



Weir Motion Metrics Ecosystem for Mines

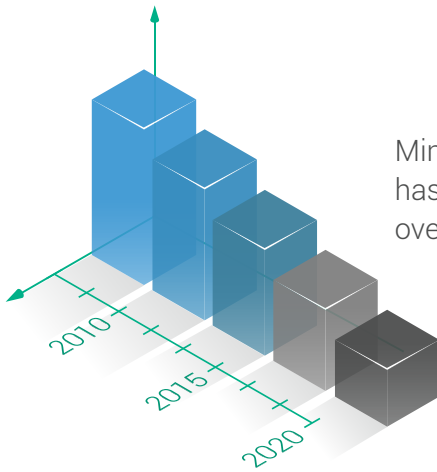
Since 1999, Weir Motion Metrics has used smart, rugged cameras to monitor your mine and transform that data into actionable information.



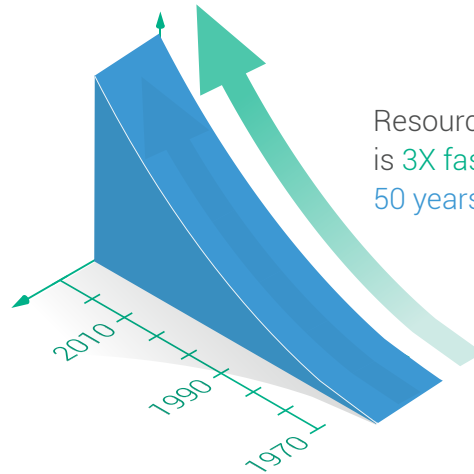
WEIR

MOTION METRICS

The mining challenges we tackle



Mining productivity has decreased by 28% over the last decade¹

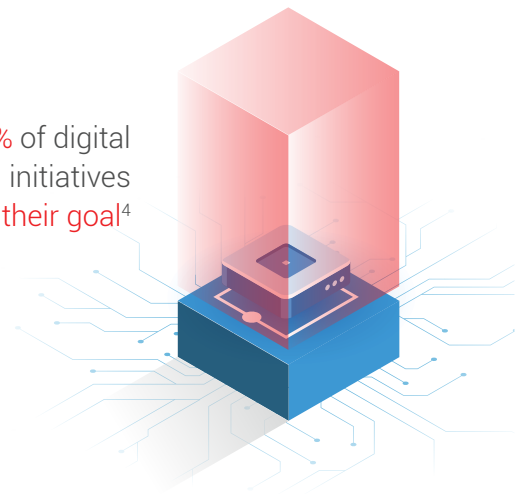


Resource extraction is 3X faster than 50 years ago²

197 countries have signed the Paris Climate Agreement³



70% of digital transformation initiatives do not reach their goal⁴



To meet these challenges, mining companies need:

Agnostic technologies that interface with existing mine systems

Customized solutions that consider every unique operating condition

Easy and simple to use for operations teams

¹ Lala, A., Moyo, M., Rehbach, S., & Sellschop, R. (2018, January 17). Productivity in mining operations: Reversing the downward trend. McKinsey & Company.

² Nature Publishing Group. (2020, February 4). Mining's climate accountability. Nature News. <https://www.nature.com/articles/s41561-020-0541-1>

³ Paris Agreement - Status of Ratification. United Nations Framework Convention on Climate Change. (n.d.). <https://unfccc.int/process/the-paris-agreement/status-of-ratification>.

⁴ Durrant-Whyte, H., Geraghty, R., Pujol, F., & Sellschop, R. (2018, January 17). How digital innovation can improve mining productivity. McKinsey & Company. <https://www.mckinsey.com/industries/metals-and-mining/our-insights/how-digital-innovation-can-improve-mining-productivity>.

Benefits and operational impact

G.E.T. Detection¹ ▲ 1.5%

+ Safety improvement + Efficiency improvement

G.E.T. Wear Monitoring²

+ Safety improvement + Efficiency improvement

Particle Size Distribution³ ▲ 6.0%

+ Safety Improvement + Efficiency Improvement

Boulder Detection⁴ ▲ 1.0%

+ Safety Improvement + Efficiency Improvement

Payload & Volume Monitoring⁵ ▲ 6.0%

+ Efficiency Improvement

Load Alignment Monitoring⁶

+ Safety Improvement + Efficiency Improvement

Carry-Back Sensing⁷ ▲ 1.2%

+ Efficiency Improvement

Up to
\$30,000,000
total estimated savings
per year*



1 According to several studies at various copper mines in the US, Chile, and Kazakhstan, missing G.E.T. components can cause more than five days of crusher downtime per year.

2 According to an earlier study, the average direct and indirect costs of an unplanned shovel tooth change-out can be up to \$40K per set.

3 Mines can improve production by up to six percent by adjusting the crusher gap. Results study that included plant validation by authors Gauti Asbjörnsson, Erik Hulthén, Magnus Evertsson, "Modelling and simulation of dynamic crushing plant behavior with MATLAB/Simulink" (2012).

4 According to case studies of both a Peruvian and Kazakh copper mine, brief crusher delays caused by oversized material can add up to multiple days of lost production per year.

5 According to a case study at a Kazakh copper mine, on average, a shovel fills 90% of a truck's available capacity. Load volume monitoring can decrease the remaining 10% of lost carrying capacity over time.

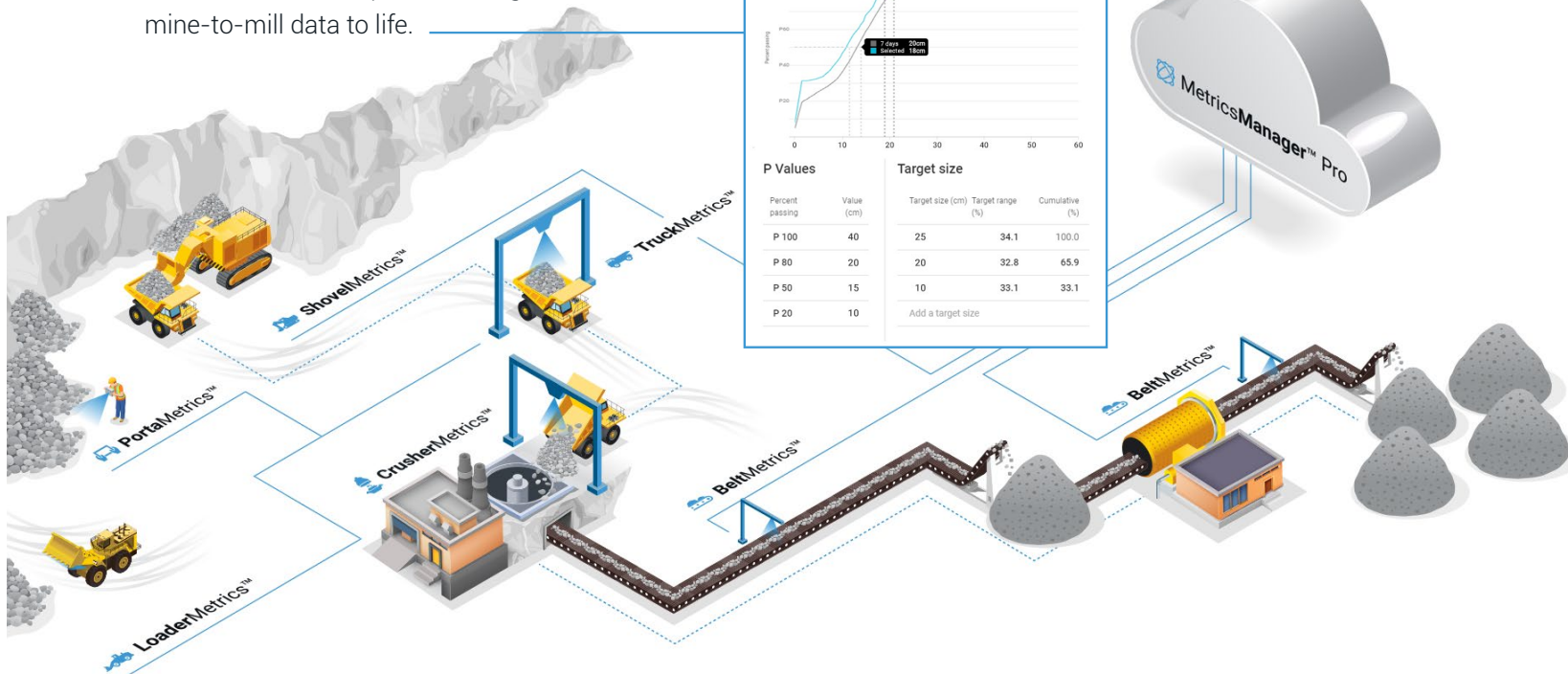
6 Load misalignments can cause significant damage to truck structure and suspension while causing loose material to fall from the truck bed.

7 According to a study in Kazakhstan, production loss and extra fuel costs due to carry-back can represent two percent or more of a mine's production costs per year.

* Productivity impact and cost saving estimates based on a medium-sized gold mine in Latin America.

Our Fully Managed Solution

Detailed, on-demand reports at every stage of the comminution process bring critical mine-to-mill data to life.



Drill & Blast

The Weir Motion Metrics Ecosystem for Mines integrates several key data solutions at every stage of the mining process.

Our systems work together to create a detailed view of mining productivity and efficiency while increasing safety and decreasing operational downtime associated with crusher jams and equipment maintenance.

Production

Secure cloud computing and data storage:

- Unlimited storage and computing power
- Authorized users can access data from any machine, anywhere
- Complex analysis and report generation
- API connectivity to mine systems (on/off premise)
- AI algorithm for automatic delineation of rock fragments and G.E.T. detection.

Haulage

Premium support services, on-site and remote:

- Intuitive technology with remote and on-site training/support
- Automatic custom report generation and KPI monitoring
- Productivity/safety improvement partnership
- Process/discrete control system integration
- No manual calibration needed for fragmentation analysis.

Processing

Productivity

Productivity is king at mines, making equipment downtime one of the costliest problems our customers face. Weir Motion Metrics provides a range of solutions that pay for themselves by reducing crusher, shovel, and loader downtime caused by G.E.T. components.

▲ **6.0%** Optimize comminution with particle size analysis.

▲ **1.2%** Minimize carry-back with haul truck monitoring.

▲ **6.0%** Monitor and optimize haul truck payload with volume monitoring.

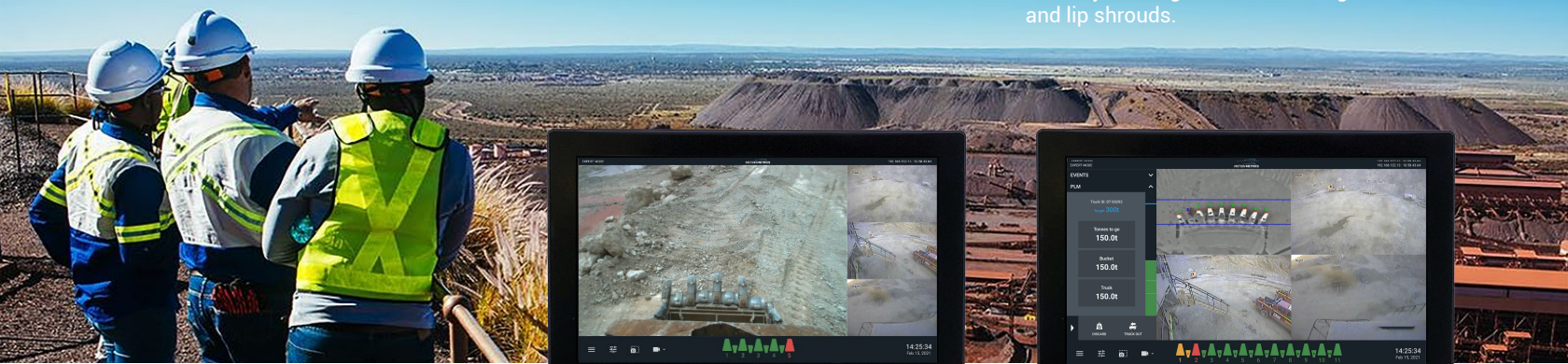
Safety



Researchers found that incidents involving crushers are the second most common cause of fatalities caused by stationary machinery at U.S. mines.

Jammed crusher incidents always present a serious safety issue for any mine due to the tremendous amount of stored kinetic energy.

Weir Motion Metrics mitigates the main culprits of crusher obstructions by providing industry-leading G.E.T. monitoring for teeth and lip shrouds.



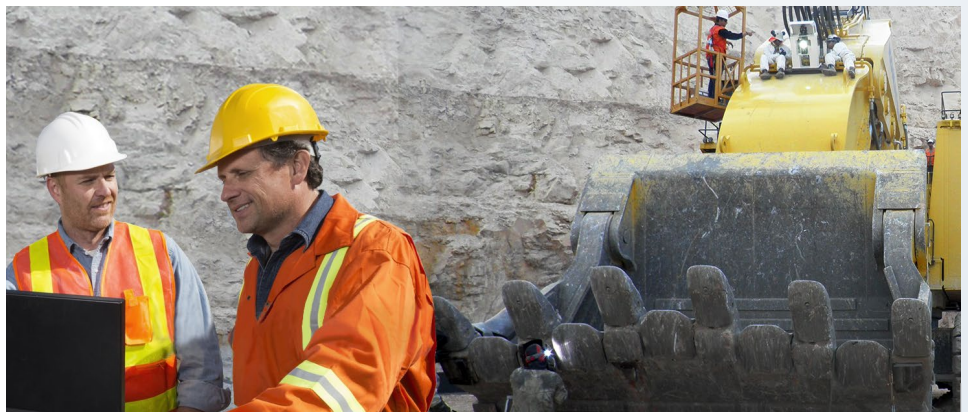
Downtime Reduction

Estimated productivity outcomes:

▲ **1.5%**
Mitigate equipment downtime caused by broken G.E.T. components.

▲ **1.0%**
Keep oversized material out of the primary crusher with boulder detection.

We use industrial cameras and distributed AI to deliver continuous **G.E.T. Detection** + **G.E.T. Wear Monitoring**



Sustainability

To limit global warming to 2° C, all sectors need to reduce GHG emissions from 2010 levels by at least 50 percent for 2050. Right now, only 2.5% of the mining sector's electricity comes from renewables. Switching to renewables will take time, but mines can start fighting climate change today **while saving up to \$30M per year** with Weir Motion Metrics non-interruptive mine-to-mill energy efficiency service.

Drill & Blast Stage

All Weir Motion Metrics products interface with our centralized data analysis platform, MetricsManager Pro. Users with authorized credentials can access particle size data from anywhere to verify and improve the effectiveness of blasting parameters.

Solutions



Features

Particle Size Analysis
No Manual Calibration

Particle Size Analysis
Boulder Detection
Missing Tooth Detection
Tooth Wear Monitoring
Lip Shroud Monitoring
Blindspot Monitoring
Payload Monitoring

Particle Size Analysis
Boulder Detection
Volume Monitoring
Load Profiling

Benefits

Identify missing G.E.T components

Blast optimization

KPI analysis

Minimize crusher maintenance

Increase personnel safety

Reduce collisions

Minimize crusher downtime

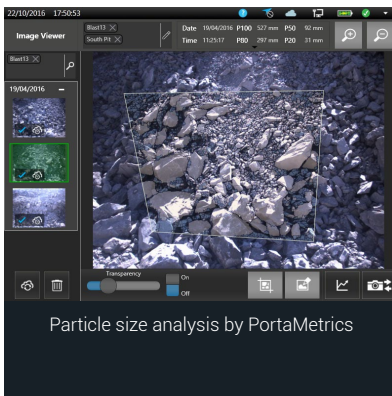
Optimize change-out intervals

Outcomes

Productivity & Efficiency Increases

Safety Enhancement

Downtime Improvement



6.0%
Particle size analysis optimizes each stage of comminution.

Productivity impact & cost saving estimates medium-sized gold mine in Latin America

Production Stage

ShovelMetrics interfaces with our centralized data analysis platform, MetricsManager Pro. Users with authorized credentials can receive automated SMS and email event notifications, in-depth performance reports, equipment activity logs, and particle size data from anywhere.

Solutions



Features

- Particle Size Analysis
- Boulder Detection
- Missing Tooth Detection
- Tooth Wear Monitoring
- Lip Shroud Monitoring
- Blindspot Monitoring
- Payload Monitoring

- Particle Size Analysis
- Boulder Detection
- Volume Monitoring
- Load Profiling

- Missing Tooth Detection
- Tooth Wear Monitoring
- Blindspot Monitoring

Benefits

Identify missing G.E.T components

Blast optimization

KPI analysis

Minimize crusher maintenance

Increase operator safety

Reduce collisions

Optimize change-out intervals

Minimize crusher downtime

Outcomes

Productivity & Efficiency Increases

Safety Enhancement

Downtime Improvement



Haulage Stage

As part of the Weir Motion Metrics solution ecosystem, users with authorized credentials can receive SMS and email boulder notifications, monitor truck volume for insight into shovel operator performance, and access particle size data from anywhere.

Solutions	Features	Benefits	Outcomes
<p>TruckMetrics™</p>	Particle Size Analysis	Identify missing G.E.T components	Productivity & Efficiency Increases
	Boulder Detection	Product size control	
	Volume Monitoring	Blast optimization	
	<p>ShovelMetrics™</p>	Load Profiling	KPI analysis
Particle Size Analysis		Minimize crusher maintenance	
Boulder Detection		Increase personnel safety	
Missing Tooth Detection		Reduce collisions	Downtime Improvement
Tooth Wear Monitoring		Minimize crusher downtime	
Lip Shroud Monitoring		Optimize change-out intervals	
Blindspot Monitoring			
Payload Monitoring			

Boulder detection by TruckMetrics

▲ **1.0%**
Keep oversized material out of the primary crusher with boulder detection.

▲ **6.0%**
Monitor and optimize haul truck payload with volume sensing.

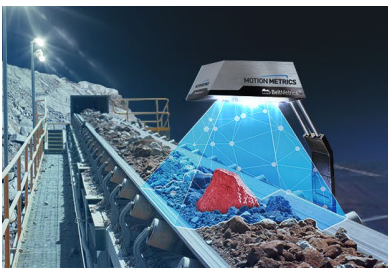
▲ **1.2%**
Minimize haul truck carry-back with TruckMetrics monitoring.

Productivity impact & cost saving estimates medium-sized gold mine in Latin America

Processing Stage

CrusherMetrics monitors crusher productivity while BeltMetrics can provide critical particle size analysis at several stages of the processing operation. Users with authorized credentials can access data summaries, in-depth performance reports, equipment and particle size data from anywhere allowing them to make informed decisions quickly.

Solutions	Features	Benefits	Outcomes
<p>CrusherMetrics™</p>	<ul style="list-style-type: none"> Particle Size Analysis Monitor Crusher Productivity 	Crusher gap setting	<p>Productivity & Efficiency Increases</p>
		Product size control	
		Identify blockages	
		Improve belt life	
<p>BeltMetrics™</p>	<ul style="list-style-type: none"> Particle Size Analysis Empty Belt Detection Volume Monitoring Load Profiling 	Minimize crusher maintenance	<p>Safety Enhancement</p>
		Reduce collisions	
		Minimize crusher downtime	<p>Downtime Improvement</p>
		Optimize change-out intervals	



Particle size analysis by BeltMetrics



▲
6.0%

Particle size analysis optimizes each stage of comminution.

▲
1.0%

Keep oversized material out of the primary crusher with boulder detection.

Productivity impact & cost saving estimates medium-sized gold mine in Latin America

About Us

A message from our Chief of AI, Shahram Tafazoli

Shahram founded Motion Metrics after completing his PhD thesis in Robotics and Intelligent Systems at the University of British Columbia (UBC). He received his bachelor and master's degrees (with honors) from Sharif University of Technology. He is an avid inventor holding numerous patents, an adjunct professor with the UBC Department of Electrical and Computer Engineering (ECE), an angel investor in many promising Canadian and international technology start-ups, and an associate member of the Creative Destruction Lab. Shahram chairs several boards of the directors and sits on advisory board of several technology companies. Shahram believes in lifelong learning.



Vision

To inspire a new generation of safe,
sustainable, and intelligent mining

Mission

To create and deploy innovative products that
combine machine vision and artificial intelligence
to solve tough mining challenges

Values

Trust, innovation, collaboration,
and determination



Ajay Agrawal is a professor at the University of Toronto, Research Associate at the National Bureau of Economic Research in Cambridge, MA, Faculty Affiliate at the Vector Institute for Artificial Intelligence, and Advisory Board Member for Carnegie Mellon University's Block Center for Technology and Society. He conducts research on the economics of science and innovation and co-authored the best-selling book "Prediction Machines: The Simple Economics of Artificial Intelligence" (Harvard Business School Press, 2018) and co-edited "The Economics of Artificial Intelligence: An Agenda" (University of Chicago Press, 2019). Professor Agrawal is founder of the Creative Destruction Lab and co-founder of NEXT Canada. The Globe and Mail listed Professor Agrawal as one of the 50 Most Powerful People in Canadian Business.

Ajay Agrawal
Senior Advisor on Business Strategy and Artificial Intelligence

Affiliations



Notes

Trademark Information

The Weir Motion Metrics logo, along with all product logos contained herein, are internationally recognized trademarks registered in the U.S. Patents and Trademark Office.

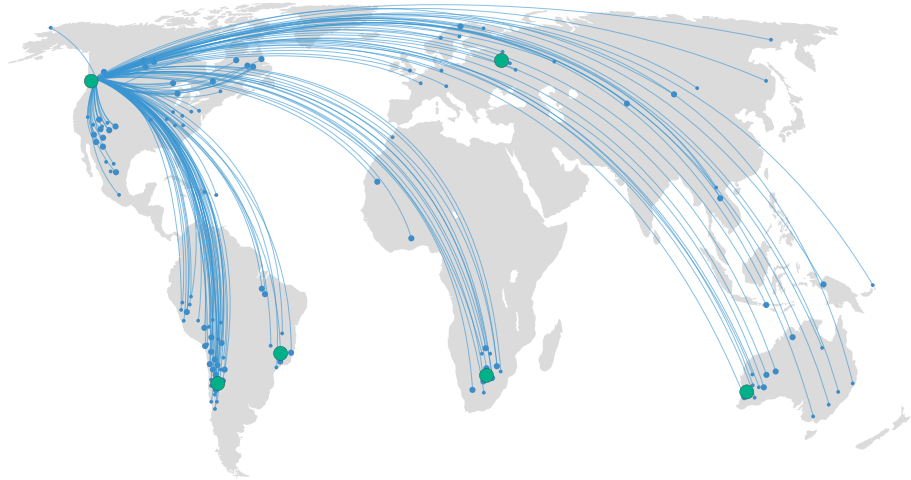


Weir Motion Metrics
Ecosystem for Mines



Our helpful representatives are present everywhere you do business.

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For additional information, advice, or support, please contact our team of solutions experts whenever you need them. Our helpline is open 7 days a week and you can visit our website for online support or product information.



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