HOW ANALYTICS CAN RESHAPE HEALTH SAFETY ENVIRONMENT MANAGEMENT IN THE MINING INDUSTRY

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Use of analytics in HSE operations

Industry 4.0 has introduced smart machines - connected through a technological ecosystem by a series of IoT devices. Connected devices churn out millions of gigabytes of data. This data, if harnessed accurately, can provide an enterprise with useful insights - both for administrative as well as operational functions.

In the mining industry, data can be used to streamline health, safety, and environment management. However, to truly capitalize on data, the focus should be on data collection as well as data analytics. In the context of HSE management, innumerable sources of data pour in. So, mining enterprises are in possession of a huge volume of disparate data - both structured and unstructured. The business challenge for mining companies? How to manage siloed data sources and extract useful outcomes in HSE management.

For mining enterprises, it is an opportune time for a comprehensive review of their HSE ecosystem and harness a powerful analytical tool. It will be useful not only in regulatory and compliance reporting but also support internal benchmarking, peer comparison, stress point forecasting, anomalies detection, and alignment of enterprise strategies.

Data sources for HSE management in a mining organization

HSE data sources are expanding beyond the traditional ecosystem. Additional internal data from machines, smart devices, and sensor data from edge devices and external data sources are becoming sources for future HSE policies. External data originates from public sources, government reports, partner insights, social ecosystems, and behavioral data.

Figure 1: Sources of data for HSE management
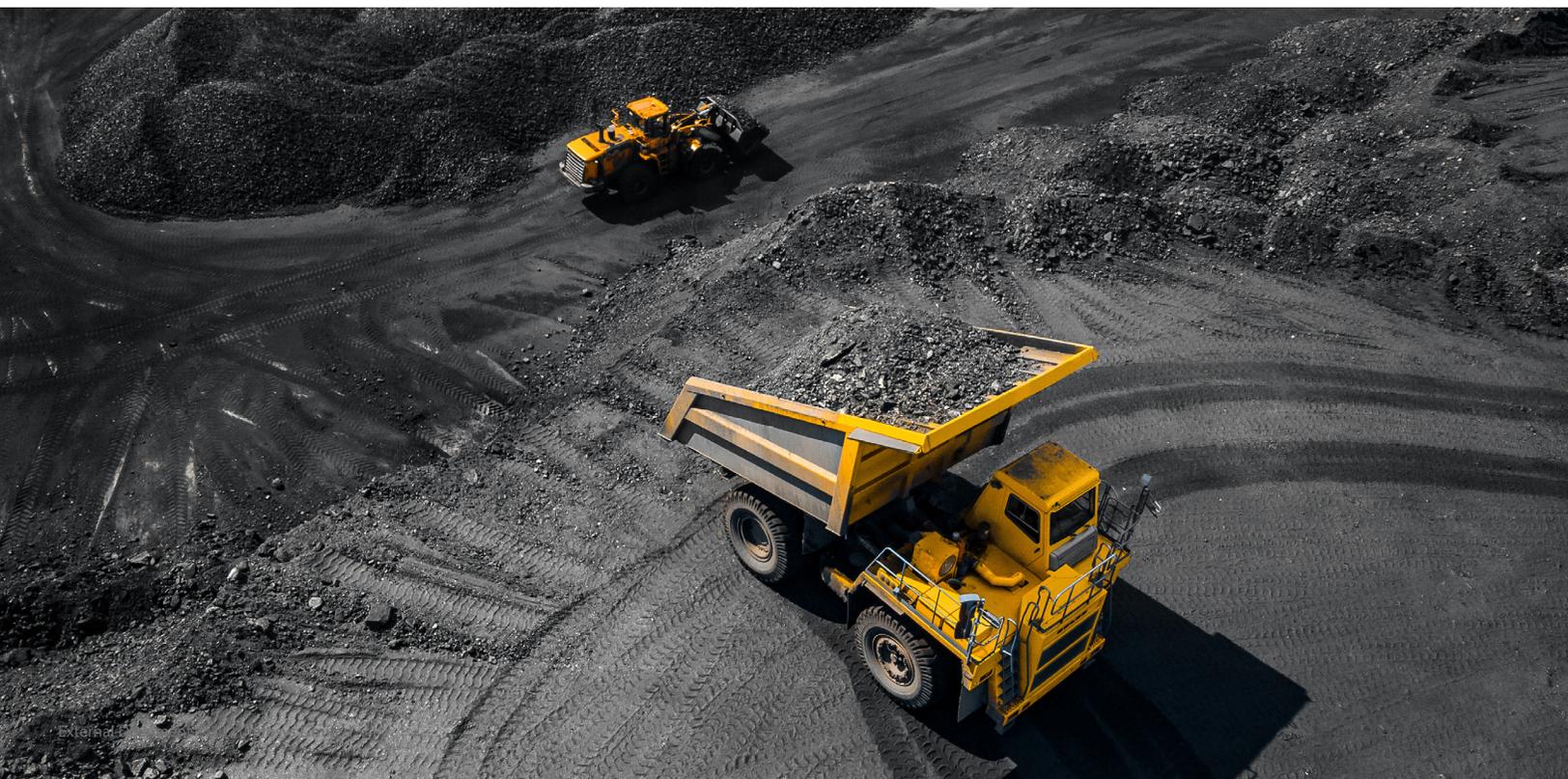
How can HSE strategy optimize operations?

Every mining enterprise has its own HSE strategy in place, but it may not always be an effective one. Enterprises plan their HSE strategy based on strategic themes for which there may be no data reconciliation. Moreover, when data sources are in silos,

the enterprise's ability to plan strategies and goals is affected.

The key to effective digitalization is to standardize how data is collected, reported, and communicated across the industry and through the value chain.

Currently, most mining enterprises report their HSE policies either to adhere to regulations or due to investor pressure. But their method of collecting and processing data is inconsistent. Cleaned data should act as a key enabler and its processing should be consistent across the enterprise.
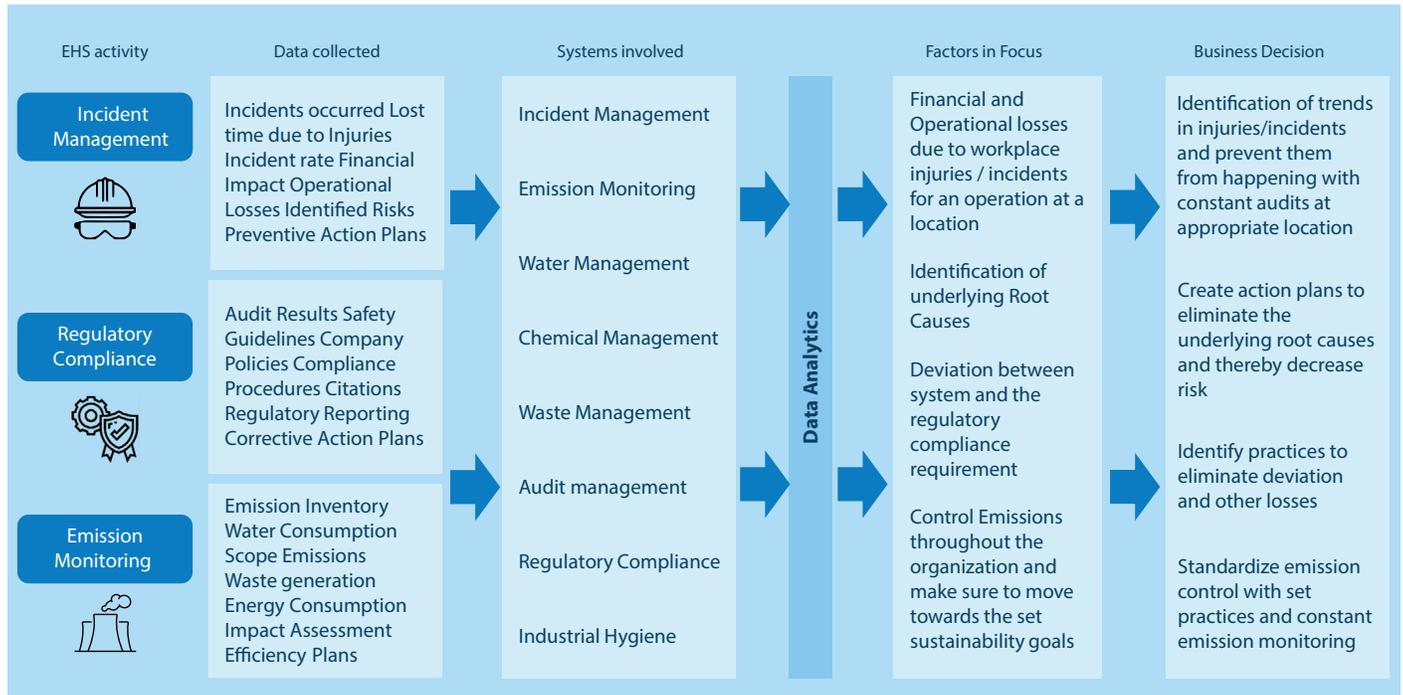
EHS activity	Data collected	Systems involved	Data Analytics	Factors in Focus	Business Decision
Incident Management	Incidents occurred Lost time due to Injuries Incident rate Financial Impact Operational Losses Identified Risks Preventive Action Plans	Incident Management / Emission Monitoring / Water Management		Financial and Operational losses due to workplace injuries / incidents for an operation at a location / Identification of underlying Root Causes	Identification of trends in injuries/incidents and prevent them from happening with constant audits at appropriate location / Create action plans to eliminate the underlying root causes and thereby decrease risk
Regulatory Compliance	Audit Results Safety Guidelines Company Policies Compliance Procedures Citations Regulatory Reporting Corrective Action Plans	Chemical Management / Waste Management / Audit management		Deviation between system and the regulatory compliance requirement / Control Emissions throughout the organization and make sure to move towards the set sustainability goals	Identify practices to eliminate deviation and other losses / Standardize emission control with set practices and constant emission monitoring
Emission Monitoring	Emission Inventory Water Consumption Scope Emissions Waste generation Energy Consumption Impact Assessment Efficiency Plans	Regulatory Compliance / Industrial Hygiene			

Figure 2: Use of data analytics in HSE management in mining

Use-cases of analytics in HSE management for mining

Much of the conversation around data analytics is centered on use cases – the result of digitalization technologies and on what the enterprise can gain out of it.

Here are a few use cases:

1. Integration of IoT with HSE applications

- Any sensor for measuring temperature which is connected to the IOT platform will alert supervisors to any breaches in the mine site.

2. Cloud-based HSE analytics

- Any number of data sources can be connected through the cloud via a command center to enable continuous monitoring data, thereby preventing incidents.

3. Data lake for HSE function

- Use of big data enables the enterprise to create a data lake which will help in analysis and creating further action plans.

4. Real-time insights and recommendations

- A dashboard with different KPIs with a combination of HSE and operational data can make decision making easier and faster.

5. AI models to predict future incidents

- A machine learning model can be trained to predict high severity incidents in the future, with historical incidents used as the training model.

Incident Management	JHA & Risk Management	Industrial Hygiene Management	Audits & Regulatory Compliance	Emission Monitoring
• Centralized System with Incidents, Impacts, Investigations, Causes • Mobility solutions which enable an incident to be raised anywhere and anytime • Predictive Analytics to forecast and predict future incidents in the workplace	• Integrated Risk Management solution that evaluates risks from all operations • Job Safety Analysis software • Disaster Management Platform which helps manage disasters in Mining Industry	• Industrial Hygiene Sampling Assessment System • Industrial Hygiene monitoring systems • Corrective and Predication Action Plans which reduces risk and improves Hygiene within the industry • Monitor hygiene using IoT connected sensors and raise alarm in case of breach	• Configurable Audit software which makes regulatory compliance easier. • Control Self Assessment tool which helps reduce gaps in current system • Legal Registry Library which contains all regulations and citations that need to be followed	• Continuous Emission Monitoring System with IoT capabilities which informs the supervisor in case a breach occurs • Interactive Dashboard and Analytics to view better insights of Emissions within the company and make business decisions

Figure 3: Emerging HSE trends

Improving HSE operations with data and analytics

Many enterprises have taken the first step to focus operations on data. However, they find it difficult to direct resources to ensure that the collected data is utilized properly. While most mining enterprises are investing in artificial intelligence and machine learning to derive actionable insights, a dedicated data scientist is a prerequisite. This will ensure complete readiness in terms of utilizing data analytics in HSE management. Besides selecting the right tools and applications to become data-driven, it is also essential to make data and analytics a part of day-to-day HSE strategies and conversations.

A few prerequisites that need to be in place are:

Restructuring HSE functions to prioritize data

The mining enterprise should invest in creating the position of a data analytics officer responsible for data analytics. In addition, there should also be an HSE analyst and safety domain expert working with the data analytics officer to help the enterprise devise analytical strategies and deploy the right decision-making tools and technologies.

Collect high-quality data

Many companies struggle to gain real business value from all the data they collect through their data management systems. The HSE systems that are deployed may have improper categorical data, free text values, and an absence of mandatory field checks, which leads to misleading information for data capture.

Strategic plan to use analytics tools efficiently

Instead of revolutionizing every aspect of the HSE domain, the enterprise should focus on one program that could yield significant results when data analytics is applied to it.

Building a data-driven culture

Data analytics should be used as the base for all HSE decisions, embracing all operations within the value stream. Enterprises should empower their employees to use data for all business operations.
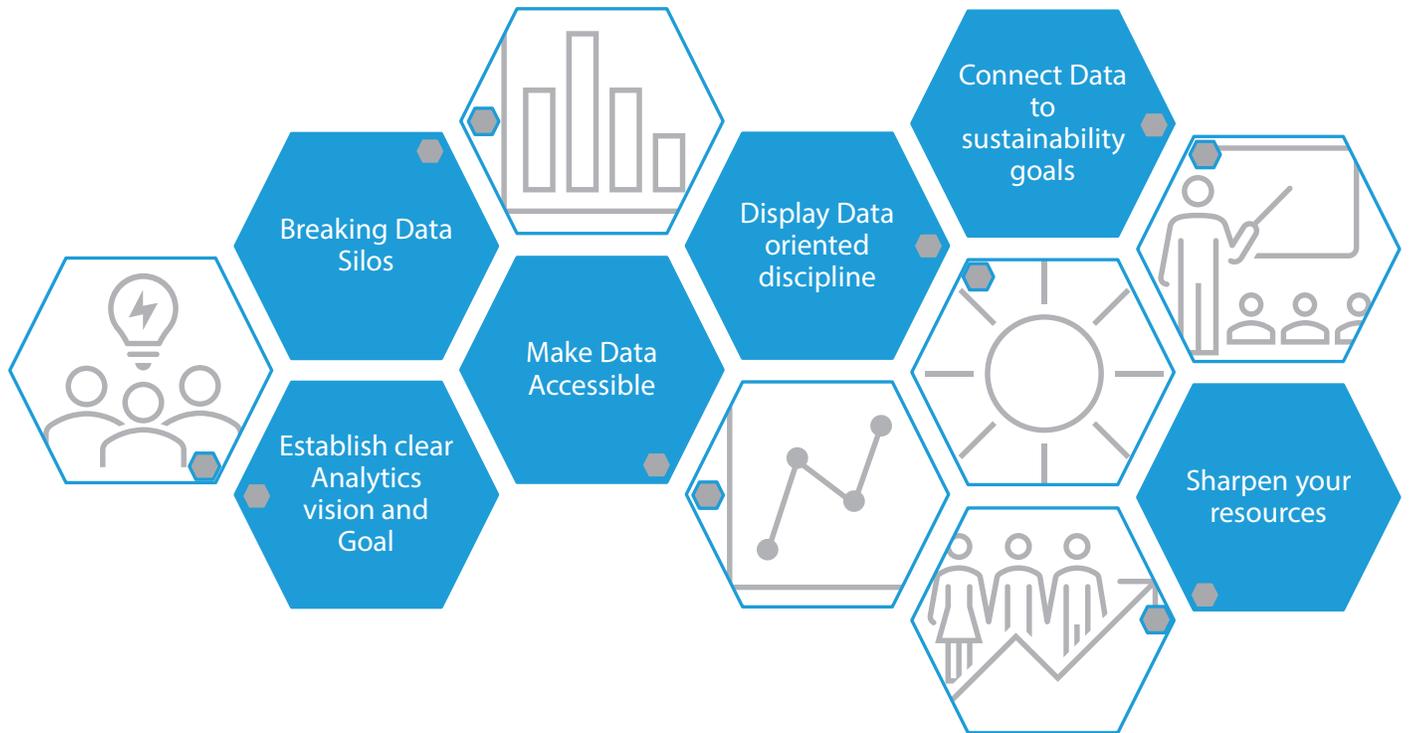
How HSE can be reshaped using analytics

Figure 4: Reshaping HSE using analytics

- **Establish a clear vision and goals:** It is critical to have a vision before introducing data analytics to the DNA of an enterprise's HSE functions. The chief sustainability officer should be responsible for driving a data-driven approach for business.

- **Make data accessible:** Managers and safety officers should have easy access to data. This will bring transparency to the value chain, with companies being able to see exactly where the most effort is needed, and then make collaborative efforts on improvements.

- **Breaking data silos:** Data sharing and interoperability around data standards is crucial. Data sharing will be needed to tap evolving digital technologies, principally artificial intelligence, followed by machine learning.

- **Display data-oriented discipline:** The enterprise should set in motion a flywheel of momentum to the 'plan-do-check-act' wheel, i.e. gather and organize business intelligence, look for patterns in data analytics, make decisions and create actions to focus on.

- **Connect data to sustainability goals:** The chief sustainability officer must set data-based goals containing valuable business KPIs for goals to be tracked quantitatively.

- **Upskilling resources for HSE functions and domain expert readiness:** Enterprises should not only hire new talent but also train the existing talent pool.

Focusing on HSE business challenges using data analytics

Enterprises face several HSE challenges. An analysis of data offers nuanced insights to address them and arrive at intelligence-based solutions.

Let us evaluate some examples.

Workplace incidents and hazards: These are commonplace in the mining industry, often causing operational losses. Historical data of such workplace incidents and hazards should be analyzed to identify deeper problems in an enterprise's vision.

Proactive risk assessment: It is always prevalent in the HSE domain of an enterprise. It is important to assess and mitigate risks to the maximum extent possible. Predictive analysis of risks can be used in assessing risks and identifying them before they can occur. Enterprises can save time and money with the right risk preparedness and mitigation plans.

Safety and operational audits: Evaluation of Audits is always a challenge. Data before and after Audit could be analyzed and enable leadership to see the difference in various safety checkpoints and improve operations if needed.

Visibility of HSE metrics: The visibility of HSE metrics has been a source of concern for mining enterprises. Using analytics and effective reporting can help mining enterprises identify areas where improvements are required.

An approach to leverage analytics in HSE

Leveraging our domain expertise, Infosys has helped enterprises improve their HSE management policies by correctly analyzing relevant data. In most analytics projects, 60% of the effort goes into structuring and cleansing the data. This is because in most enterprises, data is structured for collection and not for analysis. Infosys has rich experience in extract-transform-load (ETL) processes and data warehousing to help enterprises leverage analytics and derive more value from HSE functions.
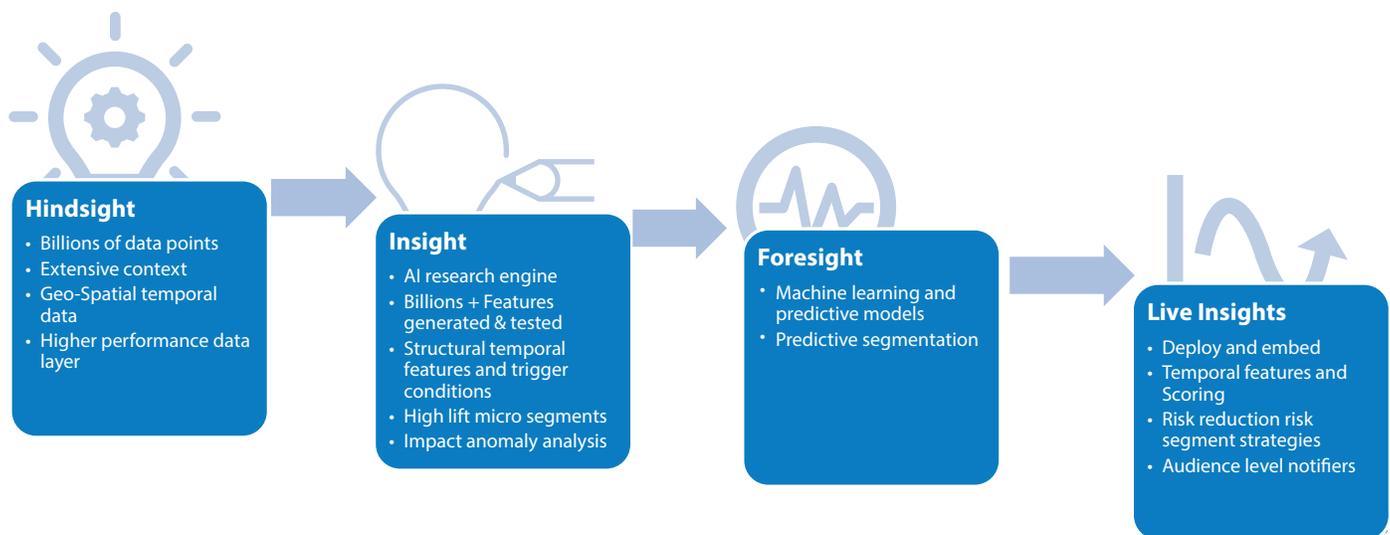

Hindsight
- Billions of data points
- Extensive context
- Geo-Spatial temporal data
- Higher performance data layer

Insight
- AI research engine
- Billions + Features generated & tested
- Structural temporal features and trigger conditions
- High lift micro segments
- Impact anomaly analysis

Foresight
- Machine learning and predictive models
- Predictive segmentation

Live Insights
- Deploy and embed
- Temporal features and Scoring
- Risk reduction risk segment strategies
- Audience level notifiers

Figure 5: List of service offerings across the analytics spectrum

Tenets of HSE analytics service spectrum:

- Hindsight: Assess risk, employee, production data and create relevant context to explore and analyze data in context. This creates a high-performance data layer for descriptive analytics by bringing all siloed datasets together.

- Insight: Find deeper insights leveraging AI research engine to generate diagnostics analytics to identify elevated risks or adverse events.

- Foresight: Build predictive models to identify the risk probability at a location, time, and department.

- Live insights and optimization: Predicting risk which evolves over time and prescribe risk reduction, audit, and investment optimization strategies.

Infosys has developed a solution that makes use of these tenets of HSE analytics service spectrum as illustrated in Figure 5. It taps into HSE data and derives useful insights. A predictive and prescriptive analysis is done on HSE data and insights are displayed in the form of customizable reports and dashboards. These dashboards can help decision makers draw conclusions from the analysis, and help them make prompt decisions on creating a safer work environment.

Solution highlights:

1. Workers can provide information for a prescriptive analysis. The information can be based on human behavior capture from IoT devices.

2. The solution provides a useful and actionable conclusion with percentage of near miss, minor, and first aid incidents and pre-set mandatory requirements for a location as illustrated in Figure 6.

3. Safety officers get insights on incident probability score based on plant, division, areas or location defined within the enterprise. This matrix can be derived using algorithms calculated by machine learning and analysis in the system, as illustrated in Figure 6.

4. HSE word trend and word cloud for all incidents are features that can be developed for incidents in a plant, division, area, or location, to set reminders, as illustrated in Figure 7.

5. HSE dashboard provides customized short reports, trends, and other quantitative figures on a need-to-see basis, as illustrated in Figure 6 and Figure 7.
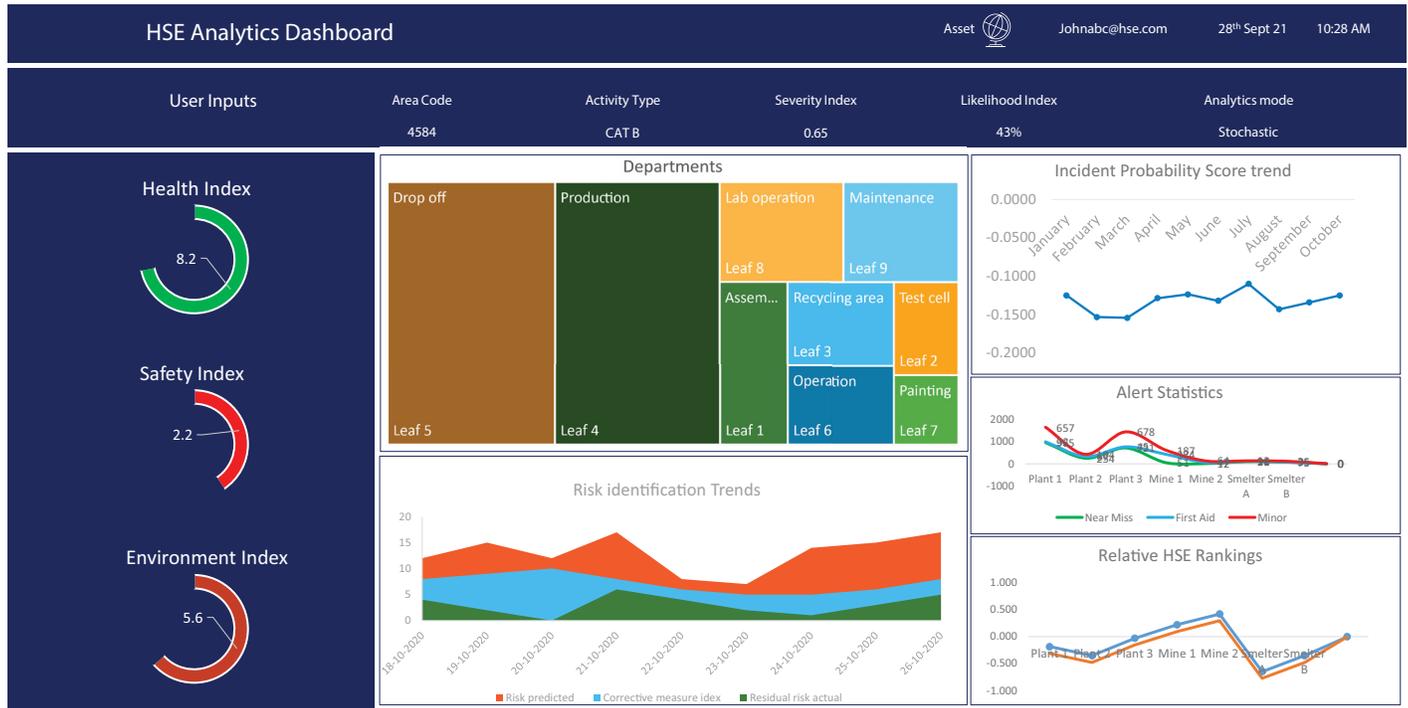
Figure 6: HSE analytics dashboard - 1
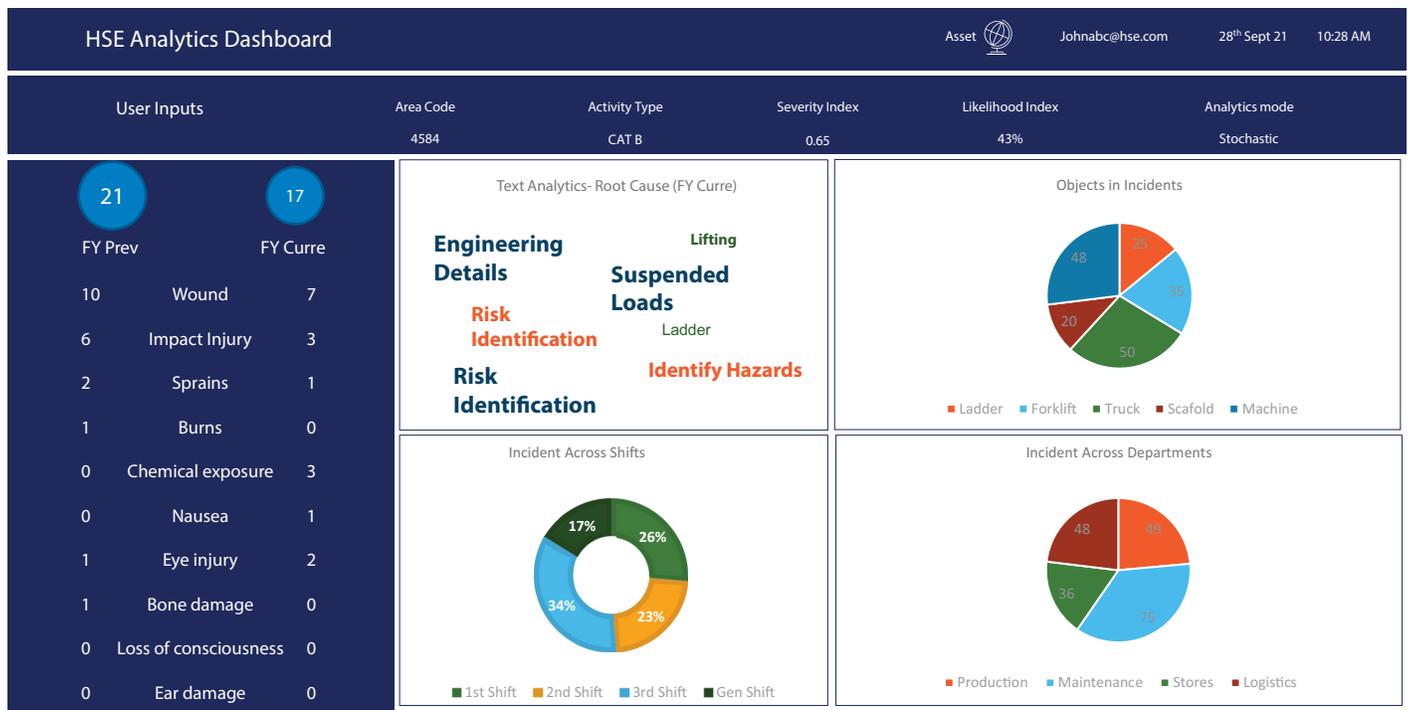
Figure 7: HSE analytics dashboard - 2

Conclusion

Mining is at an inflection point where a combination of data, cloud, network, smart devices, and new age technologies and tools are playing a major role in redefining business processes. We believe that a fresh perspective into uses of analytics in the HSE ecosystem has the potential to unlock hidden value to reshape health, safety, and environment management for a business transformation.

Cloud-based data-as-a-service providing raw data for analytical applications,

analytics-as-a-service providing outputs of analysis and insights could be a growth driver for enterprises. Some of the key characteristics of such solutions include use of the cloud, the ability to integrate different data sources, data contextualization, and a focus on insights and action that lead to business value.

With the advent of Industry 4.0, analytics is the foundation to drive a business transformation. HSE is one of the crucial functions in mining where analytics can

bring significant control measures for a sustainable working environment.

A well-rounded HSE analytics solution can offer incident control management, customized analysis and reporting, preventive recommendations, and improved insights from real-time data. This solution can help HSE operations derive value out of data and use it to their advantage in strategizing HSE operations and decision making, while creating a robust HSE functional area.

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