IMPROVEMENTS OF UDERGROUND UTILITY MAPPING METHODS

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***Abstract**: Today, we are seeing fast expanding and more complex underground utility networks, as a result of urban expansion and the transfer of some utility networks from above the ground to underground. In order to map all those underground utility networks the surveyors are using several methods: classical, radio detection and GPR. Mostly all the time a combination of at least two of those methods is required in order to meet the client requirements, in the specified time frame, also in a specified format, which is a challenge too. This paper presents how the process of collecting data using several methods, processing and preparing the final product was compiled into one single, automated process which has the benefit of: eliminating the human errors automated processing, increasing productivity, flexible output and cost reduction.*

***Keywords:** utility network, automated processing, GPR.*

1. Introduction

The main objectives in the underground mapping are to detect, record and map all the underground utilities. Because those underground utility networks are various in depths, dimensions, material and accessibility the methods used to map it are different. This will be achieved utilising various techniques such as sonde surveys, radio detection surveys, ground penetrating radar surveys and the classical visual inspection and manual data collection.

2. Processing data - existing method

Today for each type of underground survey different approaches are used:

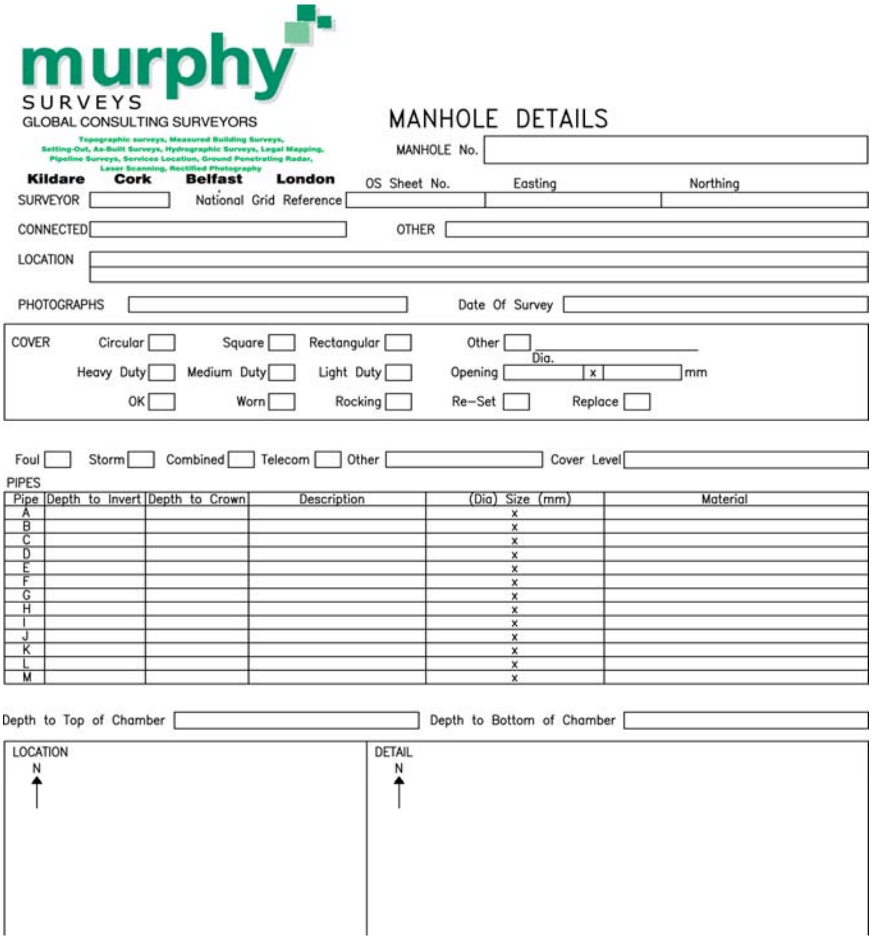
-GPR data, recorded on site, is downloaded, processed in customised software and interpreted by a geophysicist, then inserted in a CAD environment;

-radio detection data is recorded on site using GPS or total station, downloaded and processed using a topographical software then exported into a CAD environment;

-data from visual inspection and manual data collection is recorded on site using special field survey books (Fig. 1), then manually inputted into a spreadsheet and into a CAD environment.

Finally, the graphical results are merging into a CAD environment resulting a final plan of an existing underground utility networks. Additional data, such a 3D plan, 3D solid model, GIS can be obtained with additional work.

The above explained workflow is graphically shown on Fig. 2. where is highlighted the processing stages where the manually work is preponderant and the risk of human errors is very high.



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SURVEYS
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MANHOLE DETAILS

MANHOLE No.

OS Sheet No. Easting Northing

SURVEYOR National Grid Reference

CONNECTED OTHER

LOCATION

PHOTOGRAPHS Date Of Survey

COVER Circular Square Rectangular Other
Heavy Duty Medium Duty Light Duty Opening Dia. x mm
OK Worn Rocking Re–Set Replace

Foul Storm Combined Telecom Other Cover Level

PIPES

Pipe	Depth to Invert	Depth to Crown	Description	(Dia) Size (mm)	Material
A				x	
B				x	
C				x	
D				x	
E				x	
F				x	
G				x	
H				x	
I				x	
J				x	
K				x	
L				x	
M				x	

Depth to Top of Chamber Depth to Bottom of Chamber

LOCATION N DETAIL N

Fig. 1. Field book for recording underground utility network data

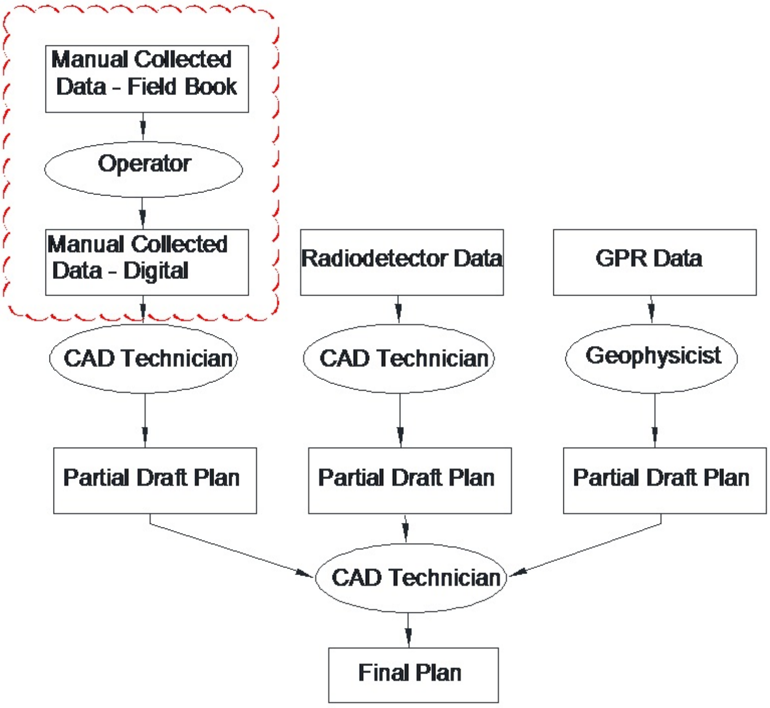

Fig. 2. Existing workflow

From the above can be easily seen that existing methods of processing has several stages of manual processing, this giving a low productivity and a high risk of human errors. Also, this way of processing data is dedicated for one product only, any additional product being obtained with additional work and cost.

3. Processing data - proposed improvements

In order to improve the existing workflow, after the existing methods were studied, the following workflow and changes are proposed:

- the manual collected data will be no more recorded onto paper field book but into a custom designed data base, running into a PC laptop or a tablet;

-at the collection time several checks will be done assuring that the human errors are eliminated and the collected data is complete and consistent;

-GPR and radiodetector data will be exported in a format compatible with the designed data base and imported into that with minimum human intervention;

-the entirely data base will be checked and exported in the desired formats, assuring a high productivity and lack of human errors.

The above changes are shown on Fig. 3.

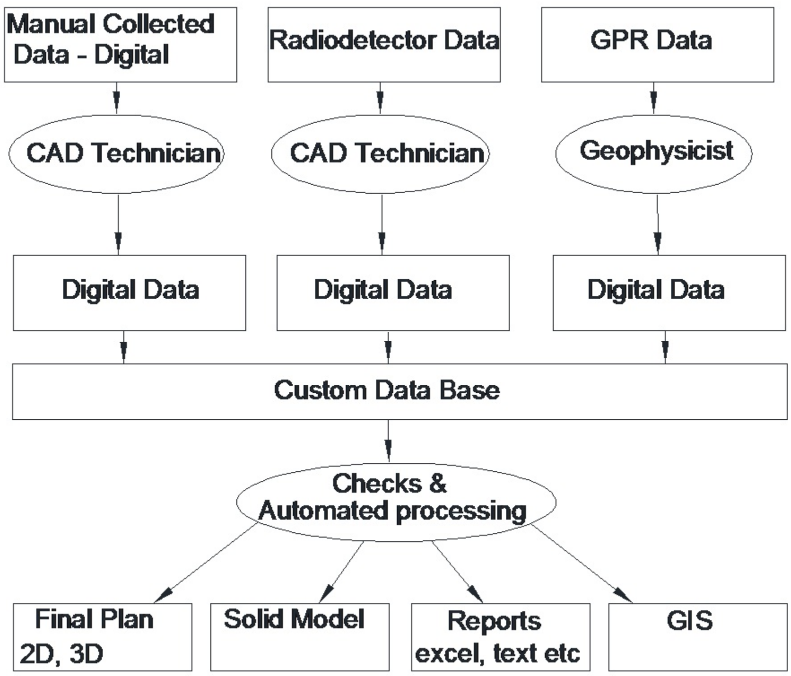

Fig. 3. Proposed workflow

4. Application and practical results

The above principles were applied and used in field for several projects having as a result an improved productivity and no human errors. The application was created in Borland Delphy 7.0 and the interface (Fig. 4) was designed to match the original paper field book, assuring that the transition will have no unwanted effects over the surveyors.

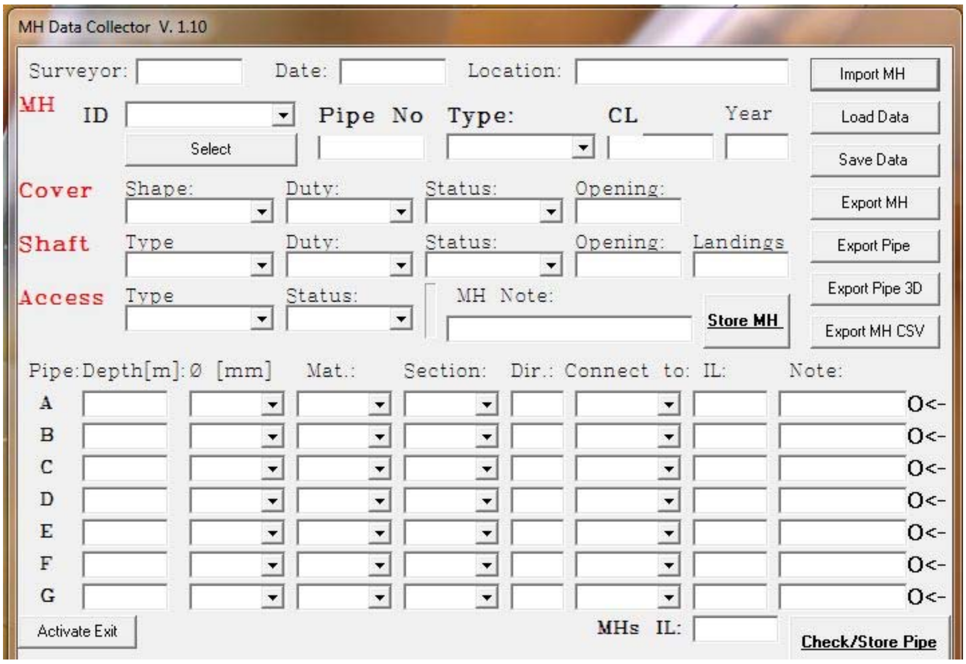

Fig. 4. Interface for digital data collector

Usually, for this kind of projects, using the current processing method, the processing time is equal with the survey time. Using the proposed method, the processing time was reduced to only 3 hours for projects where the survey time was 4-5 days.

5. Conclusions

The above proposed method of collecting and processing data from underground utility networks, combined with proper survey procedures, will eliminate the human errors and increase the productivity in this kind of projects. This method will allow also for a flexible output, having the advantage of having all data digitally stored in one place, checked and ready for use by any application.

6. Abbreviation

GPR- Ground penetrating radar;
GPS- Global Positioning System;

7. References

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