Towards 2020 - Critical Developments in Land Surveying in 60 Years

Brian J COUTTS, New Zealand and Malcolm McCOY, Australia.

Key words: key word 1, key word 2

SUMMARY

The surveying profession has undergone extensive changes in all aspects technical, regulatory and institutional in the 60 years since the early 1950s. Optical theodolites and steel bands slowly gave way to electronic measurement, firstly as large cumbersome instruments but eventually leading to total stations; computing moved from natural trigonometrical tables, logarithms and mechanical calculators to electronic handheld computational aids almost overnight; geodesy and astronomy became satellite positioning; imagery moved from film to digital and advanced from airborne to include satellite; university programmes have become ubiquitous throughout the world; governments have moved to recognise the importance of three dimensional location; and digitisation has changed the way surveyors work and interact. The practice of surveying in both the government and private sector has altered significantly and due to the new technologies the number of people required to do the work has decreased enormously. Do these changes that have taken place raise questions as to what surveyors are, how they define themselves and what they do? If so, how does the surveying profession respond.

Keywords: technology, education, change, definition of surveyor.

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1. Introduction

The methodologies of land surveying remained largely unchanged over hundreds, if not thousands, of years. Computational methods were enhanced with the use of logarithmic tables introduced by Napier in the 17th century, and supplemented by hand-powered rotational cylinder mechanisms for speed of calculation first introduced by Pascal, also in the 17th century. These were later to be electrified in the 20th century prior to the invention of the microprocessor, which introduced the electronic age in the 1970s. Advanced engineering allowed graduated circular scales to assist with angular measurement to a greater accuracy especially when in combination with a telescope, and linear measurement was carried out by using a variety of devices, often calibrated to a national standard, but the actual form used for a specific task was dependant on the accuracy required e.g. cloth tapes, steel bands. The invention of flight in the early 20th century allowed for photography to literally add a new dimension to the tools of the land surveyor.

2. Technology

While the first electronic measurement using radio waves occurred in the mid 1950s, it was not until the 1970s that electronic distance measurement (EDM), with the likes of the Wild DI10 and the HP3800, came into everyday use. While the early EDM were large and cumbersome, they quickly became smaller to the point of fitting inside angle measurement equipment. Combining the optical theodolite with small EDM allowed electronic measurement to replace the more traditional means. Glass scales in theodolites were then replaced by bar code readers which then allowed angular measurement to be made by the instrument itself, rather than requiring the operator to "read" the angular measurements. The integration of calculation into the electronics of the "total station" enabled direct read-out of "reduced" measurements, either horizontal, vertical or slope, and leading quite naturally to the data recorder.

Miniaturisation, starting with the invention of the transistor, also brought electronic calculators that could replace natural and logarithmic tables, and extended battery life allowed them to quickly replace mechanical calculators and books of natural and logarithmic tables, even in the field. At much the same time larger punch-card fed desktop computers were replacing the need for much of the time spent doing lengthy calculations in the office. Punch cards were replaced by magnetic strips, much simplifying the process again through the 1970s. However, further advances in miniaturisation made sizeable desk-top computers obsolete quite quickly, as hand-held calculators increased in power and capacity, as well as reducing in price.

Aerial photography developed in close association with the development of aircraft in the

early 20th century and was an important aspect of the developing practice of airborne warfare. First used for reconnaissance purposes it quickly became an essential tool of warfare, and developed into the discipline of photogrammetry using stereoscopic images taken with precision cameras allowing the making of maps to be revolutionised. With the advance of satellite science since the late 1950s, the ability to gather data without the use of on-the-ground measurement has again changed the way in which maps are made using remote sensing technologies. Not only has the practice changed, but the uses to which remotely gathered information can be put have burgeoned.

Finding one's location on the planet was a considerable challenge to navigators until the invention of an accurate maritime clock by Harrison in the 1770s. The ability to establish accurate longitude enabled exploration in any part of the globe and brought accuracy to not only navigation but also to the mapping and charting of the newly discovered lands and seas. The reliance on accurate time for position finding has only diminished with the use of satellite positioning and the now ubiquitous use of global positioning systems (GPS) throughout the population along with its multifarious applications.

In the late 1970s the first desktop computers started to appear. Initially they were mainly used for word processing and spreadsheets, but other applications soon started appearing that were relevant to surveyors – there are now many surveying related software packages which are used and are compatible with the latest total stations and GPS equipment.

This new era of digitisation also saw the emergence of printers and plotting devices which ultimately have replaced hand drafting which had formed part of the specialist skills of surveyors for hundreds of years. With the advent of AutoCad, Microstation and other CAD packages, hand drafting has now gone the way of the blacksmith – used seldomly by a few specialised practitioners.

Traditional cadastral, or property maps, which had been used for tenure and taxation purposes for hundreds of years became electronic in the 1980s with the advent of Digital Cadastral Data Bases (DCDB) or Digital Property Maps. Finally, Google Maps and Google Earth have now put digital maps and digital aerial photography in the hands of everyone who has a computer, a mobile phone, a tablet or an iPod.

3. Government Surveying

European settlement commenced in Australia and New Zealand in the early 1800s and this necessitated the "opening up of the land" by alienation of land from the Crown to private individuals. Accordingly, one of the first and most important establishments was a Lands Department and the appointments in these new territories or colonies of Surveyors – General. By the late 1880s the Torrens System of land registration had been established and subdividing "Crown land"on behalf of the government was under way. (Similar stories can be told in other parts of the world which were being colonised at this time ???) This continued right through until the Second World War, at which time there was an rapid expansion in surveying in these jurisdictions due to vast post war immigration. As a consequence, a vast expansion of these countries infrastructure, namely roads, rail, water,

and electricity and gas networks was undertaken. New government or quasi government departments were established and the surveying sections were an integral part of the new order.

However by the mid 1980s much of the major infrastructure had been established and these departments moved into maintenance phases rather than capital expenditure and subsequently we have seen a decline or in some cases the abandonment of the survey departments. The advancement in technology also meant that the number of people required to undertake surveys has vastly reduced, adding further pressures.

4. Private Practice

Again using Australia and New Zealand as examples, there has been a small but dynamic private surveying sector in existance for about 200 years. Like the government sector, it grew rapidly after the post Second World War immigration of the 1950s. Land subdivisions, planning and small topographical or mapping projects were the mainstays of the private sector and the firms would often get overflow work from the government sector. A number of aerial surveying and mapping specialist firms also emerged at this time.

The firms would often ebb and flow with the cycles of the economy, particularly the land development booms and busts. By the 1980s firms were diversifying their practices and providing surveying for major construction and infrastructure works , undertaking town planning and some began moving into what was originally referred to as Land Information Systems (LIS), but we now more commonly call GIS.

More recently with the advent of GPS, laser scanners, Lidar and mobile mapping systems there is the potential for private sector firms to greater diversify into non-traditional areas of practice.

5. Education

The traditional method of preparing candidates for a professional career in surveying was for them to be contracted to an employer, to work as an assistant under a recognised practitioner, and at some stage be judged competent to practise on their own. This was common in most occupations in former times. Many surveyors were trained in the armed forces, for both terrestrial and hydrographic surveying, and carried their qualifications into private practice. Others came from a background of engineering, of which at least the measurement aspects of surveying were seen as a subset. As the standard of education improved, professional bodies were formed that would undertake the preparation and administration of examinations that would then lead to professional recognition. As standards of education have risen, so have the expectations of the general public with respect to the education of professional surveyors.

Many countries now base the recognition of professional surveyors on university qualifications, and while some have existed for some time, it is again the period from the 1950s that has seen the widespread establishment of surveying programmes around the

world, and the recognition of them by professional bodies. While these programmes were, and have become widespread, recent indications have been that many are struggling to attract students and are consequently under threat of closure. In the meantime, there is anecdotal evidence that there may be a skill shortage of competent practitioners in many parts of the world, and while this may be disguised during a world economic recession, it is likely to become more obvious, if not critical, as development picks up through the period of recovery.

Additionally, some survey practitioners are redefining themselves as the ability to carry out many previously specialised surveying tasks is simplified by the ubiquitous nature of measuring or location devices in the hands of the general public, and standards of technical education improve to enable the understanding and use of them by the general public. University courses in Information Science, Information Technology and Geographic Information Systems are also eating into areas that were once the sole prerogative of the professional surveyor.

6. What is a "Profession"?

A profession has been described as "an occupation in which a professed knowledge of some subject, field, or science is applied; a vocation or career, especially one that involves prolonged training and a formal qualification. In early use applied specifically to the professions of law, the Church, and medicine, and sometimes extended also to the military profession." (Oxford English Dictionary Online, accessed 15 March, 2011).

The Australian website "The Good Universities Guide" (thegooduniguide.au.com) claims (though it does not quote its source), that an 'official definition' of surveying is "the determination and identification of the shape, contour, location and dimensions of land or water masses and their features, or planning and designing maps". The profession of surveying might therefore be expected to have a formal body of knowledge only available to its practitioners which is passed on through a "prolonged training and a formal qualification", and for the application to the current needs of society for such information.

Without going to the extent of defining the profession of land surveying further, not having a clear and succinct definition of the term (land surveyor) we are talking about, it is difficult to seriously discuss any topic in relation to what changes might have taken place that might impact on what a land surveyor is, at least in the opinion of land surveyors. It will also be difficult to test the boundaries of what may be a professional surveyor, as opposed to a technician surveyor. It is clear that there will need to be a body of knowledge that a land surveyor is expected to have, and that recognition of that body of knowledge is currently through a university education, followed by a period of "training" that is then tested after a period of practice. Finally, whatever the definition includes must meet some need or needs of the society the profession wishes to serve.

The forgoing paper must therefore raise the question "have the significant changes that have taken place in technology, education and practice changed the definition of land surveying?"

7. Does any of the above change what land surveying is?

For a considerable time land surveyors have defined the core of their discipline to be measurement science. "The expertise of linear measurement has always served as a convenient identification of our role" (Robertson, 1980) indicates a view in the middle of the period we are considering. As Vannozzi (2011) observes, in the USA at least, if asked what they do, most surveyors would answer "We render opinions on where boundary lines are, or they assure society that their boundary lines are mapped properly and when marked on the ground they are in the "right" place." While this comment has a cadastral orientation, and is parochial to the USA, as a generality it suggests there is the sharing of a common view over time that surveying is about measurement, and more particularly about land measurement.

As Vannozzi observes, much of what appeared to be the core business of the land surveyor can be carried out by technically competent assistants, and in many cases by the general public. As the ability to find topographical and other spatial information is simplified by tools such as Google Earth and Google Maps, the ability to find location in space is becoming an expectation of anyone who owns a mobile device, be it a phone or a tablet, and can connect to a network can define their own position and that of other objects. As the technology continues to provide greater accuracy, will the ability for the land surveyor to provide boundary information remain a societal need?

Is the value, respect and responsibility of surveyors different in various parts of the world? In a third world country what is the view of a surveyor and what can they bring to their society? Certainty of boundary location and an emerging land market probably would be high on the agenda. Even if it does vary, we know that the accuracy of spatial information continues to increase, that the cost of obtaining it continues to decrease, fewer staff are needed for data gathering and the skills needed to access spatial information are minimal.

With a long tradition of measurement and mapping, where does that leave the professional land surveyor? In emerging and first world nations is the role and nature of the surveyor the same? Will the new technologies make the surveyor less relevant in a nation that has a well established and defined property market with minimal boundary disputes? With new efficiences and shrinking markets where can the surveying professional find new opportunities?

The land surveying profession is left with the fundamental question – does it require a paradigm shift in identity to maintain its relevance? Has a paradigm shift already begun and it is not being recognised? Research will continue into these questions that are critical to the education, practice and continued existence of the professional land surveyor.

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BIOGRAPHICAL NOTES

Brian Coutts is a former president of the New Zealand Institute of Surveyors (NZIS), Chairman of the Cadastral Surveyors Licensing Board of New Zealand (CSLB), served as served as president of the Commonwealth Association of Surveyors and Land Economists (CASLE) and has been a member of the Royal Institution of Chartered Surveyors (RICS) Constitution Board. He is Deputy Head (Undergraduate) of the National School of Surveying at the University of Otago in New Zealand and teaches introductory planning and New Zealand planning and resource management practice. His research interests include professional regulation, surveying education, mediation, and the definition of a surveyor in the 21st century.

Malcolm McCoy is a former president of the Institution of Surveyors Australia (ISA). He was an inaugural board member of the Survey and Spatial Sciences Institute (SSSI) and was Assistant Congress Director at both the 1994(Melbourne) and 2010 (Sydney) FIG Conferences. He is Managing Director of Vekta Pty Ltd, a national survey and spatial company with offices throughout Australia.

CONTACTS

Brian J Coutts
School of Surveying
University of Otago
P O Box 56
Dunedin
NEW ZEALAND

Tel: +64 3479 7609
Fax: +64 3479 7689
Email: brian.coutts@otago.ac.nz
Web site: www.surveying.otago.ac.nz

Malcolm McCoy
Vekta Pty Ltd
90 Camberwell Road
Hawthorn East
Victoria 3123
AUSTRALIA

Tel: +61 9804 2000
Fax: +61 9804 2099
Email: mal.mccoy@vekta.net.au
Web site: www.vekta.net.au