Use of Drones on Landfills

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EXECUTIVE SUMMARY

Cutting edge technologies such as drones can be used with excellent results and cost-saving benefit. Several models are available in the market nowadays and are equipped with photometric high resolution sensors, GPS, auto controlled navigation systems and others cutting edge technologies that are used in aerospace industry. A direct interface software permits easily translation of the information to 3-D AUTOCAD drawings, geo-referenced 2-D orthomosaics, 3-D point clouds and DEMs (Digital Elevation Models) by even a non-experienced AutoCAD operator.

A case study will be presented to illustrate the use of drone technology in one of the largest landfill in South America, called Nortes III Landfill which operates 24 hours a day and seven days a week. This landfill is located in Buenos Aires, Argentina and has an operation tonnage of over 16,000 tonnes a day during the week. For purpose of illustration, a total station would take 2 days/Ha to carry out the survey and 3-D modeling whereas a drone would only take 2 hours for the similar end product. The cost of using drone (USD 20/Ha) is six times less than that of the total station method (USD 125/Ha). Other detailed comparison will also be provided in the paper.

Key Words: Drones, Landfill, Airspace Calculations

INTRODUCTION

Topographic surveys, for surface or volume determinations and 3-D modelling are frequently used in landfill environment during design and operations. Other complementary activities include slope geometry verification and identification of differences between design and actual slope shapes, borrow pit or soil stockpiled volume, and progress of operational cells.

TOTAL STATION

Traditional methods have been successfully used for a long time with support and improvement by technologies. For examples, the theodolite has been improved by using optical encoders for accuracy, the GPS and even total stations have included an optical distance meter and remote control as well. The total station is an electronic theodolite (transit) integrated with an electronic distance meter (EDM) to read slope distances from the instrument to a particular point. Robotic total stations allow the operator to control the instrument from a distance via remote control. This eliminates the need for an assistant staff member as the operator holds the reflector and controls the total station from the observed point. Figure 1 shows a typcal total station equipment and locations of measurement points.

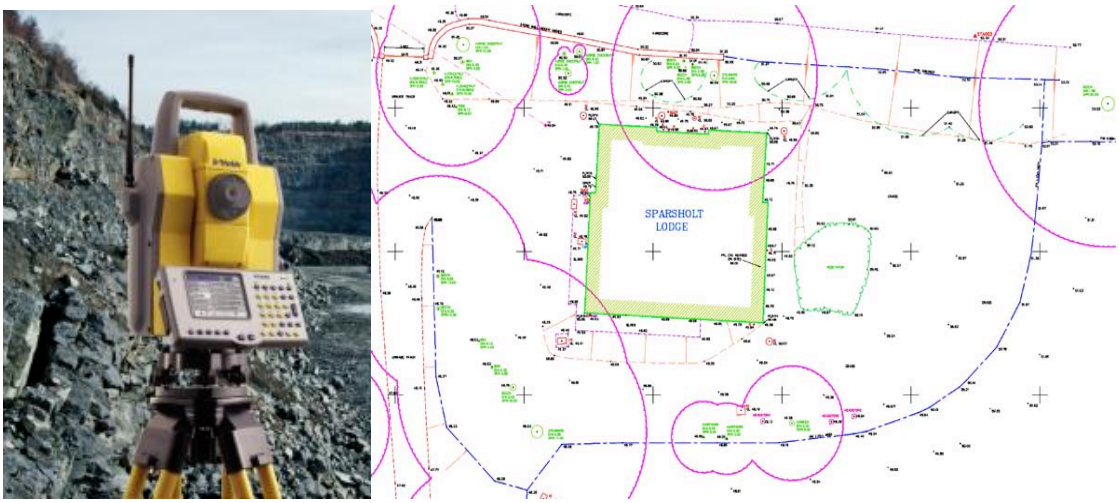

Figure 1. Total station

Although a traditional survey must be completed with a discrete number of measurement points, many points may not be safely processed especially in a landfill environment. Thus the survey might not be as accurate as it can be. In additional, a number of people (at least 2 but typically 6) are needed to perform traditional topographic surveys in a typical landfill environment.

DRONE TECHNOLOGY

Cutting edge technology like drones can be used with excellent results and a good cost-benefit rate. Figure 2 shows a typical drone flying over a surveyed area.

Figure 2. Drone Surveyed area

Nowadays, several models available in the market are equipped with photometric high resolution sensors, GPS, auto controlled navigation systems and others cutting edge technologies also used in aerospace industry. A direct interface software permits easily translate the information to 3D cad drawings, geo-referenced 2D orthomosaics, 3D point clouds and DEMs (Digital Elevation Models) by no experienced AutoCAD operator (no specials skills are required).

CASE STUDY

The case study site is located in Buenos Aires, Argentina at a landfill called Norte III Final Disposal Environmental Complex. It is composed of Norte III (closed), IIIA, IIIB, and IIIC for a total of over 250 Ha footprint. These landfills are shown on Figure 1 Site Plan below. There are landfill gas collection systems operating independent from each other on Norte IIIA, IIIB, and IIIC.

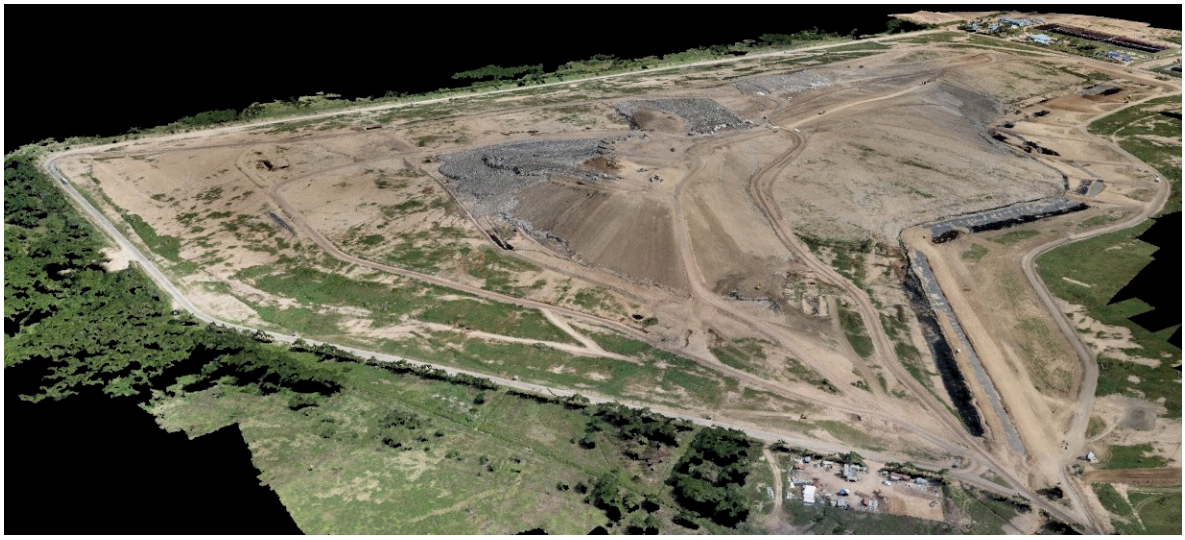

Figure 3. Surface of 200Ha to be measured at Module B NorteIII Buenos Aires.

Current landfill operations are occurring in Norte IIIB and Norte IIIB Expansion, which is a small piggy-back area in the mid-section of the IIIB landfill. The site operates 24-hours per day, 7-days per week, 365-days per year and receives a daily average MSW waste flow of 16,000 tonnes from the capital district and other cities in the province of Buenos Aires.

RESULTS COMPARISON

Comparative figures between the tradition total station method and the drone technology are shown in Table 1, with data from an active landfill operation at Nortes III, Module B.

Table 1. Performance comparison

DESCRIPTION	TOTAL STATION	DRONE
Number of measurement points [# per Ha]*	18 (normally)	7115 (maximum)
Accuracy	± 1,5 mm	± 15 mm
Time to carry out the survey per Ha (including 3D modelling)	2 days	2 hs
Cost per Ha	~US$ 125	~US$ 20
Manpower	2 field surveyors + 1 cad operator	1 cad operator part time
Amortization period	About zero	340 Ha

*1Ha= 2,47 acres

It is worth noted that the cost of operating a drone for collecting topographic surface data points is approximately six times less than the traditional method and the time taken by drone technology in producing a 3D modeling is at least 12 times faster than the traditional total station method.

The following figures show the differences in the deliverable reports.

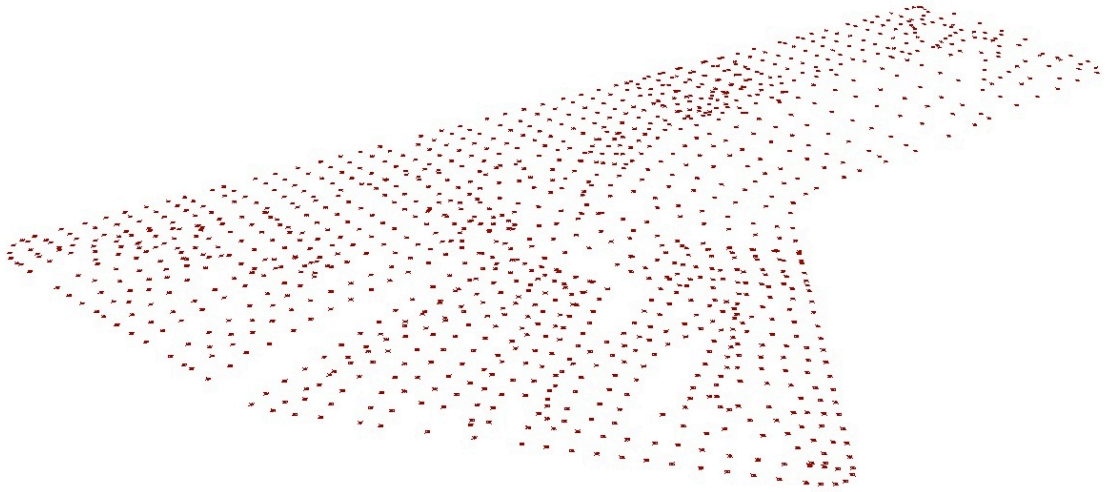

Figure 4. Survey carried out through total station. Total points - 1250

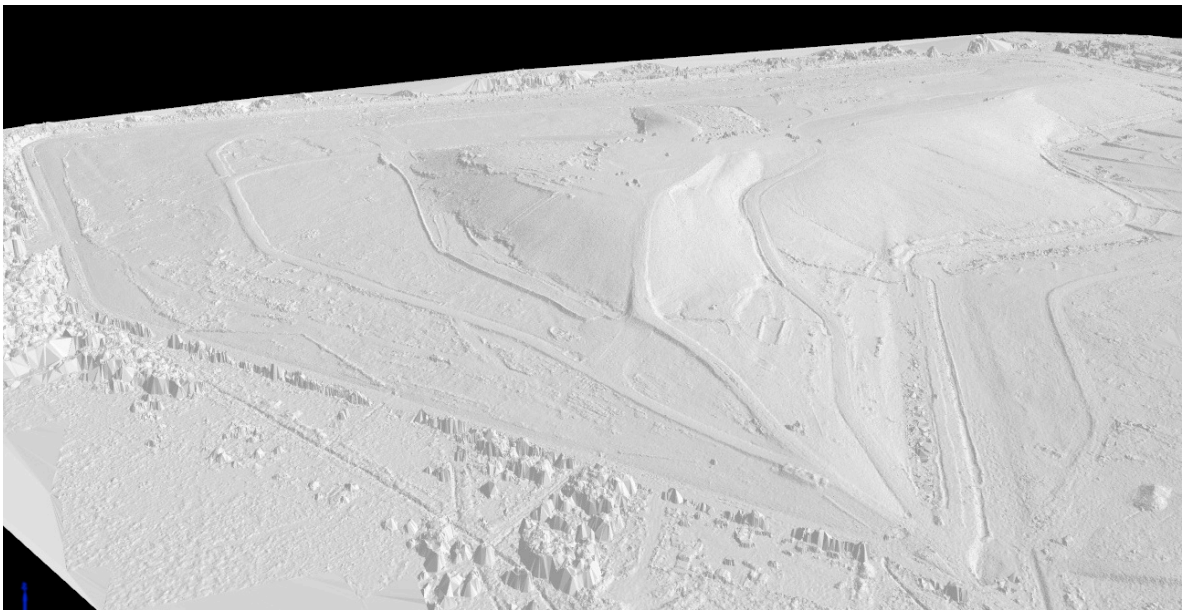

Figure 5. Survey made with drone. Total points - 2 millions

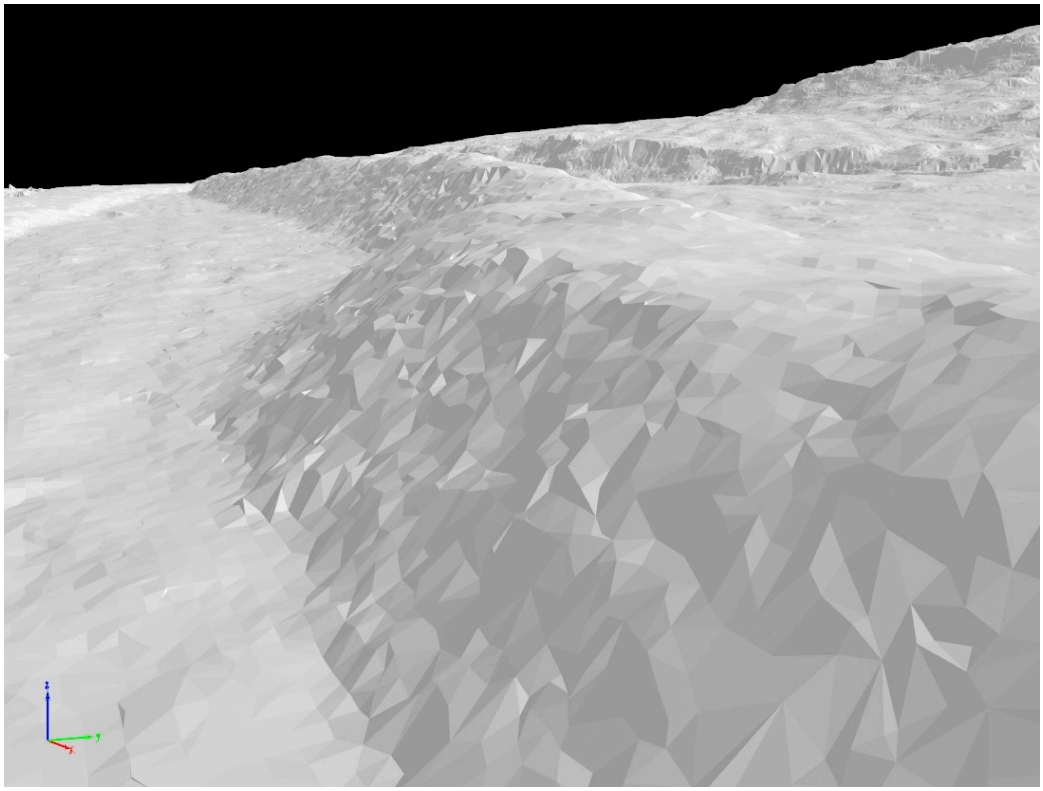

Figure 6. Detail of polygons performed by the drone technology (zoom in on Figure 5)

CONCLUSION

The drone might be the best solution for topography surveying and other supporting activities in landfills operations and design. It is cost effective and a very quick turn-around time for generating a topography map and volume determination. Its versatility, enough accuracy and easily use are also key factors to make an efficient investment decision.