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INTEGRATE GPS SURVEYS AND PDA TO GATHER THE NECESSARY DATA FOR A HYDRAULIC MODEL

BY

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Abstracts: This paper will present how to integrate PDA and GPS surveys in order to help gathering necessary data to build the hydraulic model of a city. Our study will show how we imported the gathered GPS points into a PDA/Windows application (in house built) and how that application helped engineers in developing the model. That application was developed for the city of Baia Mare.

Key words: GPS, software, hydraulic model.

1. Introduction

When this project started none of the people involved in it knew how it can be done and how to have the data ready for a digital use. After a few days of brainstorming and internet research we came up with a solution that fit our needs.

So we decided to have a system that will follow the next steps (Fig. 1):

1. Use GPS surveys to position the manholes
2. Several teams of 2-3 people with PDA's will next do the actual survey of the manholes.
3. At different points the data gathered by the teams will be merged into one database and used to do the hydraulic model.

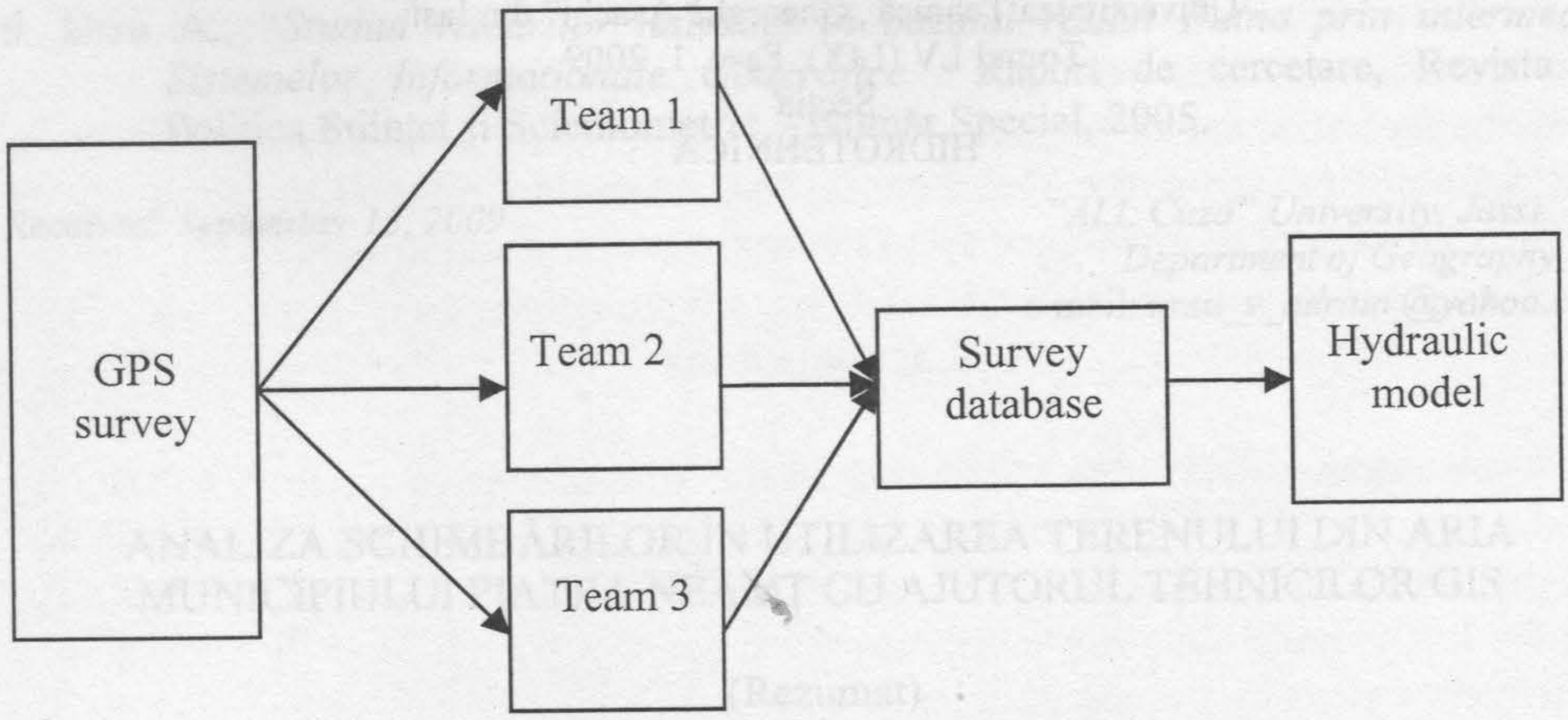

Fig. 1 – How data are gathered.

To do the GPS surveys we used two Trimble R6 GPS Systems. The data collected with the two GPS was exported into a flat file (using Trimble Office) and later used as a starting point for our PDA application. Those points look like the ones in Fig. 2.

1	v.lucaciu20	685744.168	395757.778	246.509	5		CLADIRE	<By Layer	Survey quality
2	v.lucaciu19	685754.15	395687.144	246.514	5		CLADIRE	<By Layer	Survey quality
3	v.lucaciu18	685740.827	395683.436	246.531	5		CLADIRE	<By Layer	Survey quality
4	v.lucaciu16	685786.533	395496.075	243.447	5		CLADIRE	<By Layer	Survey quality
5	v.lucaciu17	685762.405	395592.661	244.659	5		CLADIRE	<By Layer	Survey quality
6	v.lucaciu15	685792.146	395472.598	243.166	5		CLADIRE	<By Layer	Survey quality
7	v.lucaciu14	685791.654	395393.058	242.261	5		CLADIRE	<By Layer	Survey quality
8	v.lucaciu13	685795.712	395357.339	241.777	5		CLADIRE	<By Layer	Survey quality
9	v.lucaciu12	685791.519	395293.638	241.094	5		CLADIRE	<By Layer	Survey quality
10	v.lucaciu11	685785.45	395235.223	240.266	5		CLADIRE	<By Layer	Survey quality
11	v.lucaciu10	685779.518	395180.896	239.861	5		CLADIRE	<By Layer	Survey quality
12	v.lucaciu9	685773.923	395129.115	239.317	5		CLADIRE	<By Layer	Survey quality
13	v.lucaciu8	685773.519	395123.034	239.304	5		CLADIRE	<By Layer	Survey quality
14	v.lucaciu7	685772.566	395111.783	239.105	5		CLADIRE	<By Layer	Survey quality
15	v.lucaciu6	685768.361	395074.632	238.64	5		CLADIRE	<By Layer	Survey quality
16	v.lucaciu5	685764.346	395033.619	238.26	5		CLADIRE	<By Layer	Survey quality
17	v.lucaciu4	685757.158	394969.146	237.613	5		CLADIRE	<By Layer	Survey quality
18	v.lucaciu3	685752.819	394940.121	237.284	5		CLADIRE	<By Layer	Survey quality
19	v.lucaciu2	685741.866	394872.525	236.554	5		CLADIRE	<By Layer	Survey quality
20	v.lucaciu1	685734.809	394823.257	236.16	5		CLADIRE	<By Layer	Survey quality
21	nisiparilor1	685559.277	394652.977	234.338	5		CLADIRE	<By Layer	Survey quality
22	nisiparilor2	685552.347	394593.026	233.336	5		CLADIRE	<By Layer	Survey quality
23	nisiparilor3	685558.289	394544.947	233.067	5		CLADIRE	<By Layer	Survey quality
24	nisiparilor4	685504.044	394377.839	231.943	5		CLADIRE	<By Layer	Survey quality
25	nisiparilor5	685478.192	394343.203	231.384	5		CLADIRE	<By Layer	Survey quality
26	nisiparilor6	685461.195	394319.323	231.015	5		CLADIRE	<By Layer	Survey quality
27	nisiparilor7	685441.477	394256.569	230.594	5		CLADIRE	<By Layer	Survey quality
28	nisiparilor8	685437.183	394239.057	230.532	5		CLADIRE	<By Layer	Survey quality
29	nisiparilor9	685430.473	394211.935	230.423	5		CLADIRE	<By Layer	Survey quality
30	nisiparilor10	685417.088	394163.537	229.948	5		CLADIRE	<By Layer	Survey quality
31	nisiparilor11	685392.603	394111.626	229.791	5		CLADIRE	<By Layer	Survey quality
32	s.barnutiu1	685372.601	393970.541	228.555	5		CLADIRE	<By Layer	Survey quality
33	nisiparilor12	685334.099	394015.785	229.073	5		CLADIRE	<By Layer	Survey quality
34	s.barnutiu2	685264.176	394083.175	229.33	5		CLADIRE	<By Layer	Survey quality
35	s.barnutiu3	685248.67	394095.415	229.475	5		CLADIRE	<By Layer	Survey quality
36	s.barnutiu4	685185.149	394137.791	231.938	5		CLADIRE	<By Layer	Survey quality
37	horea1	685168.365	394061.411	231.932	5		CLADIRE	<By Layer	Survey quality
38	horea2	685154.547	393986.902	231.143	5		CLADIRE	<By Layer	Survey quality
39	horea3	685140.91	393897.076	230.038	5		CLADIRE	<By Layer	Survey quality
40	horea4	685135.171	393871.038	229.539	5		CLADIRE	<By Layer	Survey quality

Fig. 2 – GPS points.

To be noted that the points are already in STEREO 70 system (conversion is made by the GPS).

At this point we have only a collection of GPS points indicating the position of manholes in the city.

I will make a note at this point saying that we got a little help from an external consultant which had provided us with a survey format. This survey format was followed when we developed the PDA application. Someone could ask at this point why we needed the PDA application. So for those who have this question in their minds we will answer saying that digital data is the only useful data in GIS. For the application we decided to use SQL Server mobile edition because:

- is mobile (can be use on PDA devices) and also can be used on Windows systems with the appropriate software installed
- the data can be manipulated with SQL commands
- the data can be easily converted into a SQL Server 2005, MySQL or PostgreSQL

In order to be able to manipulate manholes we decided to have codes for every street. For every street the manholes will be numbered starting from 1. So if the street code is for example 10 and we have 4 manholes on that street, the complete set of codes will be 10_1, 10_2, 10_3, 10_4. In this way we can't mix up the manholes codes and are easy to read.

2. The Application

At this point we will start presenting the PDA application (Fig. 3).

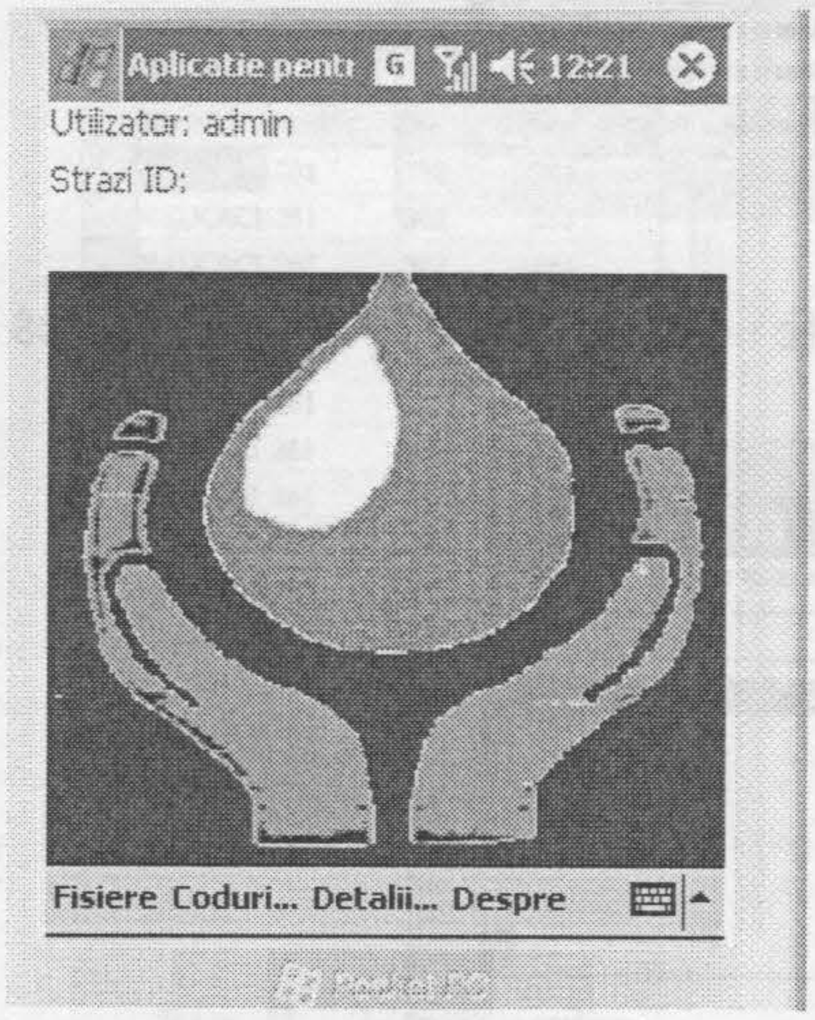

Fig. 3 – Main screen of the PDA application.

This application has a few options. We will present each option:

- Fisiere (File) with the following suboptions (Fi. 4):

- Export … - used to export the entire database content into Excel files
- Iesire (Exit) – exit the application

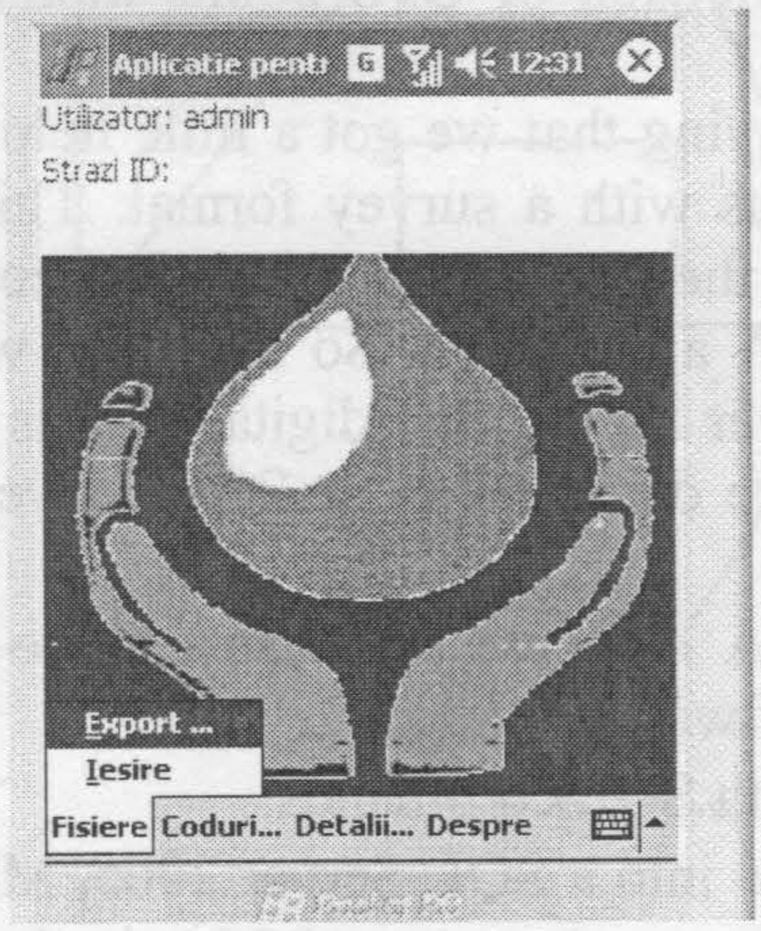

Fig. 4 – File menu.

• Coduri (Codes) with the following suboptions (Fig. 5):

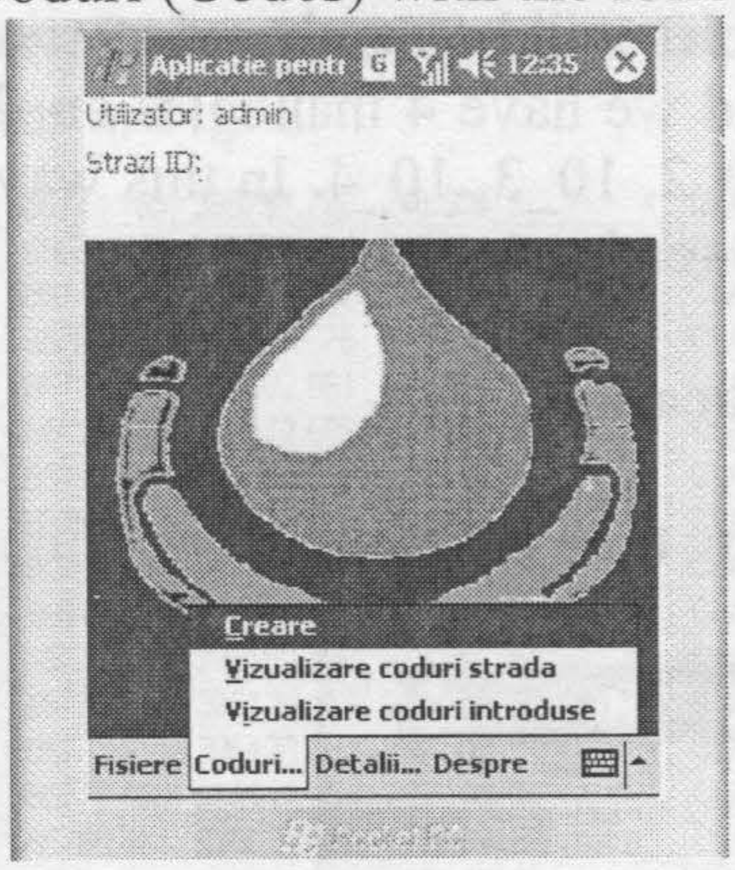

Fig. 5 – Codes menu.

- Creare (Create) – to create new street codes (Fig. 6)

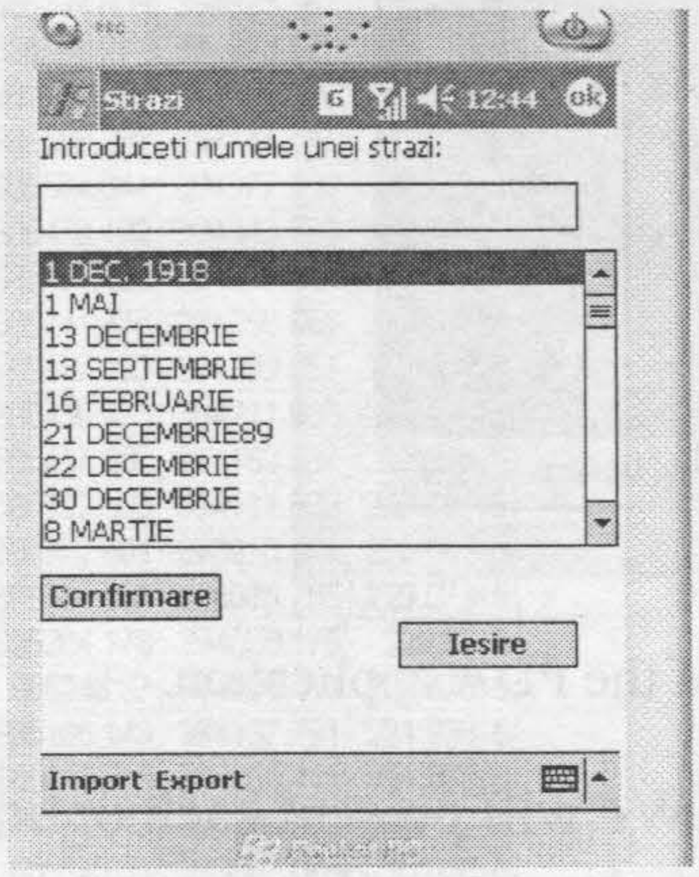

Fig. 6 – Create option.

At this point we will notice the two options available (Figs. 7 and 8): Import and Export. Import is used to import the GPS points into the application and Export is used to export the data into an Excel file format, which can be easily imported into the database of choice. Be careful in choosing the database because the effort involved in moving the data is the same either you are using some home use database or a more serious one. By using inappropriate database servers you can find yourself in that situation in which you will have to do the above step again, but using a different database server. *It is a waste of your time!*

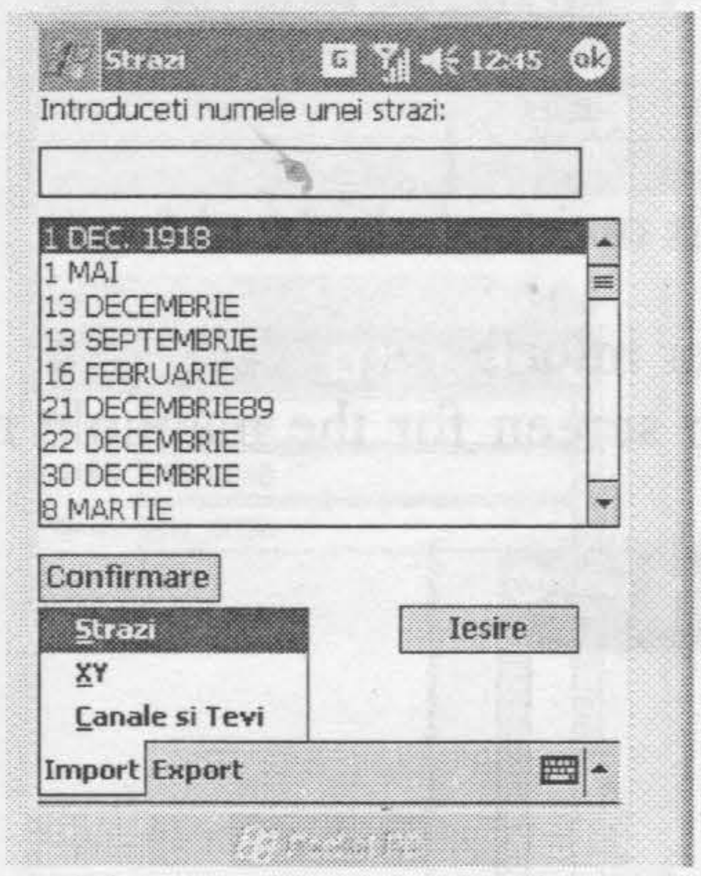

Fig. 7 – Import option.

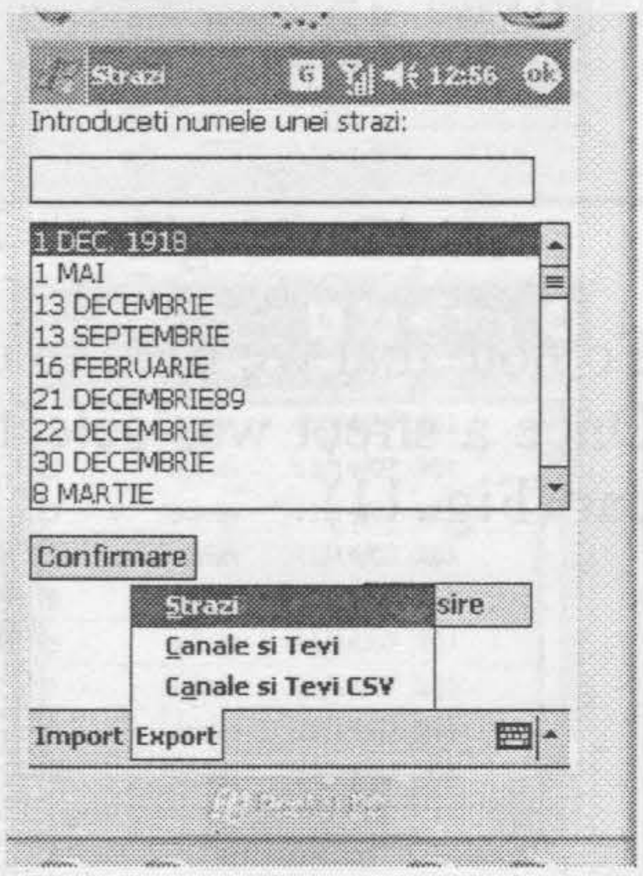

Fig. 8 – Export option.

- Vizualizare coduri strada (View codes - street) – to view street codes
- Vizualizare coduri introduce (View codes - insert) – to view the entered street codes (Fig. 9).

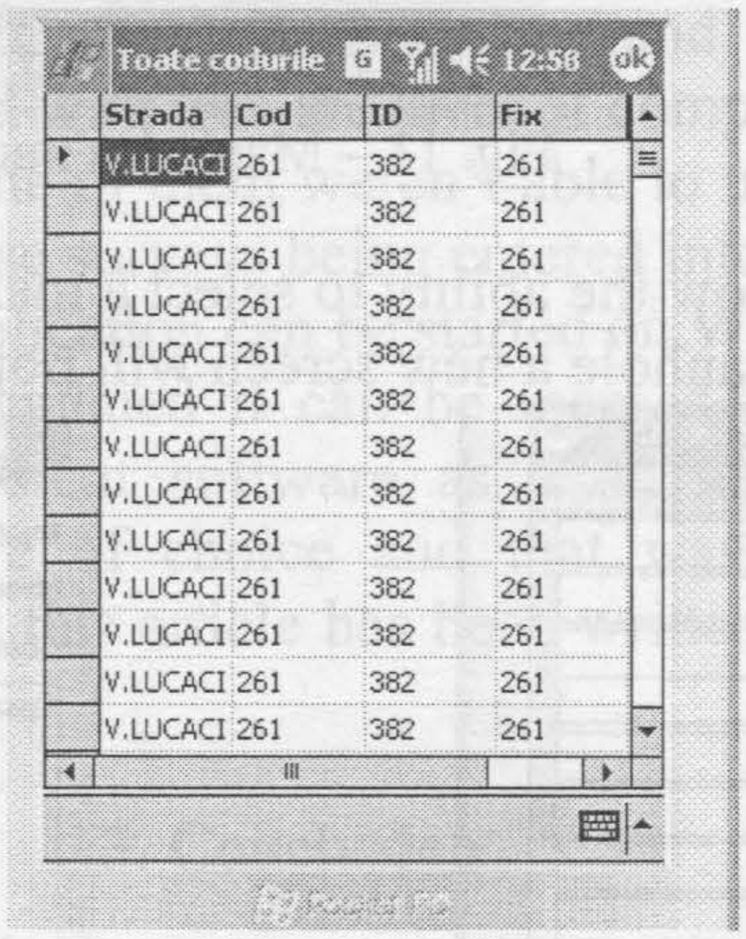

Fig. 9 – View codes.

- Detalii… (Details) – used to enter the actual survey of the manhole. The user will work on a street at one moment. So he/she will have to select the street using a search screen (Fig. 10).

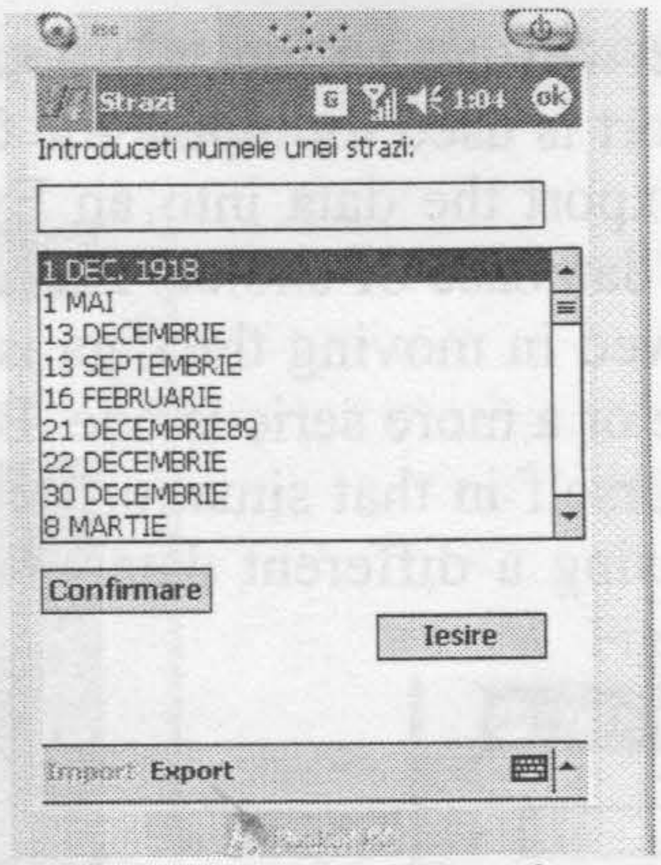

Fig. 10 – Details option.

To note that we tried to use similar user interfaces.

Once a street was selected a selection screen for the manhole numbers will appear (Fig. 11).

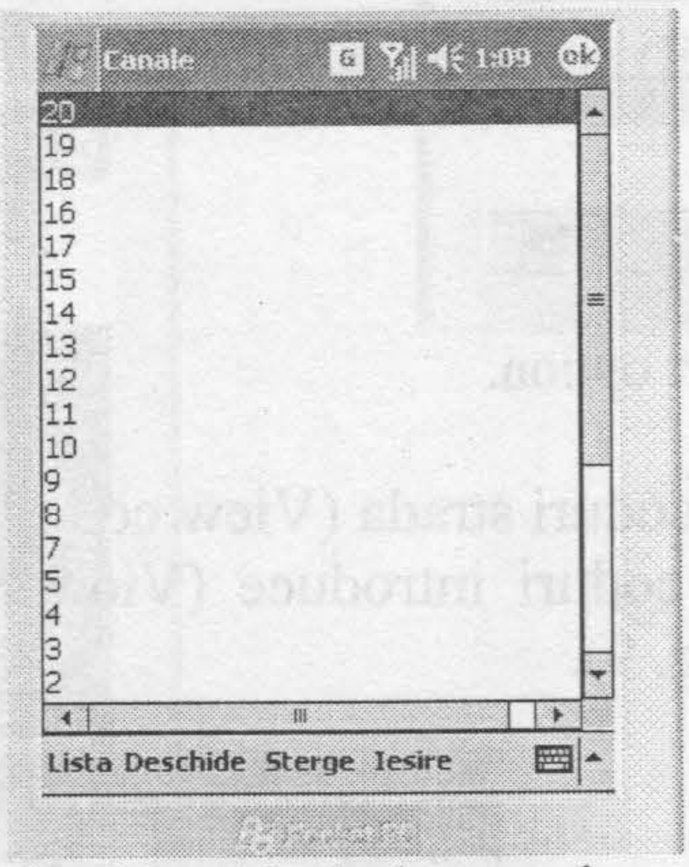

Fig. 11 – Manholes numbers.

The user has now the ability to select a manhole and work with it. Once he selected a manhole a new screen will popup (Figs. 12, …, 17).

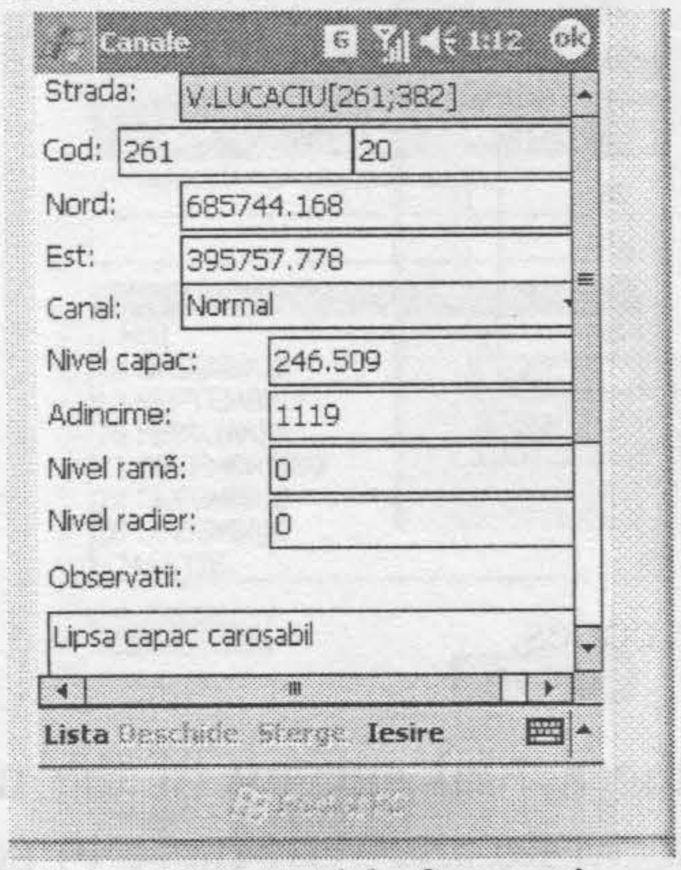

Fig. 12 - General information. (1)

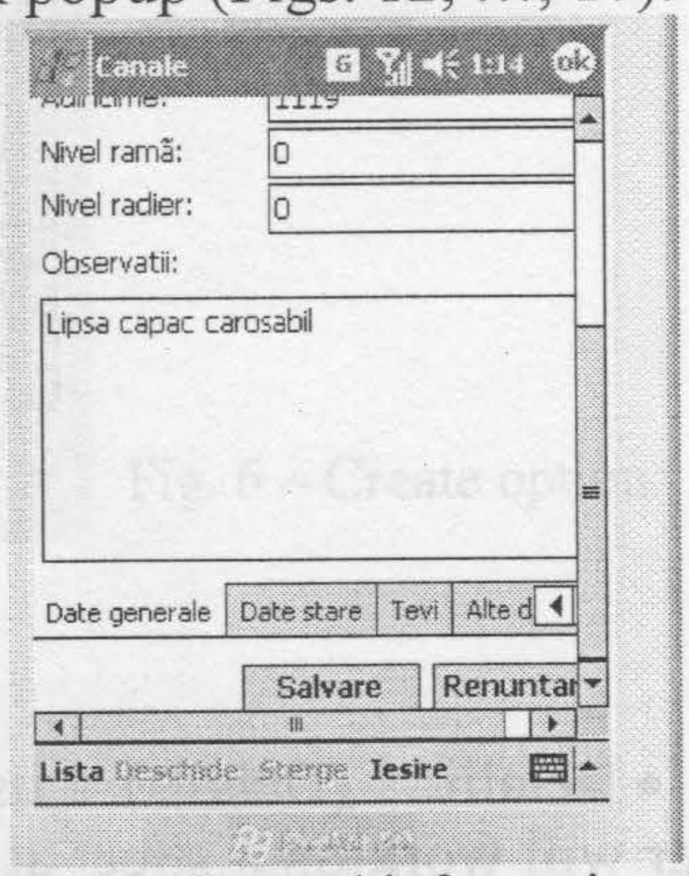

Fig. 13 – General information (2)

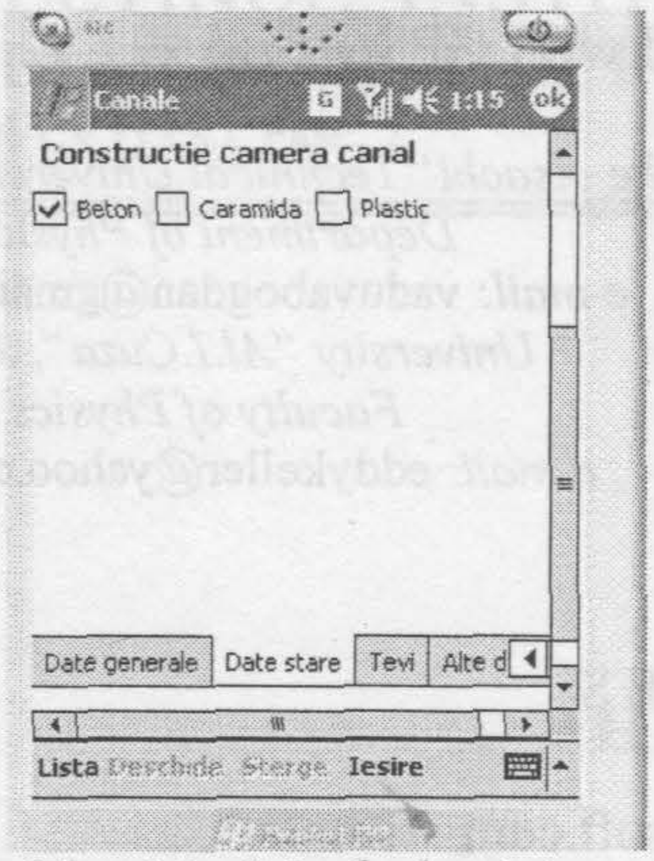

Fig. 14 - Manhole status.

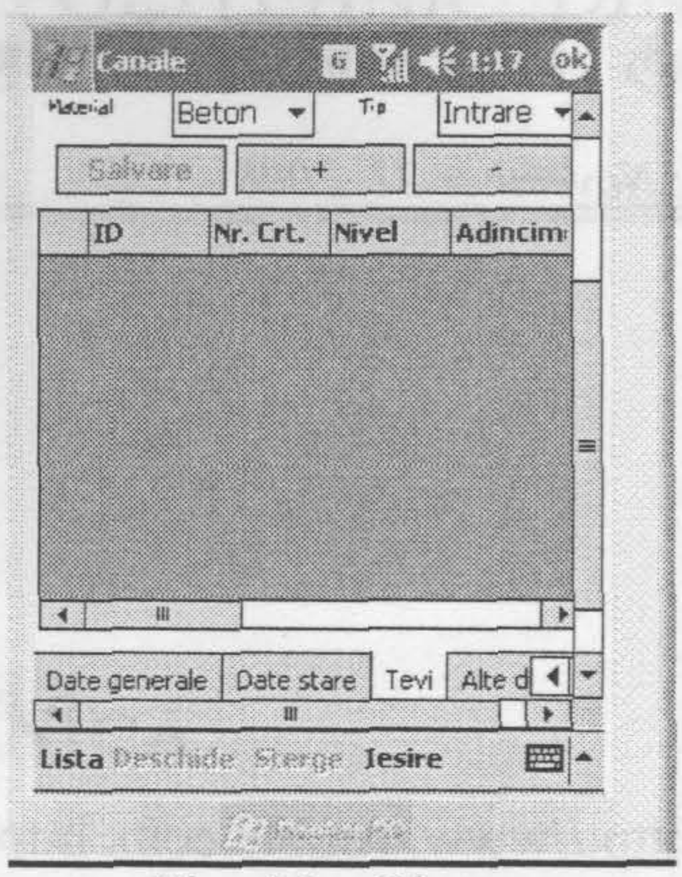

Fig. 15 – Pipes.

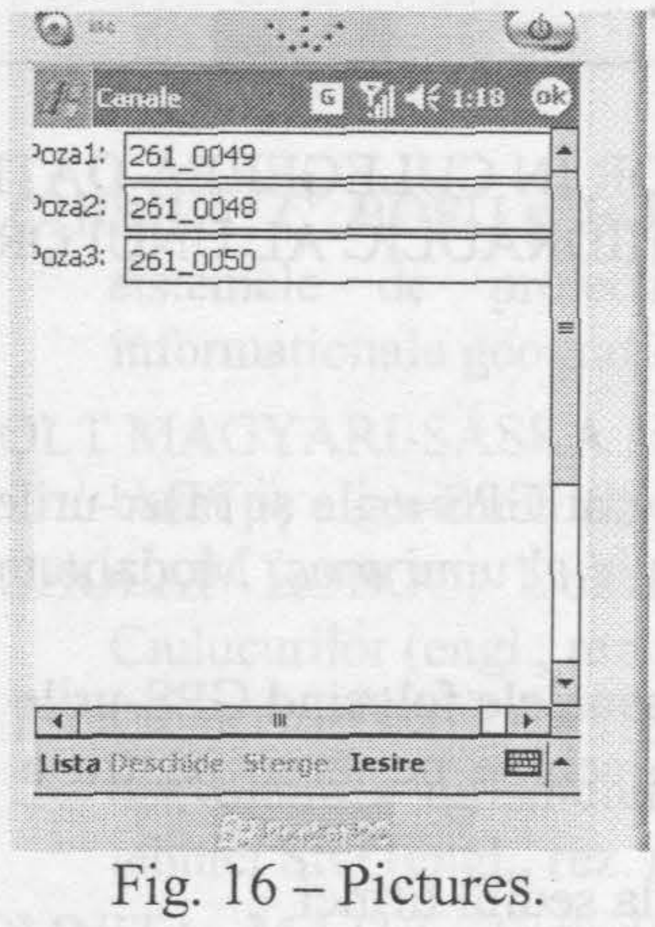

Fig. 16 – Pictures.

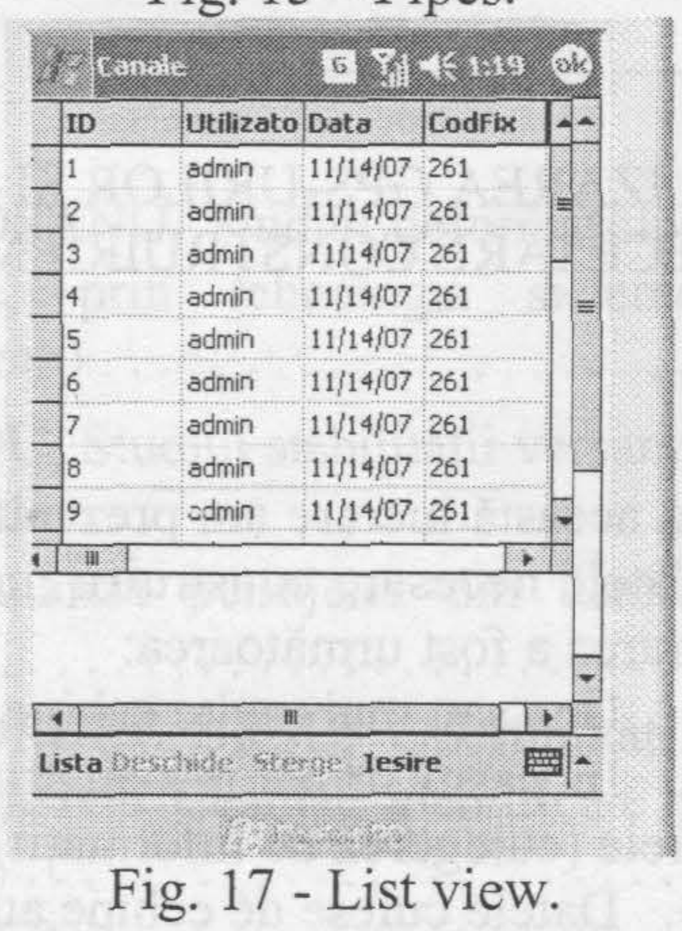

Fig. 17 - List view.

Of course the project wasn't an easy one and we've got issues. The main issue that we confronted with was the level of computer knowledge for the people doing the survey. Some of them weren't able to use the PDA's and they did the surveys on paper, those surveys being entered into the database at a later time. To do that the same application can be started on Windows systems.

Once the data is populated it can be merged into a single database which can be used in different software as a starting point. In our case InfoWorks was the software of choice and that was used to produce the hydraulic model. At the time this article has been written about 3000 manholes had been surveyed.

3. Conclusion

We will conclude our short article with a few notes/recommendations:

1. Be open in using in house built software (GIS is not only of the shelf products).

2. Be flexible when developing the software by providing exports to different formats.

3. PDA applications *can* be integrated with GPS.

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REFERENCES

1. * * * http://www.trimble.com, http://www.microsoft.com

UTILIZAREA GPS-URILOR ŞI A PDA-URILOR ÎN CULEGEREA DATELOR NECESARE CONSTRUIRII MODELULUI HIDRAULIC AL UNUI ORAŞ

(Rezumat)

În această lucrare am prezentat cum am integrat GPS-urile şi PDA-urile pentru a culege datele necesare construirii modelului hidraulic al unui oraş. Modalitatea noastră de integrarea a fost următoarea:

1. Una sau mai multe echipe au identificat canalele folosind GPS-urile
2. În pasul următor s-au trimis mai multe echipe pe teren pentru a completa formularele (culegerea de informații)
3. Datele culese de echipe au fost îmbinate la sediul firmei
4. Datele adunate au fost exportate într-un format care permite importul în aplicația de generarea a modelului hidraulic.