Trends in Surveying

Dr. Lucinda COOMBE, Australia

Key words: Surveying Trends, Positioning Equipment, Deliverables

SUMMARY

There are always changes taking place that affect the way surveyors work. For example, it wasn't that long ago that GPS was a highly specialized tool that was only useful for surveying work a few hours a day. Today, surveyors take GPS for granted and they have access to an amazing toolbox of technologies – from GNSS, sophisticated optics, 3D scanning and imaging.

What are the technology trends that are going to help transform the way surveyors work over the coming years? This paper discusses three specific areas where surveyors may see changes in the industry and their role into the next decade:

- The positioning equipment that is used
- The information that is used and how it is accessed
- The deliverables that are provided to the customer

The tools and techniques that surveyors utilize to complete jobs on time and without rework are continually changing. This paper will outline how advancements in technology are profoundly transforming the daily business of the surveying professional today and into the next decade.

1 ABSTRACT

There are always changes taking place that affect the way surveyors work. For example, it wasn't that long ago that GPS was a highly specialized tool that was only useful for surveying work a few hours a day. Today, surveyors take GPS for granted and they have access to an amazing toolbox of technologies – from GNSS, sophisticated optics, 3D scanning and imaging.
What are the technology trends that are going to help transform the way surveyors work over the coming years? This paper discusses three specific areas where surveyors may see changes in the industry and their role into the next decade:

- The positioning equipment that is used
- The information that is used and how it is accessed
- The deliverables that are provided to the customer

The tools and techniques that surveyors utilize to complete jobs on time and without rework are continually changing. This paper will outline how advancements in technology are profoundly transforming the daily business of the surveying professional today and into the next decade.

Trends in Surveying

Dr. Lucinda COOMBE, Australia

1. INTRODUCTION

"Surveying has traditionally been defined as the science and art of determining relative positions of above, on or beneath the surface of the earth or establishing such points" (Fryer et al., 1984, p. 1). The principles of surveying have not changed, but the way the surveyor completes a project is continually undergoing transformation. For example, a job completed by a surveyor ten years ago, compared to a job completed today could be different in the following three areas:

- The positioning equipment that is used
- The information that is used and how it is accessed
- The deliverables that are provided to the customer

The US Department of Labor website states that "Overall employment of surveyors, cartographers, photogrammetrists, and surveying technicians is expected to grow much faster than the average for all occupations through the year 2016" (US Department of Labor, Bureau of Labor Statistics, 2008). What are the things that you can expect to see in 2016? This paper discusses some of the trends that may influence the surveyor's business into the next decade.

2. POSITIONING EQUIPMENT

The positioning equipment that surveyors use has gone through a range of changes – from tapes and theodolites, to electronic distance measurement devices and total stations to Global Navigation Satellite System (GNSS) receivers. The equipment is continually advancing.

For example, Global Positioning System (GPS) is now a readily recognized acronym, but not so long ago it was a highly specialized tool that was only useful for surveying work in limited applications. Space based positioning systems have been around since the 1960's, when the U.S. Navy Navigation Satellite System (TRANSIT) emerged (Leick, 1995). The GPS system achieved its initial operating capacity in 1993 and the Russian Global Navigation Satellite System (GLONASS) in the 90's (Leick, 1995). Today, futher constellations are being developed, such as the European Galileo system (European Space Agency, 2008) and Chinese Beidou system (Position, 2008).

With the increased number of satellites and more sophisticated GNSS receivers, surveyors will be able to operate in a wider range of conditions in the field. In the future, environmental conditions such as overhead canopy and limited horizons are not likely to have as great an impact on the viability of GNSS for many applications.

Even the total station, which surveyors have relied on for decades, is steadily evolving. Since the 1950's there has been a transition from mechanical, to servo driven to robotic total stations (Smith, 1998). These changes have enabled the transition from two person field parties, to single person operation.

With each generation of instrument come more technological advances that improve operation and/or performance. For example, the use of Trimble's MagDrive servo technology, allows the instrument to change face smoothly in 3.2 seconds, which greatly reduces the time taken to observe traditional sets or rounds of face 1 / face 2 observations. (Lemmon & Jung, 2005). More recent developments have seen the inclusion of sophisticated scanning and imaging technology into optical based products, such as the Trimble® VX™ Spatial Station. These technologies have improved the performance of the instruments while also expanding the type of data that can be collected.

Laser scanning is another more recent technology that is changing the methods surveyors use to collect positioning information and types of data that they can collect. In contrast to traditional single-point measurement methods, scanners are able to capture thousands of points per second as well as digital images that provide visual detail for reference and analysis of complex scenes.

While laser scanning provides a convenient means for collecting rich 3D data, the amount of data the surveyor needs to work with can be daunting. According to a recent article in The American Surveyor "The sheer volume of point cloud data has been something of a mental barrier to land surveyors trying to get a handle on the scanning phenomenon" (Stocking, 2007).

Moving forward, scanning is not solely about collecting millions of millimeter positions over an entire scene. To be a productive tool to the surveyor, a scanning solution needs to focus the collection of information on the areas that the surveyor specifically needs. The solution also needs to provide the end deliverable quickly. Without easy integration, productivity gained in field data collection is lost through delays in office processing. Advancements in scanning technology, such as Trimble® SureScan™ are moving in this direction. SureScan allows users to define a uniform resolution for an entire scan in one simple frame. This allows the surveyor to capture a consistent spacing between 3D points over a framed surface, giving them the data they need, not just more data (Hook & Lepere, 2007).

There have also been a range of improvements in data collection devices. In the last few decades we have transitioned from DOS based devices, to menu based controllers and finally touch screens with full graphic interface and active background maps. This transition has allowed more intuitive interaction with the controller and sensor, which decreases the learning curve and allows the surveyor to concentrate on completing the job.

Regardless of the positioning equipment that is available in the future, the skills that will set the surveyor apart is knowing how to use the tools productively. Likewise, surveyors will need to maintain a thorough understanding of the limitations of the tools and techniques and

what specific data is needed to create their deliverables. All of these skills will be required to complete projects quickly in response to the growing demands upon the industry.

3. ACCESSING INFORMATION

Surveyors and their field crews spend a large portion of their day in the field. While away from the office, they need to access an array of information for the job they have been contracted to complete. This may include design plans, monumentation records, previous survey information etc. Often the survey vehicle becomes a mobile office, stacked up with site descriptions, paper plans and coordinate lists. Accessing information quickly and easily minimizes downtime and ensures that the surveyor, upon arrival at the job site, can focus on creating the end deliverable for the customer.

A key factor that will influence the way surveyors access information is the data collection tools that they use in the field. These devices continue to improve as advancements are made in the personal computing industry. They are becoming faster as processing technology progresses and smaller and lighter as components decrease in size. Ultimately, very highly powered devices, both in speed and storage capacity will be available. These devices will be able to store and process large quantities of information that the surveyor will need.

One of the keys to accessing information quickly is connectivity. The internet is now a tool that everyone takes for granted. It is possible today to connect a data collection device to the internet using a mobile phone with a data plan. More and more cities are investing in the infrastructure so that its citizens can be connected to the internet. For example, the city of San Francisco, in Jan 2007, announced that it has embarked on a WiFi anywhere campaign to provide free citywide wireless internet (Office of the Mayor, 2007). Just how pervasive universal connectivity becomes is left to be seen. In areas of availability, surveyors are able to maintain real-time connectivity in the field every day.

The surveyor can make use of the combination of powerful data collection devices and connectivity to access information over the internet in a variety of ways. A few examples include:

- Immediate access to digital information (for example control points from the National Geodetic Survey)
- Processing data while in the field
- Receiving immediate updates from the office about project or design changes
- Downloading data for a project while on the way to the jobsite
- Delivering survey results to the customer immediately from the field

Another important consideration is how to manage and manipulate the data in the field. With so much information readily available, the key will be in organizing and using this data. Software can help facilitate this, but it is the surveyor as the data manager that will need to ensure that they are able to make the most of the information available to them.

With powerful data collection devices and connectivity, the surveyor has access to information faster than ever before and will be able to make more informed decisions in the field. This can cut down on trips to the office and ensure the surveyor is maximizing their time in the field and concentrating on creating their deliverables. For experienced surveyors, overseeing the work of less experienced field crews, a higher level of connectivity could also allow them to oversee crews remotely and provide assistance with difficult situations.

4. DELIVERABLES

At the end of a project, the surveyor is concerned with providing the appropriate deliverable to the customer. Historically, surveyors have been required to deliver a set of coordinates. These coordinates were used to create a 2 or 3 dimensional (2D or 3D) representation of the world, generally on a 2D plan. However, in the future this 2D plan may not be sufficient to satisfy the ever changing customer needs. Two factors have combined to elevate customer expectations:

- A more "spatially aware" general public
- Accessibility of sophisticated surveying tools and techniques

A recent article in the United States outlined the problems faced by the aging survey workforce. On average, sixty eight percent of surveyors in the United States are above fifty years old (Ambourn, 2007). The implications of this statistic are twofold. First, the surveying profession needs to ensure that it is fostering the migration of a stream of young graduates into surveying. This has been a well discussed topic in the survey industry for some time (Enemark, 1995). The other implication is that the skills of these next generation surveyors will be vastly different than the earlier generations. Having been brought up playing Nintendo's Wii, Microsoft's Xbox 360 and Sony's PlayStation, the next generation of surveyors will be very familiar with digital 3D representations of the world and expect to interact with it this way, even when performing a survey job.

Not only are young surveyors more skilled in visualizing and dealing with 3D data, but the general public is now more spatially aware. With the advent of GPS based car navigation systems, such as those produced by Garmin, TomTom etc., the public's awareness of satellite based positioning systems and three dimensional world is now well established and accepted. Google Earth and Microsoft's Virtual Earth have also both contributed to this through their rooftop / 3D view of the world. Rooftop views of the world are only the start –3D views of cities are becoming available (Stocking, 2007). It is inevitable that this awareness will translate into the industry segments that surveyors work in. According to Stocking (2007) "engineers, planners and designers are getting used to working with high quality visualizations of exteriors and interiors, and data of this quality is never going to be provided by a guy with a handheld GPS unit".

The creation of rich 3D deliverables will be an important area for the future. Surveying customers will begin to expect these deliverables and the surveyors of the future need to know how to capture and manipulate the data. These rich deliverables will also provide the

potential to work in new industries or markets where surveyors have not traditionally or directly worked.

5. CONCLUSION

Surveyors, as positioning professionals are going to face a range of challenges and exciting new prospects over the coming years:

- They need to be able to keep up-to-date with the technological improvements that are available for use on a day to day basis. The skills that will set the surveyor apart are knowing how to use the tools productively, the potential errors and limitations in their operation and what specific data to collect to create their deliverables.
- They need take advantage of the technological advantages in their data collection devices and use them to access information when they need it. This can cut down on trips to the office and ensure the surveyor is maximizing their time in the field and concentrating on creating their customer deliverables quicker.
- Finally, the surveying customers are beginning to expect highly graphical 3D deliverables and the surveyors of the future need to know how to generate and manage this data. These rich deliverables will also provide the potential to work in new industries or markets where surveyors have not traditionally served.

Surveyors need to make sure that they take advantage of the new areas that they have the chance to work in and establish themselves even more strongly as positioning professionals.

REFERENCES

Ambourn, C., 2007, Our Uncertain Future, The American Surveyor, April.

Enemark, S, 1995, Educating up and coming trends to the surveyors of the future (Global Trends in Surveying Education – and the Role of FIG), Aalborg University, Denmark, http://www.fig.net/council/enemark_papers/azimuth_surv_edu_04_2005.pdf

European Space Agency (ESA), 2008, http://www.esa.int/esaNA/index.html

Fryer, J.G., Elfick, M.H., Brinker, R.C., Wolf, P.R., 1984, Elementary Surveying, 7th Edn., Harper & Row, NSW, Australia. p 1.

Hook, B, & Lepere, G, 2007, Trimble SureScan Technology Whitepaper, Trimble Navigation White Paper.

Leick, 1995, GPS Satellite Surveying, John Wiley & Sons, Inc., 560 pages.

Lemmon, T, & Jung, R, 2005, Trimble S6 with Magdrive Servo Technology, Trimble Navigation White Paper.

Office of the Mayor, 2007, http://www.sfgov.org/site/mayor_index.asp?id=54385

Position Magazine, 2008, Beidou to be Functional by the Olympics., April-May, p 18.

Smith, JR, 1998, The History of Geodimeter, Spectra Precision White Paper, 60 pages.

Stocking, A, 2007, The Future of Surveying All Over Again, The American Surveyor, April, 3 pages.

US Department of Labor, Bureau of Labor Statistics, 2008, http://www.bls.gov/oco/ocos040.htm

BIOGRAPHICAL NOTES

Dr Lucinda Coombe completed a Bachelor of Land Information (Surveying) with Honours and Doctor of Philosophy in Applied Science from RMIT University in Melbourne, Australia. She has worked for Trimble Navigation for 8 years, working in both New Zealand and the United States.

CONTACTS

Dr. Lucinda Coombe
Trimble Navigation
10355 Westmoor Drive
Westminster
USA
Tel. +1 720 587 4496
Fax + 1 720 887 6101
Email: Lucinda_coombe@trimble.com
Web site: www.trimble.com