UNIVERSITY COLLEGES CAN HELP SMALLER LAND SURVEYING COMPANIES IN INTRODUCING NEW DATA ACQUISITION TECHNIQUES.

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Abstract

The ever developing instruments, techniques and software are at the same time a blessing and a curse for the contemporary land surveyor.

Laser scanning is one of these new techniques and although its versatility, speed and accuracy are praised in articles and on exhibitions, a lot of Belgian land surveyors are somewhat reluctant to introduce laser scanning in their own company. There is still a lot of uncertainty in regard to the efficiency of this data acquisition method and especially the processing of the data and the production of deliverables that meet the client's needs and expectations.

University Colleges can contribute to stimulate the smaller land surveying companies to invest in innovation and thus maintain their competitiveness and consolidate their position in an open European market.

This article describes how researchers at university colleges translate their knowledge and experience in such a way that they can support smaller companies, which do not have the resources to do their own research, in making an educated decision concerning the introduction of laser scanning in their company.

Keywords: laser scanning, land surveying, IWT, 3D modelling

1 INTRODUCTION

Over the last two decades 3D information and 3D visualisation have become more and more important in different disciplines such as urban planning, architecture, medicine, marketing, (reverse) engineering, cultural heritage etc. When designing buildings or other civil constructions or in urban planning virtual 3D simulations and visualisations replace the traditional scaled models.

The data acquisition techniques supporting these 3D simulations can be subdivided in two classes. The first class consists of the classical land surveying techniques and equipment which cover the whole area between the most simple (like double right angle pentagon prisms, measuring tapes etc.) to technological advanced equipment such as total stations and GNSS receivers. An essential characteristic of this group is that each point of which the 3D co-ordinates are determined is carefully chosen by the land surveyor. One could state that the fundamental model is created in the field, followed by data processing and modelling in the office.

Next to the first class of selective techniques, recently there has been a vast interest in techniques that are non-selective on site. The most known techniques of this second class are photogrammetry and laser scanning. Up until now they are not yet common practice in smaller land survey companies but are mainly the field of some bigger or specialised companies and research groups. An essential characteristic of this group is that a vast amount of data is collected in the field and the whole data processing and modelling is done in the office.

2 LASERSCANNING

In adjacent countries (the Netherlands, Germany, France and Great Britain) the use of laser scanning has been generally accepted as one of the many land surveying techniques and is often used for activities that are outside the traditional boundaries of land surveying. Some examples are to be found in the piping industry, game and film industry, forensics, documentation and restoration projects in cultural heritage [1, 2], deformation measurements, as built plans [3], city modelling, … (Fig. 1)

This diversification gives a competitive advantage to those companies.

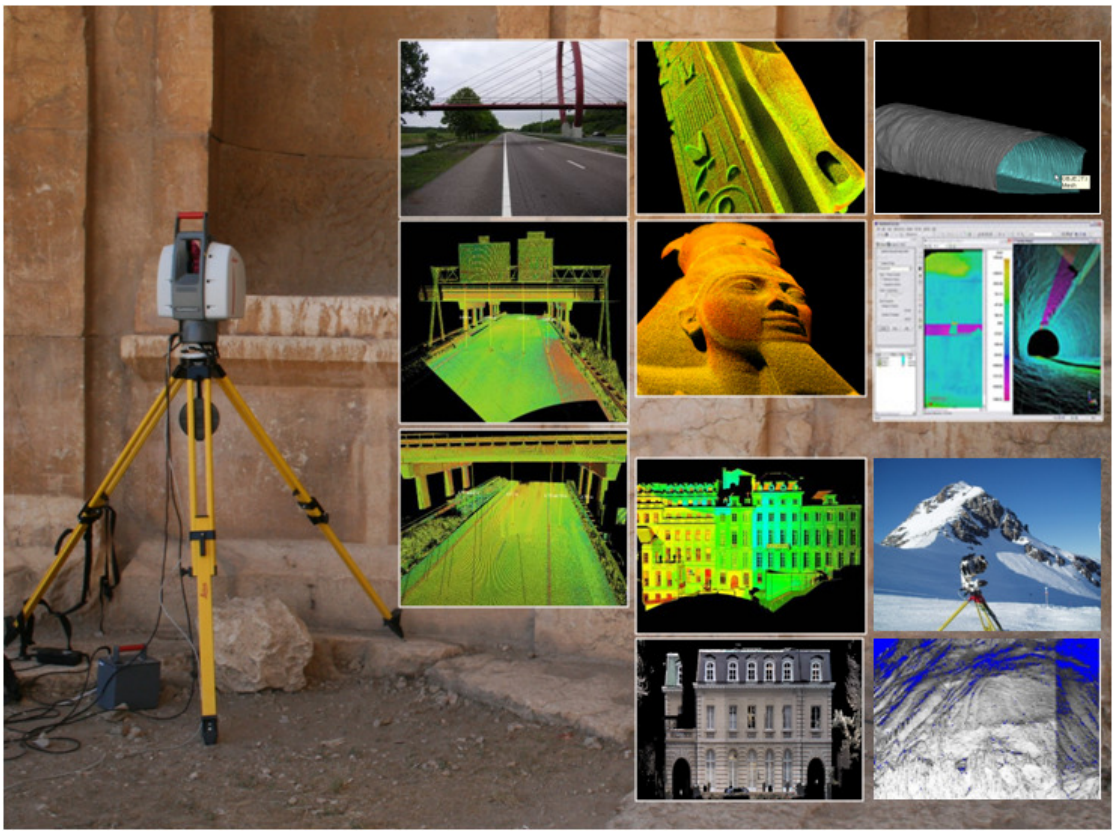

Fig. 1 – Some examples of laser scanning applications

The use of laser scanning can also be more efficient than the traditional methods for example in mobile mapping, documenting cultural artefacts, performing deformation measurements, or even site measurements for progress volume determination.

3 PROBLEM DEFINITION

In general Belgian land surveying companies are small companies with only a few employees. Although most land surveyors are eager to learn about new techniques and devices, they are somewhat reluctant in introducing these in their own companies, mostly because introducing new technology often goes hand in hand with considerable investments in equipment, software and not to forget, training.

Laser scanning is one example of a new technique that is not yet commonly adopted. When the purchase of a laser scanner is considered one tends to look only to the day-to-day activities of the traditional land surveyor and in fact the cost profit analysis can be negative in the short term. However in the mean or long term, introducing a new technique can open doors to new markets such as the gaming and film industry, renovation, forensic applications, city modelling etc. thus consolidating the position of the company, especially in the current in unstable economical situation in Europe.

The main obstructions preventing the break-through of laser scanning in small land surveying companies in Belgium are:

- a conservative way of thinking,
- the investment cost,
- lack of proper knowledge regarding the possible applications,
- limited insight in the process cycle needed to extract the correct deliverables from the point clouds,
- reluctance to think in 3D.

Not only a change of attitude needs to be introduced in the land surveying community, on the demand side similar barriers can be pinpointed with a lack of knowledge concerning the possibilities that laser scanning can offer being the most important obstacle.

4 THE ROLE OF UNIVERSITY COLLEGES IN FLANDERS

Belgium is subdivided into three regions: the Flemish, the Walloon and the Brussels Capital Region. Education and research belong to the authority of the regional governments. That is why in this and the following sections only the role of two Flemish University Colleges will be addressed although in the other regions comparable examples can be found.

The Flemish Regional Government stimulates and supports innovation trough the Institute for the Promotion of Innovation by Science and Technology in Flanders (IWT). Amongst others, IWT grants financial support to companies and research institutes who apply for projects in strategic basic research, collective research and technology transfer.

5 THE "PLATO" PROJECT

5.1 The PLATO project – background

The earlier observations concerning the introduction of laser scanning in small Belgian land surveying companies were the starting point for University College KAHO Sint-Lieven and University College Ghent to join forces and form a consortium in taking on the problems concerning the lack of knowledge on both ends of the chain: on one hand the providers of 3D data namely land surveyors and on the other hand the end-users such as architects, urban planners etc. In doing so, they do not only rely on their own specific competences, but they can rely on the expertise of several private companies.

The project, called PLATO (Project LAserscanning: Technologie Overdracht), is financed by IWT for 92.5 percent, while the remaining 7.5 percent comes from private companies that act as both sponsors as well as user group.

The same consortium had positive experiences in the past with a similar project called KLIMOP (Kabels en Leidingen uitwisselingsformaat: IMplementatie&OntwikkelingsProject). The KLIMOP project took on the problems caused by the lack of an accurate inventory of the underground utility lines such as electricity, gas, water, telecommunication …, the lack of exchange standards for data formats between utility owners and construction companies, outdated cartography, incorrect as-built plans etc. [4, 5]

5.2 The PLATO project – objectives

The objectives are threefold.

- Potential users of laser scan data will be informed of the possibilities and the limitations of laser scanning. They will be convinced that laser scanning can be part of the solution to some of their day to day problems.
- The small Flemish Land surveying companies will be informed of the possibilities and the limitations of laser scanning and they will be provided with unbiased information regarding investment costs, the available hard- and software, data processing and future evolutions in these areas.
- The bigger companies who already use laser scanning will be given a platform to promote their services to new market segments and will benefit from the research carried out within the framework of the project for example concerning accuracies, optimal work flows etc.

5.3 The PLATO project – methodology

To reach the projects goals, the following tasks were executed:

- At first, the barriers preventing laser scanning from breaking through in Belgium were prospected through surveys, in depth interviews and study of literature.
- A report, based on literature and own experience, is written in which the different techniques (total station, GNSS, laser scanning, photogrammetry) are compared to each other. This comparison reflects in a decision table which makes it easy to chose the appropriate technique based on external and internal boundary conditions such as desired accuracy, time frame, accessibility of the site, safety etc.
- The multitude of applications for which laser scanning can be used have been collected and are illustrated through understandable data sheets. (see www.plato3d.be)
- Based on existing literature reports were made on critical parameters influencing or reducing the laser scanning accuracy.
- These theoretical findings and the reported accuracies still need to be verified in a number of case studies resulting in reports on best practices.

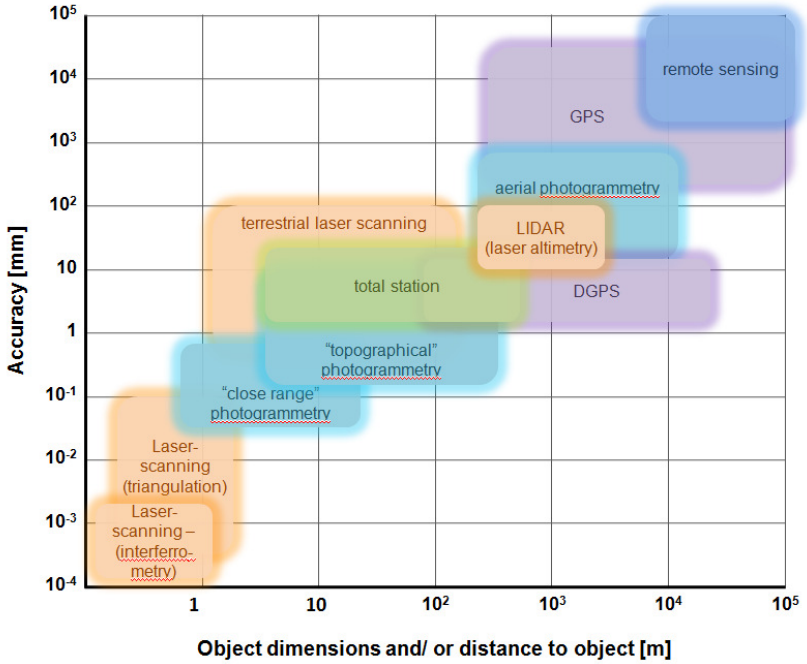

Fig. 2: Relationship between object size and accuracy for different measurement methods [6] (based on [7])

All the above tasks aim to provide the technological knowledge to start with or specialise in laser scanning. In concreto this means that the target group is provided with the necessary background knowledge needed to apply the proper technique in particular circumstances. This background knowledge includes an overview and comparison of the available software for data processing.

Additionally a view on future evolutions in the sector is provided through an extensive overview of research activities in the field, in particular on the automation of the processing phase. The project even provides an insight on the possibilities of automation that exist today with the use of commercially available software. The aim is to reduce the time spent on modelling.

Table 1: Decision table for choosing the appropriate method (+ + +: very suitable; – – –: very unsuitable)[6]

	total station		GNSS		laser scanning	photo grammetry
boundary conditions	**reflector**	**reflector less**	**RTK**	**post process (without RTK)**		
Job and output requirements						
limited time frame	+	+	+	+	+ + +	+ + +
high level of detail needed	– – –	–	– – –	– – –	+ + +	+ + +
information of characteristic points is needed	+ + +	+ + +	+	+	– – –	– – –
complex geometry	– – –	–	– – –	– – –	+ + +	+ +
3D data needed	+ + +	+ + +	+ +	+ +	+ + +	+ + +
high level of accuracy needed	+ + +	+ + +	+ + / –	+ + + / –	+ +	+ + +
high level of precision needed	+ + +	+	+ + / –	+ + + / –	+ +	+ + +
realistic visualisation	– –	–	– – –	– – –	+ +	+ + +
image of complete surface	– – –	– – –	– – –	– – –	+ + +	+ +
low processing time	+ + +	+ + +	+ + +	+ +	– – –	– – –
trained personal might be a problem	+ + +	+ + +	+ + +	–	– – –	– – –
stake out possibilities required	+ + +	+	+ + +	– – –	– – –	– – –
environmental parameters						
The accessibility of the site is limited in time and the objects are only visible from a limited number of positions within a medium range	+	+ + +	+	+	+	+ + +
The site is not accessible, but is visible from a wide range of positions located at a medium range.	– – –	+ + +	– – –	– – –	+ + +	+ + +
The data acquisition is done mainly indoors (inside building, tunnel, cave, ...)	+ + +	+ + +	– – –	– – –	+ + +	+ + +

5.4 The PLATO project – dissemination of results

For the dissemination of the project results different channels will be used.

Installation of a web portal (www.plato3D.be) providing:

- Detailed technical information. This section comprises the different reports made in the course of the project, but also other relevant information. (already available on the web portal)
- Guide of best practice based on optimal work flows, validated through case studies.
- General information for the end-users (architects, local governments, planning agencies, …).

Publications in technical journals for both the data producers as the end-users.

Organisation of workshops:

- Hands-on training sessions.
- Workshop for the cultural heritage sector.

Study day on which the end-results, the reports, tutorials etc. will be presented.

All findings will be integrated in the curricula of the Master in Applied Engineering Sciences in Land surveying/ Geomatics at both participating University Colleges, thus ensuring that the knowledge of the new generation of land surveyors is up-to-date.

Both University Colleges will continue their research in laser scanning. The results of that research, especially the practical implications, will be disseminated in the context of lifelong learning programs.

6 CONCLUSION

Although University Colleges offer courses in the context of lifelong learning programs on a regular basis, a project like PLATO can only be realised because of the financial support granted by the Institute for the Promotion of Innovation by Science and Technology in Flanders (IWT). To be eligible for granting, projects have to fulfil some conditions. Amongst others there has to be an interaction between research institutes and private companies, the research topics have to relate to existing problems in the industry and/ or society and preferably the research (results) have to be integrated in the educational system.

The intention of the project is to promote the use of laser scanning in Flanders through knowledge transfer, thus helping land survey companies consolidate their position in a highly competitive sector in Europe.

As the target group is rather extensive, is imperative that the results are sufficiently disseminated. This is done by putting together a heterogeneous user committee in which many different key-players are represented, by contacting professional confederations, by setting up a website, by realising test-cases and by organising seminars and by making available technical studies, test results, decision tables and best practices.

The project also has a link with education. Both institutes (University College KAHO Sint-Lieven and University College Ghent) provide a Master in Applied Engineering Sciences in Land surveying/ Geomatics. The knowledge of 3D data acquisition techniques, data processing and data modelling are base competences of their graduates.

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