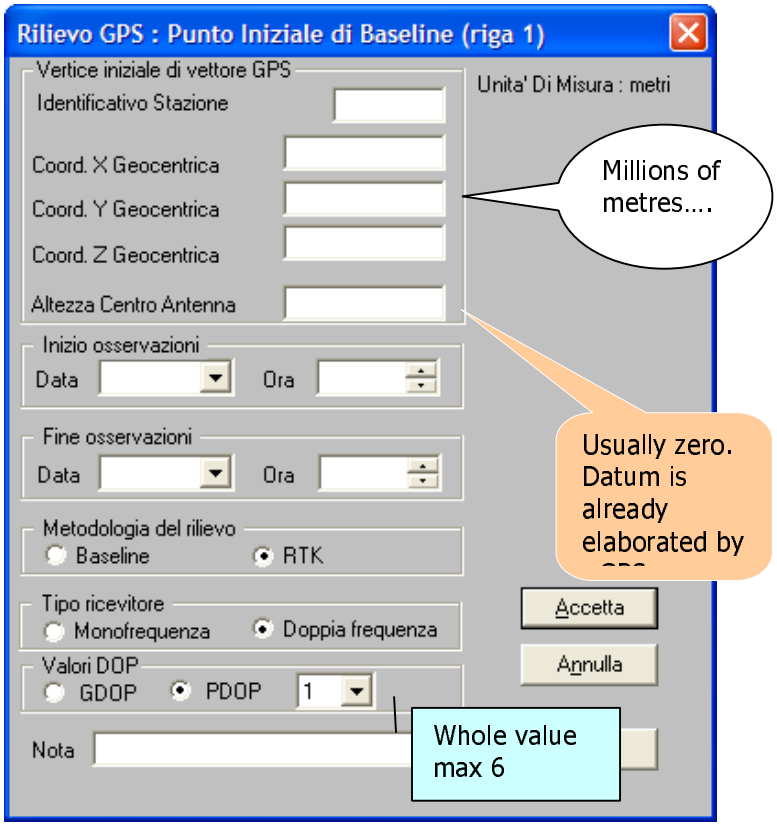
Annotazioni

Istruito:

Verificato:

Annullato:

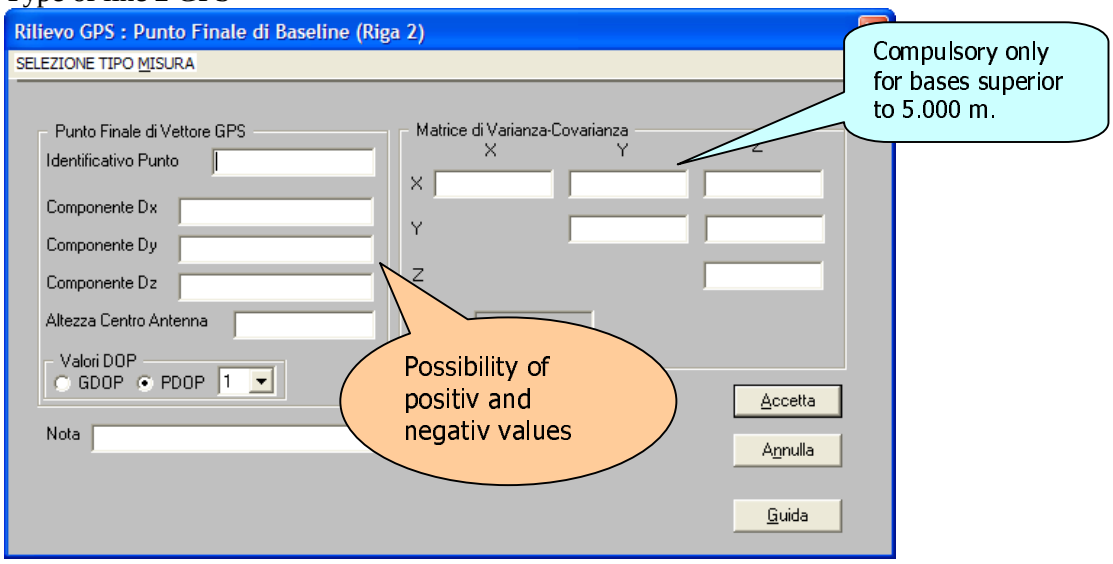
Type of Line 1 GPS



Type of line 1	Name point	Geocentic coordinates divided by a comma	Height antenna	Materialization of the point

Type of line 6	Type of receiver	Date and time start of observation	Date and end time of observation	Modality of survey	Type and DOP value

Type of line 2 GPS



Type of line 2	Name point	Baseline components divided by a comma	Precision indicators divided by a comma	Type and value of DOP	Height antenna	Materialization of the point

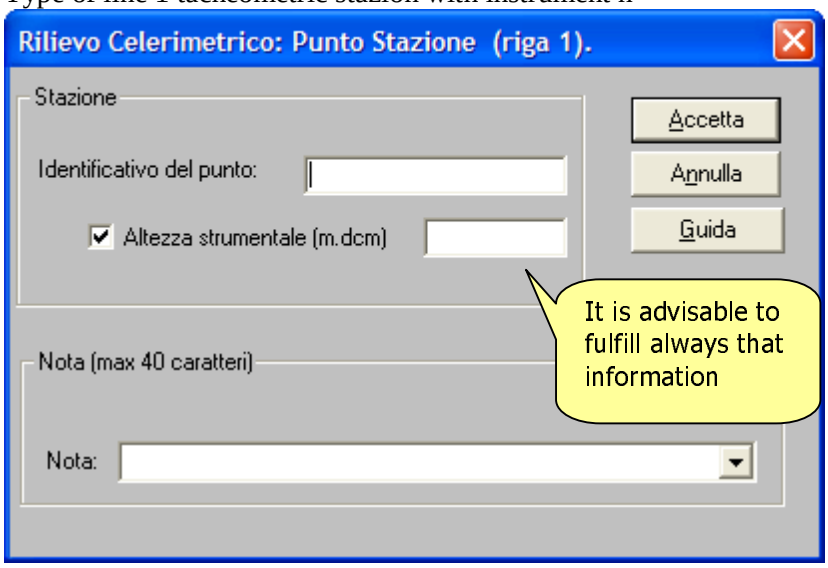
All the measures of the beaten point are expressed in differences with that one of the base. For this reason, the numbers will be very small (they only depend from the distance and from the difference of level between the mobile antenna and the base) and they can be also negative values.
As it is ascertained, the administration has chosen geometric measures that refer locally in order to execute the calculation with a local reference (net of confidential points, surveyd in the same work) and also with mixed measures (tacheometric measures and alignments).

There is also the existence of another type of tacheometric line 1, but without “instrumental height”. As all PF points and, at least, one point of the object of survey had to contain altimetrical information, and the most important purpose of stations consisted in the survey of the object and in the link of the above object to the PF, it stands reason that all stations must be furnished with altimetrical information. For this reason, it is better to insert in that line instrumental height measured in the field.

It is possibile to use 3 types of tacheometric line 2: with horizontal distance, with inclined distance and target height. In every case, it would be always better to use the third type, fulfilling the field “Target height” only when it is necessary to have the altimetrical information of the beaten point (station ahead and behind, confidential point, one point of the object of survey).

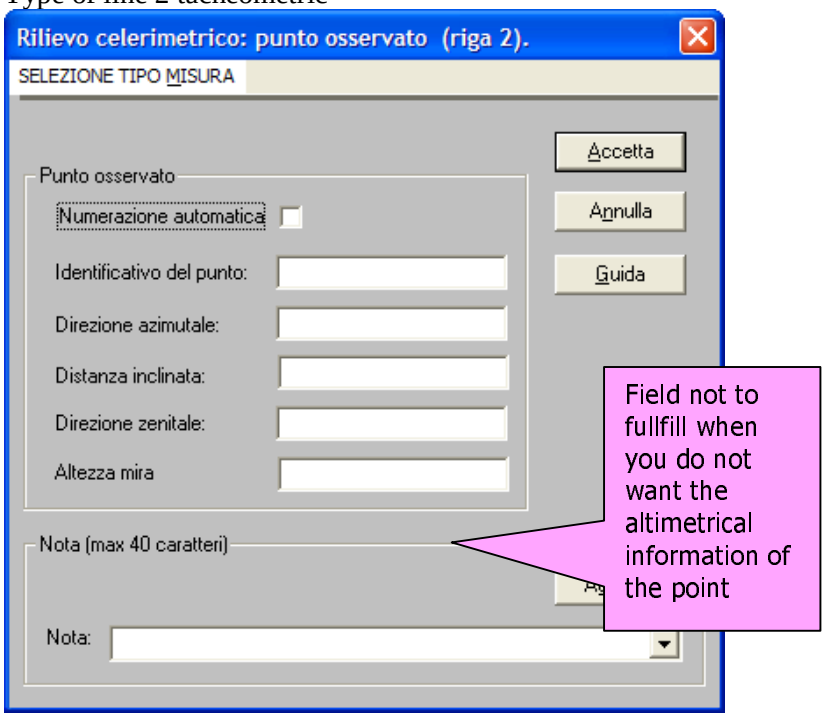
The 0 value (zero) in the field of “Target height” is valid (case of instruments in reading without prism) and it calculates the altimetrical information for the point.

Type of line 1 tacheometric stazion with instrument h



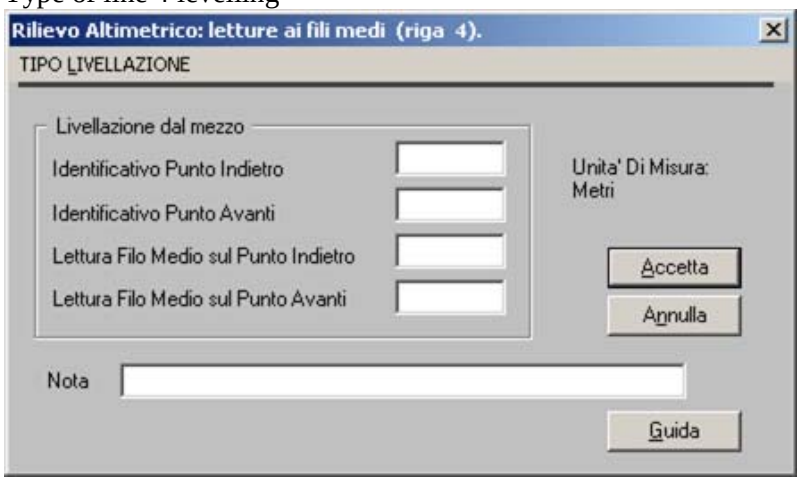
Type of line1	Name point	Instrumental height	Materialization of the point

Type of line 2 tacheometric



Type of line 2	Name point	Azimuthal Direction	Zenithal Direction	Sloging Distance	Target height	Materialization of the point

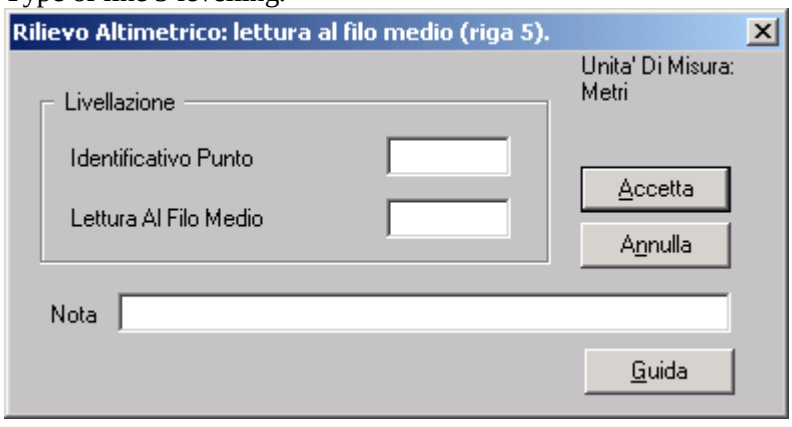
Type of line 4 levelling



Type of line 4	Name point	Medium cable reading	Materialization of the point

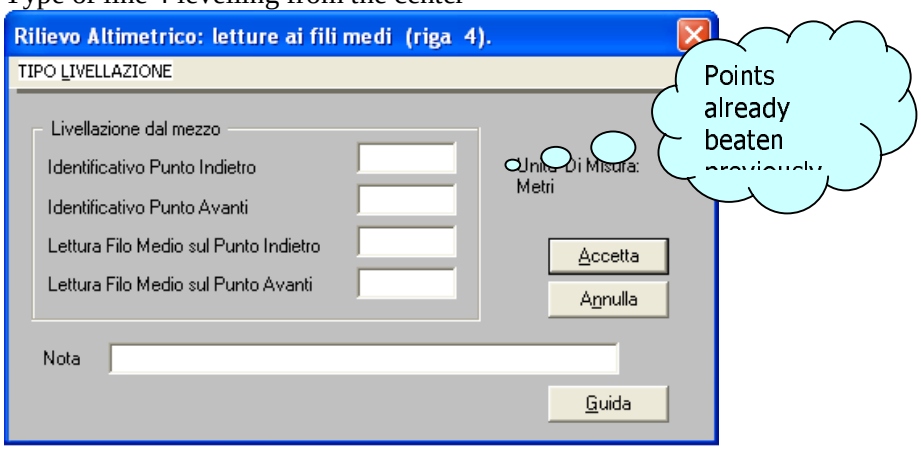
This kind of operation is needed to calculate the difference of level on PF, when this one is not surveyed directly (impossibity of calculation through GPS or prism), and it is beaten cause of alignments and surveyor's cross. This operation can be carried out with the level, but for small distances we can use metrical canes, laser with buddles and grated metres.

Type of line 5 levelling.



It is necessary after the type of line 4 levelling.

Type of line 4 levelling from the center



Type of line 4	Name point behind	Name point ahead	Medium cable readig behind	Medium cable reading ahead	Materialization of the point

This operation is advisable when the nearest point of the known difference of level is not close to the desired one, so it was not possible to beat the altimetrical information directly.
In that case the use of the level is necessary.

5. CONCLUSIONS

What does the italian surveyor expect from all these innovations?
The elements that the italian surveyor expects from all these innovations are the following:

- The telematic transmission;
- The approval, the updating of the map and of taxable values in real time;
- The consultation ON-LINE, both of maps and of taxable information.

Today, we have at our disposal the informatic structure to realize all said above, hardware and software in use in the cadastral field can give this possibility. We are only waiting for the renew of some national regulations that allow to operate (or to better utilize) with the new procedure, and could bring our Category to the most updated and computerized level at this moment.

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Geom. Fiorenzo Guaralda – Secretary of Consiglio Nazionale Geometri.

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