



Joy Smart Solutions Utilizing Mechanized Mining for Salt Extraction

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The System

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Focus:

- Safety
- Productivity
- Cost per ton



12HM Miner



Flexible Conveyor
Train (FCT)

Conveyor System



The Solution



The conversion from drill and blast to mechanized mining takes a focused and planned approach

- Equipment to surface communication
- Inter machine communication
- Application specific sensors and monitoring

- Application engineering experts
- Technical and field services
- Life Cycle Management



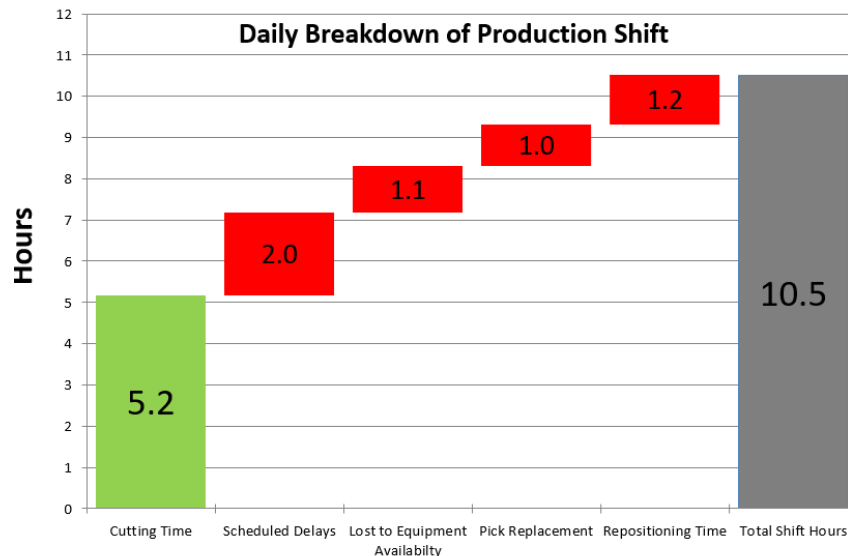
- Prognostics and health monitoring
- Komatsu analytics
- Performance optimization

The Solution – Direct Service

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- Application engineering experts
 - Productivity modeling, scenarios, mine plan recommendations, cut sequence, shift schedules, etc.
- Technical and field services
 - On-site to support through product launch and commissioning
 - Long term on-site support provided as requested

**Productivity model
becomes the
backbone of the
project**



1 Cut Sequence & Move-Up Cycle											
Cut Sequence (Sublayer)	Width (Feet)	Width (Meters)	Length (Feet)	Length (Meters)	Reposition Time (Hours)	Cutting Time (Hours)	Total Time (Hours)	Tons (U.S. Short)	TPH	Handle Cable Between Cuts (Minutes)	Tram Distance Between Cuts (Feet)
1	13	3.96	52	15.85	0.11	0.96	1.27	684	540	5	100
2	13	3.96	102	31.10	0.11	1.88	2.38	1343	564	5	100
3	13	3.96	102	31.10	0.16	1.88	2.43	1343	551	7.5	150
4	13	3.96	102	31.10	0.16	1.88	2.43	1343	551	7.5	150
5	13	3.96	50	15.24	0.11	0.92	1.22	658	538	5	100
6	13	3.96	50	15.24	0.11	0.92	1.22	658	538	5	100
7	13	3.96	100	30.49	0.11	1.84	2.34	1316	564	5	100
8	13	3.96	144	43.90	0.16	2.65	3.37	1895	562	7.5	150
9	13	3.96	144	43.90	0.22	2.65	3.42	1895	554	10	200
10	13	3.96	44	13.41	0.22	0.81	1.20	579	484	10	200
11	13	3.96	94	28.66	0.11	1.73	2.20	1237	562	5	100
12	13	3.96	50	15.24	0.11	0.92	1.22	658	538	5	100
13	13	3.96	50	15.24	0.11	0.92	1.22	658	538	5	100
14	13	3.96	50	15.24	0.11	0.92	1.22	658	538	5	100
15	13	3.96	50	15.24	0.11	0.92	1.22	658	538	5	100
16	13	3.96	52	15.85	0.35	0.96	1.51	684	453	16.25	325
17	13	3.96	102	31.10	0.11	1.88	2.38	1343	564	5	100
18	13	3.96	102	31.10	0.16	1.88	2.43	1343	551	7.5	150
19	13	3.96	102	31.10	0.16	1.88	2.43	1343	551	7.5	150
20	13	3.96	50	15.24	0.11	0.92	1.22	658	538	5	100
21	13	3.96	50	15.24	0.11	0.92	1.22	658	538	5	100
22	13	3.96	100	30.49	0.11	1.84	2.34	1316	564	5	100
23	13	3.96	144	43.90	0.16	2.65	3.37	1895	562	7.5	150
24	13	3.96	144	43.90	0.22	2.65	3.42	1895	554	10	200

The Solution – Smart, Connected Products

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Communication

- ✓ FCT to Miner
- ✓ Miner to FCT
- ✓ FCT monitoring health of Conveyor System
- ✓ System data to the surface



Smart Products

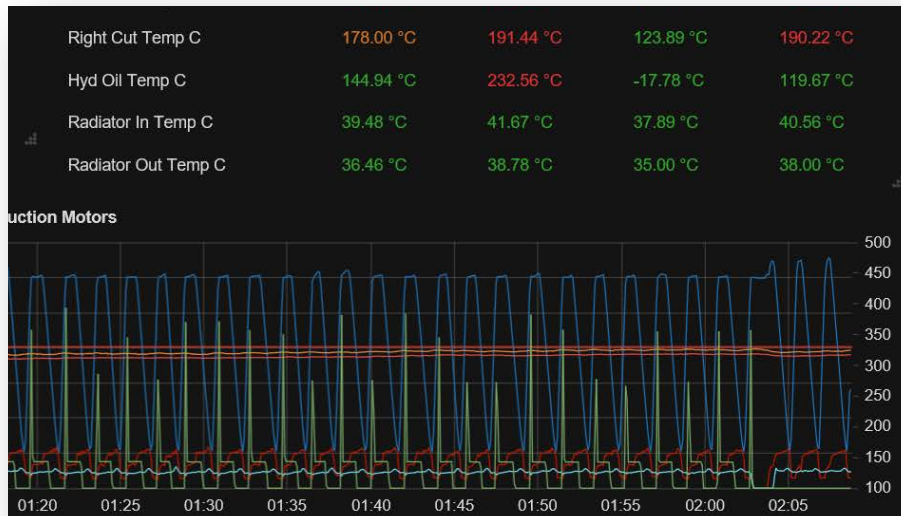
- Sensors to match customers needs
- Data collection to support performance KPIs
- Control system to reduce maintenance and protect health of the equipment
- Control platform with the ability to grow



The Solution – Analytics and Processes

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- Prognostics and health monitoring
 - Real time vibration analysis
 - Component life trending for preventive maintenance schedules
- Performance optimization
 - Parameter adjustment to support changing conditions
 - System optimization to minimize operating cost
- Remote trouble shooting in real time to minimize downtime



The Plan – Bringing it all Together

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Transitioning to Mechanized Mining

Planning

- Developing high level mine KPIs
- Building productivity models to support goals
- Change management at all levels
- Project plans to align with corporate targets

Execution

- Building equipment specifications that meet the unique challenges of the mine
- Strong project leadership to hit necessary timelines
- Breaking down high level KPIs into meaningful metrics
- Communication at all levels

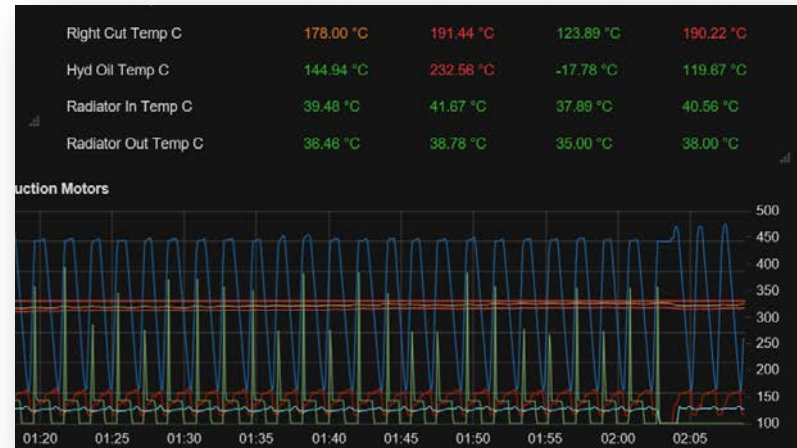
Monitoring

- Monitoring metrics and understanding impact on productivity
- Feed actual data into productivity model to drive improvement
- Communication loop to close change management process



The Road Forward

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**Automated Cut for
Set Distance**

**Machine Spatial
Awareness**

**Single Operator
FCT/CM**

Remote Operation

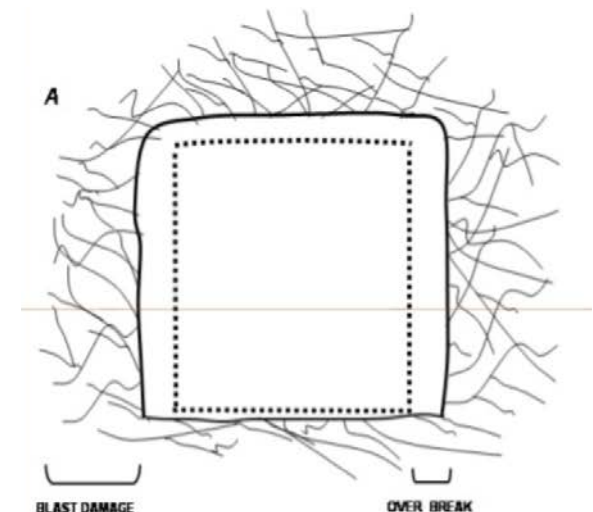


The Benefits



- ✓ Fewer operators at the face
- ✓ Reduced number of moving equipment
- ✓ Reduced operator exposure to DPM and other toxic gasses
- ✓ Better strata control
- ✓ Reduced ventilation requirements
- ✓ Eliminates needs for explosives underground
- ✓ Consistent product sizing

EPA Emission Regulation			
Engine Power: 175 - 750 HP			
Emission (PPM)	1997	2017	% Reduction
NOx	6.9	0.3	2200%
HC	1	0.14	614%
CO	8.5	2.6	227%
DPM	0.4	0.01	3900%





Questions?