Times are Changing : How New Technologies Diversify the Role of the Surveyor

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SUMMARY

Times are changing. New technologies bring people closer, making the world smaller. Smartphones are now democratized and loaded with miniaturized hardware components that were expensive and hardly compatible only a decade ago (GPS receiver, digital compass, accelerometers and gyroscope). By combining data from these components, an absolute position and orientation of the device at the surface of the Earth can be calculated. Also, the main players in the smartphone market (iOS, Android, Windows Phone, Blackberry) all offer a software development kit (SDK) enabling developers to build their own applications and easily publish them afterwards. Therefore, the table is now set to provide context-related geospatial information at mobile users. For instance, a tourist in a foreign city wants to have dinner, but he can't read the signs. A dedicated mobile application can help him find a restaurant suitable for his needs: under a certain price, serving typical food and at a reasonable walking time from his position. In addition to the common map view displaying the selected restaurant, an icon representing its direction can also be drawn directly in real time over the camera video stream. Augmented reality triggers the imagination and creativity since it is possible to display any virtual object at a specific location on Earth. Imagine visualizing through your mobile device a virtual 3D model of a new building to be built at site. You could then send your comments on the fly to decision makers about the way the building integrates in the existing environment. Augmented reality can also be used as a tool to look into the past. Monuments destroyed centuries ago can be bring to life once again by this technology at the exact place they once stood. Looking at the business side, Juniper research estimates an extraordinary annual growth, from 2M$ in 2010 to 1.5B$ in 2015 (Levett 2011).

Imagination becomes less constrained by technological limitations and augmented reality is only one example. Emerging tools and paradigms are diversifying the traditional ways of gathering, exchanging and displaying geospatial information and therefore the role of the surveyor.

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1. Introduction

Walking on the street of a foreign city, you find yourself hungry. With the help of your smartphone, you are able to find restaurants in your area, see their menu and consult their ratings from other customers. Finally, your smartphone gives you the directions to the nearest restaurants suiting your tastes. This would have been impossible only a couple of years ago. Today, many people carry these mobile devices embedding miniaturized equipment worth a lot of money in the beginning of the last decade (e.g. GPS receiver, gyroscope, accelerometers, and camera). These hardware equipments allow applications to access the smartphone location and orientation and use it to present context-aware information to the user. Mobility is one of many geospatial trends that are redefining the role of geomatics experts.

This paper highlights how three major trends, Web 2.0 and Open Data, mobility and spatial data quality are changing the traditional role of the surveyor. Other trends such as Geographic Business Intelligence (GeoBI), 3D and cloud computing are as important but will not be covered in the scope of this paper. The finality of this work is to encourage geospatial experts to stay curious about what is going on their field so they will consider more options to tackle their daily activities. The cited trends are closely interconnected and influenced by each other and these interrelations are going to be briefly discussed. Finally, a reflection about the future of geomatics will conclude this paper.

2. Main Trends

2.1 Web 2.0 & Open Data

Popular websites such as Twitter, Facebook and Wikipedia have made the web a social place. Everyone can be an actor of the web, not only a spectator as it used to be at the beginning of the last decade. People can now share their ideas on their own blog or through social networks, contribute to global knowledge by writing or enhancing articles of an online encyclopaedia or have fun playing multiplayer games with people from all around the world. The term Web 2.0, even though it lacks a solid definition, evokes a web more social, interoperable and interactive than it was in the early days of the Internet (Tim 2005).

A sub concept to Web 2.0 is the Geospatial web or Geoweb. It implies to link geographic location to information present on the Internet(Haklay, Singleton and Parker 2008). For instance, your location can be attached to your tweets on Twitter or to your messages on Facebook to make them more relevant for your friends. Another well known geographic application is foursquare. The goal of this game is to check in at coffees, malls, airports and even the International Space Station (Friedman 2010) in order to earn badges and eventually become the “mayor” of that venue. Local merchants use this location-based social networking website to attract new customers by offering them coupons and special deals. An interesting fact is that your tweets, Facebook account and foursquare check-ins are available through web services for developers to use. It is possible for a retailer to see how popular his shop is by analyzing tweets from twitter users. Foursquare even provides business owners with a free analytical dashboard for market analysis (Figure 1) (Bilton 2010).

Figure 1- foursquare Analytical Dashboard (foursquare n.d.)

Another concept related to the geoweb is volunteered geographic information (VGI). According to Goodchild, “VGI is the harnessing of tools to create, assemble, and disseminate geographic data provided voluntarily by individuals” (Michael 2007). Mapping is not reserved to professionals anymore. Perhaps the best example is the OpenStreetMap (OSM) project (www.openstreetmap.org). The goal of OSM is simple: to create and provide free geographic data and mapping to anyone who wants it. Volunteer geographers are entitled to contribute to OSM by adding or editing new roads, parks, buildings and more. VGI proved to be of great help in case of a crisis. During the 2010 earthquake in Haïti, volunteers mapped Haïti and the capital city Port-au-Prince providing up to date geoinformation to the United Nations and NGO delivering humanitarian aid in the island in the most effective way possible (Figure 2) (Waters 2010).

Figure 2 - Evolution of Port-au-Prince mapping (Waters 2010)

Geospatial data available freely on the web does not only come from volunteer work. Many cities, governmental agencies and institutions share their geospatial data (geometric and descriptive data) through web portals. The concept is simple: citizens pay for these data, so they should be able to access them. Of course, nominative data such as tax declaration are kept confidential. An online catalogue of open data from the world can be found at (datacatalogs.org n.d.). Open data stimulates the development of applications for the benefit of everyone. One example comes from one of my colleagues who took the initiative to reshape the Quebec City website for outdoor skating rinks. On the original page, the citizen can't see all the rinks at once on the map. Using available data, he incorporated all outdoor rinks on the same map, added Street View imagery on callout windows, clustered icons when zooming out and allowed the user to confine his search to a particular area or activity.

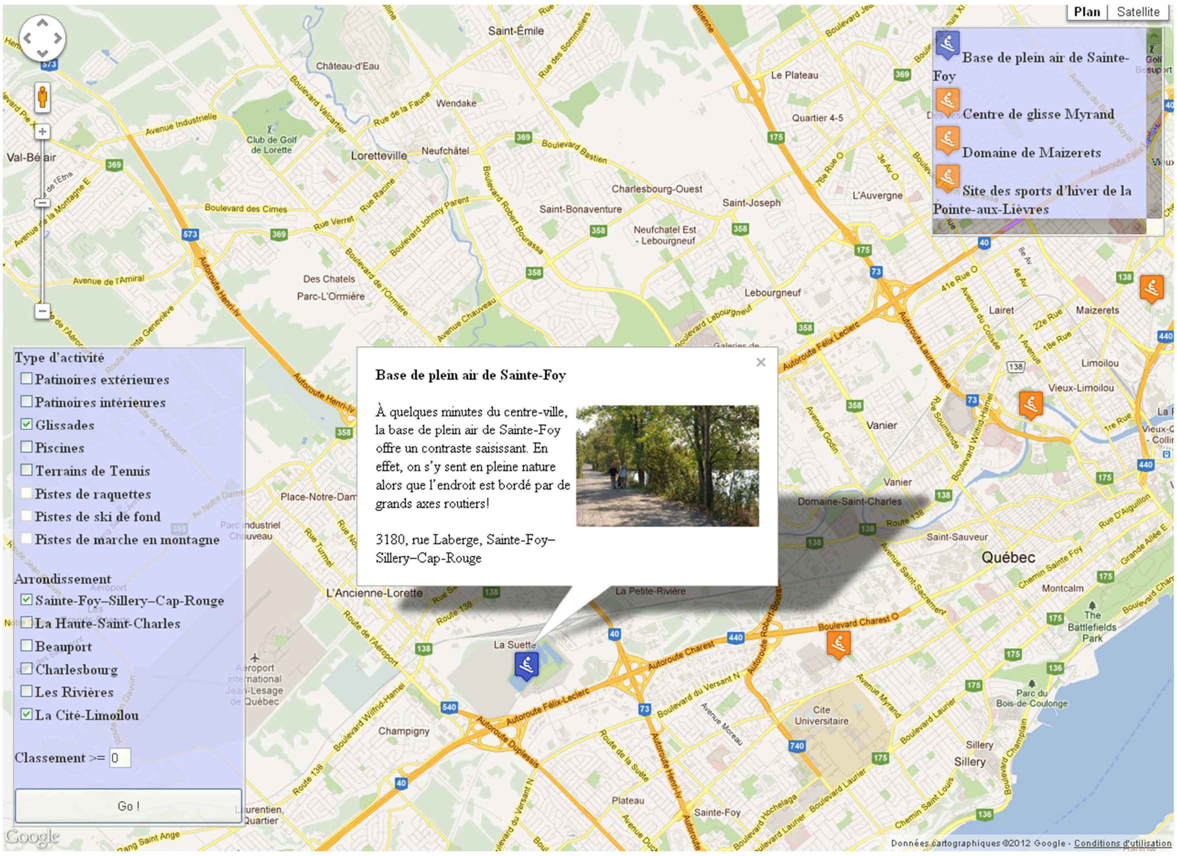


Figure 3- Web mapping of Quebec City outdoor skating rinks

A great example of a geospatial web portal is provided by the city of North Vancouver in Canada (District of North Vancouver n.d.). Over 170 datasets are freely available to download in different formats and each of them is accompanied by detailed metadata (Figure 4). These metadata ease the task of the surveyor to determine if the dataset can be useful or not relatively to his work context in terms of accuracy, coverage etc.

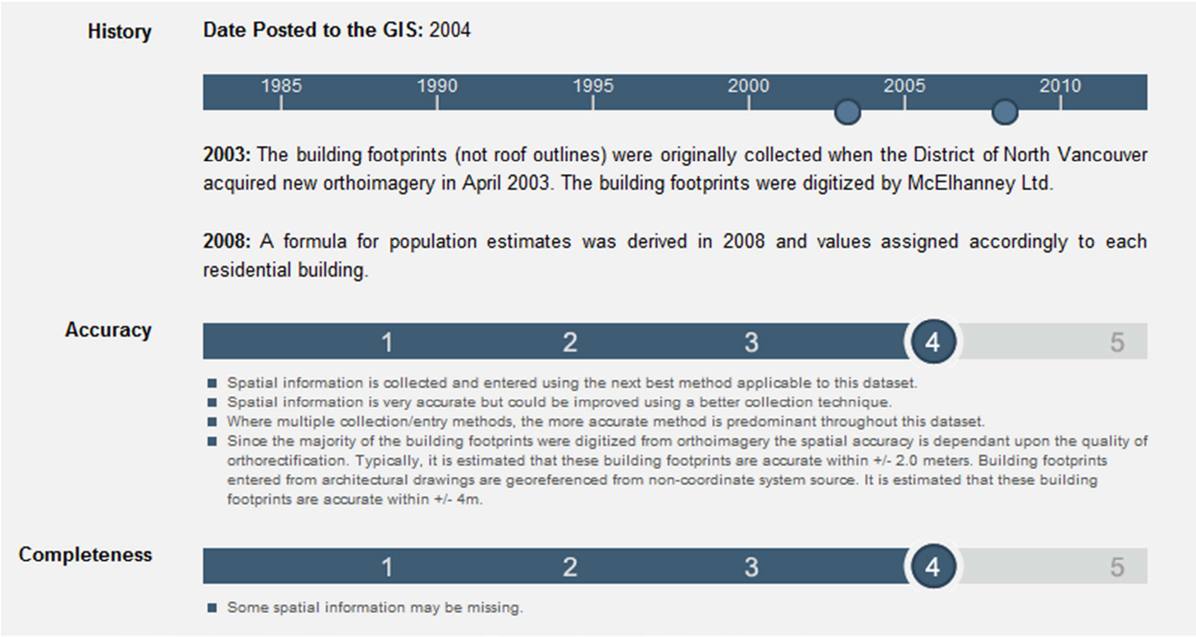


Figure 4- Metadata accompanying each dataset(District of North Vancouver n.d.)

An online map server is also available for developers to import raster or vectorial layers directly into their mapping applications.

Not all cities or governmental agencies have the same politics about distributing their data freely. In these situations, we have seen many cases of citizen groups emerging and promoting to executives the benefits of distributing their data. Montréal Ouvert (montrealouvert.net) or Capitale Ouverte (Quebec City, capitaleouverte.org) are two examples of these groups. They organize events, such as hackathons (marathon of hacking), where developers meet in one location to build applications with datasets released by the city/government agencies for the occasion. For instance, the third Montreal hackathon gathered more than 150 developers who built 14 applications. The city of Montreal was a partner of the event and it was an occasion for them to see what type of applications can come out from their dataset. The success of the event reassured the city officials on their decision to open a web portal (donnees.ville.montreal.qc.ca) (Becker 2011).

Traditionally, to gather geospatial data, experts needed to go on the field with a GPS receiver or a total station, to buy datasets from third parties or to ask city or governmental officials for maps. It is crucial that surveyors are aware of existing data portals of which they can take advantage for free. It can speed up applications development at a reduced cost. However, these freely available geospatial data might not be suitable for every need. For instance, a surveyor cannot produce a certificate of localisation based on Google maps coordinates because of their lack of precision. Web 2.0 allows the information to circulate instantly and therefore it is the best way to stay posted on the latest news or to ask questions. For instance, on Twitter you can follow companies, influent actors in your area of expertise and governmental agencies so you will always be on the edge of newest technologies.

In this section we also explained the notion of volunteering geographic information (VGI). If citizens are committed to your cause, they can gather geospatial data as volunteers and take action by mapping a particular region as a global emergency relief tool like some did in Haïti. In a less dramatic fashion, they can also simply do small things like reporting potholes location for a city transportation department. Next section will highlight a new paradigm, which is the mobility of geospatial data users.

2.2 Mobility

According to Gartner, smartphones sales have risen by more than 47% in the 4th quarter of 2011 (Goasduff and Pettey 2012). The popularity of these devices justifies the need to develop application designed especially for roaming users. Main smartphone operating system manufacturers supply tools for developers to create their own applications. Also, smartphones usually embed miniaturized hardware components such as GPS receiver, accelerometers, gyroscope, camera and digital compass. As the mobile device's absolute position and orientation at the surface of the Earth can be calculated, it is therefore possible to deliver location-aware answers to questions that the user might have:

- Where's my car? (Presselite n.d.)
- What's around me? (Wikitude n.d.)
- What's the schedule of the bus for this stop? (Réseau de transport de la Capitale n.d.)

New tools such as ESRI's free ArcgGIS mobile software development kit (SDK) for Android, iOS or Windows Phone, allow the display of web maps, execute queries, geocoding, geometric operations and much more (ESRI n.d.). These advanced geographic tools enable the development of rich geographic applications; much more then showing simple pins on a map. For instance, a power company worker can inspect poles on the spot and modify the map according to the terrain, change descriptive attributes and add a picture with only a smartphone for equipment.

Using the ESRI's SDK, we developed a simple park application, where the user can identify the parks with wanted activities (Figure 5), choose his favourite base map (Bing, Open Street Map and more), check if a park is open right now and if notices are issued. Having the GPS coordinates of the user, it is also possible display the distance information.

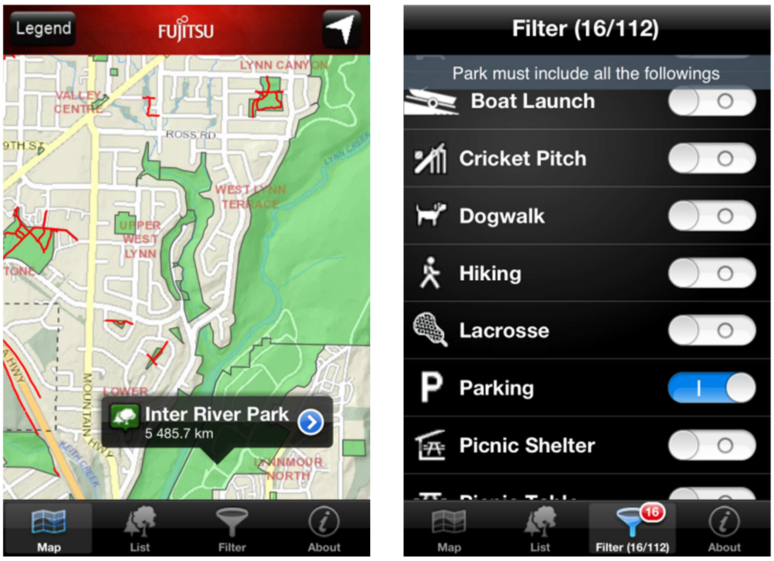
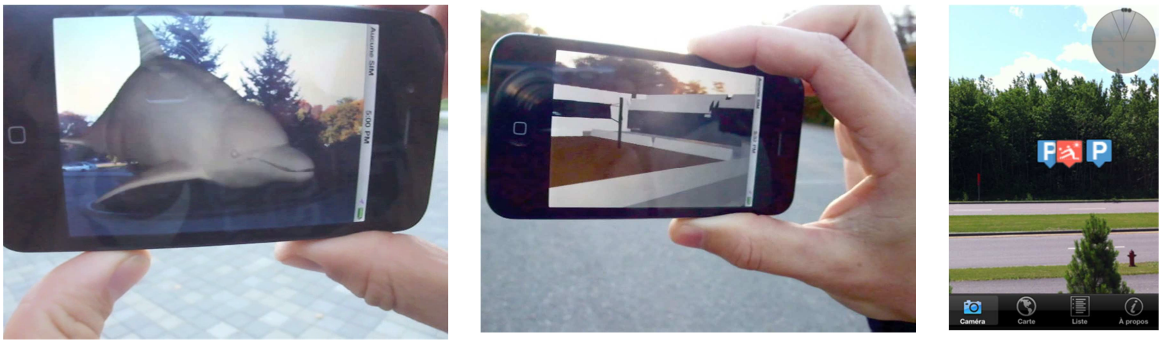


Figure 5- Park application using open geospatial data and the ESRI SDK

Of course, since many operating systems (OS) are disputing market shares (e.g. iOS, Android, Windows Phone), developing a native application for each can be time consuming since the source code must be rewritten for each OS. For instance, Apple's iOS is developed in a programming language called Objective-C, Android runs on Java and Silverlight or XNA are used for Windows Phone. However, alternative solutions exist. If the application is simple and does not need all the smartphones features, a mobile friendly website could do the job. Also, tools exist to build cross platform applications such as PhoneGap, Titanium or Rhomobile. They imply only one coding development for all OS, but custom plugins might have to be developed in order to access all the smartphone's features. On the other hand developing native applications for each OS multiplies code lines and demands expertise for each, but you can reach the best performances, in addition to the best look and feeling. (Jagani n.d.)

Knowing the position and orientation of smartphones through their hardware components boosted the development of augmented reality (AR) applications. AR is a technology that displays virtual content as if it were part of the real world. Popular AR applications known as "World Browsers" such as Layar (layar.com) or Wikitude (wikitude.com) enables the user to see layers of points of interest (geolocated information) superimposed to their reality. The AR view is sometimes complemented by a normal map view (Presselite n.d.). Some applications switch between these two depending if the smartphone is in a flat position or not. AR can be useful in many situations. For instance, figure 6a shows a virtual dolphin swimming around as a marketing tool for an aquarium. In figure 6b, a 3D model of a volleyball court is displayed at location prior to its construction. In these two examples, the virtual 3D objects are displayed relatively to the smartphone position and orientation and therefore the users are able to walk around the virtual objects and see them from all angles. Another example of an AR application is presented at figure 6c, where the direction towards available parking and the volleyball court is shown to the user.



a) b) c)

Figure 6- Augmented reality applications by Fujitsu Canada - a) A dolphin swimming around, b) A volleyball stadium standing virtually in its future location, c) Icons showing the direction to parking lots and the volleyball stadium

With 472 million smartphones sold in 2011 (Goasduff and Pettey 2012), mobile users cannot be ignored by geospatial professionals. Having the information about the user location and orientation is a new paradigm that has to be taken into account when developing geographic applications. Tools and technologies supplied by geolocated information are emerging to provide the roaming user a location-aware experience. One of these new technologies, augmented reality, offers a new perspective to display geolocated data right in the user's field of view.

2.3 Spatial data quality

Geospatial data can come from a wide range of sensors (e.g. satellite or aerial imagery, total station, GPS receiver, lidar). This base data is then processed to produce cartographic products such as paper or online maps, 3D models, certificates of localisation, GPS navigation software and much more. Elements of the reality could have been simplified or aggregated. Also, original coordinates could have been projected into a plane using various projection (Mercator, Lambert conformal conic projection, etc.) and datum (NAD83, WGS84, etc.). These products are only models of the reality they are representing and as we will see, sometimes give a false impression of accuracy (Gervais 2012).

Geomatics experts are dealing with a lot of possibilities when time comes to choose the best geospatial data available for their needs. One dataset can be appropriate for a certain usage, but useless for another. For instance, polygons representing private lots overlaid to a satellite base map can be useful for descriptive attributes visualization (e.g. showing addresses and number of stories when clicking on a lot), but is surely not accurate enough for legal delimitations and placing fences. Developing applications without reviewing the geographic data properly beforehand can result in major problems and legal issues. For instance, the development of a GPS navigation application with an inappropriate road network can result in disastrous consequences (Daily Mail 2011).

It is therefore essential before using a geospatial dataset to assess its quality. A dataset can be evaluated for its internal and external quality. Citing Sboui : « The internal quality of a context refers to the extent to which a producer meets specifications, that is, the extent to which the required context information is free from errors and inconsistency » (Sboui, et al. 2009). On the other hand, external quality is the fitness for use of the dataset. In other words, how the data is able to suit your needs. ISO TC211 suggests nine parameters in order to assess the quality of geospatial data: positional accuracy, thematic accuracy, temporal accuracy, completeness, logical consistency, currency, lineage, purpose and usage (ISO/TC211 1998).

With more and more different sources and processing methods of geospatial data, the surveyor must be aware that not every dataset is suitable for his needs. Many questions should be asked prior to using a certain geospatial dataset. Does the dataset really meet the announced specifications? Is it enough (or too) accurate for the projected use? Having a precise methodology to validate the data quality will ease the path to create an appropriate geospatial product.

3. **Conclusion**

More and more geospatial data are available to geomatics experts to develop new and exciting applications. Nowadays, data comes from a broad spectrum of technologies such as Lidar, satellite imagery, GPS and is diffused in a variety of formats, sometimes through web portals. Today, geomatics experts and surveyors must be extra alert to new technologies and possibilities in order to be more productive but also to prevent misused data. To do so, the quality of each dataset should be assessed and its limitation clearly defined before using it.

To reach users and provide them with geospatial information, new platforms and paradigms recently surfaced. Mobile users have access to a wide variety of localized information related to their own location in the palm of their hand. To visualize this information, street imagery such as Google Street view is a nice addition to conventional map view (Figure 3), and augmented reality offers yet a new option we can take advantage of. Virtual points of interest can be superimposed to the live camera feed of a smartphone to provide an intuitive way to see what is around the user. Geospatial information taken from the user's point of view seems to be a growing field. Terrestrial Lidar for instance can show high accuracy and impressive data acquisition speed, more than 1M points/seconds for certain equipments (Leica 2012).

If we project ourselves ten years in the future, we believe that cloud computing will play a main role in stocking, analyzing and delivering massive amount of geospatial data for commercial business intelligence or public applications. Lidar data, terrestrial and satellite high-resolution imagery, 3D models will come in much greater importance. The adoption of common geospatial formats will ensure the interoperability and ease the integration process. Right now, over 50 file formats exist, just for 3D objects (Wikipedia n.d.)! Mobile users will have all the information they need through their smartphone, or directly shown in front of their eyes through special glasses (Bilton 2012) or even contact lenses (Babak 2009).

Geomatics experts will have to be leaders in developing new ways to deliver this massive amount of data to users wherever they are, no matter what platforms they use. Surveyors, in a broad sense including geomatics engineers, who are specialists at gathering, analyzing and broadcasting geospatial data, would do well to keep themselves informed about new technologies and trends shaping their field.

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BIOGRAPHICAL NOTES

Vincent Thomas and Matthieu Bach are IT Specialists at the Quebec City office of Fujitsu Canada. They are passionate about mobility, augmented reality and emerging technologies. The authors would like to thank François Pelletier, a colleague at Fujitsu Canada, for the web mapping application images. Also, we are grateful to Alborz Zamyadi at Université Laval for his relevant comments and Marie-France Arsenault for her language skills.

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