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Digitalize Conveyor Belt Monitoring

Reduce Production Loss and Ensure the
Operational Continuity

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INTRODUCTION

DIGITALIZE CONVEYOR BELT MONITORING

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INCREASING OUTPUT AND PRODUCTIVITY, WHILE DECREASING FAILURE RISKS THROUGH DIGITAL CONVEYOR BELT MONITORING

Pivoting from a reactive to a predictive and proactive monitoring and asset management system is now essential. Are you doing to most to reduce production loss and maximize productivity in your mining operations?

In this eBook, we detail how digitalizing the monitoring infrastructure of conveyor belts enables a proactive, predictive and intelligent approach towards throughput and downtime prevention.

While this eBook focuses on critical imperatives and challenges for the mining industry, the current and future state of conveyor belt monitoring and how you can proactively monitor your operations and predict fires on belt conveyors for Mining & Metal, Pulp & Paper and Chemical plants in the U.S., many of the concepts described are applicable to other regions served by Yokogawa.

On behalf of the entire Yokogawa crew, we hope this resource will help you improve your operations.

Enjoy!

EBOOK

This eBook explains how to proactively prevent abnormal situations with no downtime for maintenance. Discover how DTSX gives you the insight needed to proactively prevent abnormal situations, reduce safety and fire risks, and identify irregular conditions and shifts in-process applications in conveyor belt monitoring.
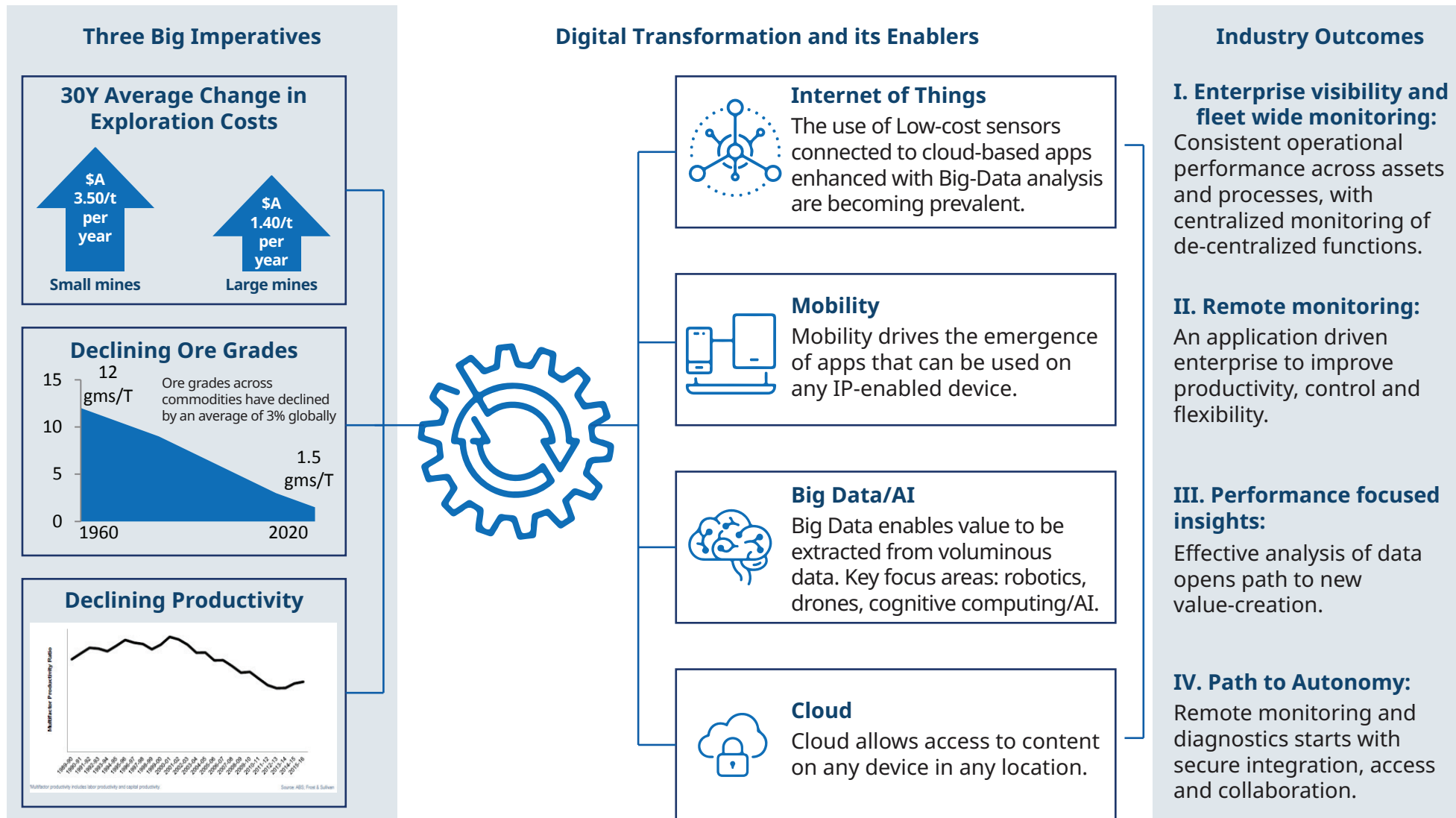
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CHAPTER 1

Industry Challenges

1.1 THE DIGITAL CHALLENGES FOR THE MINING INDUSTRY

FACING THREE BIG IMPERATIVES

Mining organizations face three big imperatives, that challenge profitability. Effective adoption of **Digital Solutions pave the way for smarter, safer and efficient operations**. However, the industry is slow to ramp up on this journey.

Three Big Imperatives

30Y Average Change in Exploration Costs

$A 3.50/t per year — Small mines

$A 1.40/t per year — Large mines

Declining Ore Grades

15

12 gms/T

Ore grades across commodities have declined by an average of 3% globally

10

5

1.5 gms/T

0

1960 — 2020

Declining Productivity

Multifactor productivity includes labor productivity and capital productivity

Multifactor Productivity Ratio

Source: ABS, Frost & Sullivan

Digital Transformation and its Enablers

Internet of Things
The use of Low-cost sensors connected to cloud-based apps enhanced with Big-Data analysis are becoming prevalent.

Mobility
Mobility drives the emergence of apps that can be used on any IP-enabled device.

Big Data/AI
Big Data enables value to be extracted from voluminous data. Key focus areas: robotics, drones, cognitive computing/AI.

Cloud
Cloud allows access to content on any device in any location.

Industry Outcomes

I. Enterprise visibility and fleet wide monitoring:
Consistent operational performance across assets and processes, with centralized monitoring of de-centralized functions.

II. Remote monitoring:
An application driven enterprise to improve productivity, control and flexibility.

III. Performance focused insights:
Effective analysis of data opens path to new value-creation.

IV. Path to Autonomy:
Remote monitoring and diagnostics starts with secure integration, access and collaboration.

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1.2 CURRENT STATE OF MINING VALUE-CHAIN

### THE SILOED AND BROKEN NATURE OF MINING VALUE-CHAIN

The **disconnects in the value-chain leads to weak data integration across the process areas**. This leads to lack of data collaboration and thereby greater operational inefficiencies. While demand for commodities are poised to increase (due to growth in electronics and electric vehicles), the **industry needs to engineer strategic digital transformation pivots to improve operational profitability.**

Exploration → Mine design, planning and development → Extraction → Processing → Transport → Trade
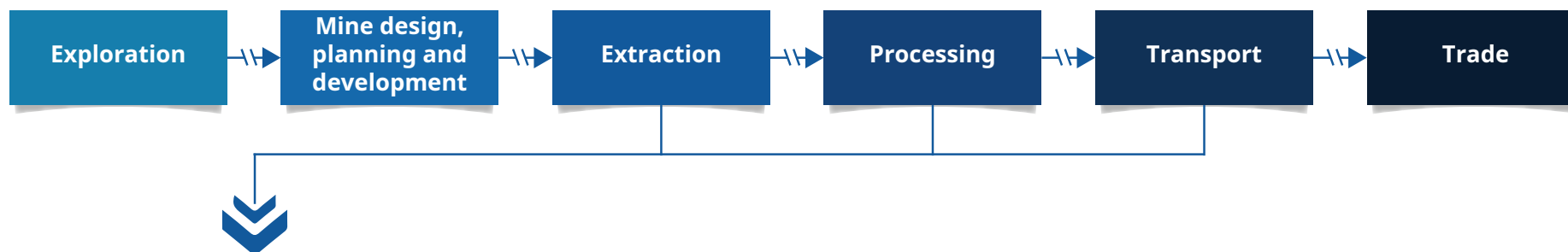
Extraction to Processing to Transportation account for 65-95% of the overall cost of the mining operation.

Blasting 15%
Drilling 16%
Loading 21%
Transport 48%

source: Yokogawa
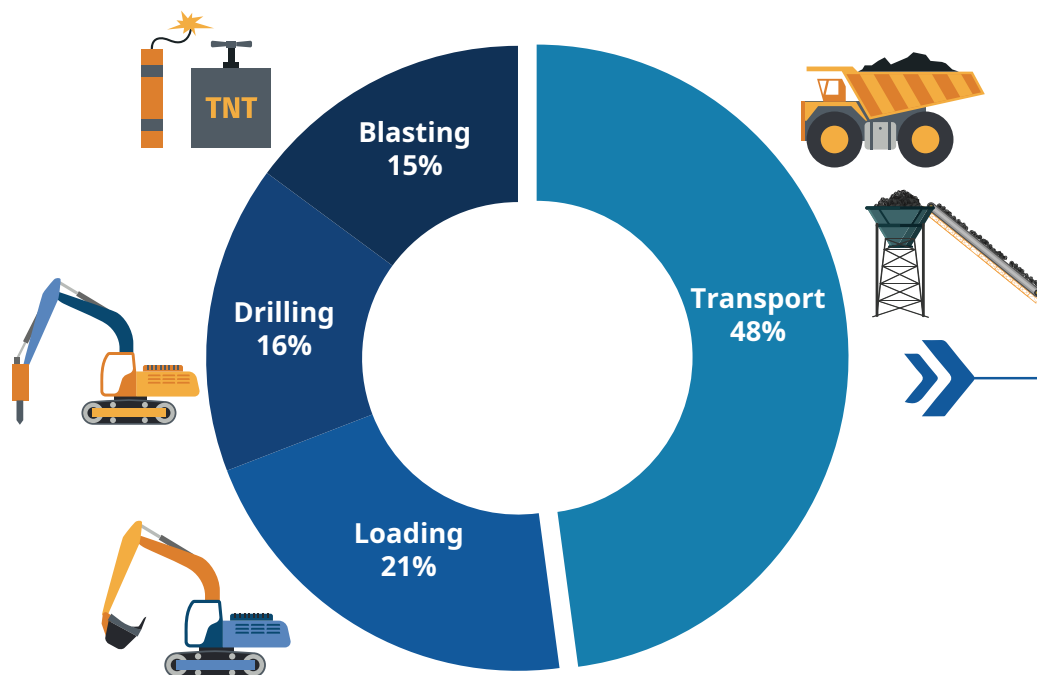
- Transportation costs (includes use of heavy duty trucks and conveyor belts) transfer the material to its various destinations within the mining facility.

- Apart from haulage trucks, the conveyor belts use in mining industry are significant and plays a production critical role in day-to-day operations. A typical mining conveyor belt system, is difficult to maintain, and it consists of:
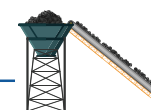
20,000 rollers across a 8km conveyor belt system

100,000 data points need to be captured to maintain the system reliably

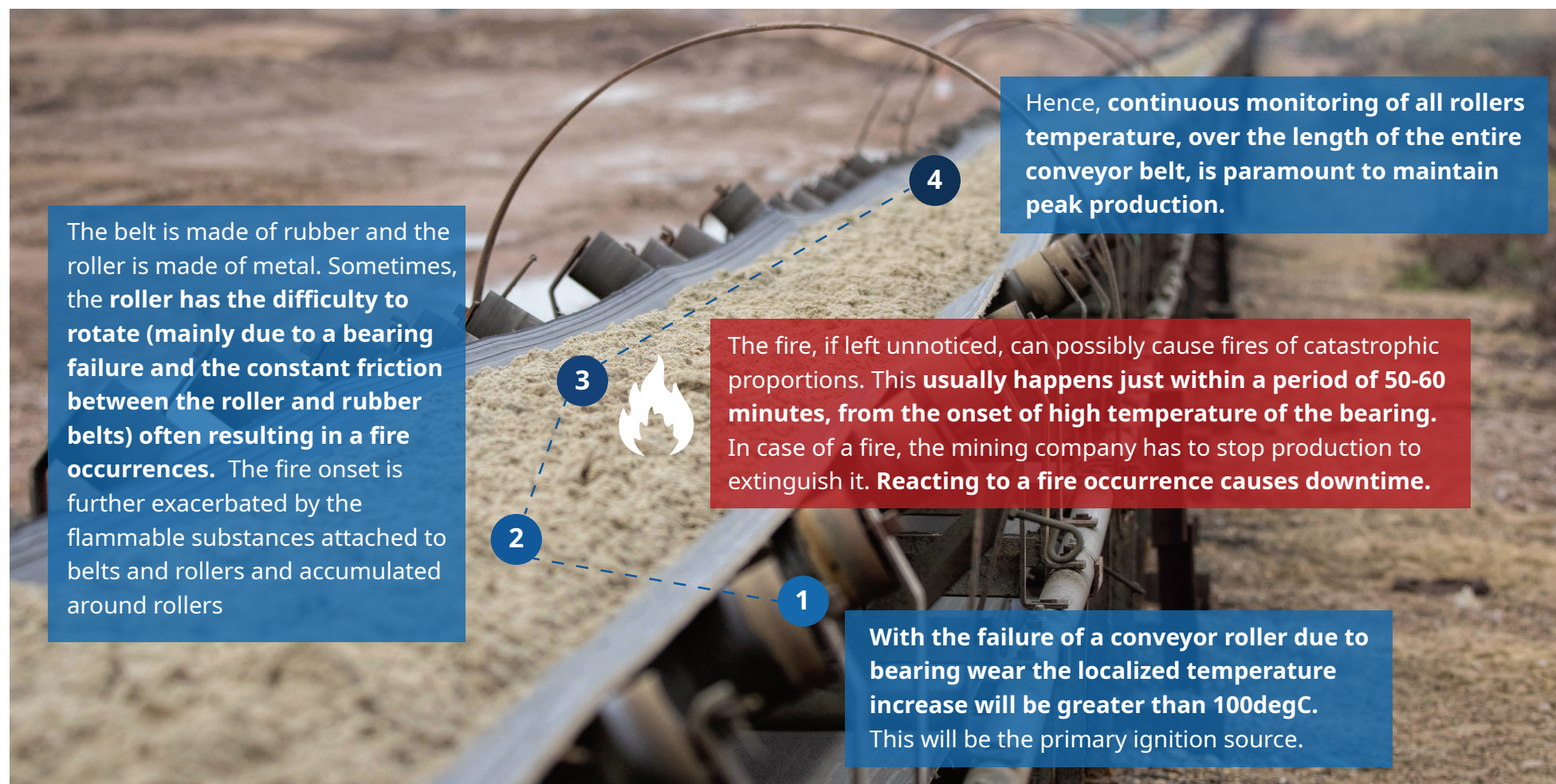Typical production loss: ₹9.3M – ₹22M / hour

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CHAPTER 2

Critical Issues

2.1 THE CRITICALITY OF CONVEYOR BELT SYSTEMS

THE THROUGHPUT IN A MINING OPERATION IS DIRECTLY PROPORTIONAL TO THE CONVEYOR BELT SYSTEMS PERFORMANCE

The **mining industry's throughput depends on material flow from its above ground and underground operations**. The **material flow depends on the conveyor belts,** that depend on idler bearing mechanisms to move material from one point to another. **Onset of a fire or mechanical failure are the biggest issues for conveyor belts**.

4 Hence, **continuous monitoring of all rollers temperature, over the length of the entire conveyor belt, is paramount to maintain peak production.**

The belt is made of rubber and the roller is made of metal. Sometimes, the **roller has the difficulty to rotate (mainly due to a bearing failure and the constant friction between the roller and rubber belts) often resulting in a fire occurrences.** The fire onset is further exacerbated by the flammable substances attached to belts and rollers and accumulated around rollers

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2

1

The fire, if left unnoticed, can possibly cause fires of catastrophic proportions. This **usually happens just within a period of 50-60 minutes, from the onset of high temperature of the bearing.** In case of a fire, the mining company has to stop production to extinguish it. **Reacting to a fire occurrence causes downtime.**

With the failure of a conveyor roller due to bearing wear the localized temperature increase will be greater than 100degC. This will be the primary ignition source.

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2.2 INDUSTRY CHALLENGES AND PERSONA-SPECIFIC CRITICAL ISSUE

INABILITY TO MONITOR REAL-TIME TEMPERATURE OF CONVEYOR BELT SYSTEMS' IDLER BEARINGS CHALLENGES UPTIME

Conveyor belts span for many kilometers in length and **are often placed in difficult to access areas within the mining processing facilities.** This **makes it difficult for maintenance personnel to navigate and inspect idler bearings temperature in real-time. Conventional ways of monitoring involves maintenance personnel to use an handheld radiation thermometer and physically inspect every roller** (this usually takes about a week to complete) bearing for temperature deviations. This process is time consuming, manual and has potential to **miss out on any precipitating event. Further reactive maintenance to issues causes downtime, productivity losses, safety issues, material loss and non-compliance to safety regulations.**

Plant Operations Manager
1. **Avoiding unproductive time: Due to conveyor belt breakdowns,** across operations**.**
2. **Maintain low variances in OPEX: Through failure prediction** and advance diagnostics.
3. **Manage and prevent high insurance costs: Due to potential failures** that a plant can experience.
4. **Responsiveness in starting production back-up:** Typically after mass employee strikes in plant.

Maintenance and Reliability Manager
1. **Reduce reliance on manual route based monitoring: Shift from manual and episodic inspection to automated and realtime** health status checks.
2. **Centralized monitoring: Integrated visual of the conveyor belt systems health** across the plant.
3. **Investment planning and continuously improving asset reliability: Co-relating MTBF** with remaining useful life on equipment **to drive investment planning and reliability.**

HSE Manager
1. **Proactive management of safety issues:** To maintain compliance with environmental regulations.
2. **Accident causes harm to reputation to the company: Report on safety issues in a predictive manner,** by leveraging data from sensors.
3. **Recommend modernization of conveyor belts:** Based on **incident history**
4. **Increased focus on moving towards a zero-risk workplace: Decrease HSE risk** by preventing manual inspection.

Project Manager / Engineering Manager
1. **Responsible for key decisions.** Decides on the type of technology being used
2. **Responsible for trouble shooting.** Addresses the issues in any engineering activities which results in hazard free run.
3. **Decision authority** & Proposes budgets for new projects.

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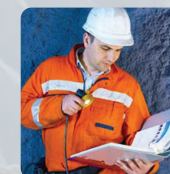
CHAPTER 3

Monitoring

3.1 CURRENT STATE OF CONVEYOR BELT MONITORING

## CUSTOMERS PREDOMINANTLY ADOPT THREE TYPES OF MONITORING

There are three main challenges with obsolete monitoring models:

I. Manual hand-held and route-based human inspection causes infrequent inspection and thereby an increased probability of failure.

II. Inability to cover large distances quickly and effectively

III. Rising complexity of industry issues coupled with lack of internal skill sets drives need for better technology solutions to bridge the gap

Typical reactive conveyor belt monitoring models

Deploy manual/route-based monitoring with IR thermal inspections
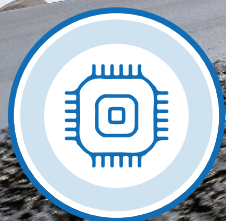
Install wireless point sensors to measure temperature at a given point

Install convectional linear heat detector

Drawbacks of these models

(1) The onset of temperature spikes cannot be predicted. It could happen after the route has been completed.
(2) Labor intensive process and some areas of the conveyor belt maybe in unsafe places, which makes it a safety issue for technicians.

Only a partial health status visibility of the assets within the plant. These solutions have its place for specific applications like yard monitoring, but for wide length applications like conveyor belts – the customers can experience better benefit with advanced technology solutions.

This solution can detect when fire-accident actually happens by the short circuit of twisted pair metal wire with melted outer. It can alert once fire-accident is happened, but cannot prevent fire and detect the location of fire.

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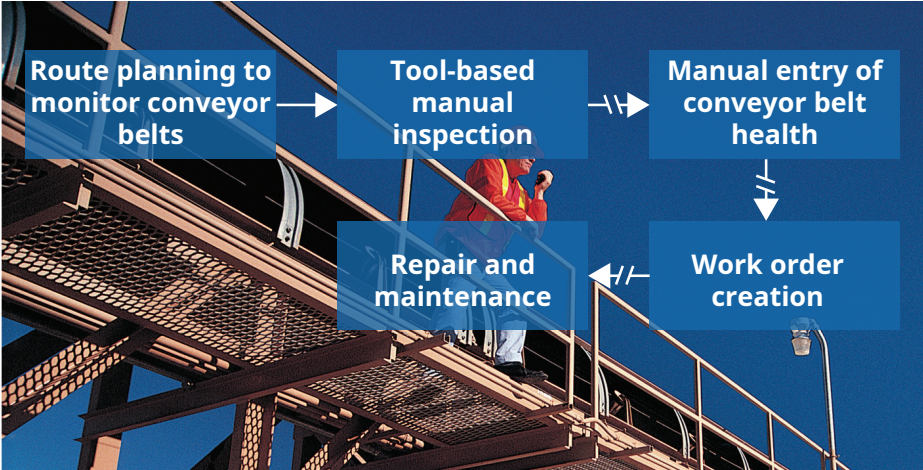
3.2 ASPIRE TO PIVOT

PIVOT FROM REACTIVE CONVEYOR BELT MONITORING TO PREDICTIVE AND PROACTIVE ASSET MANAGEMENT MODEL

The erstwhile model is route-based human inspection and reaction to potential safety incidents. **Customers need to pivot from a reactive model of operation to a 24x7 online/inline mode of asset management with cutting edge technology solutions**. As customers feel the pinch on doing more with less, they should **aspire to move towards digitalizing the inspection and maintenance processes.**

Today: A Reactive model

Route planning to monitor conveyor belts → Tool-based manual inspection ⊣\⊢ Manual entry of conveyor belt health

Repair and maintenance ←⊣/⊢ Work order creation

Highly reactive, complex and time consuming process

| Time consuming inspection | Complex workflows | Data silos leads to high OPEX | High down-time |

Tomorrow: A Proactive, Predictive and Digital model

Central Conveyor Belt Health Monitoring Software Platform

Dynamic, real-time and responsive operations management

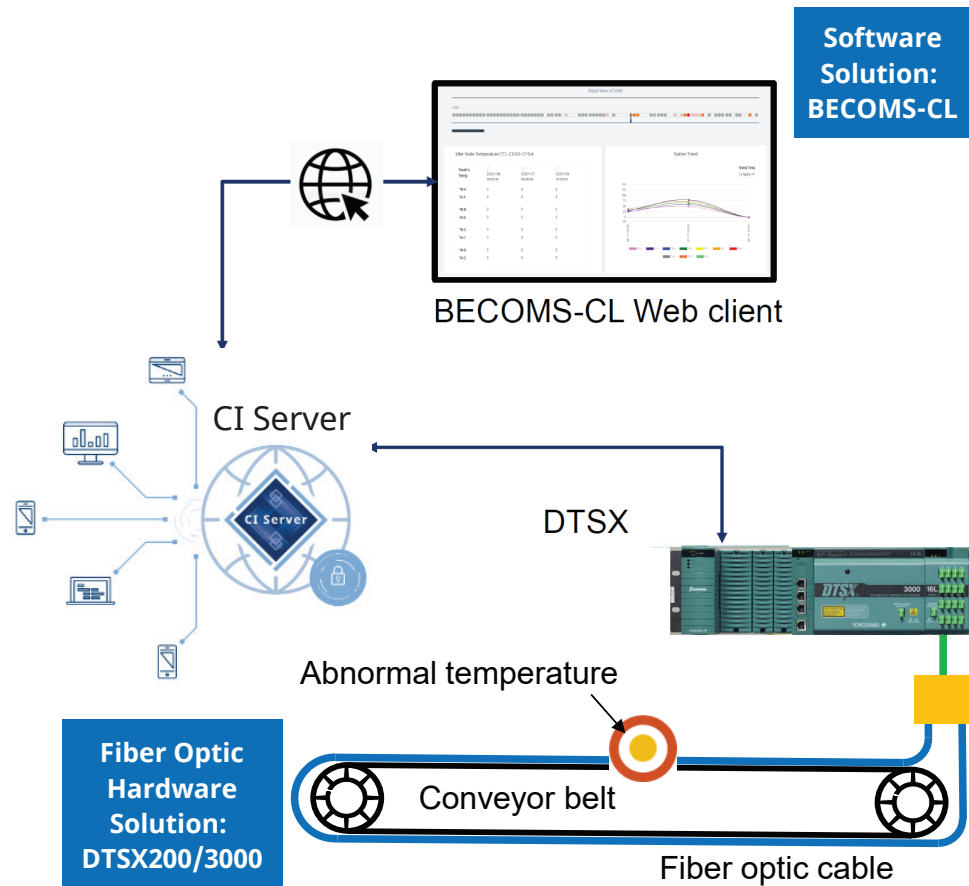| One data thread | CAPEX and OPEX optimization | 24/7 online roller monitoring | Maximized uptime and safe |

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CHAPTER 4

Solutions

4.1 YOKOGAWA'S DTSX SOLUTION

THE DTSX SOLUTION IS NOT JUST A HEAT DETECTION SOLUTION BUT AN INTEGRATED OFFERING THAT CAN PREVENT FIRES ON BELT CONVEYORS.

Yokogawa's value-proposition aims to assure the operational continuity and in assisting **mining customers pivot from reactive/proactive maintenance → predictive maintenance (prior detection of abnormal temperatures in conveyor lines and driving maintenance before the fire's onset).** The integrated solution contains two components: DTSX hardware (DTSX200/3000) and software (BECOMS-CL), that works together to **shorten unproductive time and asset downtime.**

The Integrated Conveyor Belt Monitoring Solution

Software Solution: BECOMS-CL

BECOMS-CL Web client

CI Server

DTSX

Abnormal temperature

Fiber Optic Hardware Solution: DTSX200/3000

Conveyor belt

Fiber optic cable

Expected Customer Outcomes

- **Ability to monitor long and wide conveyor belts** in real-time.
- **7-10x lower downtime and 70% OPEX savings** compared to reactive and proactive monitoring models.
- **Centralized monitoring and diagnostics permits failure prediction and prevention.**

Reactive

Proactive

Predictive

Fault

Alert

Alarm

- Unproductive time
- Preparation time
- Reparation time
- Adjust time
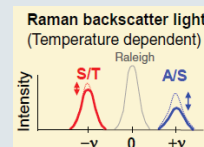
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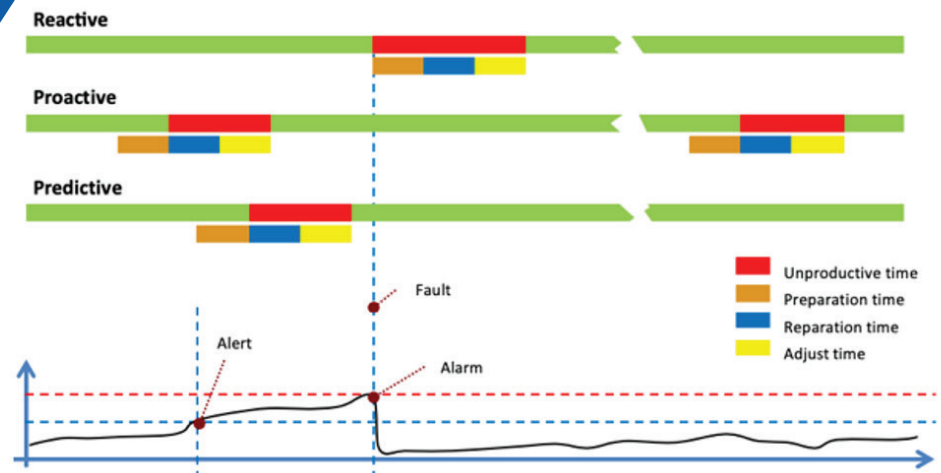
4.2 YOKOGAWA'S DTSX SOLUTION - HARDWARE

DTSX200/3000 IS AN OPTICAL FIBER TEMPERATURE SENSOR THAT CAN SENSE TEMPERATURE AND IDENTIFY LOCATION OVER LONG LENGTHS.

The **primary differentiations** of the hardware are: **(1) Electronics free, which makes it immune to electromagnetic noise (2) Plant-wide temperature monitoring (3) Real time and remote monitoring and (4) High measurement repeatability (5) Best-in-class, accurate and high resolution temperature measurement**.

DTSX Solution Integration with Conveyor Belt System

DTSX200: Monitors upto 6km

DTSX3000: Covers upto 10, 16, 20, 30 and 50 km

Solution Benefits
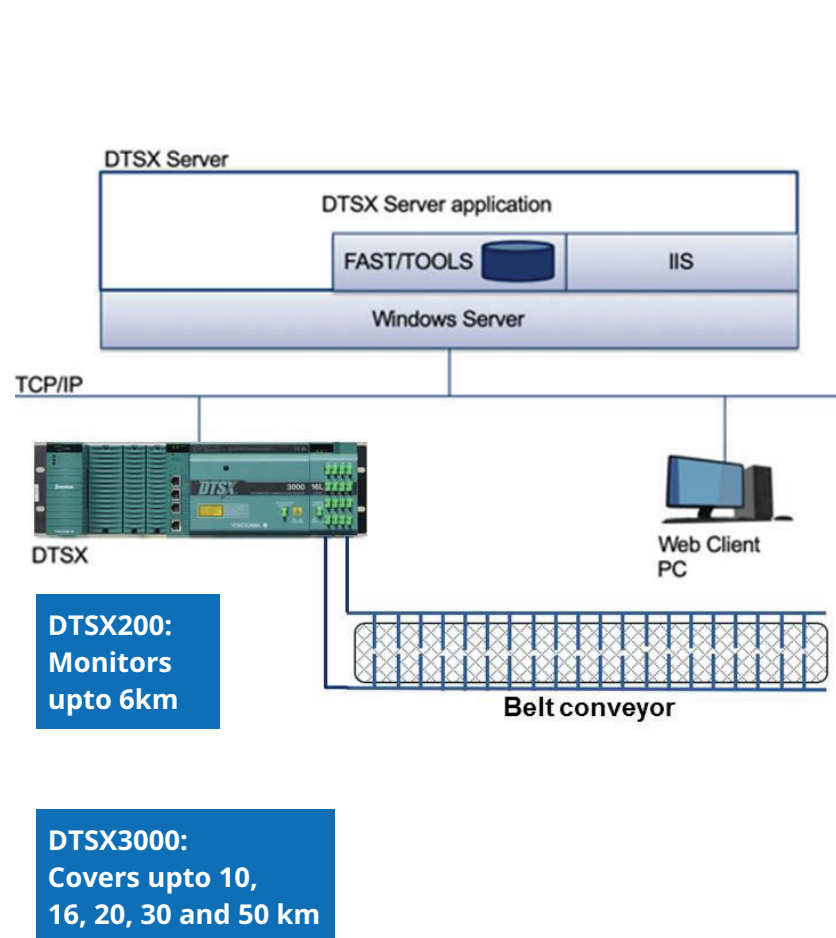
Plant-wide, real time, remote monitoring over the length of an optical fiber using the Raman scatter principle	Better ROI compared to conventional monitoring models, instead of installing several point sensors across the conveyor belt length, customers could leverage fiber optic sensors that can effectively help predict failure cover long lengths, using one integrated sensor.
DTSX measurement stability and dedicated algorithm for quick and precise roller failure early sign detection	Predict failure rather than reacting to it. Conventional solutions allow customers to react after a fire has onset. DTSX predicts equipment failure and prevents it.
Experienced engineering to install FO sensor cable	Minimize the installation time and cost, arrange for quick and precise roller failure early sign detection, allows customers to easily change roller for the replacement

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4.3 YOKOGAWA'S DTSX SOLUTION - SOFTWARE

THE CONVEYOR BELT MONITORING SYSTEM (BECOMS-CL) INTEGRATES DATA FROM DTSX AND VISUALIZES IN AN INTUITIVE INTERFACE.

The **software solution has a temperature analysis module** (software implements an algorithm that minimizes the false alarm due to the fluctuations in ambient temperature for conveyor belt) and a **web interface** (that helps customers visualize temperature deviations and abnormalities). Application can **intake data at 1 second intervals from multiple DTSX hardware systems**.

BECOMS-CL Human Machine Interface

An **intuitive solution** that helps customers predict asset failures and potential source of issues. The s**oftware platform helps visualize health of all conveyor belt systems in a plant, on one single platform.** The following are the key benefits, customers can experience:

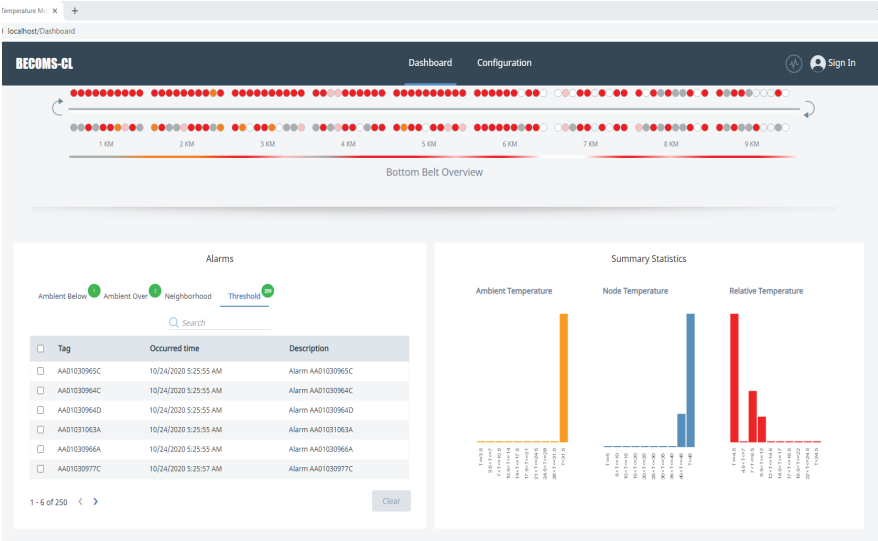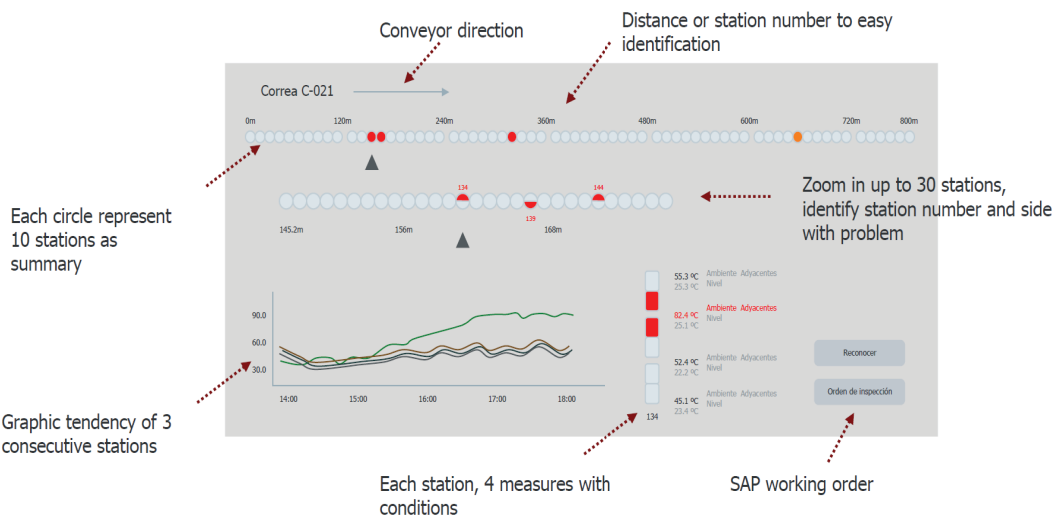| TOTEX Optimization	Outcomes-focused	Converged infrastructure	Digitalization of belt monitoring	Alarm rationalization	Integrated view of health, usage and alarms	Seamless collaboration with enterprise systems

4.4 YOKOGAWA'S DTSX SOLUTION - DIFFERENTIATION

THE INTEGRATED SOLUTION, FROM YOKOGAWA, IS A DIFFERENTIATED SOLUTION AND IS BEST-IN-CLASS IN THE MARKET.

Core Differentiator	Details of the Differentiation
Plant-wide temperature monitoring	• Possible to **monitor a huge mining area and all conveyor rollers** where it's difficult for human inspection and other sensors (e.g. Smart idler with battery) to cover • DTSX has **maximum 50 km length and 30,000 data measurement capability**
Real time and remote monitoring	• **Never miss monitoring and detect quick abnormal** location • **Maintenance cost reduction,** not human inspection needed • Release human work in hazardous area
High measurement repeatability	• Best-in-class performance within 1℃ • **Make a quick and accurate failure prediction**
Dedicated algorithm for precise roller failure early sign detection	• Tool to support better prediction of abnormal conditions • Future plans including AI for further prediction
Technology advantages	Technology with many plus points compared to Linear Heat Sensor or Detector • Pinpoint identification at every 1mtr, possibility of setting up multiple set points, operates even after crossing the threshold limit, operates for long segments more than 1km, repeat usage of same cable • Very good with respect to rapid detection of fire over a wide area, human error reduction, reduction in OPEX & warranty cost.
Know-how and experiences to install FO sensor cable	• **Extensive credibility and functioning projects in Chile and Peru**
DTSX system integration	• Provide an **integrated solution including DTSX server** for a quick and accurate failure prediction system for all rollers in conveyor belt
Quick local service and support	• **Sales and service office in Chile and Peru** with direct and strong support from DTSX manufacturer, if necessary
Accuracy, reliability and temperature resolution	• The solution provides **excellent measurement precision and high reliability** thanks to statistical analysis of temperatures and self-diagnostic routines.
Intuitive graphics Inter-face BECOMS-CL	• The **solution provides a graphical interface specially designed to display information about the conveyor belts** in a friendly and easy-to-use for the operators.

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SUMMARY

Case Studies & Recommendations

YOKOGAWA'S SOLUTION STRENGTH IS VISIBLE IN ITS IMPLEMENTATION

Quick implementation of new conveyor belt fire detection

Realize managing bioleaching in vast Copper Mines
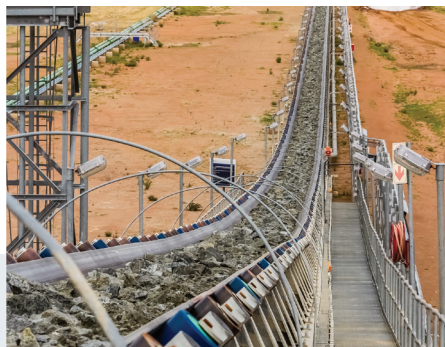
Challenge

Customers had implemented a Linear Heat Detection (LHD) cable system to detect the presence of fires, however the maximum coverage length was 3kms and was furthermore unable to precisely locate the relative position of the heat build up. Subsequently, the customer needed a maintenance free early fire detection/prevention system.

Challenge

Bioleaching is a popular organic process to extract metal from low-grade ores. The organic process involves the application of bacteria, which loses its effectiveness at very high and low temperature extremes. The challenge was to measure the thermal profile of phreatic level over a vast area.

Solution

Yokogawa performed a quick site feasibility study and implemented the Distributed Temperature Sensing (DTS) solution with no lead time for the customer. The solution was implemented with ease and HMI was setup to enable centralized monitoring for the customer.

Solution

As it was difficult to measure temperature over a long distance using traditional electronic based measurement, The customer selected Yokogawa's DTSX200 fiber optic cable. The solution provided a high resolution temperature profile over long distance with no need of specialized knowledge.

Outcomes

• Ability to detect fires on conveyor belts and prevent it from occurrence.
• Insights from the software helped with quick action
• Trouble free solution helped in lowering the OPEX

Outcomes

• 24/7 access to temperature data from a HMI panel allowed the customer to take necessary actions to adjust temperature levels.
• Improved environmental friendliness

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Optimizing costs requires a prudent **implementation of technology solutions.** Transportation accounts for 48% of mining customers' operating costs. The critical asset within this segment are mining trucks and conveyor belts. Breakdown of conveyor belts will cause multi-million dollar losses in production for all applicable customers.

Digitalizing the monitoring infrastructure of conveyor belts helps customers be proactive, predictive and intelligent around through-put and downtime prevention.

Prepare today, stay differentiated for tomorrow!
Intelligent conveyor systems are a reality with Yokogawa!

For more information, please visit
http://www.yokogawa.com/dtsx/

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EXTRA

DTSX INTRODUCTION
VIDEO

DETECT ABNORMAL EVENTS IN REAL TIME

INTRODUCING FIBER-OPTIC TEMPERATURE SENSOR, DTSX

Yokogawa's Distributed Temperature Sensing Cable design provides the insight needed to proactively prevent abnormal situations, reduce safety and fire risks, and identify irregular conditions and shifts in process applications.

Benefits of Fiber Optic Distributed Temperature Sensing Systems
- DTSX gives you the insight needed to proactively prevent abnormal situations, reduce safety and fire risks, and identify irregular conditions and shifts in-process applications.
- Fiber optic sensing cable design offers high reliability, accuracy, and quick update times to ensure 24/7 monitoring of the fiber temperature sensor application with no downtime for maintenance.
- Watch the video to learn more.

More Information about Distributed Temperature Sensing

What is Distributed Temperature Sensing?
How Does DTS Work?
What is the Raman Scatter Principle?

▶ PLAY

INTRO VIDEO

This Video is a thorough introduction how using optimal temperature monitoring solitions will help plants comply with corporate HSE policies, using Yokogawa's Distributed Temperature Sensing Cables.

Video: Yokogawa DTSX

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OTHER PUBLICATIONS

INCREASING TUNNEL SAFETY WITH FIRE DETECTION APPLICATION NOTE

Gain insight on to detect the outbreak of a fire in a tunnel, but also to pinpoint its exact location with the DTSX system to increase tunnel safety and minimize operational costs.

DOWNLOAD

CONVEYOR BELT FIRE DETECTION APPLICATION NOTE

Technicians are invited to review this real-world application note collection, describing a needed customized a monitoring system to output monitor screens and reports that mirror the needs of the site and how this total Yokogawa solution resolved it.

DOWNLOAD

FIBER OPTIC HEAT DETECTOR BROCHURE

Learn how to prevent heat-induced equipment failures and abnormalities, as well as large fire incidents that may result from them, maintain operations in plants and other places, and protect your assets.

DOWNLOAD

DISTRIBUTED TEMPERATURE SENSING TECHNOLOGY ARTICLE

Discover how to improve operations, efficiency, and safety with distributed temperature sensing technology, including benefits to lower total cost of ownership.

DOWNLOAD

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THANK YOU!

We appreciate you taking the time to read this eBook.

Are you interested in free consulation about how heat detection can improve your operations? Do you have any further questions?

With one of the most comprehensive families of products to detect abnormal events in real time, year-round with virtually no maintenance, Yokogawa is recognized as a world leader in the field of distibuted sensing equipment.

For more information, please visit our website or get in contact with one of our experts.

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ABOUT YOKOGAWA

Yokogawa provides advanced technologies and services in the areas of measurement, control, and information to customers across a broad range of industries, including energy, chemicals, materials, pharmaceuticals, food, and water. Yokogawa addresses customer issues regarding increasingly complex production, operations management, and the optimization of assets, energy, and the supply chain with digitally enabled smart manufacturing, enabling the transition to autonomous operations.

Founded in Tokyo in 1915, Yokogawa continues to work toward a more sustainable society through more than 17,500 employees in a global network of 119 companies spanning 61 countries.

Yokogawa Corporation of America is a wholly owned subsidiary of Yokogawa. Established in 1957, the business is headquartered in Houston, Texas and supported by other domestic manufacturing and service locations across the U.S, Canada and Mexico.

For more information, visit **www.yokogawa.com/us**