Surveying Instruments
And their applications for Mining Engineering Systems

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Presentation Overview…

- Description of some Mining task using Geospatial Information.

- Description of surveying technologies used for Geospatial Data Collection.

- State of art of the Surveying technologies for Monitoring.

- Engineering systems for Surveying Technologies.
Geospatial Information for Mining...

- Some geospatial information requirements...

The earth moving calculation as tones volumes of useful minerals production is a key point for higher production in a Mining Project.

The asset data collection, specially the geometry of access roads for mining trucks, is a very important point, specially for the fuel consumption and mineral transportation efficiency.
The geospatial data collection in a mining environment is always a risky component to be considered in any mining project. The machinery moving, heavy weather environment, terrain sliding and several other aspects of the mining site, are important challenges to be considered when choosing a geospatial data collection device.
Besides data collection, another important event to be considered in a mining project is the terrain instability condition, mainly in open pit mines. Human lives can be saved and instrument damage can be spared just by a powerful structure monitoring. Geospatial Information is the key also to prevent it...
Which technologies do we have available today to get the Geospatial Information...?
Polar System Measurements...

• The oldest and easy to use technology available for geospatial data collection is the Total Station... The instrument reads Angles and Distances and an on-board CPU computes the local position... But this system requires the user to be in the site to sample the geo information data.

• Poles and Prisms > Risky Conditions...
Global Navigation Satellite System - GNSS…

- With the introducing of the GNSS system for positioning tasks, the geospatial data collection, for any surveying application, can be done faster and reliably. But again – the system still requires the user to sample the geoinformation data in site...

- Poles and Antennas > Risky Conditions...

Accuracy 10-30 mm
Polar System Measurements... With Laser Beam

- Another interesting technology available for the mining geospatial data collection is the Total Station with a coaxial laser beam included in the instrument’s line of sight for point measurements. Replacing prisms by laser beams, the surveyors can still do a reliable job faster and safer than before.
- Remote measurement > Less risky conditions
What is New?... Is there a new technologies to get the Geospatial Information...?
Polar System Measurements... With Images!

- With the introducing of imaging capabilities in the Total Station the surveyors, besides sampling the data with laser beams, can now easily document the features during his Geospatial Information data collection. With a proper technology, one can even perform basic photogrammetric operations as, for instance, image-retification and others to improve ones post-processing data analysis.
- Remote measurements with automatic features collection> Less risky conditions.
High Definition Scanning… Cloud Points!

• With the introducing of the High Definition Scanning System a new paradigm was imposed to the mining sector. Surveyors can now perform more than just geospatial data collection. One can now bring the data to the office and decides afterwards what really needs to model.
• Remote measurements and office modeling > Less risky conditions.
New technologies to get the Geospatial Information!... But Can I integrate all information Collected?
New technologies to get the Geospatial Information!... But Can I integrate all information Collected?

- Existing Viva TS15 Total Station
- Existing Viva GNSS System
- Other Brands
- Existing TPS and GNSS System-1200
- Support Project data
- Flow Project Data
- Convert Tools

User
The integration of all Geospatial Sensors in one Platform!... SmartWorx Concept!

Powerful TPS Sensor Integration

Powerful data Collection

Geospatial Data Collection Integration

And Then...!

GS12

Powerful GNSS Sensor Integration
The integration of all Geospatial Sensors in one Platform!... **SmartWorx Concept!**

All sensors using the same platform, data exchange and data analysis - Powerful Integration - SmartWorx Viva!
Can I use these Geospatial Technologies in other Applications than just Data Collection?...
Slide Monitoring in Open Pit Mines...
Slide Monitoring in Open Pit Mines...

- Slide Monitoring with Robotic Total Station is the first example of the use of geospatial technology other than spatial data collection.
- A Robotic Leica Total Station linked to a communication port and managed by an intelligent data processing and data analysis system (GeoMos) has been the standard for years.
Civil Engineering Infrastructure Monitoring...
Civil Engineering Infrastructure Monitoring...

• Civil Engineering Infrastructure Monitoring with GNSS technology is another example of the use of geospatial technology other than spatial data collection.
• GNSS sensors linked to communication ports and managed by an intelligent data processing and data analysis system (GeoMos) is the newest solution used worldwide.
Automatic Monitoring System…

Polar Monitoring Architecture

Radio / LAN / GPRS etc.

SQL:
- Measurements and results

Leica GeoMoS Monitor
- Sensor Configuration
- Measurement scheduling
- Calibration and calculation
- Profiling
- Limit checks and messaging
- Data Archiving

Leica GeoMoS Analyzer
- Analysis
- Reporting
- Data import/export

Leica GeoMoS Web
- User management
- Analysis
- Reporting

Internet
Automatic Monitoring System…
Multi-Sensor Monitoring Architecture

- Sensor Configuration
- Measurement scheduling
- Calibration and calculation
- Profiling
- Limit checks and messaging
- Data Archiving

- Analysis
- Reporting
- Data import/export

Leica GNSS Spider

Radio / LAN / GPRS etc.

Leica GeoMoS Monitor

Leica GeoMoS Analyzer

Internet

Leica GeoMoS Web

SQL: Measurements and results
Automatic Monitoring System... Real Time GNSS Monitoring Architecture

Reference Station
- RTK corrections
- Radio
- GX1200 Receiver
- Direct power supply (220v)

Monitoring Point
- Real time, permanent connection
- NMEA X,Y,Z
- GX1230 Receiver
- Solar panel

Monitoring Point
- Real time, permanent connection
- NMEA X,Y,Z
- GX1230 Receiver
- Solar panel

GNSS QC GeoMoS Professional
- Real time, permanent connection
- Radio
- Wireless LAN
- Serial or TCP/IP Interface

Other Sensors
Automatic Monitoring System…
Advanced GNSS Monitoring Architecture

Reference Station(s)
- GeoMoS GNSS QC
- Profiling
- Limit checks
- Messaging
- Analysis
- GNSS Spider
- Direct power supply (220v)
- GMX901 or GMX902 GG or GRX1200 receiver

Monitoring Point
- Solar panel
- Real time, permanent connection or periodic downloading of data logged onboard
- Radio Modem, GSM Wireless LAN Cable (RS232, RS485)
- Raw Data
- GRX1200
- NMEA X,Y,Z
- GPS computation
- Raw data archiving
- Sensor configuration
- Monitoring Point
- Monitoring Point
- GMX901 or GMX902 GG
Fleet Management System…
Advanced GNSS and Multi-Sensor Architecture

Real Time Interfacing With Most Manufacturers
Vehicle Health Monitoring Systems

Mobile 802.11 or Mesh Access Point

INTRANET / INTERNET

Jigsaw Server

Supervisor

Maintenance Shop

Web-based System Access

Leica Geosystems
Today’s technologies…
for fast, reliable and efficient spatial data collection

- One point
  - TPS
  - GPS
  - DISTO™

- Millions of points
  - Laser Scanning
  - Point-cloud Management

- Image-based
  - Aircraft-based
  - Remote sensing
  - Photo-grammetry

Many Thanks for your attention…