



# SMART RADAR INSTANTLY UNLOCKS MINE AND PLANT PERFORMANCE

2D | 3D RADAR

RTLS | UWB | GNSS

AUTOMATION

INVENTORY CONTROL

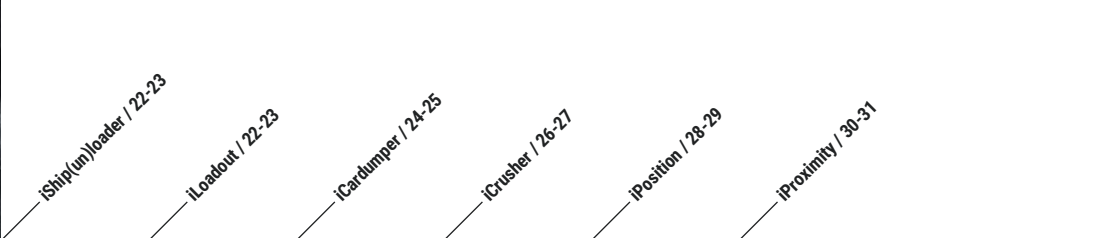
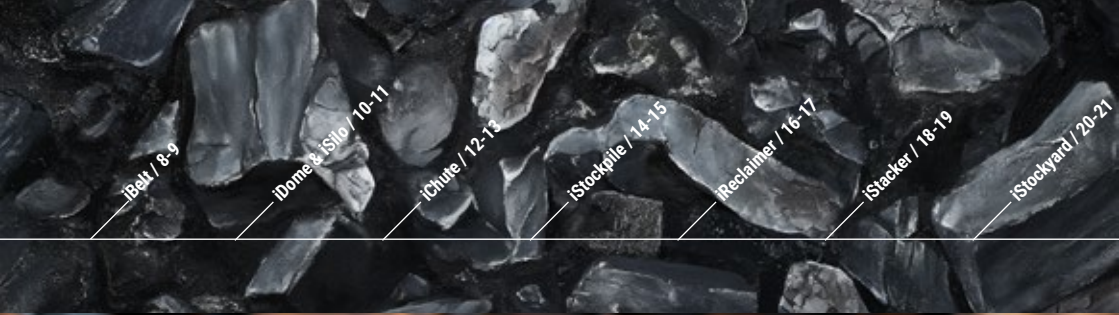
ANTI-COLLISION

DEBOTTLENECKING

REMOTE CONTROL

PIT TO PORT





# REVOLUTIONIZING THE BULK MATERIAL VALUE-CHAIN WITH INDURAD'S MODULAR SMART RADAR SOLUTIONS.

## Empowering Global Industries with indurad's Smart Radar Solutions

At indurad, a trailblazer in advanced radar technology, we take pride in our heritage as a worldwide operating company headquartered in Aachen, Germany. Our mission is to revolutionize the bulk material value chain with our high-end, extremely robust radar sensors, reliable hardware, and modular software solutions tailored to meet the unique demands of each industry we serve.

## Customized Solutions for Every Sector

Understanding that each sector within the bulk material value chain has its own set of complexities and requirements, we have developed modular software solutions that cater to the specific needs of each branch. Whether it's mining, processing, logistics, or stockyard management, our software possesses an in-depth knowledge of industry-specific dynamics, enabling it to provide actionable insights that drive safety, efficiency, and productivity.

## A Commitment to Excellence and Customer Value

With a focus on creating real, measurable value for our customers, indurad continuously strives to transform industry standards. Our solutions not only enhance operational excellence but also set new benchmarks for safety and efficiency in the global bulk material handling space.

# INDURAD SMART RADAR: EXCEPTIONAL PRECISION AND ENDURANCE UNDER EXTREME CONDITIONS.

## Unparalleled Reliability in Harsh Conditions:

Radar technology, unlike LiDAR or laser systems, maintains its precision and accuracy even in the most challenging environmental conditions. Its capability to see through dust, deep fog, extreme cold, and heat is unparalleled. This is a critical advantage in mine processing, bulk logistics, and underground mining, where operations often face extreme dust, moisture, and temperature variations. indurad's radar solutions ensure consistent performance and reliability where other systems falter.



## Enhanced Safety and Efficiency:

Radar technology ensures safety and reduces downtime by operating reliably in all conditions, making indurad's solutions key to safer, more efficient operations across the mining and logistics sectors.

## Mine Processing Illustrated Through Radar Technology:

Radar technology minimizes blockages and downtime in mine processing, boosting throughput and efficiency by ensuring continuous material flow, even in dusty or adverse weather.

## Bulk Logistics Navigating Visibility Challenges:

Radar technology overcomes visibility challenges in bulk logistics, speeding up operations and improving safety and efficiency in train logistics, stockyard management, and ship loading/unloading.

## Underground Mining Safety in the Forefront:

In underground mining, radar technology enhances safety and productivity by providing reliable collision avoidance and guidance, even in the dustiest and darkest conditions.



INDURAD 1D RADAR



INDURAD 2D RADAR



INDURAD 3D RADAR

## Conclusion:

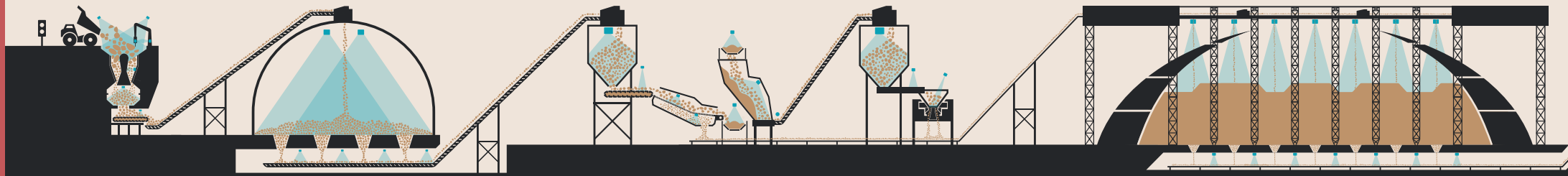
indurad's smart radar technology's robust performance under extreme conditions distinguishes it from LiDAR and laser systems. indurad harnesses this strength to boost safety, efficiency, and productivity across the bulk material value chain, transforming industry standards and generating real, measurable value for customers.

# OUR MISSION

indurad is dedicated to transforming asset efficiency and safety through our pioneering radar technology and software solutions. Our mission is to enhance safety, reduce downtime

and establish connectivity across the mining and plant sectors, ensuring optimized performance and sustainable operational excellence.

MINE PROCESSING



## MINE FEED

Significant reduction in blockages & downtime

## BULK FLOW IN PLANT

Increased throughput via analytics & automation

## BULK VOLUME

Uninterrupted 3D inventory & quality control

BULK LOGISTICS



## TRAIN LOGISTICS

Increased payloads & reduced waste

## STOCKYARD MANAGEMENT

Enhanced efficiency via remote control & automation

## SHIPLOADING

Make export safe, fast, plannable

UNDERGROUND MINING



## COLLISION AVOIDANCE

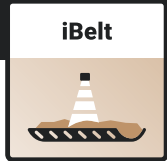
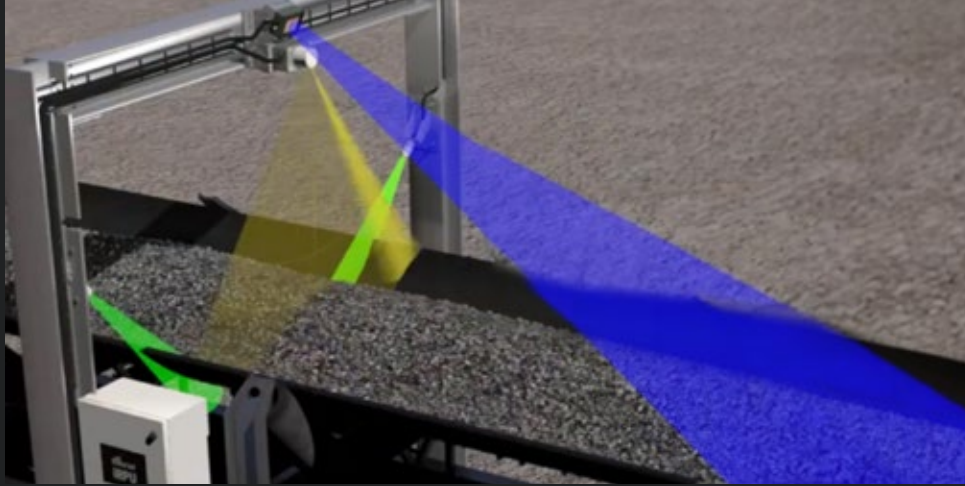
Safety & operator guidance

## PRODUCTION & AUTOMATION

Increased throughput via debottlenecking

## CONTINUOUS HAULAGE

Monitoring & control of conveyor and transfer points



## BULK MATERIAL FLOW & BELT MONITORING

- › For volume reconciliation & production control
- › Allows feed optimization & belt monitoring
- › Contact-free sensing with no maintenance required
- › Reliable radar for operation under all environmental conditions
- › Can be commissioned by the customer

### iBELT SOLUTION MODULES

MATERIAL VOLUME MEASUREMENT

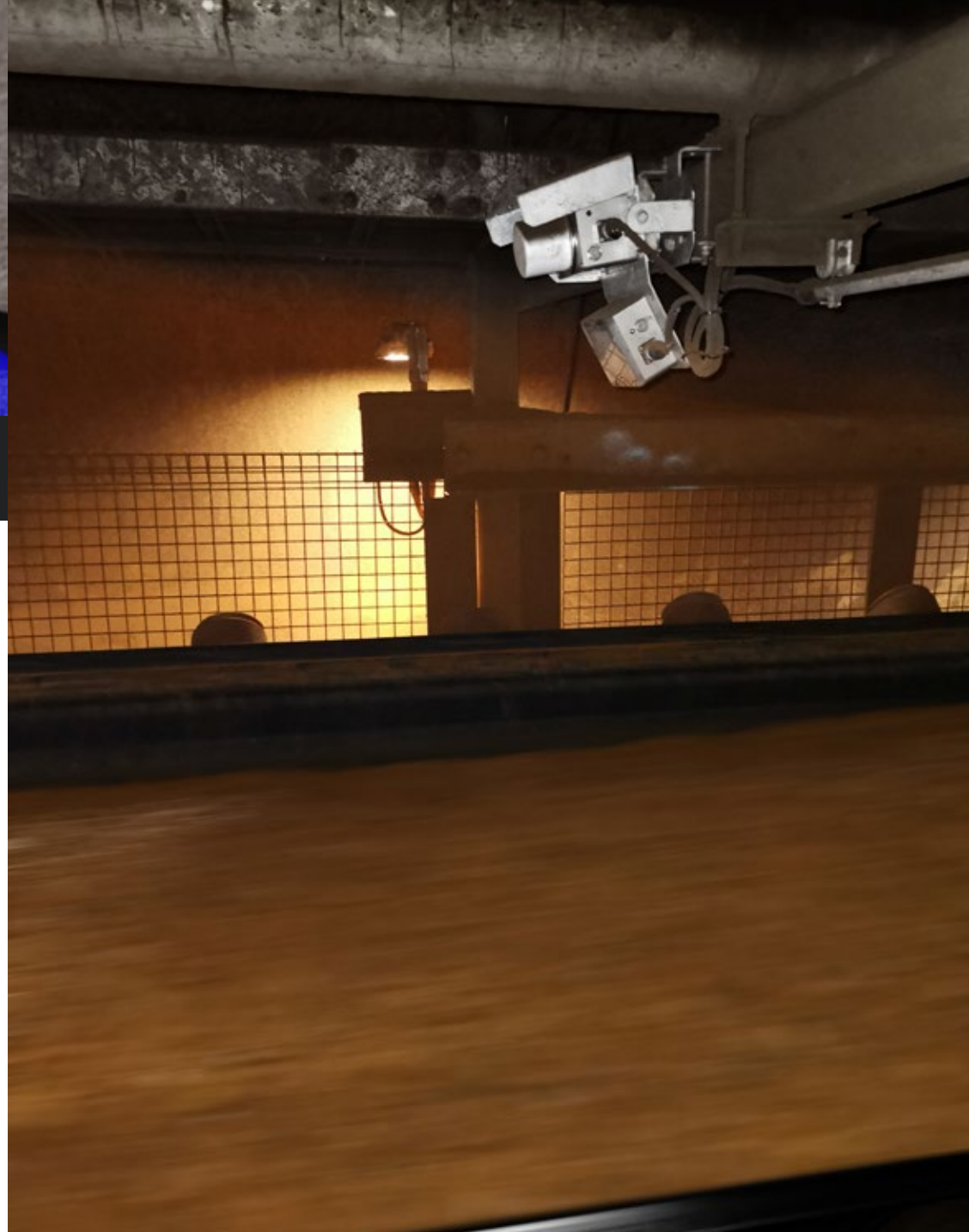
MATERIAL SPEED MEASUREMENT

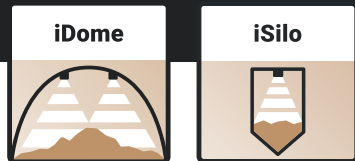
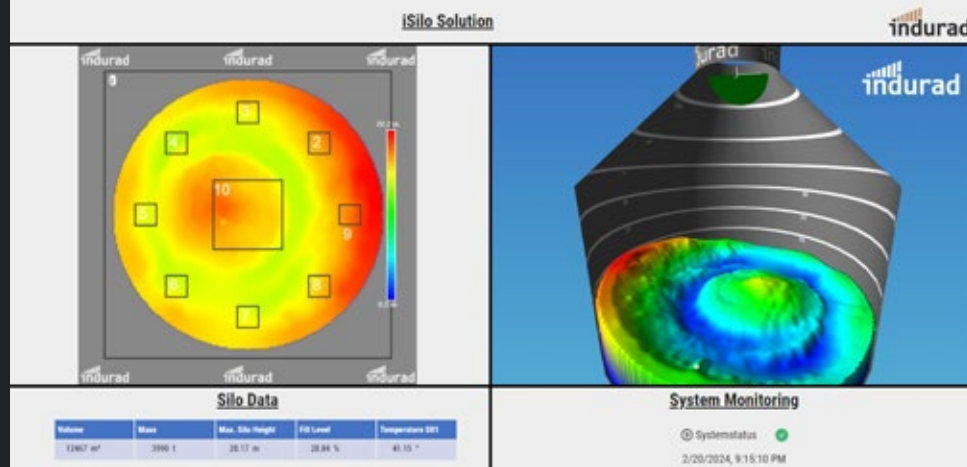
BELT MISALIGNMENT TRACKING

BELT FREEBOARD MEASUREMENT

DENSITY CALCULATION

4G / 5G / STARLINK CONNECTIVITY





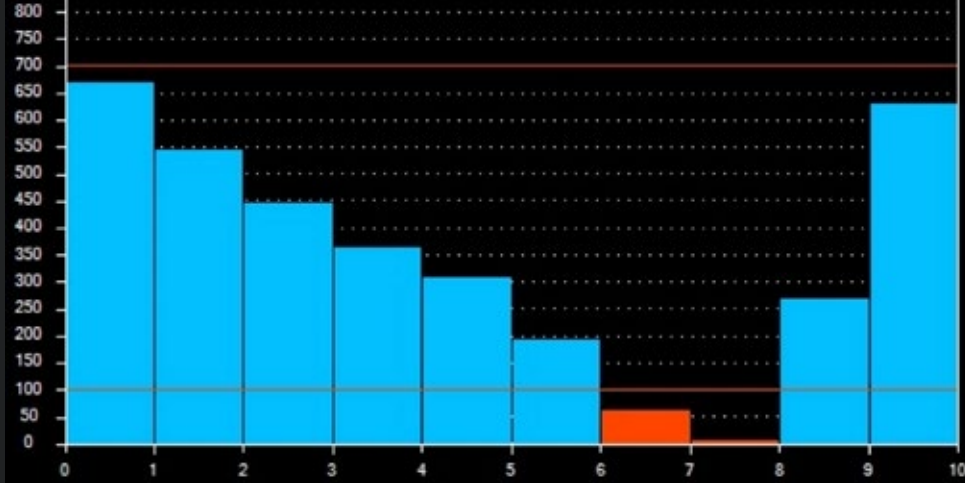
## VOLUME MEASUREMENT & FEEDER DRAW CONTROL

- › 1D: Level measurement
- › 2D: Cross section measurement
- › 3D: Full volume measurement for advanced inventory control
- › ATEX and high temperature sensor enclosing available
- › Replaces expensive and time-consuming manual surveying

### iDOME & iSILO SOLUTION MODULES

VOLUME CONTROL	DEAD MATERIAL IDENTIFICATION
FEEDING HEIGHT IDENTIFICATION	MATERIAL FLOW IDENTIFICATION
DISCHARGE ZONE IDENTIFICATION	SEGREGATION CONTROL





## LEVEL CONTROL & BLOCKAGE DETECTION

- › Increased throughput
- › Minimizes unplanned downtime
- › 1D and 2D measurement available
- › Surface contour used for visualization and control functionality suitable for weak / old infrastructure
- › Measures even under harsh environment

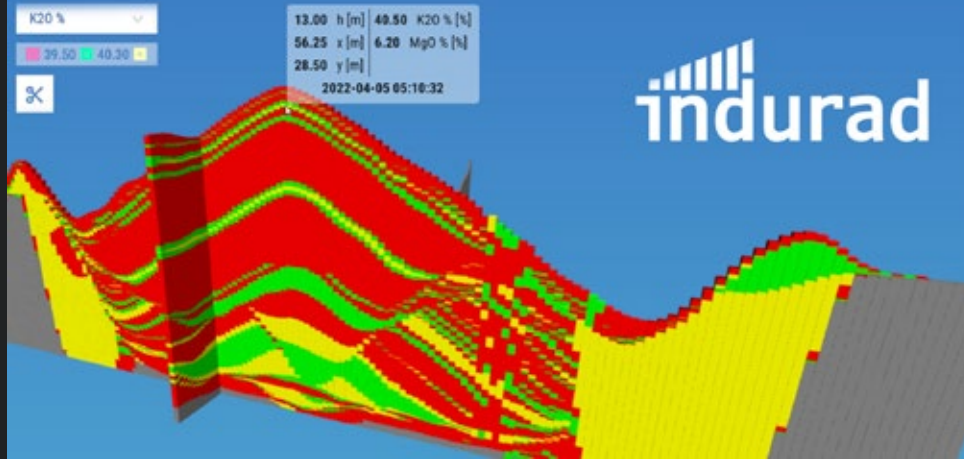
### iCHUTE SOLUTION MODULES

FILL LEVEL MEASUREMENT

DETECTION OF BUILD UP MATERIAL

SUPPORTS ALL CHUTE SHAPES

MATERIAL FLOW VISUALIZATION

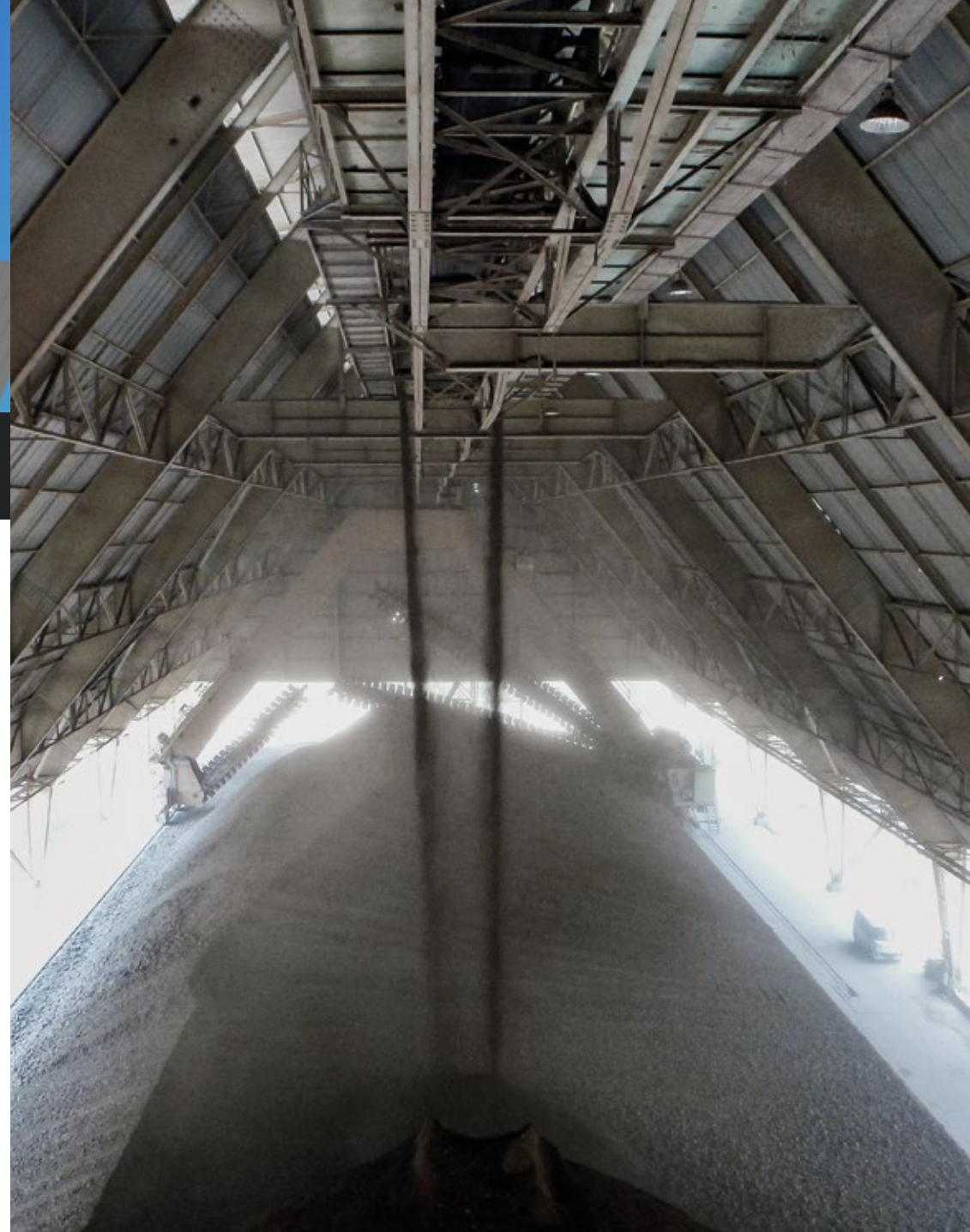


## 3D INVENTORY CONTROL & PROCESS IMPROVEMENTS

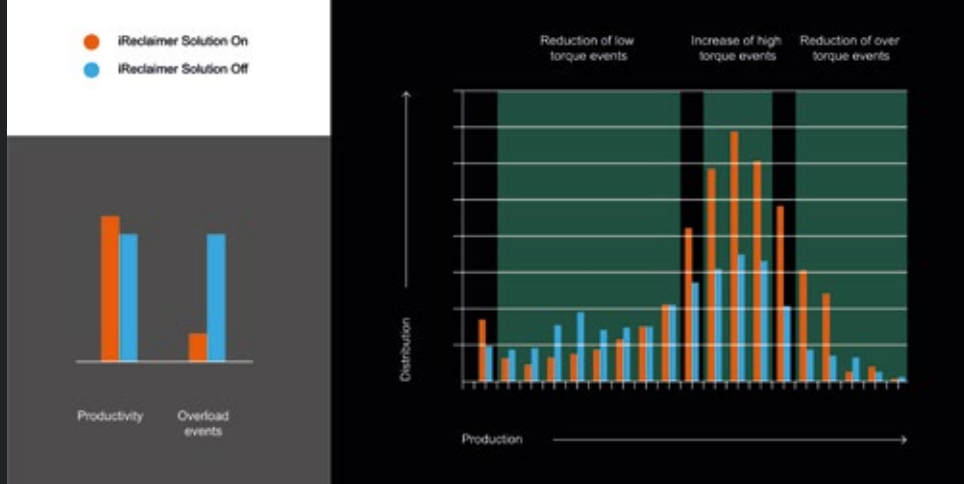
- › Volume control & feeder draw control
- › Ore reconciliation & automation
- › Stockpile volume history, extended reporting, & stockpile visualization
- › Scan from tripper, portal, crane or fixed installation

### iSTOCKPILE SOLUTION MODULES

3D STOCKPILE VOLUME INFORMATION	4D MATERIAL AGE INFORMATION
ANGLE OF REPOSE INFORMATION	4D MATERIAL QUALITY INFORMATION
FACE UP POINT INFORMATION	5D MATERIAL FLOW INFORMATION





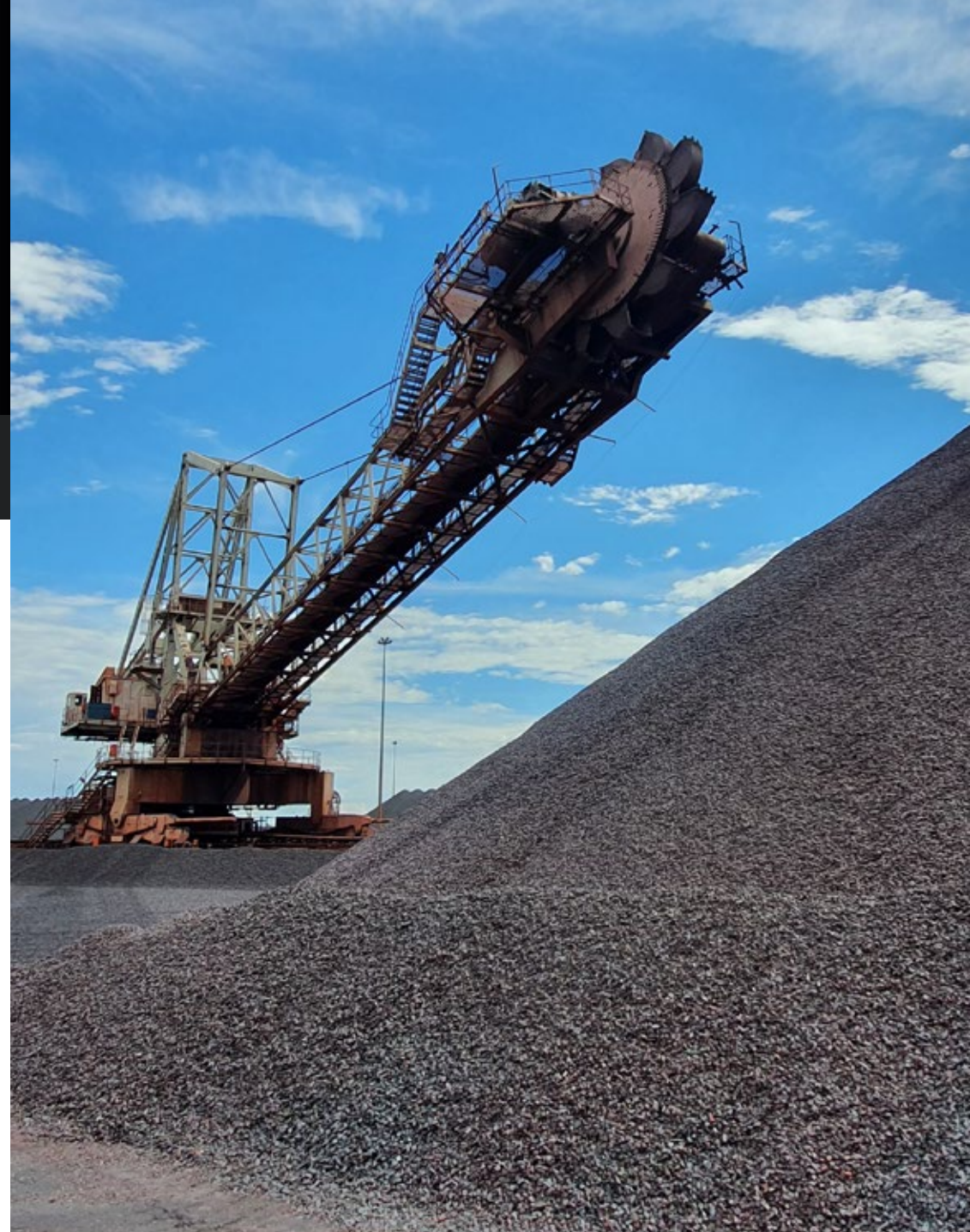


## RECLAIMING CONTROL & PRODUCTIVITY BOOST

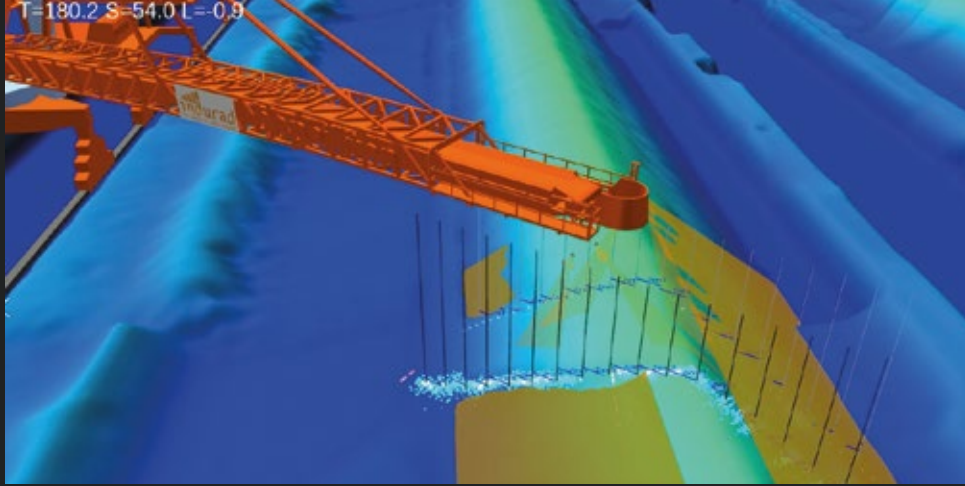
- › Predictive volume calculation, cutting span estimation, & automation
- › Typically 75 % overtorque reduction & 10 % productivity gain
- › 3D volume control & visualization
- › Scalable from operator assistance to autonomous machine

### iRECLAIMER SOLUTION MODULES

CUTTING DEPTH AND BENCH HEIGHT	OPTIMIZED SLEW CONTROL
MACHINE POSITIONING	COLLISION AVOIDANCE
FACE UP POINT CALCULATION	+ 6 MORE ON <a href="http://INDURAD.COM">INDURAD.COM</a>



T=180.2 S=54.0 L=-0.9



## STACKING ASSISTANCE & INVENTORY CONTROL

- › 3D volumetric inventory control
- › Live angle of repose measurement & dump height control
- › More uptime, process control & consistency
- › Pile shaped to increase pile volume and reclaiming speed

### ISTACKER SOLUTION MODULES

PILE SCANNING

BOOM TO PILE DISTANCE

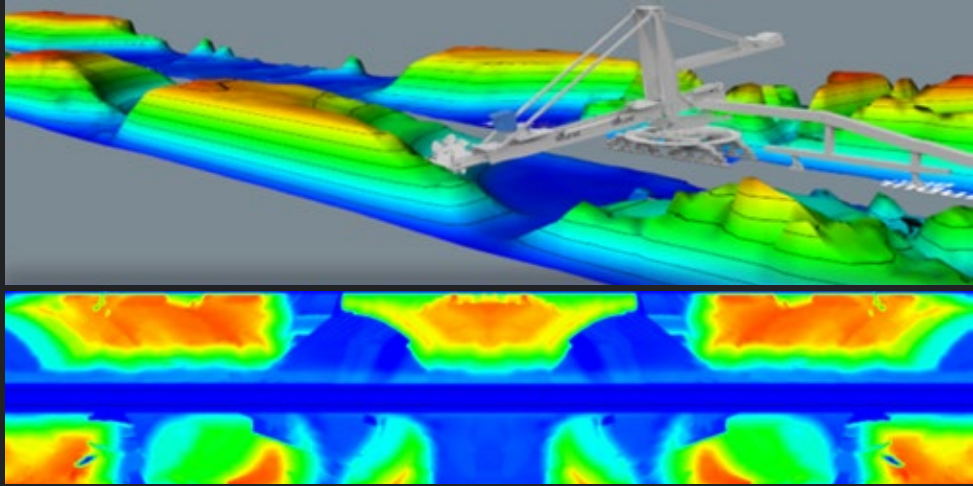
MACHINE POSITIONING

FACE UP POINT CALCULATION

DUMP HEIGHT CONTROL

COLLISION AVOIDANCE





Perspective view, Top view



## FULL VISIBILITY OF YOUR STOCKYARD

- › Increased productivity
- › Minimized unplanned downtime
- › Increased usable capacity
- › Increased safety

### iSTOCKYARD SOLUTION MODULES

2D / 3D STOCKYARD MODEL

5D MATERIAL FLOW INFORMATION

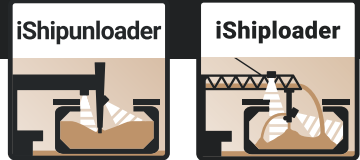
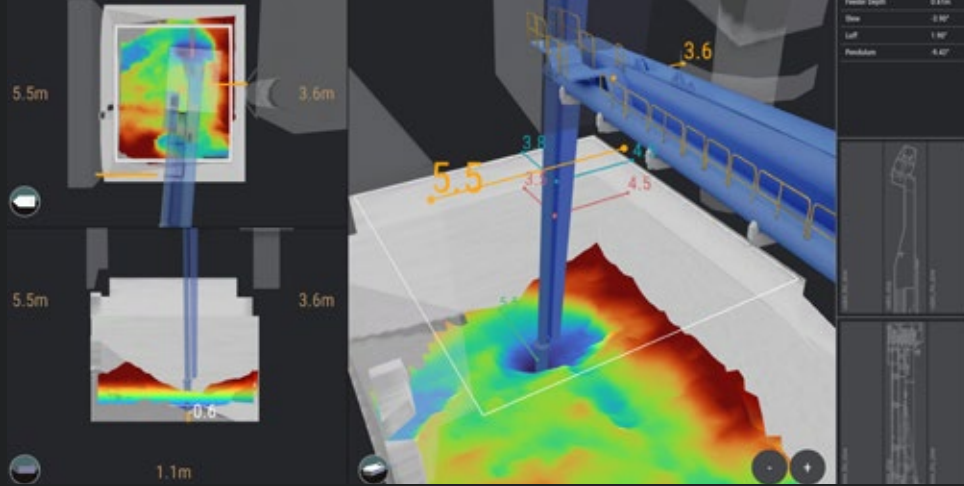
4D MATERIAL AGE INFORMATION

MACHINE2MACHINE CAS

4D MATERIAL QUALITY INFORMATION

FACE UP POINT CALCULATION



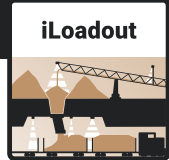
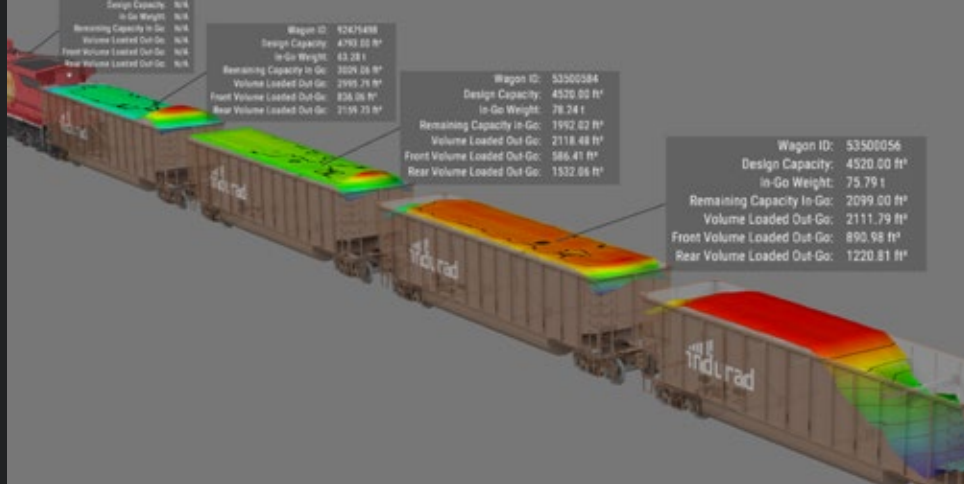


## COLLISION AVOIDANCE, REMOTE CONTROL & AUTOMATION

- › Fully autonomous loading & unloading
- › Ship-hold mapping, hatch size & limit detection
- › Central control & visualization of entire berth operation
- › Reduces crew exposure to hazardous operations

### iSHIPUNLOADER, iSHIPLOADER SOLUTION MODULES

COLLISION AVOIDANCE	REMOTE CONTROL
LOADING ASSISTANCE	FULL AUTONOMOUS AUTOMATION
SHIP ROLL, PITCH, YAW	+ 5 MORE ON INDURAD.COM

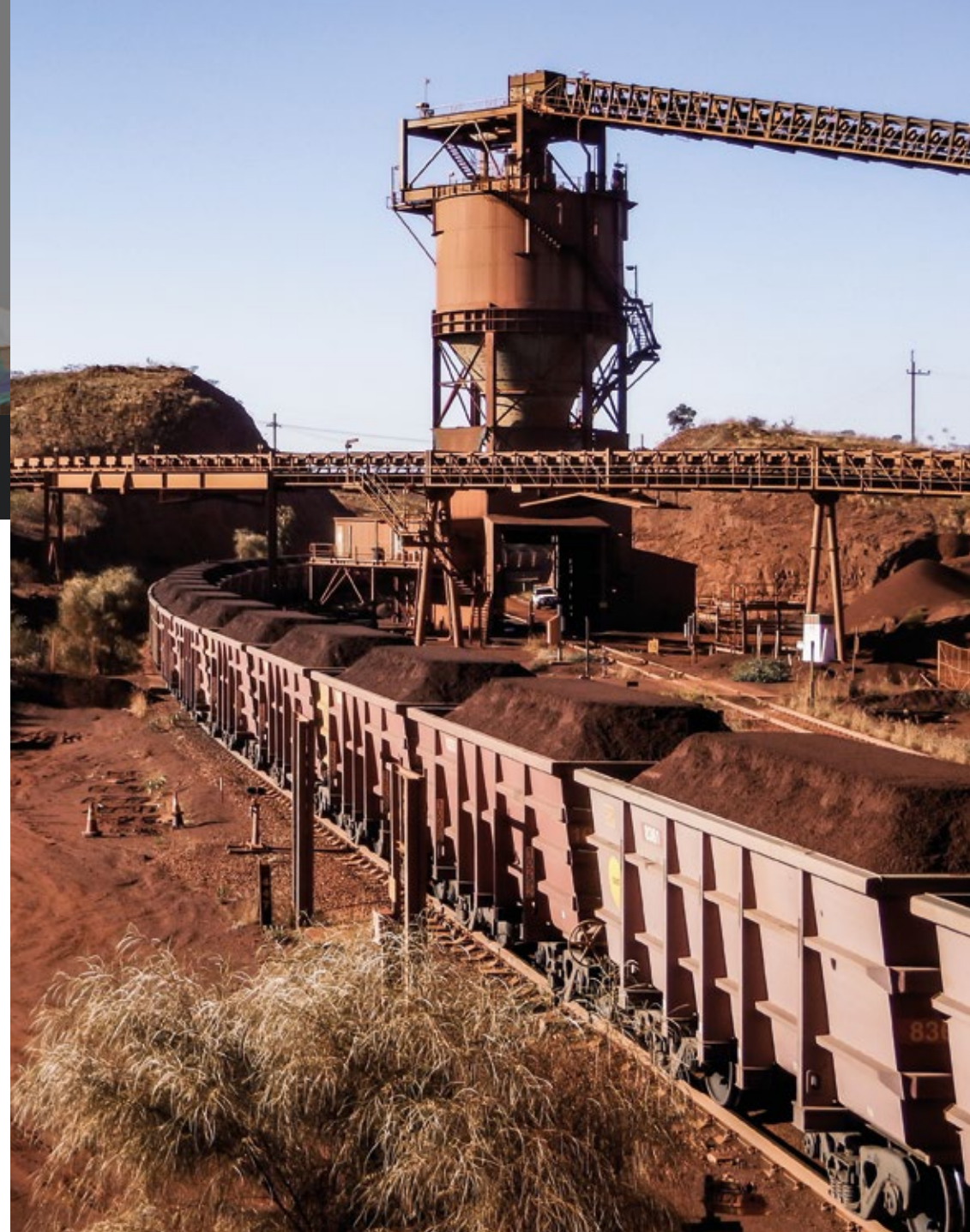


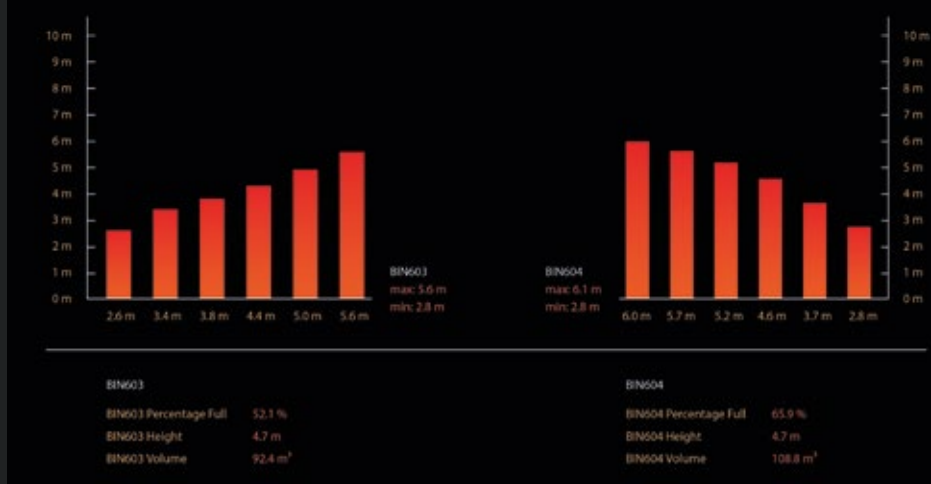
## ADVANCED PROCESS CONTROL: HIGHER SETPOINT, LESS DEVIATION

- › Radar based control solution for train & truck loadout systems (TLO)
- › Enables process optimization, automation, & inventory control
- › Reduces over/underloading (improving compliance)
- › Increases train speed by 10-30% & load by 1-3 tons per car
- › Ensuring uniform axle loads

### iLOADOUT SOLUTION MODULES

TRAIN SPEED MEASUREMENT	WAGGON IDENTIFICATION
VOLUMETRIC WAGGON CONTROL	RESIDUAL MATERIAL CHECK
WAGGON LOAD DISTRIBUTION	+ 11 MORE ON INDURAD.COM





Easy retrofit and integration into existing PLC/SCADA system



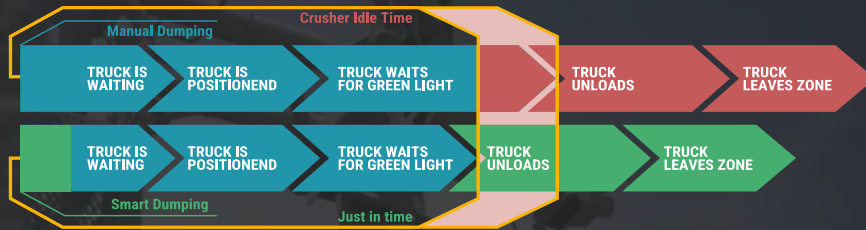
## IMPROVE RELIABILITY & AVAILABILITY IN INLOAD

- › Process optimization in rail car dumper/waggon tippler
- › Indexer positioning, waggon identification, apron level control
- › Significantly reduce wear & damage to cardumper & apron feeder
- › Reliable measurement in harsh installation environments

### iCARDUMPER SOLUTION MODULES

INDEXER POSITIONING	INDEXER GAP POSITIONING
WAGON CLASSIFICATION	APRON FEEDER CONTROL
RESIDUAL MATERIAL CHECK	OUTGOING BELT VOLUME





## PRIMARY, SECONDARY & TERTIARY CRUSHERS

- › Crusher productivity optimization & rock breaker automation
- › Truck dump timing control
- › Level control (keeps secondary and tertiary crushers with consistent choke feeding)
- › Digitization of the crushing process & crusher components
- › Truck dump time reduction by up to 25%

### iCRUSHER SOLUTION MODULES

TRUCK DUMP CONTROL

BLOCKAGE DETECTION

MATERIAL SURFACE DETECTION

CRUSHER CHAMBER LEVEL

MATERIAL FLOW DETECTION

APRON FEEDER LEVEL









- › Access control
- › Transponder
- › Light Vehicle
- › Heavy Vehicle



## FULL LEVEL 9 UNDERGROUND COLLISION AVOIDANCE SOLUTION


- › Complete access control, people tracking and collision avoidance solution
- › Helmet & lamp transponders, light vehicle, & heavy vehicle
- › Underground „GPS“: precise localization & access control
- › ISO21815 / EMERST Level 9

### iPROXIMITY SOLUTION MODULES

VEHICLE2VEHICLE	VEHICLE2PERSON
VEHICLE2INFRASTRUCTURE	POSITIONING
ACCESS CONTROL	SMART DATA LOGGING





-   
Dust
-   
Snow
-   
Rain/Water
-   
Ice/Cold
-   
Heat
-   
Contamination
-   
Sand
-   
Low Visibility

# RADAR & RTLS SENSORS

## MADE IN GERMANY

We are constantly innovating radar and RTLS (real-time locating system) technologies to develop the next generation of sensors. We are manufacturing at our facility in Aachen, Germany. Our main design criteria is the suitability for mining applications.

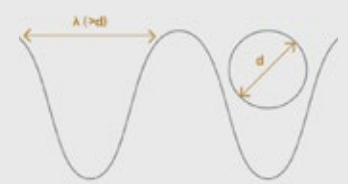
## INDURAD – INDUSTRIAL RADAR

Since inventing the first 2D radar for industrial use, the iDRR (indurad DualRangeRadar), in 2008, our technology and product range have significantly advanced. Today, we offer a comprehensive range of radar sensors that boost the productivity and sustainability for our customers in all environmental conditions.

Our product range now includes RTLS sensors, GNSS sensors, and processing units, enhancing our offering. While our sensors are mainly utilized within our systems, we also support OEMs with ROS2 interface capabilities.

### RADAR: $\lambda = 4 \text{ MM}$ ; $D = 3 \text{ MM}$

The illustration highlights our radar's ability to penetrate obstacles like dust, fog, snow, and steam, showcasing a radar wave navigating around a 3mm dust particle.



<h4 style="text-align: center;">1D RADAR</h4>  <p style="font-size: small;">Compact design for long distance measurement with mm precision and above 1000Hz.</p>	<h4 style="text-align: center;">2D RADAR</h4>  <p style="font-size: small;">Long, medium and short range 360° scanning radars made for mining automation.</p>	<h4 style="text-align: center;">3D RADAR</h4>  <p style="font-size: small;">World's only 3D scanning radar portfolio for medium- and long-range lidar-like quality.</p>
<h4 style="text-align: center;">SPEED RADAR</h4>  <p style="font-size: small;">Family of doppler radar sensors for speed measurement from low to high speeds.</p>	<h4 style="text-align: center;">RTLS</h4>  <p style="font-size: small;">Transponder based on UWB (ultra wideband) suitable for large scale applications.</p>	<h4 style="text-align: center;">GNSS</h4>  <p style="font-size: small;">GNSS solutions for position measurement and collision avoidance.</p>



## OUR COMPANY

indurad's mission is to make mining and bulk material handling safer and more efficient. We do this by using our own radar sensors and solution framework.

Founded in 2008, we are headquartered in **Aachen, Germany**, with service and sales **offices in Australia, Canada, Chile, Brazil, South Africa and Kazakhstan**. In addition, we have an extensive network of OEM and integration partners to serve our customers around the clock, wherever they are.



indurad Headquarters: Aachen, Germany

# indurad References: Customers & Partners



## GLOBAL OEM CUSTOMERS



## GLOBAL DISTRIBUTORS AND TECHNOLOGY PARTNERS





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