ORBIT GEOSPATIAL TECHNOLOGIES BRIDGES THE GAP BETWEEN AIRBORNE AND MOBILE MAPPING

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***Abstract**: Efficient use of geospatial technologies enhances your resource management, decision support and communication. Orbit embraces every department: from Urban Planning, Environment and Road Maintenance, over Traffic Management to Demographics analysis, we provide tools adapted for each task within the administration, public safety, and mapping industry. The specialized know-how and exceptional flexible software system architecture guarantees effective and affordable integration in each business process, adding geospatial awareness and intelligence to everyone's daily job and to each decision making process. In this paper, we present a unique mapping concept based on one system that combines 360° panorama's, point clouds and photogrammetry in one GIS.*

***Keywords:** Orbit GeoSpatial Technologies, UAV, mobile mapping, Strabo photogrammetric.*

1. Introduction

Geospatial information is everywhere. As 90% of all enterprise data is geo-related, you are able to boost your business and optimize your organization's resources by effectively using this information. Geospatial information is the key to better, faster, and more efficient work processes and decision making. However, for many government bodies and private companies mapping and managing geographical information – from roads and utilities to buildings and planted areas – is a labor-intensive and time-consuming business. Today, Orbit GeoSpatial Technologies is proud to present its integrated GIS system bridging the gap between Airborne and Mobile Mapping: new mapping technologies are now opening up groundbreaking prospects for everyone involved in the cataloguing and management of geographical information. Integrating them is the key to a flexible mapping and inventory process of collecting and structuring geospatial information in your business or organization.

2. Bridging the gap between airborne and mobile mapping

With over 45 years of experience in aerial photography, photogrammetry, mapping, geo-databases and geo-data processing, Orbit GeoSpatial Technologies (and previously, Eurotronics, www.orbitgis.com) is able to call on a great deal of specialised knowledge. This knowledge and experience has for many years been transformed into innovative technology.

In the 1970s, the hardware for digitally recording difficult-to-make measurements and an early digital production line for geo-data and maps was first created.

The 1980s brought newly structured software for photogrammetric production, with the unique support for the first relational databases.

This resulted, in the 1990s, in a highend geographic information system that could be applied to all GIS usage. In the second half of that decade, the development of PC hardware made it possible to bring this complex technology to everyone’s desktop.

The first years of the 21st century brought us the desktop integration of generic GIS applications, geo-databases and photogrammetric applications. Now we are adding low-altitude mapping with UAVs and mobile mapping with panoramic images and scatter diagrams.

Bridging and Integrating technologies

The technology for gathering data has evolved in spectacular fashion in recent years. In particular, mobile recording is now in full swing.

All of these technologies stem from the basic principles of photogrammetry. Through the knowledge, experience and software specialisation already in place, Orbit GT is the only provider able to bridge the gap between classic photogrammetry, based on photos taken from great altitude, low-altitude photogrammetry, and photo-recording from standing height (panoramic or other images from mobile mapping). Until now, the manual surveying and mapping of buildings, roads, utilities, or planted areas has been a thorn in the side of many companies and government departments. Today, Mobile Mapping technology and UAV imagery enables geographical information to be gathered and interpreted particularly quickly and cost-effectively, ranging from civil infrastructures to complete industrial sites. Now in just a matter of hours, hundreds of kilometers can be mapped by mobile mapping technologies or at and in any time an inaccessible terrain can be mapped from the air by high-resolution UAV imagery.

High- and low-altitude Mapping

The Orbit Strabo Photogrammetry package covers all tasks in photogrammetric mapping. Assisted by user friendly administration tools, Strabo manages and optimizes many formats of digital imagery and converts any project to a flexible mapping environment. Stereo Viewing and Softcopy tools are GIS integrated, gaining access to a full range of editing tools and data access. Data processing tools include bundle block adjustment, automated tie-point matching, dynamic roaming through stereo-models, orthorectification, mosaicing and stitching, DEM creation and 3D viewing. Focused on taking images from a UAV, Orbit GT has developed its photogrammetric software fully enabled to process fully automatic high resolution UAV images.

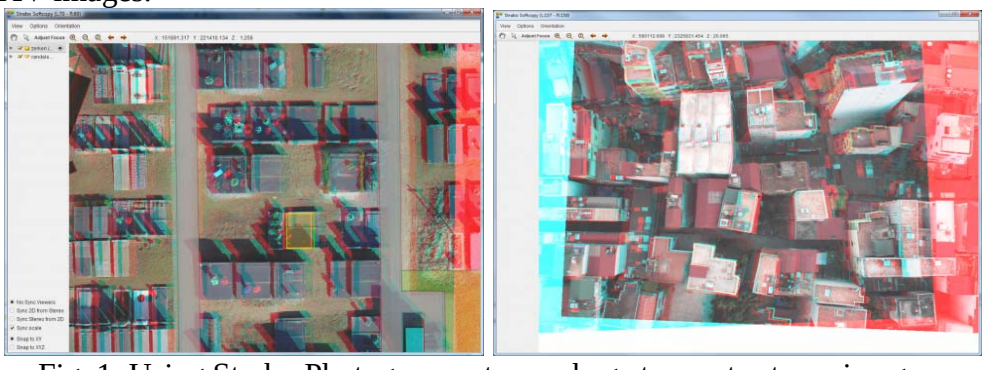

Fig. 1. Using Strabo Photogrammetry package to create stereo imagery

UAV Low-Altitude High-resolution Mapping

UAVs made it possible to - fairly low cost and not affected by weather or seasons - produce aerial photos and metrically correct orthophotographs. In this way, Orbit GT fully equiped the Microdrone (MD4-1000 and MD4-200) with GIS mapping software for low-altitude high-resolution mapping. The excellent qualities of the Microdrone make this mini-helicopter the best device of its kind for this type of application: usable immediately and everywhere, right here and now, high stability and outstanding GPS positioning, high-resolution cameras. The Orbit Microdrone Airborne Mapping extension enables a flight plan to be calculated immediately on site, so that the Microdrone can be sent to precise locations to take aerial photos. The device takes all of its photographs fully automatically. The results can be processed immediately with the Orbit Strabo photogrammetric applications into a stereo image and/or orthophotograph. This creates super-detailed aerial photo images that are ideal for recording small objects.

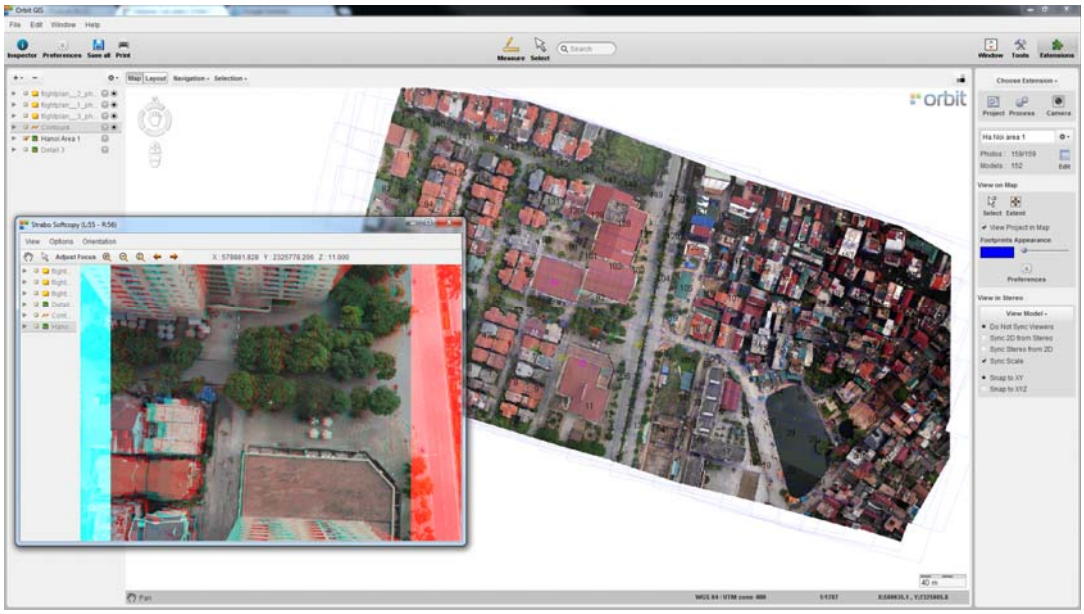

Fig. 2. Combining UAV 2D aerial images with 3D images in the same photogrammetry-GIS package (city project Hanoi, Vietnam 2011)

The use of Orbit GT UAV mapping capabilities is illustrated in many cases. In what follows, we go into more details concerning two Orbit GT UAV projects: (i) a sophisticated digital cemetery management system and (ii) surface mine mapping.

(i) Managing different cemeteries and thousands of burial plot concessions is no easy task: the issue of cemetery management is becoming increasingly complex for cities nowadays. However, the move to a digital cemetery management is more than just entering concession details in an administrative application. Digital cemetery management is an essential tool for building a vision of the future. Having a graphic overview, showing available capacity, tells us how we can implement our future approach and management of the cemetery and gives the possibility to inform the citizens via the usual 'e-way'.

Fig. 3. From High-resolution digital aerial photograph to the vector spatial plan

Orbit GT developed the Microdrone to produce quickly on an ad hoc basis a high-resolution digital aerial photograph of the cemetery. Working from a height of approximately 60 metres, the Microdrone photographs the graveyard in a pattern that covers the whole area. The flight path is automatically calculated in OrbitGIS and uploaded to the Microdrone, which then undertakes the calculated photo flight totally automatically and autonomously, producing a high-quality aerial shot of the whole area. After the flight, post-processing is carried out in OrbitGIS, creating an orthophotograph. The result is an aerial photograph that can be used for measurements, with a pixel resolution of less than one centimetres. This aerial shot provides a usable base for pinpointing headstones and the surrounding elements: a complete GIS system can be build and put online. A spatial plan can then be produced based on this accurate aerial photograph. In addition to gravestones, other surrounding elements, such as paths and green areas, can be mapped, all of which contributes to a map or plan that is clearly laid out and easy to read. Having a detailed photo of the graveyard does more than merely pinpoint headstones – it is also very useful in managing the green areas and other assets at the location. It’s a technique that is also of value for the architect when it comes to designing a new cemetery.

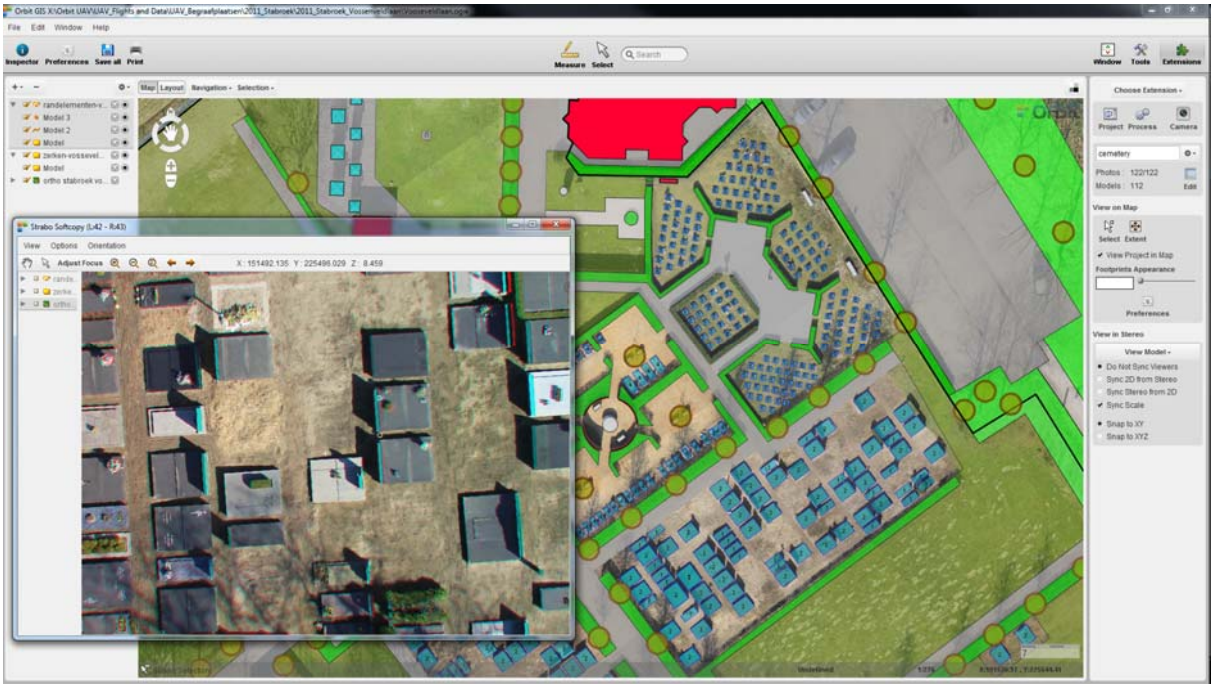

Fig. 4. Integrated GIS system for cemetery management based on UAV captured images

(ii) It is extremely important for the mining industry to be able to monitor production closely. It can even be a matter of life or death for the technology or methodology used when operating an above-ground mine to be assessed quantitatively and qualitatively on an ongoing basis. Companies need to keep improving these technologies by deploying increasingly sophisticated bulldozers and other extraction equipment. As a result of their sometimes cuttingedge technological properties, this specialised machinery can have a direct effect on the turnover generated – and this effect should not be underestimated. Which is why checking the volume being extracted is important. This is already done during the planning, execution and subsequent checks on a very regular basis, right across the entire mine.

Fig. 5. Ground image of the surface mine in The Netherlands

Defining a 3D model of the area of a mine site is not only required for calculating volumes, but it also enables us to observe movements in the area on condition that the 3D modelling can be carried out repetitively within a specific period of time. A 3D model is also an important tool for complying with the strict safety requirements so that are no human victims or other damage caused to the infrastructure of the mine. These days, determining a 3D model of a mine site is usually done using LIDAR laser scanning units, both on the ground and from the air, with the accompanying sky-high costs involved. Orbit GT has developed a technology based on photogrammetry in which aerial photographs are produced using a UAV (Unmanned Aerial Vehicle). This device is fitted with a carefully calibrated metric camera and is guided by GPS so that exactly the same flight can be carried out to precision at different times. This UAV Surface Mapping technology means that a particular site can be mapped repeatedly, thereby enabling the volume to be calculated each time. Interpreting the different volumes provides a good image of any movements in the ground.

Fig. 6. the Microdrone MD4-1000 in action

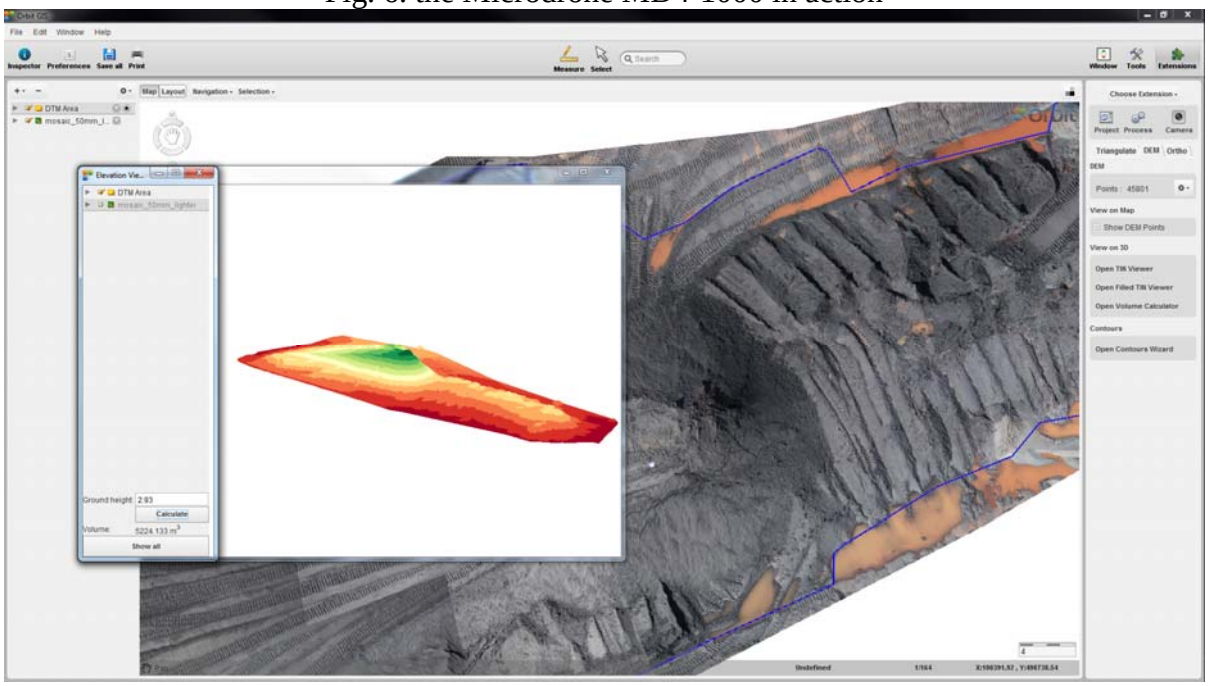

Fig. 7. The resulting 3D model of the surface mine.

Mobile Mapping and Asset Inventory Management

The Orbit Asset Inventory Management solution is the perfect tool to bridge Mobile Mapping content to your GIS database, enabling anyone to use the Mobile Mapping content and to create and maintain any inventory of e.g. public domain objects. Mobile Mapping gets you anything between normal imagery and high density point clouds. The data gathered from mobile mapping can be reduced to 2 types of data: photographic material, and scatter dots.

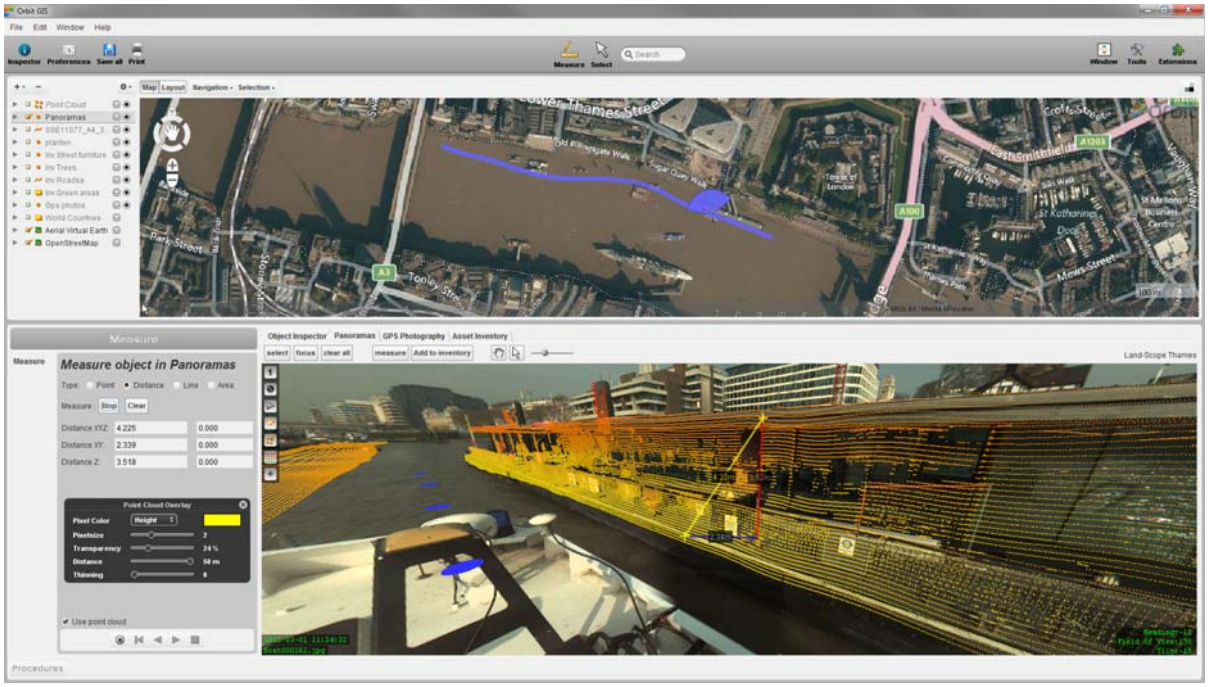

Fig. 8. High density point clouds over river Thames

We know the photographic material best as 360° panoramic images. Scatter dots are gathered in large numbers to created scatter diagrams. The various recording techniques result in a difference in quality, density and accuracy. Some techniques focus on image material, while others concentrate on laser-measure scatter diagrams. In all cases, obtaining this material is just the first step. It is usually desirable to use the data gathered to identify the objects in question that we want to locate as users, i.e. to make an inventory. Based on image material with accurate positioning, we are able to measure a great many objects. We take measurements in 2 images, as with classic photogrammetry. The result is a coordinate that we store in our GIS file. This is also identical to photogrammetric mapping. With mobile mapping image material, we have an additional advantage: we can document the point measured with a snapshot of the photo. We can also add in other properties of the object as attributes to the measurement. For example, a height, a width or some other dimension. This is an essential part of any Mobile Mapping system. The Orbit AIM software stands out from the crowd as a powerful, easy-to-use application for interpreting and extracting specific content. The Orbit AIM software enhances the geographical database with the required intelligence. Based on image material with accurate positioning, we are able to measure many objects but each meta-information can be added to each object: attribution, classification, snapshots, and photos, through entire documents.

The technological development has given us the possibility to combine top quality camera's, lidar, GPS, IMU and odometers in a single setup, combined with the processing power, transmission and storage capacity that is inherent with capturing huge amounts of data in a continuous way, a MoMa car drives around at normal traffic speed and can easily gather terabytes of data in a single half-day run.

Using Mobile Mapping to enhance Situational Awareness

Situational Awareness is a term used by intervention and defence forces to describe the understanding of the location and situation in which they need to operate. There are quite some cases in which mobile mapping content, and especially panoramic images, can aid to lift this understanding to a higher level. Let's take a look on some dramatic advantages for Police, Defence, and other Public SafetyForces.

MoMa in Crime Analysis.

Crime and strategic analysts can use Orbit tools to manually and automatically map any crime phenomenon. Traditional results can be statistic, a density or heat map, up to fine graded results on address locations. Orbit's Business Intelligence tools add drill-down graphs and maps to list and report.

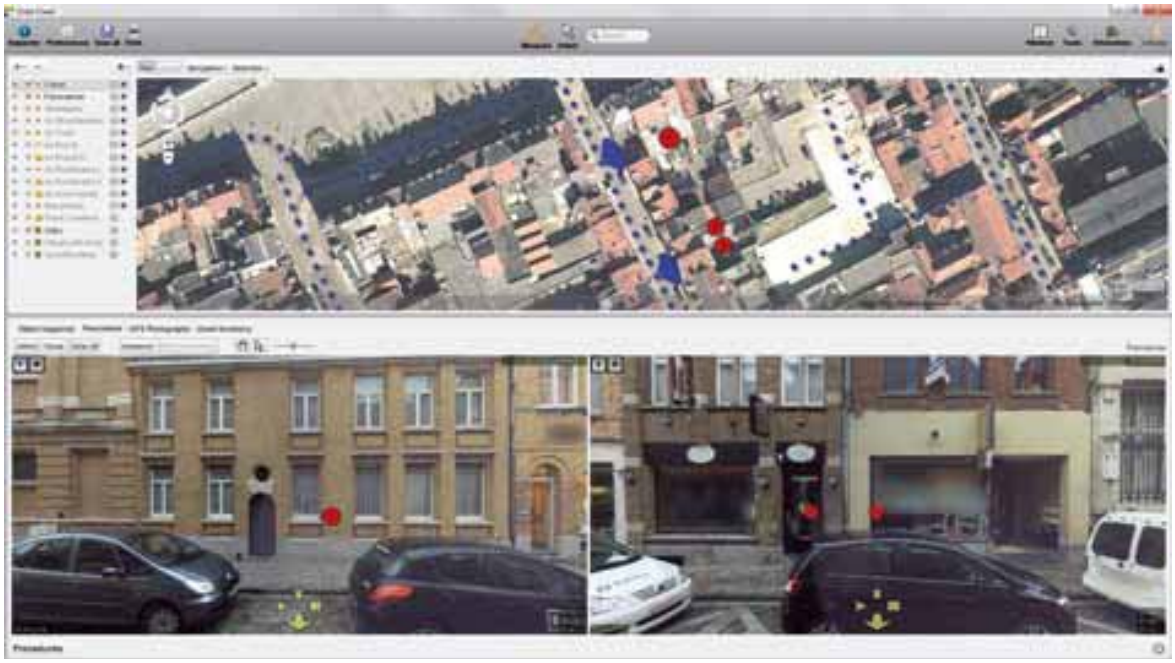

Fig. 9. Interpreting crime records.

As a researcher digs deeper into the analysis results, panoramic imagery can help identify the situation in which crimes have taken place : by simply looking around on the spot, and comparing that to other spots that have suffered a simila crime, a situational analysis may result in better determination of the problem at hand, and finally in improved crime prevention**.**

MoMa in Contingency Planning.

The Contingency Planning extension to Orbit GT 's core GIS system uses the standards in conventional signs to prepare for manifestations, sports or any other event that require security forces to supervise, mainting public order and intervene where and when

required, in proportion to the given situation. The extension allows preparation, briefing, live registration and debriefing/playback. Especially the briefing moment benefits dramatically from MoMa content. For example, every single location that holds any risk during a manifestation can be clearly shown, in detail, to each participating officer. No need to go out of take random pictures, just look at the string of panorama's that follow the route.

Fig. 10. Situational insight when briefing for event safety operations

MoMa for Fire Departments.

As for Contingency Planning, Fire Departments have equal dramatic advantages from mobile mapping content. The availability of a realistic view of the environment is a paramount asset to intervention preparations, safety planning, risk analysis and real time intervention challenges.

MoMa for Military and Intervention Forces Training.

As for Contingency Planning, mobile mapping can be used for police and military training purposes. Instead of building a 3D model of an exercise zone just to discuss tactics or explain training instructions, MoMa content can be easily captured for any training field at much lower cost, fully up to date and very realistic. Just mount your hardware on a quad and you're ready to capture any battlefield or training compound.

MoMa in Mobile Applications.

The availability of MoMa content, especially the panoramic imagery, will raise demand to have it ready on mobile devices. Orbit GT already delivers a MoMa Publishing Server and smartphone/tablet apps to wirelessly access this innovative content. By combining this with your real life or database content, either overlaying on the panoramic image or comparing the same cointent using Augemnted Reality, Public Safety forces can gain immensly from these new technologies.

Fig. 11. Intervention planning aided by mobile mapping content

3. Conclusions

By connecting the various techniques, we are now able to select the right tools for every challenge: classic photogrammetry, UAV recordings and Mobile Mapping. Integrated in one GIS system, Orbit GT now presents a unique solution for every government body or private company mapping and managing geospatial information… It is just a matter of choosing the right tools...

4. References

1. www.orbitgis.com