Longwall Automation: Ambition Across the Years and the Hemispheres

Stephen Bessinger
ANGLO AMERICAN COAL

&

James Sudworth
JOY GLOBAL INC.

LONGWALL USA 2015
Pittsburgh, PA
In the beginning…There was R.O.L.F

R.O.L.F: Remotely Operated Longwall Face

- Proof of concept in 1959
- UK National Coal Board attempt to “Realize the Dream” of Longwall Automation
- Media reports technology triumph
- Royal commissioning ceremony

ROLF was unsuccessful due to availability and maturity of technology
55+ years later… We are yet to “Realize the Dream”

Technology improved, but individual focused development resulted:

- Powered Roof Support (PRS) electronic controls
- Shearer technology
  - Data communication on power cable
  - Automated cutting and tramming
- Armored Face Conveyor (AFC) control
  - Motor load sharing
  - Chain tension management

Safety, productivity and cost have improved, but fully automated face is still a vision
A new field offers insight: Process Control Engineering

It sounds difficult … But it's not:

- Generate a detailed PROCESS MAP (Example Bi-Directional Cutting)
- Do a GAP ANALYSIS … What can be done versus need to be done
- Make a plan of how to “Fill the Gaps” (Technology or Policy)
- Development of “Known” solutions
- Research tasks where reliable solution are not available
- Implement solutions based on Cost/Benefit, Complexity and Risk
- Evaluate performance
- Continue efforts until success is achieved

The best solutions are simple and reliable
LONGWALL MINE OF THE FUTURE AUTOMATION JOURNEY PLAN

Moranbah North

- 2014: UNI-DI Operation
- Simple Automation

- 2015: UNI-DI Operation
- Simple Automation

- 2016: Remote Monitoring and Advanced Automation
- Smart Services
- BI-DI Operation
- 850 web depth
- BI-DI Cutting
- 1000mm web depth
- Improved Face illumination
- Improved Dust Control
- Shearer & Area cameras
- High Speed Digital Communications

- 2017: Remote Operation with Fully Automated System
- Smart Services
- Spatial Awareness
- Seam Positioning
- Remote Mining

Grosvenor

- 2018: Remote Supervision
- Semi Autonomous Operation

- 2017: Smart Services
- AFC/BSL VFD Control or 11kV?
- Enhanced cameras

- 2016: Remote Monitoring and Advanced Automation
- Smart Services
- BI-DI from ROC
- 1000mm web depth
- Improved Face illumination
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- 2015: BI-DI Operation
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Rom Coal (MNM & Grosvenor)

June 2015: Longwall USA
Focused on safety, Reducing risk

Impact of 103 Safety Items Identified
Grosvenor Peer Review Process

- Original 1750t MNM Equipment Matrix Rating
- Grosvenor Equipment Matrix Rating
- Grosvenor Equipment Operated via ROC Matrix Rating

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Hazard Effect / Consequence

- Insignificant
- Minor
- Moderate
- Significant
- High

Likelihood

- Low
- Medium
- Significant
- High

Consequential Losses

- Loss Type (Additional ‘Loss Types’ may exist for an event; (BI/MD) Business Interruption / Material Damage & Other
- (R/S/C) Impact on Reputation / Social / Community
- (S/H) Harm to People (Safety / Health)
- (EI) Environmental Impact
- (L&R) Legal & Regulatory

Risk Rating

- 1 (Rare)
- 2 (Unlikely)
- 3 (Possible)
- 4 (Likely)
- 5 (Almost Certain)

Risk Level

- A low risk exists that management’s objectives may not be achieved. Monitor risk, no further mitigation required.
- A moderate risk exists that management’s objectives may not be achieved. Appropriate mitigation strategy to be devised as part of the normal management process.
- A significant risk exists that management’s objectives may not be achieved. Appropriate mitigation strategy to be devised as soon as possible.
- A high risk exists that management’s objectives may not be achieved. Appropriate mitigation strategy to be devised immediately.

Guidelines for Risk Matrix

- Assessment of Risk
  - Assess the Threat
  - Assess the Consequence
  - Assess the Likelihood
  - Assess the Likelihood

- Impact of Adverse Consequence
  - What impact will this adverse consequence have? (seriousness)
  - How likely is adverse consequence? (probability)
  - What are the disadvantages with this alternative?
  - Are we close to any MUST limit?
  - What could go wrong, in both the short and long term?

- Risk Level
  - Low
  - Medium
  - High

- Consequence of Adverse Events
  - Impact on People
  - Impact on Business
  - Impact on Environment

- Likelihood of Adverse Events
  - Rare
  - Unlikely
  - Possible
  - Likely
  - Almost Certain

- Likelihood of Adverse Events
  - Low
  - Medium
  - High

- Consequence of Adverse Events
  - Insignificant
  - Minor
  - Moderate
  - Significant
  - High

- Consequence of Adverse Events
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- Consequence of Adverse Events
  - Minimal
  - Slight
  - Considerable
  - National
  - International

- Risk Level
  - Low
  - Medium
  - High

- Consequence of Adverse Events
  - Insignificant
  - Minor
  - Moderate
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Partnership Journey: Remote Operation Center
What is Longwall Automation?

Definition of Automation:

- Equipment repetitively performing consistent sequences of required tasks without human intervention.

The Vision

Autonomous Operation

The Reality

Remote Operation
Longwall Mine Of The Future Journey Plan

RM Coal (MNM & Grosvenor)

UNI-DI Cutting
FaceBoss ASA & RS20s
Face alignment
850mm web depth
Smart Services

2014
UNI-DI Operation
Simple Automation

2015
BI-DI Operation
Simple Automation

2016
Remote Monitoring and
Advanced Automation

2017
Remote Operation with
Fully Automated System

2018
Remote Supervision
Semi Autonomous Operation

Grosvenor

Smart Services
Control Shearer from ROC
Improved face illumination
Improved Dust Control
Shearer & Area cameras
High Speed Digital Communications

167%

Moranbah North

Smart Services
BI-DI Cutting
Integrated Automation
Automated Face Straightening
Collision avoidant configuration

5 Operators on the Face
Remote Monitoring and Operation

100%

0 Operators on the Face
Remote Operation and Supervision

Benchmark Performance
with Drive to Zero Harm

June 2015: Longwall USA
## Migration to Remote Operation – Journey Plan

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<td>(ROC) for monitoring</td>
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### Smart Services

### Exception Management

### Change Management
Migration to Remote Operation – Phase 1 & 2 Highlights

Advanced Shearer Automation – Realize Value
- Fully automate run of face cutting sequences & gate end turnarounds
- Consistent operation – cut heights, haulage speeds, cut sequence

*Consistent use of Automation improved productivity – up to 12*

Face Alignment – Optimize Productivity, Reduce Downtime
- Implement automated face alignment
  - Reduce pass to pass cycle times

*Rate improvement by utilizing Automated vs Manual face alignment – up to 8%*
Migration to Remote Operation – Phase 3 & 4 Highlights

Environmental Awareness – Consistent Automation

- System anti-collision
- Cavity detection
- Coal face visualization

*Consistent environmental awareness improved stability & hours – up to 9%*

Remote Monitoring – Reduced Exposure

- Individual displays for remote system monitoring & operation
- Fully integrated communication

*Minimize exposure: Zero Harm*
“Realize the Dream” of Remote Operation is attainable

Migrate to Remote Operation from the ROC
General Discussion
Close