CUSTOMER STORY

OPEN-PIT MINE SCANNING IN INDONESIA, HYDRONAV SERVICES OF SINGAPORE

TRIMBLE 3D SCANNING CASE STUDY BY PAUL BIDDISCOMBE

Nusa Tenggara is the Indonesian name for the more than 500 islands east of Bali, running from Lombok in the west to Timor in the east. Nusa Tenggara stretches over 1300 kilometers and lies just a few degrees south of the equator. The island of Sumbawa, in the northern part of this Indonesian island chain, is home to the Batu Hijau project, a significant part of the mining activities of PT Newmont Nusa Tenggara (PTNNT). PTNNT is a contractor to the government of Indonesia and employs, directly or indirectly, thousands of workers in the area. As such, operational efficiency, safety, environmental protection and commitment to the community are part of PTNNT's core business values.

So when PTNNT mandated Hydronav Services of Singapore to explore new ways of carrying out complex survey operations at the mine facilities, they turned once again to Trimble for solutions. Hydronav have supplied Trimble survey and positioning equipment and software to PTNNT for a number of years. To meet PTNNT's expectations, the decision was made to conduct a series of trials using laser scan techniques and a Trimble® GS-Series 3D Scanner.

ROCK SLOPE ANALYSIS AT PORT SITE

Fig. 1: Slope area surveyed with Trimble GS-Series

- Setup time: 10 min
- Scanning time: 4 min 15 sec
- Data-processing time: 15 min
- Number of 3D points collected: 82,498
- Number of setup stations: 1
- Scan Resolution: 10 mm spatial resolution at 10 m

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The lightweight and portable GS-Series minimizes field setup time. One scan from one position was sufficient in this case, and the resulting 3D data set was processed in RealWorks Survey™ software in just 15 minutes. In this time, a 3D visual analysis was carried out and contours were generated. Printouts showing 2D and 3D contours were prepared. All data shown can be exported in various formats including ASCII, X Y Z or AutoCAD DXF for further processing.

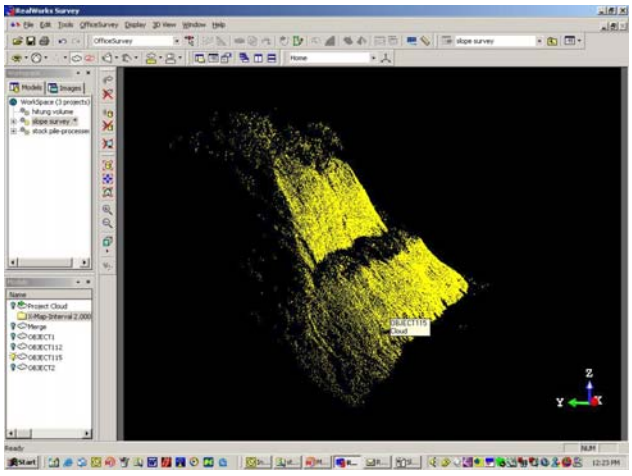

Fig.2: Rotated point cloud shows cross-section.

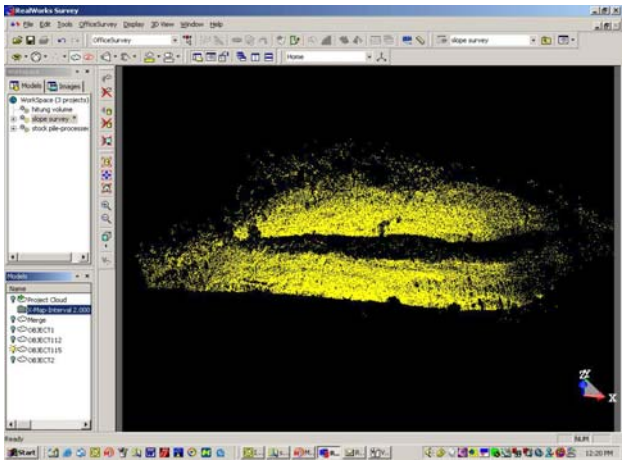

Fig. 3: Rotated point cloud shows frontal view.

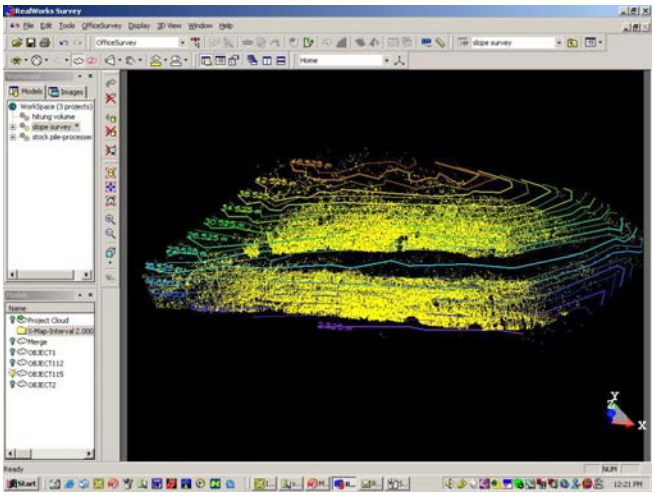

Fig. 4: Contour model fitted to point cloud.

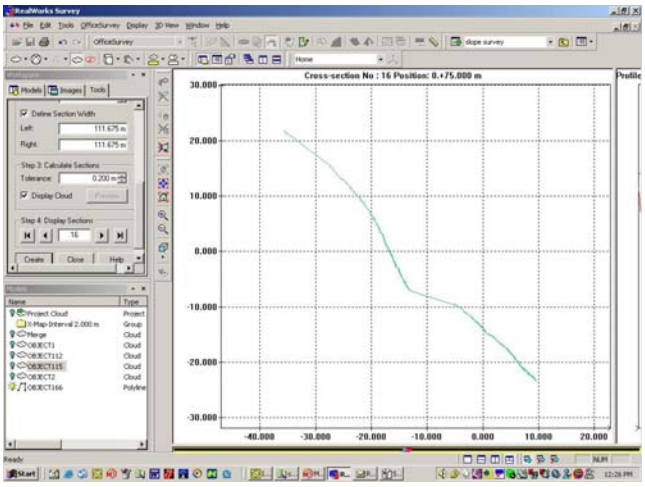

Fig. 5: Cross-section cut across the slope.

SURVEY NOTES

The results achieved clearly show the power of the Trimble system in terms of acquiring very accurate high quality data sets of very large slopes entirely remotely, and then quickly and easily computing and producing hard-fact deliverables with compelling graphic representations. This slope survey took less than 15 minutes to conduct including setup and scanning time, and involved no human presence on

the slope itself. The ability to edit data in the field on the laptop is a significant advantage. The Trimble system showed it could increase productivity, efficiency, and safety.

STOCK PILE SURVEY AT PORTSITE

Fig. 6: Stockpile surveyed with Trimble GS-Series.

- Setup time: 10 min
- Scanning time: 15 min 45 sec
- Data-processing time: 30 min
- Number of 3D points collected: 1,569,410
- Number of setup stations: 4
- Scan Resolution: 14 mm spatial resolution at 10 m

The challenge with this survey was to acquire a rich data set in a short time without exposing personnel to excessive risk. A stockpile of copper ore was surveyed with Trimble's GS-Series Laser Scanner to determine the volume. The actual time taken on site to survey the complete stockpile from four different locations around the perimeter of the stockpile, and process the data to get an end volume result was approximately 1 hour and 20 minutes. Data processing involved registering the scans and then calculating volumes using various tools in the RealWorks Survey software.

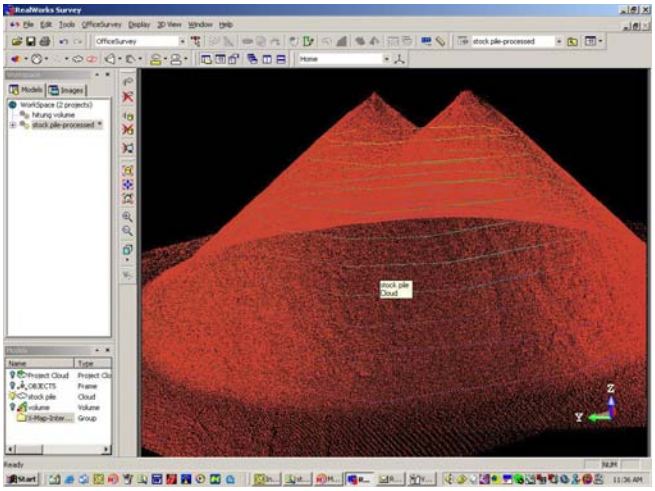

Fig. 7: Registered point cloud. Contour lines overlaid at an interval of 2 m.

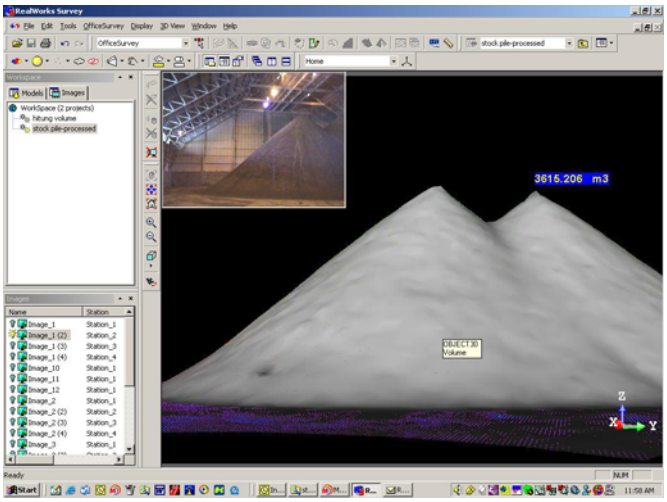

Fig. 8: Surface model in RealWorks Survey. Volume computation result shown in blue tag. Note: video capture shown in top left of screen, automatically captured by Trimble GS-Series.

SURVEY NOTES

Typically this survey would be carried out once per month using traditional survey equipment. It would involve a two-person team, one of whom would have to physically move over the stockpile carrying a prism. Around 100 discreet points would be surveyed with several meters of spacing between points. Such an operation takes a long time and yields only rough results. The advantages of the Trimble system are:

- significantly faster data acquisition thanks to excellent portability and fast setup
- fast data editing
- vastly improved result accuracy
- increased safety for personnel.

With such a productive system, the company could carry out such monitoring exercises less frequently, thereby further improving operational efficiencies.

PIT WALL SURVEY

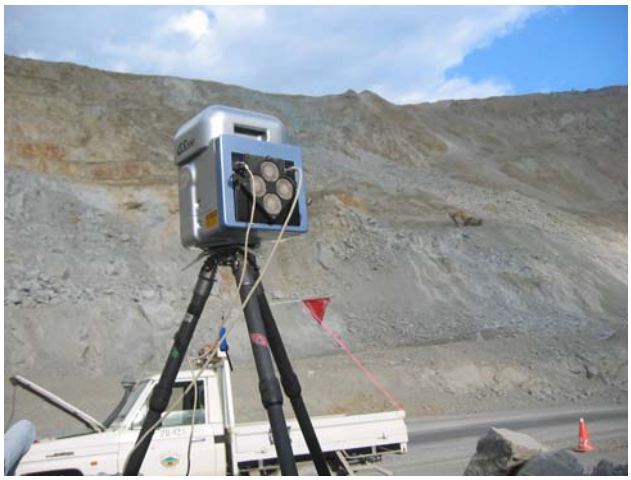

Fig. 9: Pit wall surveyed with Trimble GS-Series

- Setup time: 20 min
- Scanning time: 20 min 00 sec
- Data-processing time: 60 min
- Number of 3D points collected: 744,954
- Number of setup stations: 1
- Scan Resolution: 50 mm spatial resolution at 10 m

An area approximately 100 m high and 200 m wide was chosen. Over 700,000 points were measured in this area in less than 20 minutes at a resolution of 50 mm at 10 m range. This data was then processed in RealWorks Survey to form a model of the area with contours and cross sections. The full extent of the scanner's range capabilities (350 m with OverScan™) would allow for larger surface areas to be scanned where appropriate. The only proviso is that pit dust be sufficiently sparse to allow the laser beam to penetrate the atmosphere efficiently.

Because the survey data had to be tied to the local Newmont survey site coordinate system, three red cross marks were painted on the rocks along the base of the slope. The coordinates of these crosses were measured using GPS by the Newmont Survey department. RealWorks Survey software allows such coordinates to be input into the database to transform the surveyed data to the local site coordinate system.

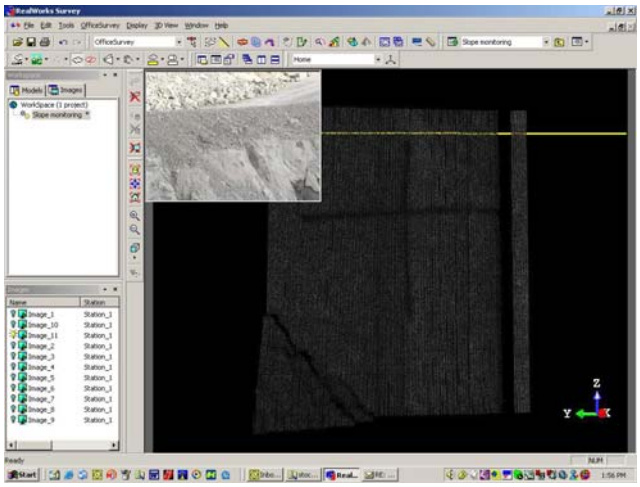

Fig. 10: Close-up of scanned cross used for georeferencing the survey to the Newmont Survey Grid. The red cross is just visible in the photograph center.

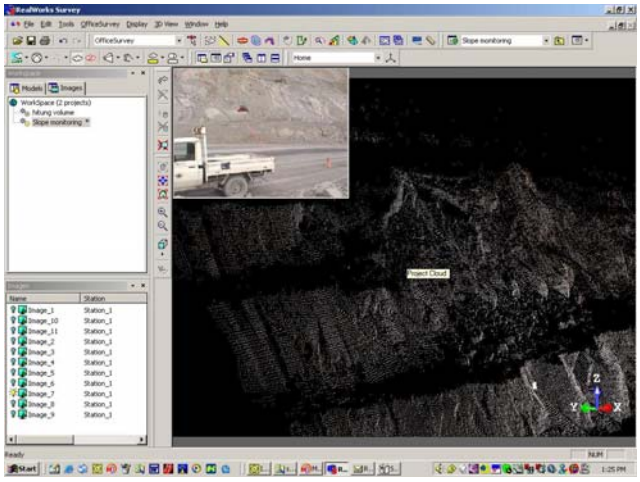

Fig. 11: Raw point cloud of points and a photograph from the same viewpoint.

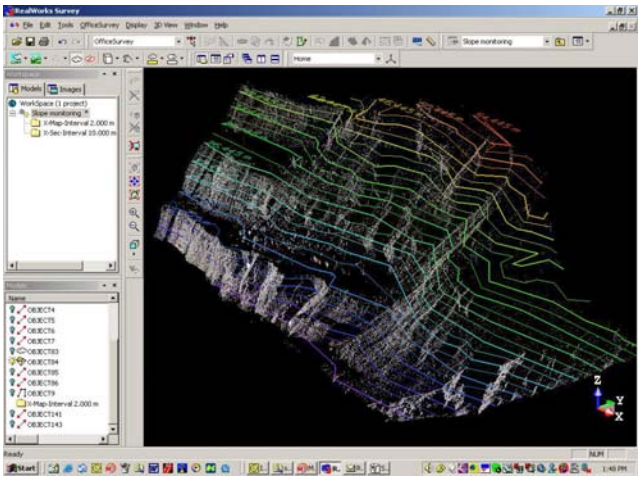

Fig 12: Contour model fitted to point cloud.

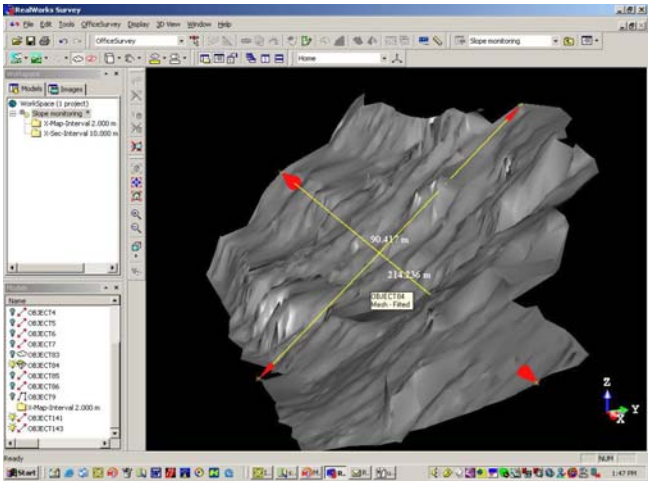

Fig. 13: Surface model fitted to point cloud, with measurements taken to show model scale. Note: width measurement shows 90.417 m and height measurement shows 214.236 m.

SURVEY NOTES

This survey was carried out over an area of the pit wall which would be very dangerous for surveyors to access with prisms to measure by traditional methods. Using the Trimble GS-Series, an entire 200 m x 100 m section could be surveyed in 20 minutes only, and the results processed and

displayed in the local Newmont coordinate system. Over 700,000 points were measured over the entire area, which allows a very accurate surface model to be built up.

Once again, the advantages of fast setup and easy scan operations can be seen. Same areas are scanned from one day to the next so that surface and volume differences can be computed. Such a high level of monitoring capability was previously impossible to envisage. Today, an extremely efficient tool exists for slope deformation analysis and modeling, allowing engineers to gain greater insights into pit wall behavior and characteristics. Such advances have major implications in terms of planning efficiencies, productivity, and safety.

CONCLUSION

Trimble's GS-Series Laser Scanners and associated data editing software, RealWorks Survey, have clearly shown their potential to provide mining and quarrying professionals with a tool set that not only provides vastly improved results compared with traditional methods, but does so in a significantly faster and more efficient manner. The additional benefit of improved worker safety, by simply eliminating the requirement to physically access areas to be surveyed, also contributes to overall operational efficiencies. "We are delighted with the performance and capabilities of Trimble's GS-Series Laser Scanners" confirmed Grant Rawlinson of Hydronav, Singapore. "This is exactly the type of new generation equipment and software solution with which surveyors can easily come to grips, while still making huge advances in terms of productivity, efficiency, and revenue generation".

ABOUT THE AUTHOR

Paul Biddiscombe is the Senior Product Manager for Trimble 3D Scanning. He joined Trimble's 3D Scanning operation in 2002.

This article is written with thanks to Grant Rawlinson and Hydronav Services, Singapore.