



MOBILE MAPPING FOR THE ARABIAN CANAL

NEW MONITORING TRENDS FOR THE CONSTRUCTION INDUSTRY UTILIZE STATE-OF-THE-ART GEOMATICS MOBILE MAPPING TECHNOLOGIES IN DUBAI

Limitless, a Dubai World business unit, is a global integrated real estate developer, specializing in master-planning of large scale mixed-use projects and conceptualization and execution of waterfront developments. The Arabian Canal, one of its current projects, is one of the largest developments of its kind in the world and perhaps the most complex civil engineering project in the Middle East. It will become a globally recognized landmark destination for Dubai's visitors and residents. The man-made waterway will flow inland from the north, near Palm Jumeirah, to Dubai Waterfront at Jebel Ali, and will feature a range of mixed-use developments by some of the region's top developers. Limitless is proud to be managing the design and construction of the canal to ensure the project's success, and to be master developing an area in excess of 10,000 hectares through which the canal will flow. Figure 1 shows Dubai Master Plan with the Arabian Canal project. Figure 2 illustrates the 3D view of the Arabian Canal.

Construction of such a large project involves several challenges, including the need to accurately measure the amount of earth moved each day, which is in the order of hundreds of thousands of cubic meter per day.

Progress reports on the number of cubic meters of earth moved allow project managers to accurately track the project and to quickly identify any variances that need addressing to meet three critical

requirements: progress against plan, as-built against plan and approving invoicing. Methods used for these measurements must be very fast and effective: for example, we need to accurately measure topography of 100 hectares within hours. An accurate 3D map of the excavation provides a fast and efficient means for continuously monitoring the dig against the plans and for making adjustments as necessary.

For smaller construction projects, earthworks monitoring is often carried out using traditional survey equipment such as total stations or GPS, or more recently with 3D static scanners that produce highly accurate point clouds from which geometric measurements can be made.

However for such a large area, and given the constraint that measurements should be made between shift changes, it was quickly determined that traditional static survey methods would require a large number of crews and equipment, meaning increased cost. Another challenge was that the area might not be able to be surveyed within our time constraints. So, Limitless decided to use mobile mapping technology instead of static surveying techniques. Mobile mapping reduces both the cost and the schedule risk by increasing the efficiency of the collection process.

Two mobile mapping platforms were chosen. An airborne, a helicopter based Applanix 439DSS system with a rugged medium-format of 39 mega pixel aerial camera, a flight management system, a



3D View of the Arabian Canal

GNSS-Aided INS Direct Georeferencing system and a full suite of processing software. These components are custom-designed and engineered to be tightly integrated with the RIEGL LMS-Q240 LIDAR system. In terms of production process, flying the helicopter at 450 meters above ground, Limitless GIS Department is able to deliver within one week from the flight mission an Orthophoto and a DSM/DEM with 10cm precision along the X, Y, and Z axes.

The second system is a Land Mark system consisting of a very accurate GNSS-Aided INS Direct Georeferencing with the RIEGL LMS-Q240 LIDAR system. A digital rugged camera is also built into this integration. The Land Mark system is custom-designed to deliver 5 to 10cm positional accuracy, which put this prototype as the first of its kind in the world. Both systems produce directly georeferenced high-resolution 3D terrain model in the form of laser point clouds and finally filtered digital surface models. In addition, the airborne system produces orthomosaic color image maps, while the Land Mark system provides oblique imagery. To ensure seamless integration and Georeferencing to the same datum system, five GPS/GNSS Liеча reference stations were installed to operate 24 hours a day to provide the necessary GPS data corrections for the navigation systems. Figure 3 illustrates the distribution of these stations.

Figure 4 illustrates some of our system deliverables. Figure 4a shows the mapped area with our system (e.g. more than 4500 images), knowing that the produced pixel size precision is 10 cm. Figure 4b shows the active excavation and filling sites within phase one of our

development. Figures 4c, 4d and 4e illustrate area 1 progress level with 3d model and colour coded image. Figure 4f, 4g and 4h illustrate another active site that reached -6.5 meters below mean sea level with 3d model and colour coded image.

The process of measuring excavation sites within the time frame highlights the strength of such a system. We can, in one hour, accurately measure about 200 hectares with either the mobile mapping landmark or the airborne aerial mapping system, or both. Another achievement is that within one week of conducting our scans we are able to deliver the accurate topography as a final product. We are now working on speeding up this process to be within three days exploring various filtering automation techniques, and are exploring ways to combine and integrate the datasets of both systems to assure a high-density 3D terrain model of the excavation or filling with built in redundancy.

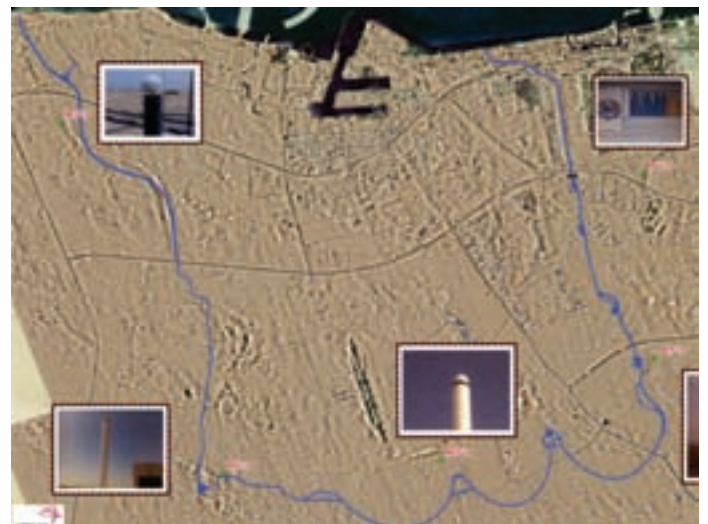
So far, this technology has highlighted the ability to produce accurate measuring in a short time, reinforcing our distinctive, innovative approach to development.

To learn more about the Arabian Canal project, visit www.arabiancanal.com.

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Dubai master plan with Arabian Canal



Distribution of five GPS/GNSS reference stations around the Canal.