# MY RECOLLECTIONS OF PARADIGM SHIFTS IN LAND SURVEYING

## WILL THE "INTERNET OF THINGS" BECOME THE ULTIMATE SURVEYOR?

When I started my career almost 34 years ago as a graduated land surveyor I never imagined how my path would change in so many amazing ways. My dream was to become a surveyor, not only to take measurements and make maps, but to also contemplate the beauty of our universe expressed in its geometry laws.

The first revolution occurred during my studies: the pocket calculator. My buddies and I spent hours debating the relative merits of Reverse Polish notation versus the algebraic notation. As any surveyor who has been liberated by such a pocket computer it was an amazing feeling to deliver results instantaneously. So much capability packed into a small package.

There was no turning back, both measurement instrumentation and computing embraced electronics and the possibilities suddenly became limitless. The two became more fused, more connected. Real-time data and immediate processing meant there was hardly any distinction between a "measurement" and a final "result". An expensive example I had used was a Ferranti Fils2 inertial platform that was connected to, and driven by a portable UNIX computer!

The rise of "automatic surveying" started me questioning about the future of surveying. I had an idea to collect information at the pole and no more on the Total Station. At a conference one person came up to congratulate me and told me he made the trip from Sweden to meet me. He was the product manager of the first Robotic Total Station at Geodimeter!

I was recruited by a software company to develop processing software to handle surveying data from "field-to-office". It required a new coding system and an automatic processing chain that included the most rigorous least squares adjustment. It was also question of interfacing electronic field books and data loggers. More survey automation.

When I moved to the representative of a surveying instrument provider it was because I was so impressed by GPS! I first got hooked when I was working at the geodetic department of the Belgian IGN. It was just so exciting to receive signals from space and then compute the position so accurately. GPS has really turning classical geodesy on its head.

But then things became even more exciting with the advent of Real Time Kinematic (RTK) GPS solutions. More automation, immediate results!

Fortunately it was so difficult to use radio frequencies in Belgium that we wisely waited for the advent of GSM wireless. But why stop at GPS-RTK over

GSM? From field to office, back and forth, connecting Total Stations, GPS, and more. I was struck by the possibilities of the “e-survey” concept. You go to the field and survey, then you forward your data to the office and the office responds, maybe ask you for more information, more data. No need for a coding system anymore as you can interact with the office-based CAD system in real time. We were not just surveying anymore, we were drawing our map in the field.

I spent also some years promoting GPS “Network-RTK”, becoming concerned with “Positioning Infrastructure”. Communications was one of the key issue in GPS-RTK and we developed the first transmission protocol over the Internet. We were excited when we demonstrated how a GPS reference station in Beijing streamed the data to Atlanta USA, then redirected the data to Hong Kong where the corrections were applied at another GPS station. Using a wireless internet mobile connection, a GPS-RTK solution was possible with less than a second latency!

I then thought that perhaps we were not necessarily doing it the right way. Why not forward data from the field receiver to a computing centre and then send the results back to the field. I asked a Japanese company to demonstrate this in China. Data flowed from Kunming to Shanghai and Tokyo, where it was processed in RTK-mode, and the position result sent back within 2 seconds. Today it is even easier using “cloud computing” based servers.

I left behind the GPS Network RTK technology for a while, to develop the geodetic monitoring business. This also required communications between sensors. However, the paradox was that people wanted high accuracy but also low cost. So I investigated again the technologies of “smart sensors” and low-cost GPS.

The director of the Kunming Surveying and Mapping Institute told me the “GPS Network will be the basis of infrastructure to build the digital cities”. That statement was made in 2004, and it sounded so fabulous! Of course I did know about GIS as I have been project leader for national and international projects … but “Digital Cities” seemed such a far out idea! When I came the first time to Korea and questioned people whether they were looking also to build a digital Korea, the director of the Korean Cadastre told me “No, we have another concept! We want to build Ubiquitous Korea!” Japan was also planning something similar. The key technology was RFID – an electronic tag that can store data.

A few years ago I became concerned that surveyors will have to change the way they were doing surveying. My thinking was “What if we could tag everywhere, something that will keep the information the surveyor has collected, and leave that information for anyone?” The more I was thinking about this the more I became excited about the possible applications. So many questions popped into my head: installing hundreds of RFID tags, rebuilding the geometrical space around us, providing location inside buildings … But giving an (IPv6) identifier to every spatial object is a way to “animate” them, to bring them alive.

What about the QR Code? You can imagine how easy it would be to have a QR Code Reader inside a Total Station. An imaging TS could retrieve for instance the coordinates of the point that is tagged. No surveying necessary! A reflective QR Code Tag could be used for measuring distance from TS to tag. The QR Code pattern could even help automatic target sighting. Again the more I was thinking about the possibilities, the more applications I was discovering. Instead of storing the information on the RFID or QR Code Tag, it was even easier to store just a hyperlink to a web page that could deliver much more information.

So in my vision, the surveyor would not only survey the coordinates of spatial objects, but also tag objects and in so doing would make them come alive. But that's what surveyors have been doing many years: giving a unique identity to physical points. GIS would have to be adapted to cope not only with this new way of surveying, but also to provide to non-surveyors the information they can easily interrogate from the tags. What could social networks do with such a vision?

So here we are. The "Internet of Things" is clearly the next big revolution of the web. We use the web for posting information, for performing transactions, for connecting with old friends and new people … and now it's about to network with "non-living" things! For me that is the ultimate paradigm shift in land surveying! This revolution will change the work of surveyors. Many of us have tried to convince surveyors that GIS was made for them, and they should embrace GIS. Many resisted and continue to find solace in their fieldwork. But are we today at the dawn of something that will really change the surveyors' role in society?

I suggest that we are going to be engaged in Animated Surveys! From the first "e-survey" ideas we have been inextricably moving in the direction of "a-survey. Who better than surveyors to "animate" objects? The surveyors can bring geospatial objects alive, and facilitate contact people querying the tags.

The mass of data (Big Data) we are collecting, the information we are retrieving, and the analysis we are applying will support a vision of a society where everything is connected with people, machines, objects and living or even enchanted things. Surely it is people and enchanted geospatial objects that will be the building blocks of SENSEable cities and ubiquitous spaces.

Surveyors can play the pivotal role in ushering in such a meta-connected future.

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