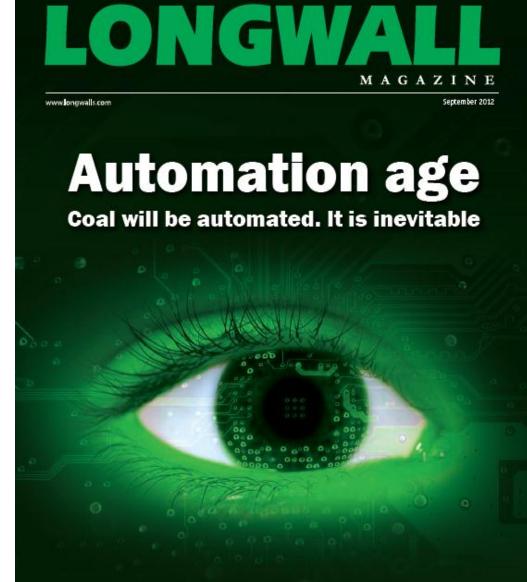


AUSTRALIAN

Introduction

What is the direction of coal mining in Australia?

AUTOMATION AGE "Coal will be automated. It is inevitable"



Courtesy Australian Longwall Magazine

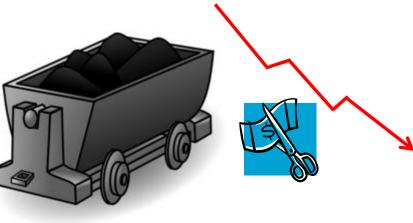
Introduction

What has driven longwall automation in Australia to the level it currently is?

Ageing mining population potentially resulting in a shortage of experience

Coal price – Thermal and Choking



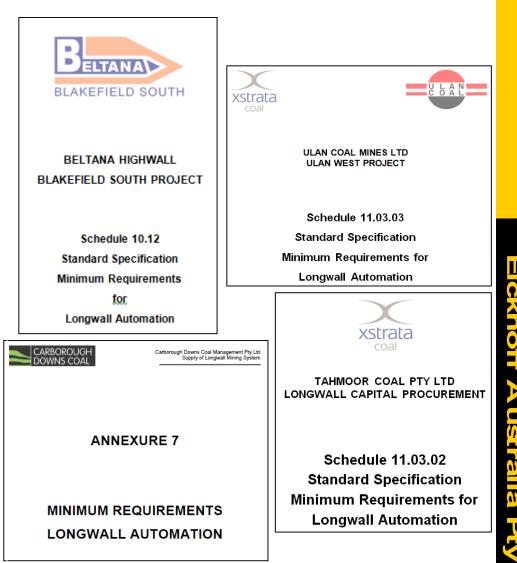


Introduction

How is the technologies driven to form part of the equipment?

CUSTOMERS PROCURING NEW LONGWALL EQUIPMENT

Each longwall tender has a clear specification which outlines "Standard Specification Minimum Requirements for Longwall Automation"



Introduction

Aspects of longwall automation:

- Shearer State Based Automation
- Radar detection
- Shield Automation
- Ethernet Communication and
- EIP interface between equipment
- Operational visibility
- Trending and Event Log
- **LASC**





Carborough Downs Integra Mine





Oaky Creek No.1 Oaky North Mine Tahmoor Colliery Ulan Coal

Introduction Aspects of longwall automation:

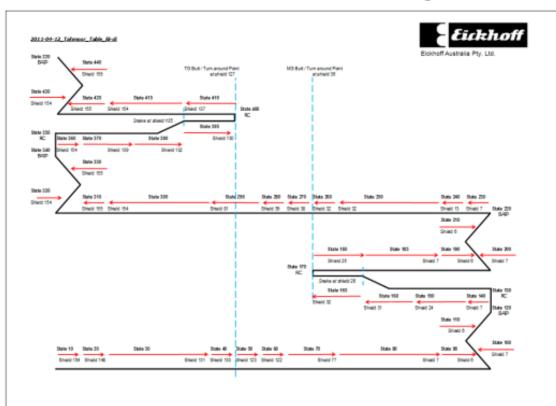
VALE Carborough Downs Integra Mine

Grasstree

xstrata

Oaky Creek No.1 Oaky North Mine Tahmoor Colliery Ulan Coal

Shearer State Based Automation
Shearer behaviour is defined to automate each state of a cutting cycle, irrespective of the cutting method used.



Introduction **Aspects of longwall automation:**

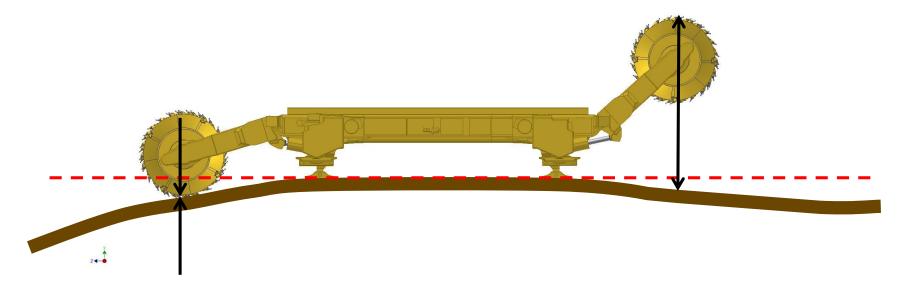
Shearer State Based Automation

State		-	_	-		x
State No.: 390	Name RH Drum to	cut roof in sna	ake (E2P alt mod	e)	De	lete state
Haulage reaction:	10 [m/min]	<=		=>		Print ppy state
	Left		Ri	ght		
Automation mode	PanFollow	•	FixExt		Ŧ	
Altern. automation mod	de ExToPrev	•	Unknown		-	
Cowi	0		0			
ldle height [mm]	Use 0		Use 0		[mm]	
Roof height [mm]	Use 0		Use 0		[mm]	
Radio required						
Step limitation	Undercut	-100	Uppercut	100	[mm]	
Water 1						
Water 2						
	Transition	1	132	[Shield]	State	
Next state	Face Position	•	233.55	[m]	395	Go to
Altern. next state	Unknown	~	0	[sec]	0	Go to
						CIOSE

Introduction **Aspects of longwall automation:**

Shearer State Based Automation

Drum height indication calculated and referred to the TRUE floor

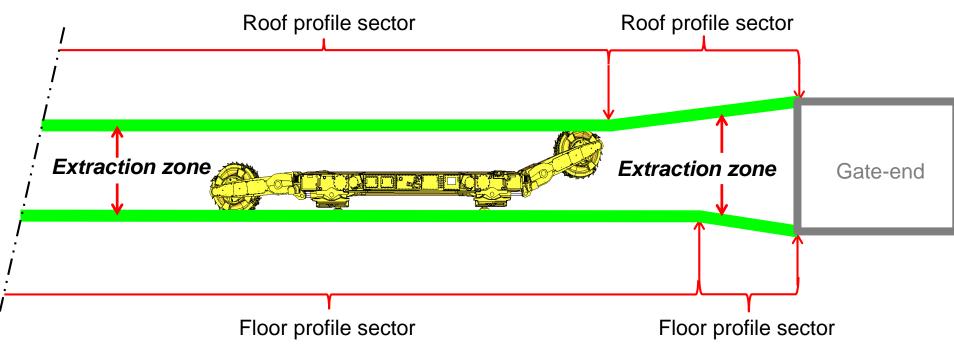


Introduction Aspects of longwall automation:

Shearer State Based Automation

A parameterized roof and floor profile is defined into sectors to create an extraction zone.

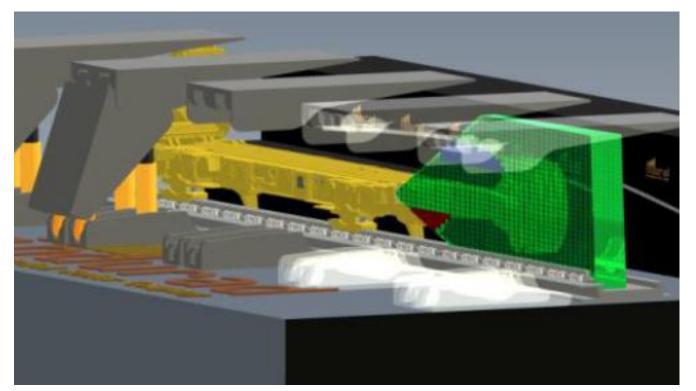
- This becomes the reference to steer face horizon -



Introduction **Aspects of longwall automation:**

Radar detection

Collision avoidance between cutting unit and shield canopies



Introduction

Aspects of longwall automation:

Shield Automation

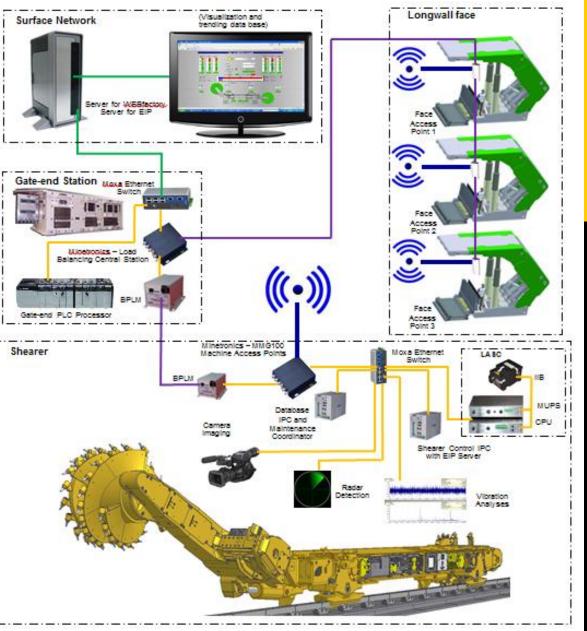
By means of comms interfacing, shearer position is used for shield defined sequences which includes gate-ends.



Introduction

Aspects of longwall automation:

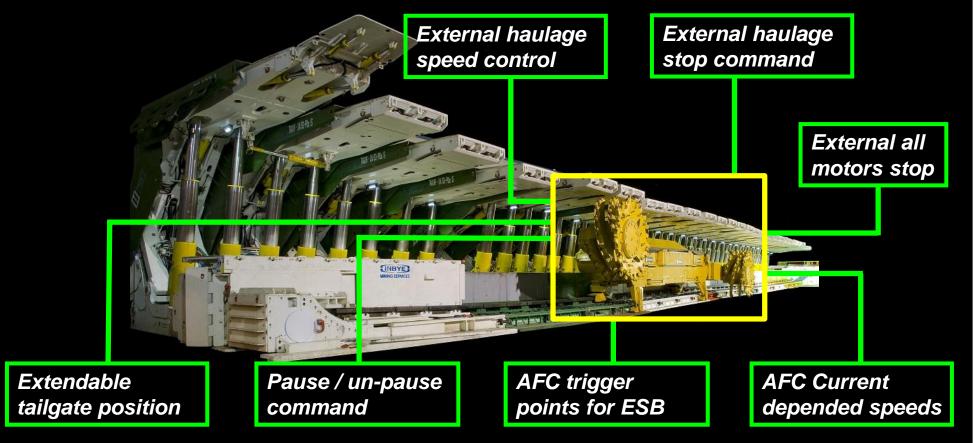
Ethernet Communication Fast and reliable communications set the platform for EIP interface, visualization & SCADA tools, trending of operational data & event logging and LASC



Introduction

Aspects of longwall automation:

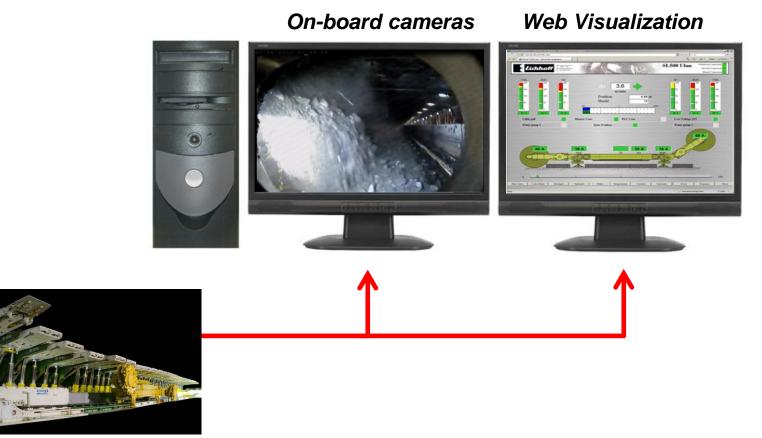
• EIP interface between equipment



Introduction

Aspects of longwall automation:

Operational visibility



Introduction

Aspects of longwall automation:

Trending and Event Log

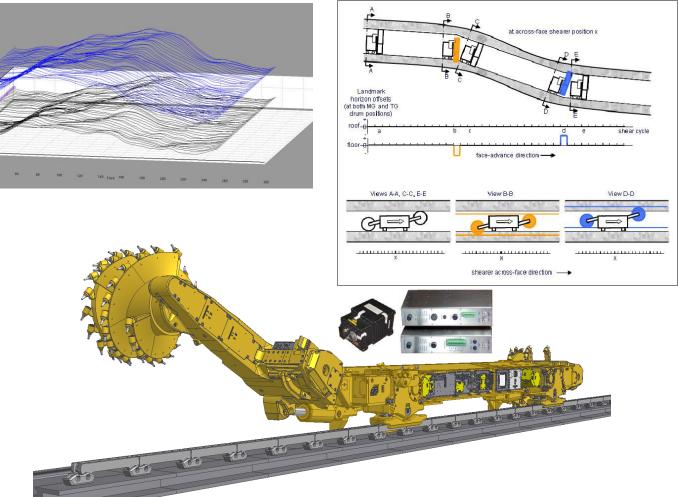
Position / Shield / Speed	Left y	axis haul.ShearerPosition	Show from: 1/13/12 12:03	PM Choose parameter				
2012-01-14 11:27:30			Show to: 1/14/12 12:03				Ap	ply filter
pdo_haul.ShearerPosition 657 pdo_haul.Shield 5 pdo_haul.SpeedPercent 8			Time	Name	New Value	Old Value	User Machine	User Surface
	ŧ`		2012-01-14 11:46:04.550	ShearerDimensions.inclinationTransverseOffset2.ActLimit	-5	0	Service	None
			2012-01-14 11:46:04.550	ShearerDimensions.InclinationTransverseOffset1.ActLimit	.7	0	Service	None
	6 Right	haul.Shield	2012-01-14 11:44:38.800	ShearerDimensions.InclinationLongitudinalOffset2.ActLimit	9	0	Service	None
		haul.SpeedPercent	2012-01-14 11:44:38.800	ShearerDimensions.inclinationLongitudinalOffset1.ActLimit	9	0	Service	None
	-5		2012-01-14 11:28:25.800	HAUL UseInverseDirection.Disable	1	0	Service	None
			2012-01-14 11:24:09.999	HMR. LevelGearOilHaulagemaxTripping. Disable	1	0	Service	None
	E.		2012-01-14 11:24:09.999	HMR. LevelGearOilHaulageminTripping. Disable	1	0	Service	None
	F* 1		2012-01-14 11:24:09.999	HML.LevelGearOilHaulagemaxTripping.Disable	1	0	Service	None
		Refresh data	2012-01-14 11:24:09.999	HML.LevelGearOilHaulageminTripping.Disable	1	0	Service	None
	- 3 Prede	fined datasets	2012-01-14 11:23:18.0	WATER.CameraSprayRH.Disable	1	0	Service	None
0	E	Position / Shield / Speed	2012-01-14 11:23:18.0	WATER.CameraSprayLH.Disable	1	0	Service	None
	-,	CM Temperatures	2012-01-14 11:23:18.0	WATER.PressureDrumSprayRHmaxThpping.Disable	1	0	Service	None
		HM Temperatures	2012-01-14 11:23:18.0	WATER.PressureDrumSprayRHminTripping.Disable	1	0	Service	None
0			2012-01-14 11:23:18.0	WATER.FlowDrumSprayRHmaxTripping.Disable	1	0	Service	None
			2012-01-14 11:23:18.0	WATER. FlowDrumSprayRHminTripping. Disable	1	0	Service	None
	1	- 144	2012-01-14 11:23:18.0	WATER.PressureDrumSprayLHmaxTripping.Disable	1	0	Service	None
	E.		2012-01-14 11:23:18.0	WATER.PressureDrumSprayLHminTripping.Disable	1	0	Service	None
12 ¹²⁰ 12 ¹³⁰ 12 ¹⁴⁰ 12 ¹⁵⁰ 12 ⁸⁰⁰			2012-01-14 11:23:18.0	WATER.FlowOrumSprayLHmaxTripping.Disable	1	0	Service	None
2012-01-74 11-27-20 2012-01-74 11-27-30 2012-01-74 11-27-50 2012-01-74 11-27-50 2012-01-74 11-27-50			2012-01-14 11:23:18.0	WATER.FlowDrumSprayLHminTripping.Disable	1	0	Service	None
			2012-01-14 11:23:18.0	WATER.PressureWaterInletminThipping.Disable	1	0	Service	None
ፍ F4 🚽 F5 🚽 F8 🕞 F6			2012 01 14 11 22 10 0	WATCO Desseu ve Caolin ditist seminitien in a Disable		0	Contes	Name

Introduction

Aspects of longwall automation:

• LASC

A system created by CSIRO which provides data of the cut profile, which can be used to maintain horizon control in a longwall panel, as well as face alignment

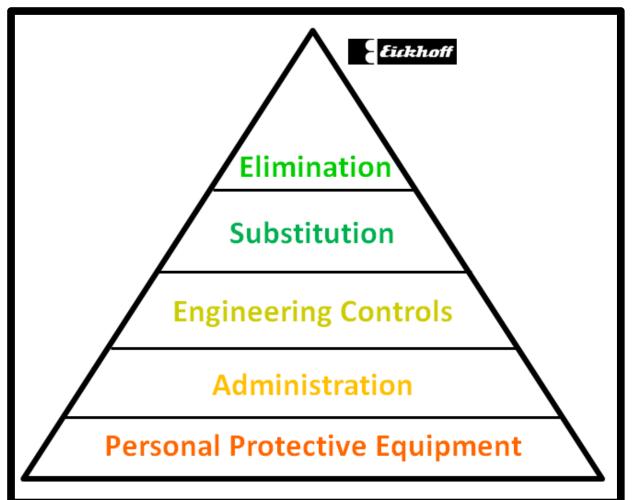


Immediate objectives for automation



Immediate objectives for automation

To reduce exposure to the risk and elements of longwall mining



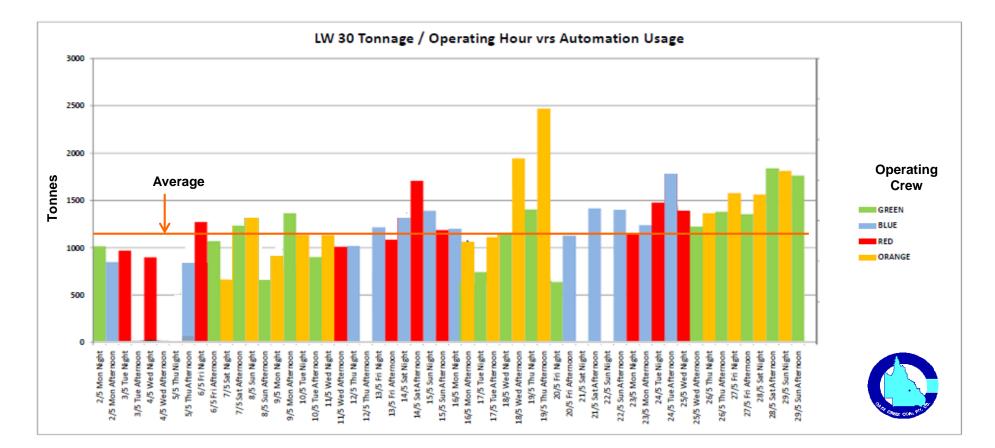
Immediate objectives for automation

To maintain consistency in longwall production

Comparison in production at Oaky Creek No. 1 prior to the implementation of ESB and ESB in use.



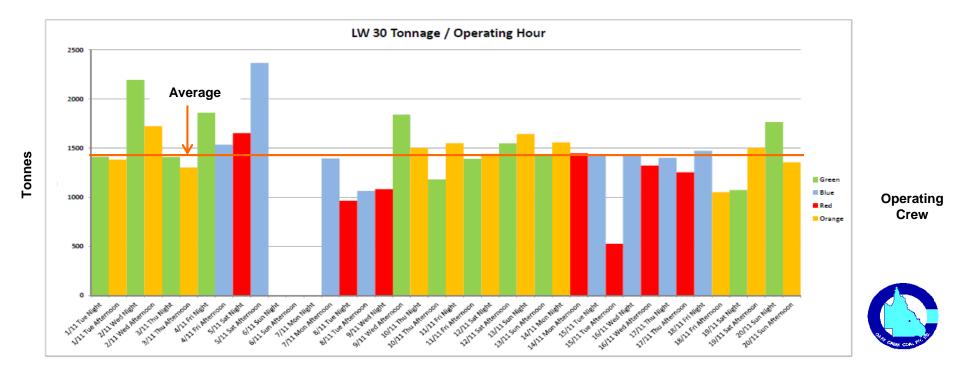
Immediate objectives for automation



• OCC #1 Tonnes / Operating Hour (May 2011)

Immediate objectives for automation

To maintain consistency in longwall production



OCC #1 Tonnes / Operating Hour (Nov 2011)

Courtesy Oaky Creek No.1 mine 2011

Immediate objectives for automation

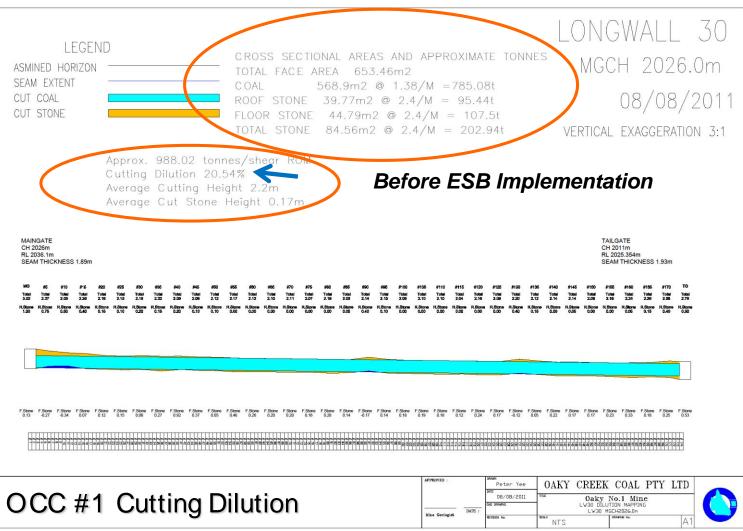
To maintain consistency in longwall production



• OCC #1 SCA DA TRENDS – Haulage speed reduction vs. Methane

Immediate objectives for automation

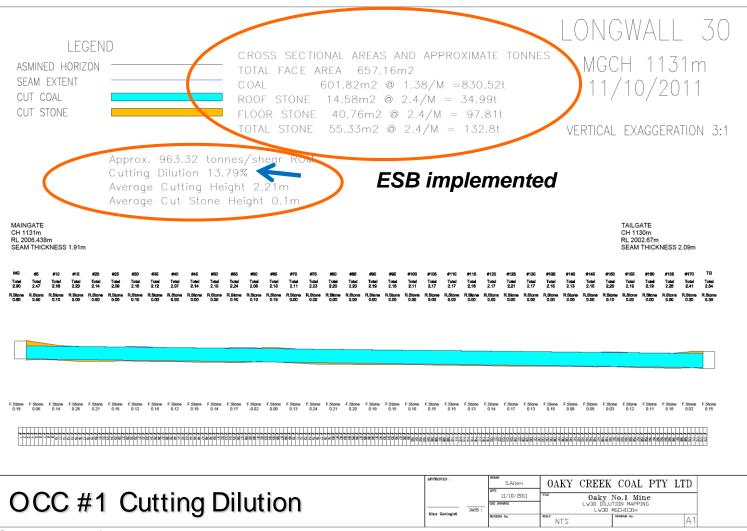
To maintain consistency in longwall production



Courtesy Oaky Creek No.1 mine 2011

Immediate objectives for automation

To maintain consistency in longwall production



Immediate objectives for automation

To maintain consistency in longwall production

A positive impact has been observed particularly directly after implementation, in the availability of equipment at <u>all</u> mines where automation was implemented.

<u>Reduce equipment downtime and it</u> <u>will positively impact production</u>





Carborough Downs Integra Mine XStrata Oaky Creek No.1 Oaky North Mine Tahmoor Colliery Ulan Coal



Courtesy Carborough Downs 2009 25

Requirements for effective automation



Requirements for effective automation

Redundancy of automation components



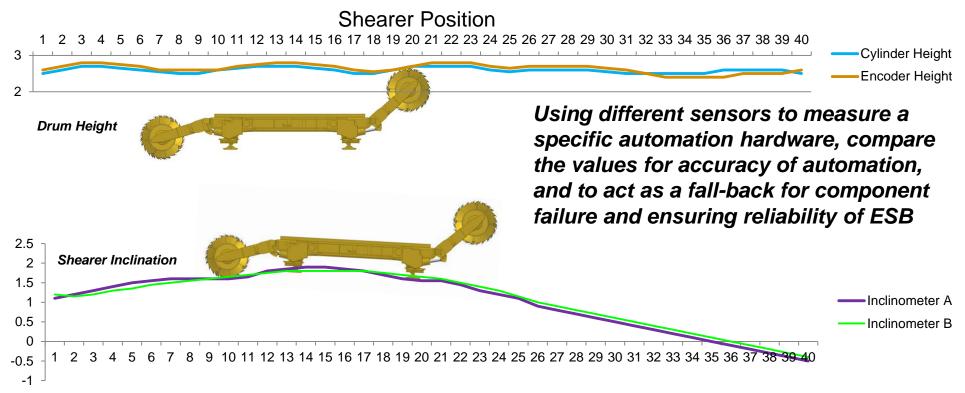
28

Application of Shearer Automation

Requirements for effective automation

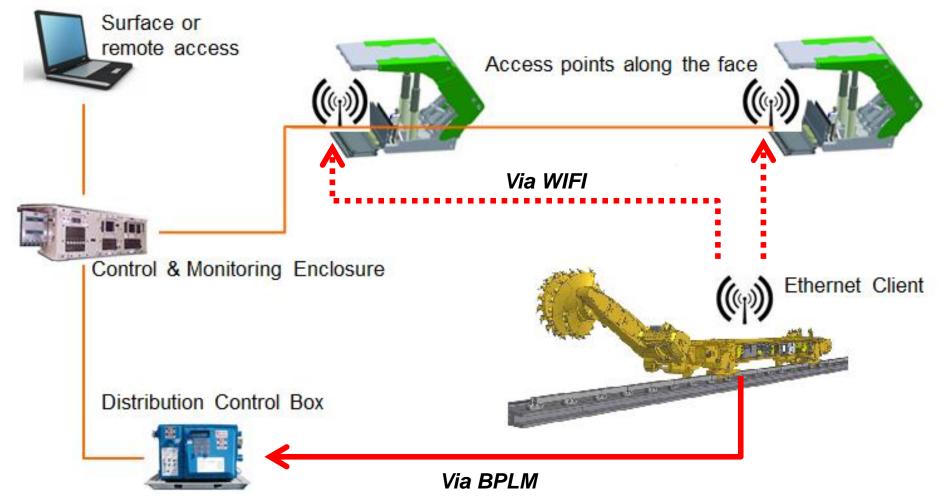
Redundancy of automation components

Sensor redundancy



Requirements for effective automation

Redundancy of automation components



Requirements for effective automation

Understanding each site's method of coal cutting PRIOR to implementation.

Avoid the "cookie mold" mentality.

Understand how automation needs to be applied.



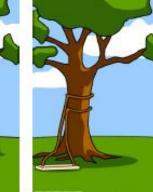
Requirements for effective automation

Follow solid project practices when implementing automation













How the business consultant described it



What operations

installed

How the customer

explained it



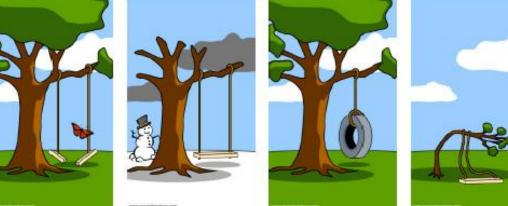
How it performed under load

How the analyst designed it

When it was delivered

How the programmer wrote it

What the beta testers received



What the customer really wanted



The disaster recover plan

Requirements for effective automation

Follow solid project practices when implementing automation:

SAFELY ON TIME, WITHIN BUDGET AND IN SPEC

- Stay focused on the final outcome from the start.
- Planning should be broken down into stages.
- Set smaller targets in order to meet the COMPLEX one.
- Continuously manage your risk and have contingencies.
- COMMUNICATE, COMMUNICATE <u>AND</u> COMMUNICATE.
- Test in stages: BENCH→INTERFACE→FACTORY→COMMISSION.
- Measure the progress made and *capture the details.*
- Review the good & bad and set the benchmark for the next.



Carborough Downs Integra Mine



Grasstree Mine



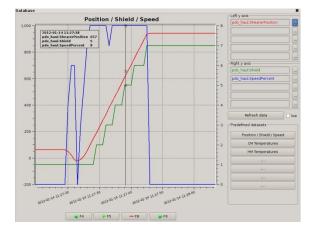
Requirements for effective automation

Database applications and analyses to monitor behavior patterns

show from:	1/13/12 12:0	3 PM 🗘	Choose parameter					
Show to:	1/14/12 12:0	B PM				Ap	ply filter	
Time 2012-01-14 11:46:04:550 2012-01-14 11:46:04:550		1	Name	New Value	Old Value	User Machine	User Surface	
		ShearerDimensio	-5	0	Service	None None		
		ShearerDimensio	-7	0	Service			
2012-01-14	11:44:38.800	ShearerDimensio	ins.inclinationLongitudinalOffset2.ActLimit	9	0	Service	None	
2012-01-14 11:44:38.800		ShearerDimensio	9	0	Service	None		
2012-01-14	11:28:25.800	HAUL UseInverse	1	0	Service	None		
2012-01-14 11:24:09.999		HMR.LevelGearO	1	0	Service	None		
2012-01-14	11:24:09.999	HMR.LevelGear0i	1	0	Service	None		
2012-01-14	11:24:09.999	HML.LevelGearOi	1	0	Service	None		
2012-01-14	11:24:09.999	HML.LevelGear0i	L.LevelGearOilHaulageminTripping.Disable 1 0			Service	None	
2012-01-14	11:23:18.0	WATER.CameraS	orayRH.Disable	1	0	Service	None	
2012-01-14	11:23:18.0	WATER.CameraS	orayLH.Disable	1	0	Service	None	
2012-01-14	11:23:18.0	WATER Pressure	DrumSprayRHmaxTripping.Disable	1	0	Service	None	
2012-01-14	11:23:18.0	WATER Pressure	ATER PressureDrumSprayRHminTripping.Disable		0	Service	None	
2012-01-14	11:23:18.0	WATER FlowDrum	SprayRHmaxTripping.Disable	1	0 Service		None	
2012-01-14	11:23:18.0	WATER FlowDrum	SprayRHminTripping.Disable	1	0	Service	None	
2012-01-14	11:23:18.0	WATER Pressure	DrumSprayLHmaxTripping.Disable	1	0	Service No		
2012-01-14 11:23:18.0		WATER Pressure	DrumSprayLHminTripping.Disable	1	0	Service None		
2012-01-14	11:23:18.0	11:23:18.0 WATER FlowDrumSprayLHmaxTripping.Disable			0	Service	None	
2012-01-14	11:23:18.0	WATER FlowDrum	SprayLHminTripping.Disable	1	0	Service	None	
2012-01-14 11:23:18.0 WATER PressureWaterInletmin			WaterInletminTripping.Disable	1	0	Service	None	
301 2.01.1.4	11.33.10.0	WATCO Drasoural	La alia attist armin Trina in a Disa bla		0	Contra	Hana	

Changes made to

parameters



Trending shearer operational data and events

xbo	nt to: 1/14/12 12:04 PM		0 = AB Events	Apply Filter
	Time	Event Id	Message	State
1	2012-01-14 11:37:19.699	012-01-14 11:37:19.699 341 Motors OFF from command transmitter		o
5	2012-01-14 11:37:18:199 341 Motors OFF from command transmitter		1	
3	2012-01-14 11:31:50.0 341 Motors OFF from command transmitter		0	
4	2012-01-14 11:31:50.850 341 Motors OFF from command transmitter		1	
5	2012-01-14 11:31-15.850	01-14 11:31:15,850 345 stuck button I release all motors ON button		0
6	2012-01-14 11:31:14,450	.450 345 stuck button ! release all motors ON button		1
7	2012-01-14 11:26:57,500	345	stuck button I release all motors ON button	0
8	2012-01-14 11:26:57,149	345	stuck button I release all motors ON button	1
8	2012-01-14 11:25:49.50 523		Unplaned cylinder movement RH	0
10	2012-01-14 11:25:49.50	522	Unplaned cylinder movement LH	0
11	2012-01-14 11:25:12.950	523	Unplaned cylinder movement RH	2
12	2012-01-14 11:25:12.950	522	Unplaned cylinder movement UH	2
13	2012-01-14 11:25:12:900	253	Unplaned cylinder movement RH	I
J4	2012-01-14 11:25:12.900	522	Unplaned cylinder movement LH	I
15	2012-01-14 11:25:08.0	2	Restart of shearer control for SL 300 Tahmoor C515261	1
16	2012-01-14 11:25:08.0	2	Restart of shearer control for SL 300 Tahmoor C515261	2
17	2012-01-14 11:24:19.699	559	PH Haulage: Gear Oil Level Too Low: 22822	0
18	2012-01-14 11:24:19.699	556	LH Haulage: Gear Oil Level Too Low, 21822	0
19	2012-01-14 11:23:40.750	341	Motors OFF from command transmitter	0
20	2012-01-14 11:23:40.600	341	Motors OFF from command transmitter	1

Event log

Requirements for effective automation

Clear visibility of what exactly occurs in the longwall





Requirements for effective automation

Clear visibility of what exactly occurs in the longwall



Requirements for effective automation

Clear visibility of what exactly occurs in the longwall

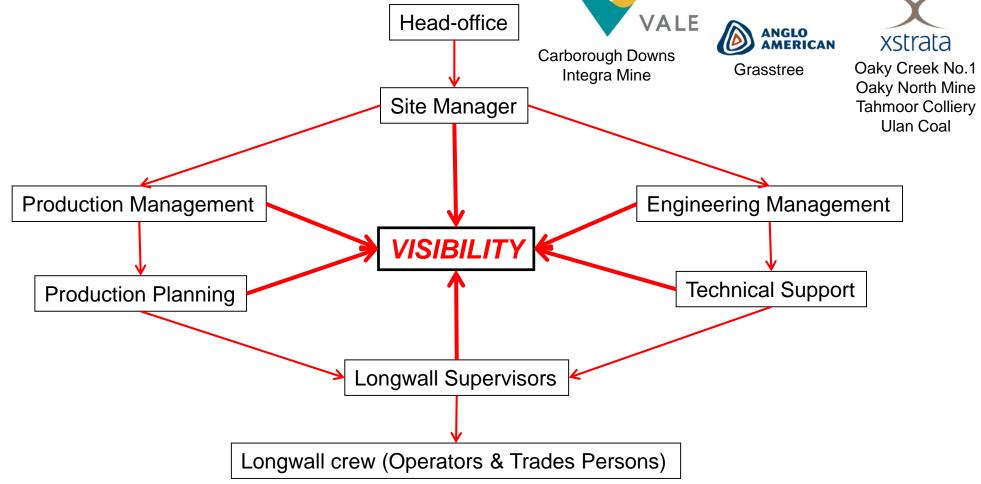
Regular underground representation – Support agreements with the OEM





Requirements for effective automation

Mind-set for automation – Involvement from management to end-users





Oaky Creek North Australian Record Breaker

- Oaky North 2009 Longwall Panel retreated a total of 4,985m
- □ Total metres travelled = 4,985m x 250m = 1,246,250m
- The Shearer travelled a total of 12,462 km
- 12hour shift 29,642 tonnes from the Longwall
- 24 hour 56,890 tonnes
- Weekly 312,506 tonnes
- Monthly 1,146,721 tonnes.
- In 2009 the mine produced 8.1M tonnes ROM (second highest producer)

Was the highest producer of longwall coal in Australia for 2010, 2011 and 2012

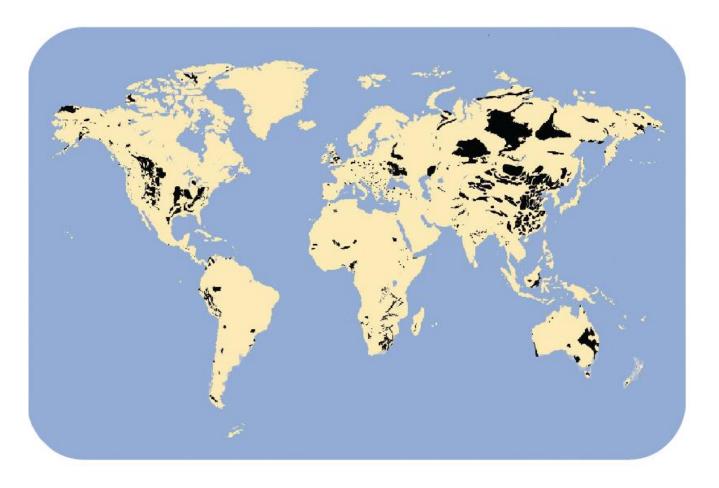


The challenge we currently face!!

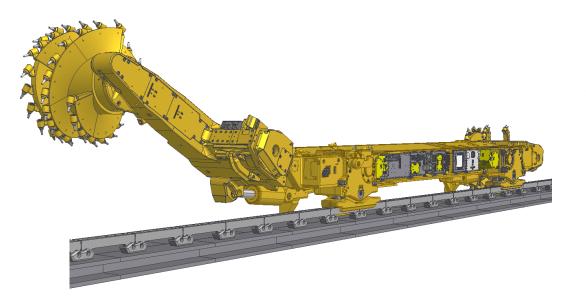


Challenges within automation

A large amount of shearers are installed in longwalls globally



Shearers equipped with class-leading technologies???



There is a lack in the application of automation referring to the global longwall mining industry.

Challenges within automation

This has an impact in the growth of longwall technologies when comparing with other mining industries.



Automated longwall systems <u>AND</u> adequately managing these systems has the potential to play a vital role in safe and consistent production.

By having more longwalls automated, will speed up the progress in advanced technologies and will contribute in the future of this great industry.







Eickhoff SL Shearer Series

Highest reliability combined with state of the art automation features makes work at the coal face most productive and safer than ever before.

Even for difficult applications and harsh mining conditions, the most powerful and reliable solutions are available through Eickhoff.

Experience has no substitute - Eickhoff since 1864



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