BI for EHSQ: Realizing the Benefits of a Data-Driven Journey

INTELEX

Introduction

Advanced analytical capabilities are the foundation for improved decision-making and performance in all key functions of a business.

That's true for quality improvements and also applies to improving safety. The more data gathered, analyzed, and shared, the greater the potential for discovering opportunities to make our workplaces and our world safer. The collection of high-quality data forms the foundation, but the real power is realized when raw data is transformed into business decision-making insights that are shared across an organization.

Getting there happens in two ways:

a) Through embedded analytics, where insights are served up in real time, directly from machine to user (and machine to machine); and,

b) Through self-serve analytics, where the end user creates and communicates their own insights through easy to use analytics portals.

Self-service tools make EHSQ (Environment, Health, Safety, and Quality) analytics possible at every level of the organization, helping to align people processes and technology to play a key role in change management. Additionally, enterprises in pursuit of transformational change are embracing machine learning technologies that help them make discoveries, optimize their workflows, and reduce human failure points.

This brave new world of analytics involves experts sharing everything. The aviation industry is a great example of how shared data supports efforts to predict (and avoid) failures and accidents, improve quality and drive smarter business decisions.

This paper discusses how the use of shared data improves business processes and supports safety efforts in new high-risk areas. It also demonstrates how transforming your company to becoming more data-centered is both possible and easier to achieve than may have been originally thought.

"In God we trust. All others must bring data."

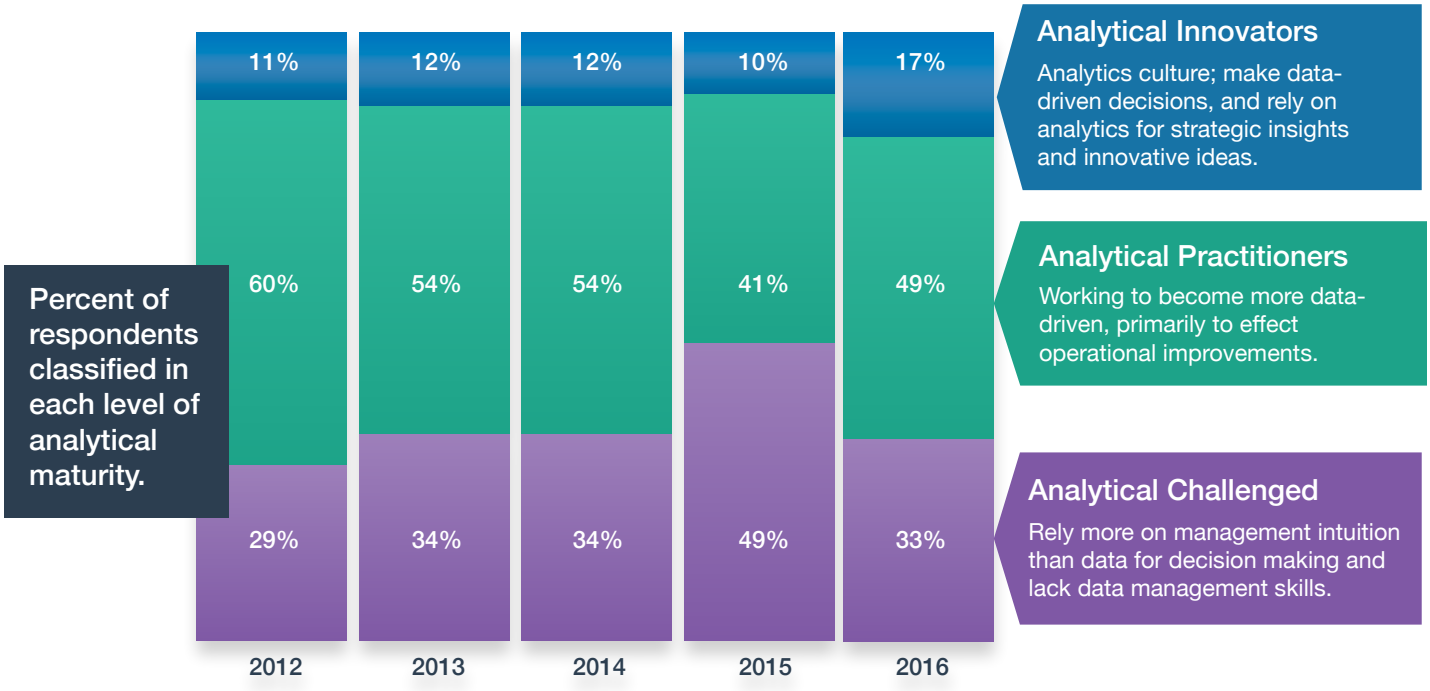
- W. Edwards Deming

The EHSQ Business Intelligence (BI) Maturity Curve

Everyone throughout the organization needs to be involved in the creation of a data-centred approach.

However, MIT Research (as shown in the table below[1]) reported in 2016 that less than one in five organizations can be considered "Analytical Innovators" – a position fostered by data-centred thinking – when it comes to making data-driven decisions. But, the trend is moving upward as these numbers show significant improvement from 2015 when only one in 10 organizations were similarly ranked.

Creating a culture of analytical innovators takes time and rather than becoming overwhelmed with the consideration of a vast overhaul to get there, it's perhaps better to consider a steady climb up a business intelligence (BI) maturity curve when it comes to EHSQ functions.



The journey up this curve begins by assessing where your company is currently ranked. The chart, below, shows a framework for three possible stages where an organization might rank on a BI maturity curve.

Rather than becoming overwhelmed with the consideration of a vast overhaul, companies must consider steadily climbing up a business intelligence maturity curve as applied to their EHSQ functions.

	Stage 1: Limited BI Compliance	Stage 2: Modest BI Performance	Stage 3: Advance BI Transformation
People	Safety/Quality stewards Limited data analytics capabilities	Safety/Quality team Business Analysts included Dep't head use analyses/reports	Safety/Quality Center or Excellence Data Science (full stack) team Data Personas at every level & role
Process	Minimalist Ad hoc	Central data experts	Advanced insights Experimental and future based Self Service
Technology	Spreadsheets Descriptive statistics	Management dashboards Trend analysis, forecasting frequent, timely reporting	Data Mining Predictive & Prescriptive statistics Machine Learning with IoT High Velocity Algorithmic
Business Strategy	Reactive to events Stationary survival mode	Proactive to priorities Project based Pursuing north star	Pervasive in all business functions Culture of "how we do everything" Mapping entire landscape

Stage 1:

Data Basics for Compliance

Companies at Stage 1 or Limited BI Compliance focus on the basics – recording failure incidents, launching investigations, conducting annual audits, and reporting these incidents to appropriate authorities. The work is typically ad-hoc, utilizing basic toolsets, such as a clipboard (real or virtual), a spreadsheet, and a makeshift classroom for teaching safety. Initial visibility into outcomes relies on injury statistics and numbers of staff trained. These metrics provide little guidance on what to change and how to improve. At this early stage, companies can drive some measure of improvment by putting in place basic, structured EHSQ programs, policies and toolsets.

	Stage 1: Limited BI Compliance
People	Safety/Quality stewards Limited data analytics capabilities
Process	Minimalist Ad hoc
Technology	Spreadsheets Descriptive statistics
Business Strategy	Reactive to events Stationary survival mode

Considerations for assessing whether you organization is in Stage 1 of the business maturity curve include:

1. Do your users rely heavily on Excel spreadsheets to work with data?
2. Are you finding it difficult to know which chart types to use for certain scenarios?
3. Do you find that most of your records are not stored in a standard way?
4. Are there major gaps in your data management practices?

Stage 2:

From Data to Insights

In Stage 2, an organization understands what is working and what needs to be overhauled in terms of BI processes and practices. An organization may have put in place a team to guide analysis, and provides organizational communication and education. The focus is no longer simply to know what has happened – they are considering why. Moving beyond "what has happened" to "why is it happening," means both qualitative and statistical methods are used to better understand root causes, variations in performance, and developing future forecasts to identify operational opportunities to improve safety and quality.

At this stage, companies typically use multiple solutions, including behavioral change programs, and have created and adhere to a comprehensive set of policies and procedures. They also utilize an all-inclusive platform with tools to help their efforts.

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Real-time reporting from real-time data offers insights into performance, provides critical indications of apparent danger, and may even predict outcomes as a result of various actions.

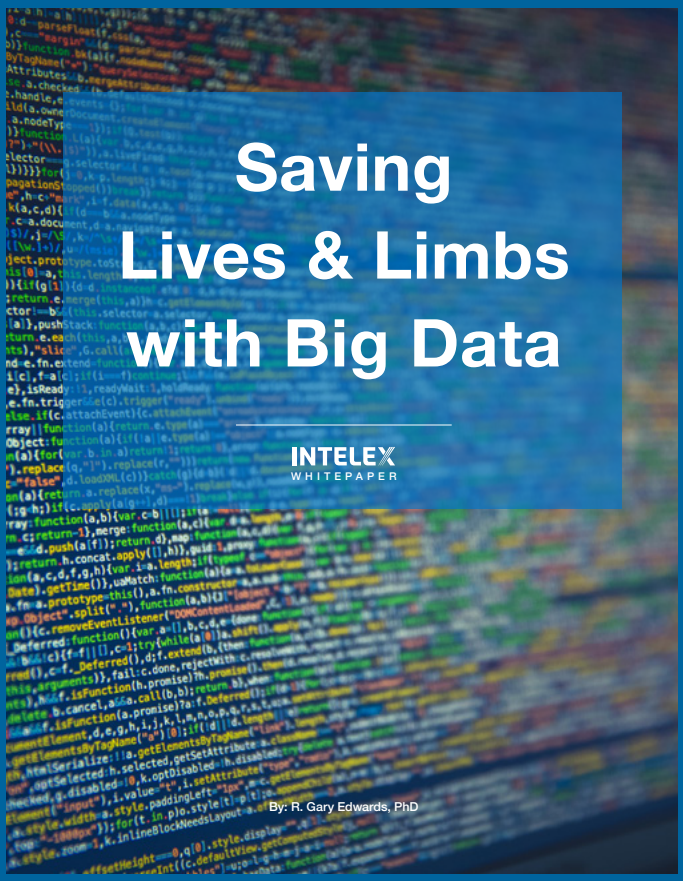
A study conducted by Forrester estimates organizations on average analyze only 37% of their structured data, 22% of their semi-structured data, and 22% of unstructured data.[2] Much of this semi-structured and unstructured data sits in activity logs and workflows, the so called "dark data" of an enterprise. It typically goes unanalyzed, yet has vast potential for real insight that might help an organization improve its EHSQ capabilities and processes.

Intelex Safety Index

The Data Science team at Intelex had the opportunity to sift through 10 years of dark metadata collected from 1,000 customers, from activities, including software usage, applications and features used in their frequency and patterns. The objective was to investigate if there were any hidden insights that could help enterprises understand safety risks and best practices.

Several insights surfaced. For example, recently the team observed that customers that saw reduced safety incidents over time had increased the number of reports they viewed. This insight is an indicator, not cause and effect, in which we might note that users who are more engaged seem more likely to lower safety incident rates. Along this line of reasoning, as summarized in Saving Lives and Limbs with Big Data, Intelex's Data Science initiative discovered the following:

- Going the extra distance to collect enormous amounts of non-regulatory data is associated with lower rates of minor and major incidents
- Recording "near misses" associates with occupational safety ratings that are up to three times better than companies that do not
- Keeping records of employee "pain" is an excellent predictive indicator of occupational safety ratings
- Demographics are predictive, including on the downside the percentage of new employees and contractors on site; on the upside by location size (larger is better) and the ratio of supervisors to workers and on the upside by the ratio of supervisors to workers (higher is better)
- Dramatic variation exists among the various locations of an organization, with up to 14x differences in occupational safety between high and low performing locations within the same company



The Intelex Safety Index was developed from discoveries found in the Saving Lives and Limbs white paper. These elements were those items identified that consistently determined to predict lower OSHA rates. Enterprises that capture these elements can benchmark their safety efforts for valuable decision guidance.

In almost all jurisdictions, incidents and fatalities are reported, based on the location of where these happened, as a regulatory requirement. Similarly, companies also may track product defects. In the event of poor quality causing human safety risk, companies must pay for recalls and corrections. As mentioned, tracking product and safety failure rates is a requirement. But those companies looking to compete more effectively pursue higher metrics of success in order to win in their marketplaces. These efforts may include assessing customer satisfaction through Net Promoter Scores and other metrics.

Employees need to be motivated to do the right things by also understanding the root elements of what drives success in addition to what fails. Celebrating doing things right is highly motivating and often reverses the regulatory compliance mindset that keeps successes secret and makes failures public. It's good for business.

Industry benchmarks that help organizations understand how they stack up relative to the competition, provide a clear indication of where they are today and the direction they may be heading. A self service BI platform is a means to improve benchmarking capability by offering a data-driven view into events, including failures.

Data is not enough

Data is not the same as information. And information is not necessarily "insight".

In business, smaller subsets of information are derived from large data sources. The analysis of data becomes information. And insights can be generated from information. An insight should bring in new knowledge to a decision-making audience, of which they would not otherwise be aware. Insights must be digestible and grab the attention of an audience in order to be understood. Lastly and most importantly, insights should drive appropriate action.

Embedded Analytics

To support good decision-making, insights need to be available in the moment, embedded into the business process application – that is, embedded BI. The term may be relatively new, but the concept has been around for a long time. An analogy of BI can be visualized in terms of driving a vehicle. The dashboard tells you exactly what is happening in that moment. You can see your vehicle's traveling speed, rpm, temperature, fuel, engine performance, etc. Triggered alerts provide critical real-time information sourced from sensors embedded throughout the vehicle – things like tire pressure, oil and fuel levels or doors being ajar. You drive with constant data feedback. Although we take it for granted, a lot of consideration goes into what data needs to be served up in order to create actionable insights that improve the safety of driving while also maintaining the quality and performance of the vehicle itself.

Manufacturers are now looking to create similar “dashboards” in order to manage and improve quality. Predicting machine failures is one example. A steady stream of data is available during the operation of machinery, including temperature and vibration. Over time, certain equipment may break down and the outcome correlated back to sensor data on temperature and vibration, for example, may trigger an alert for preventive maintenance. Ultimately, such actionable insight provides the potential for significant cost savings as a result of mitigating breakdowns. Up until recently, an experienced technician or operator was the most reliable source of predictive failures.

Why operators cannot be the only source for knowledge:

1. Not all operators have the same level of experience or expertise.
2. There may be slight variations in temperature and vibration that may be undetectable by a human, but could be immediately recognized by a sensor wired to an embedded analytics engine.
3. An algorithm that predicts problems and failures never needs to rest or take a break, and more importantly does not have its judgement influenced by extraneous factors (e.g., taking bigger risks or skipping steps when time is tight).
4. For large-scale manufacturers, data from thousands of sensors can be run simultaneously versus the human limit for processing one thing at a time. Algorithms served up through Internet of Things (IoT) sensors that provide embedded analytics feedback and automated action is the way of the future.

Constructing a BI platform that monitors critical business functions can be the beginning of a journey to deliver better than ever business outcomes. Big Data capabilities offer the ability to make various sources of streaming data available directly to end users and decision makers – not just the data analysts. Think back to the vehicle example.

In addition to what you might see on a dashboard, analytics might offer additional information for use with maintenance planning. Data that’s gathered and used to analyze how you accelerate in traffic could conceivably help save you money on fuel by suggesting an economical speed to drive on highways. You might also monitor the wear and tear on components like brakes and shock absorbers through analysis of past driving conditions and habits.

Stage 3:

Advanced Data Use through Algorithms and Machine Learning

What new disasters might be averted from risks that we have not even contemplated? For every giant leap forward in progress, the world is forced to confront new risks and, with these, new thinking on how to prevent the worst from happening. To make further breakthroughs in quality and workplace safety, industry professionals might look to build and share dynamic maps of this fast-changing landscape.

Stage 3 Transformation companies look to match their pace of innovation in building out and adopting breakthrough technologies with innovation in quality and safety. They examine established processes then collaborate with multi-function, multi-disciplinary teams to drive innovation in safety and quality improvements.

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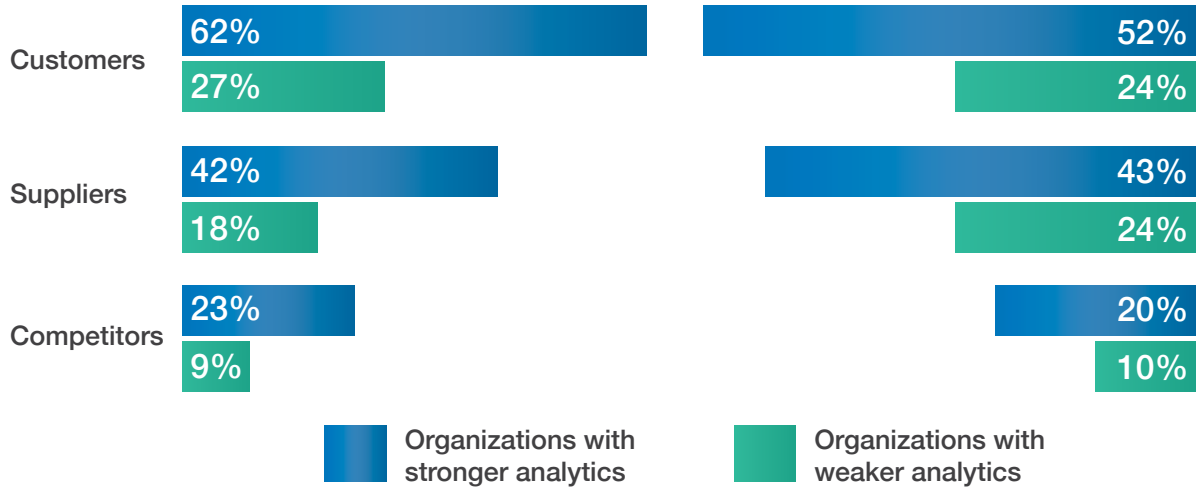
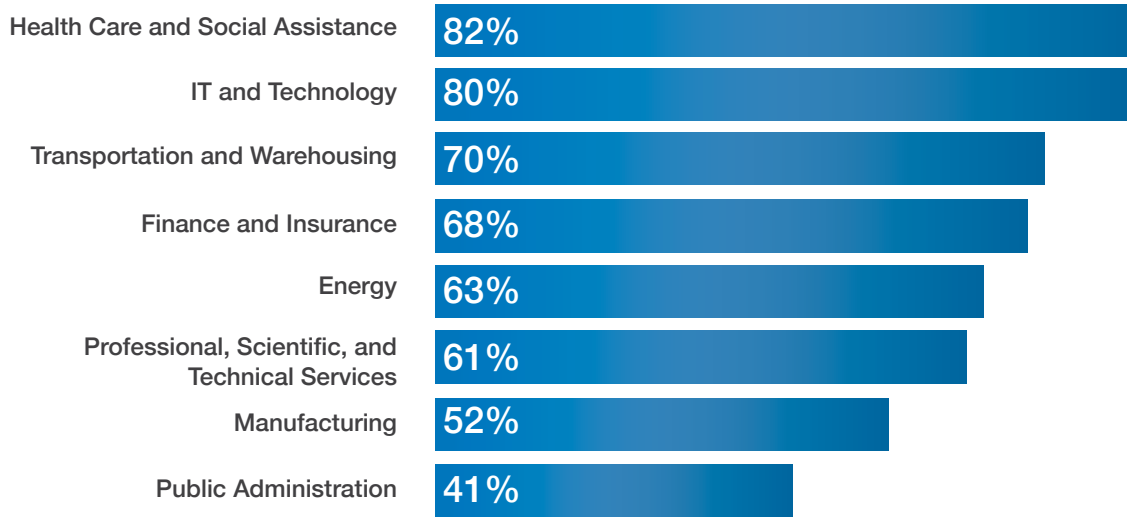
It's a shift in approach that transforms safety and quality improvement from being reactive to becoming proactive and has the potential to deliver breakthrough strides. Stage 3 companies continually fine tune their processes by using data from field teams in addition to shared industry data.

Companies at the transformative stage understand they are at the upper end of the maturity curve. Wins at this stage happen through the aggregation of small gains where small advances are made by many team members in many areas to improve overall individual and team performance.[7]

A recent MIT research report[10] reveals analytically strong organizations significantly more often share their data with their customers, suppliers and competitors. The transportation and warehousing sectors sit highest on the list of those companies who share data to enhance their value to the market.



Many governments also recognize the value and importance of sharing open data. For example, Canada's Open Data Exchange focuses on simplifying and enhancing access to open data for commercialization purposes in Canada. Similarly, in the European Union Open Data Portal, a broad compendium of open data resources is available. In the US, Project Open Data, serves to encourage open data exchanges including code, tools and case studies.



Machine Learning

In software, the Network Effect in digital technology is well known: certain types of software become more valuable as more people use it. Personal social networking software is a good example. It becomes more valuable to you the more your friends and family use it too. Machine Learning is in a sense, the Network Effect applied to statistical modelling. In certain circumstances, the more data we get in continuous streams, the more accurate our predictions become. An example here is mobile mapping software. It could be programmed with a simple, static model that measures the distance between two points and the posted speed limits to provide the user with a route and an estimated arrival time. But that would ignore the myriad of other factors that influence how long it takes to drive somewhere. Modern mapping software accumulates data from all users taking a route, both from the past and those currently driving, to continuously update its statistical machine model. The Network Effect applied to Machine Learning here is clear: the more users who adopt the mapping software, the more accurate the constantly adapting model becomes.

Machine Learning approaches often blend several statistical procedures (called “ensemble models”) to obtain an insight. Whatever combination of techniques are used, the road to improved Safety and Quality lies in part on our ability to provide better predictive insights and improved classifications such that algorithms can reduce error and increase our efficiency in getting things done. The United States Army is advancing its use of machine learning to develop safety based diagnostics for aircraft, along with integrating machine learning into health and conditioning programs for soldiers. Whether it’s equipment or people, machine learning systems are delivering improved safety, quality and performance.

60%

Reduction of Quality Inspection Resources

21%

Improved Product Quality by Elimination of False Defects and Stoppages

13%

Increase of First Pass Yield

8%

Improved Production Throughput by Elimination of Bottleneck

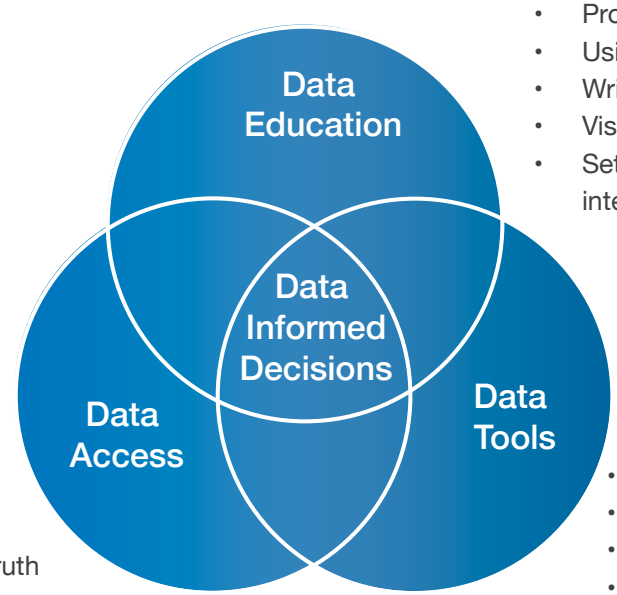
In manufacturing, machine learning approaches have dramatically improved quality control while reducing human error and costs. A recent example of digital quality management was a neural network, trained on historical quality control data, used to correctly identify defects in casted parts of complex equipment. It tracked sensitive deviations from standards that inspectors might have missed, while successfully ignoring false signals that inspectors may have wrongly inputed. Not only did this approach improve detection, it drastically reduced the need for quality control inspectors.

Building a Team

One simple observation working with so many companies across varied industries is that much of the "data-centeredness" of such approaches, ties directly to how core data is to their businesses. The construction industry lags other industries in using data-based decision making because it is not a core requirement for the business. Manufacturing companies have more data requirements. At the highest level of analytical maturity, digital companies often have data as core to their business. Not surprisingly then, a construction firm may hire one analyst, a manufacturing company may put together a team of 2 to 5 while top digital enterprises like AirBnB have teams of hundreds of Data Scientists. This large team tackles the tools, people and process they need in a similar manner to that of much smaller dedicated teams.

Five people rarely do the job of 100, but it is simply not practical for many companies to have a data analyst team of hundreds. To achieve a better economy of scale, 20 to 50 companies might work together to create a single collective analytical brain.

Airbnb Approach to Data Based Decision Making[13] :



- Problem solving with data
- Using statistics & analysis
- Writing SQL & using data at Airbnb
- Visualizing data
- Setting up, delivering & interpreting experiments

- Single source of truth
- Access permissions
- Data documentations
- Data & tools request process

- Aipal
- Data portal
- ERF
- Knowledge Repo
- Microsoft Excel
- Superset
- Tableau

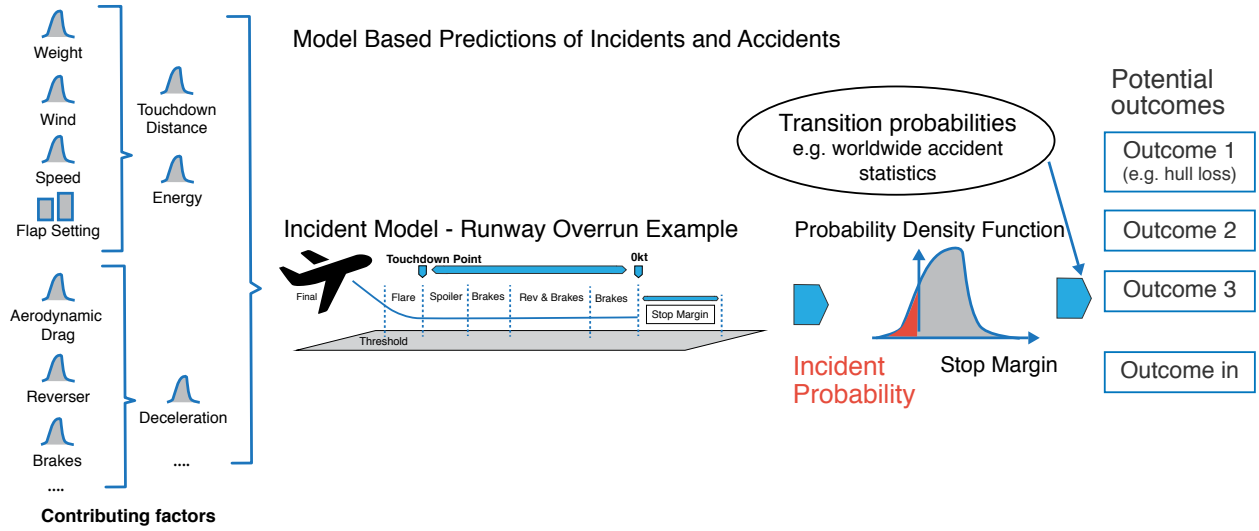
Airbnb, despite being in a highly competitive digital business, has built an open source library where technical approaches to analytical problems in their industry are shared. They realize the power of collaboration. Even in hyper-competitive digital businesses, the sharing ideas within networked communities is an effective approach to solving problems and generating ideas. Airbnb is so committed to the organization-wide sharing of data that they have opened Data University , an initiative to make its entire workforce data literate.

Lessons from the Aviation Industry

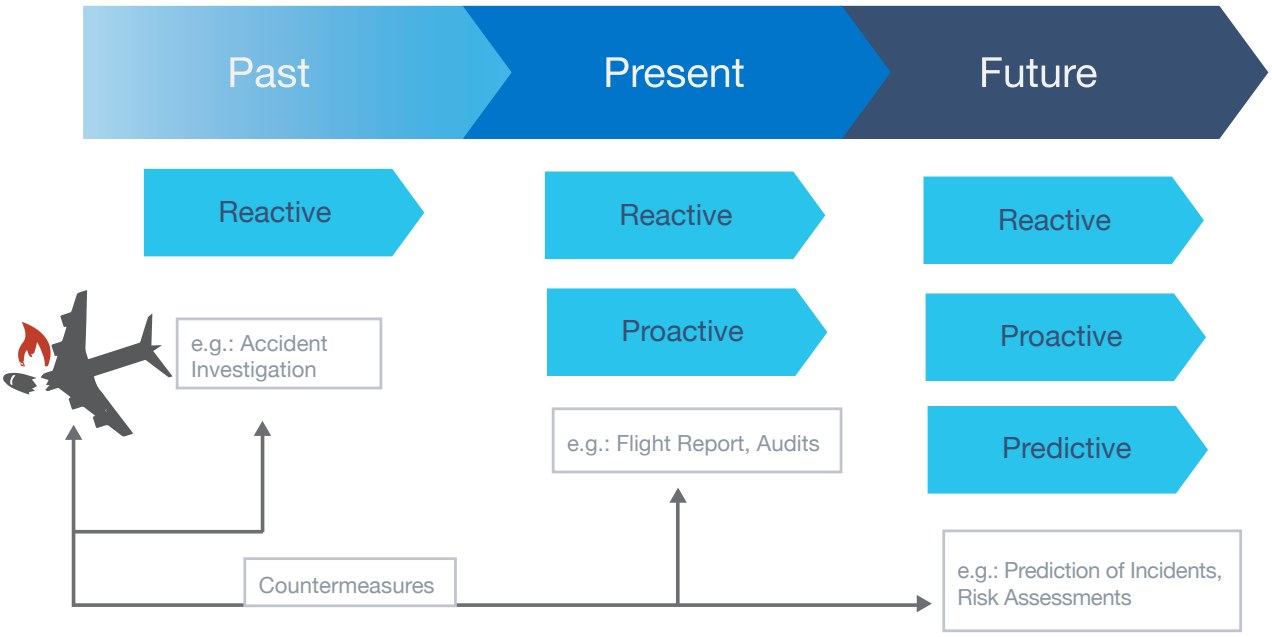
The aviation industry, since the 1980s, has undertaken in earnest the use of data and analytics in automating airplanes and flight control. Since human error accounts for vast majority of failures that lead to airplane accidents, and since the consequences are so dire, the obvious goal has been to reduce human intervention needed to fly a plane. Sensors are now placed throughout airplanes and combined with onboard computerized systems much of the task of piloting is now automated. Commercial cockpit crews today have just two key positions – the pilot and co-pilot. Gone are the "tech positions" of onboard flight engineer and navigator. Automated technologies that allow commercial airplanes to fly on their own have been in place since the 1980s.

Machine Learning has been applied to aviation by examining terabytes of operational and sensor data collected on flights prior to adverse events. For example, a team at the Institute of Software Integrated Systems together with systems manufacturer Honeywell used machine learning to discover improvements needed for fuel injection systems to prevent engines from overheating and shutting down. They then build new monitors and more accurate embedded diagnostic knowledge systems that can now detect faults in airplane fuel systems.

Advanced statistical modeling has been used by the airline industry to assess and predict the likelihood of failure incidents occurring in order to proactively mitigate these, and have even quantified the effectiveness of risk mitigation measures prior to implementing them. As the Institute of Flight System Dynamics outlines, data from normal flight operations take high-risk components of flying (e.g., landing) and break down each stage of the process to determine the likelihood of its contributing to an incident. Risk models are built by combining all contributing factors for every airline based on probabilities of incidents occurring.



Like the Intelex BI Maturity Model, airlines adopt a "future" Stage 3 analytical approach[19] involving predictive assessments.



Businesses at large are catching up to the world of aviation. In every aspect of business life, new frontiers are defined by cognitive technologies, artificial intelligence, machine learning, and the Internet of Things – the notion of a connected world of intelligent and embedded sensors that gather and process data to make "things" smarter. Like flying an airplane, the notion is that we can replace human failure points with technology that never fatigues, never gets distracted, never needs a day off and mostly functions exactly as we program it.

These technology innovations have sparked debates around whether automation is always safer. When we consider that a jumbo jet can self-drive with more than 500 passengers on board then perhaps the much-hyped idea that safer self-driving cars will soon proliferate is not far-fetched. Humans make errors in judgement. Boredom and distraction, and cognitive overload are our biggest human threats to safety. These are the cause of more workplace incidents and fatalities than all others. Whenever repetition is excessive or too many alternatives need to be weighed and calculated, technology and automation typically provide a safer and better approach. Taking a data-driven policy approach to this issue, in a new world of automated driverless vehicles the number to reduce will be some 40,000 annual deaths resulting from more than 5 million traffic accidents in the United States.

The Aviation industry is again instructive in how its Association, the International Authority Transportation Authority (IATA), takes a shared approach when it comes to using data in an effort to improve transportation efficiency worldwide through a publicly accessed website of the following information:

- Sources of data for Business Intelligence,
- Forecasting statistics portals (plus the opportunity for customization),
- Sources of safety data, and
- Feedback from their Global Passenger survey.

Additionally, they actively encouraged various members to participate in not only sharing best practices but also in finding ways to share data across various partner and value chains. IATA recently sponsored the 11th World Cargo Symposium in 2017 where a strong case was made for greater data exchange across all participants in the value chain in order to improve operational efficiencies and to build out new revenue pools for the entire industry.

Endnotes

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Institute of Flight System Dynamics

Institute of Flight System Dynamics

Conclusion

Lessons from the past and current demands of business make one thing clear – the insights to be gained through the widespread sharing of and access to data has never been more important particularly for the future of safety and quality.

Data-centric and collective business intelligence, as evidenced by the examples given in this white paper, can significantly help organizations discover ways to increase safety and minimize risk. Much of the intelligence yielded from data comes not only through shared approaches to problem solving, but also through sharing best practices, code, and data. Advancing the analytical capabilities of business in all key functions provides a foundation for improved decision-making and performance at all levels. That is certainly the case for quality improvements, but the principle definitely applies to increased safety.

Traditional businesses can learn lessons from the aviation industry where small errors have large consequences and every detail matters. Aviation is at the forefront of safety and quality, and it is pioneering the use of data and analytics.

The aviation industry like many others is highly regulated, highly competitive, and highly data-driven in the running of its day-to-day operations. It has a vested interest in predicting and mitigating all forms of risk, both financial and human. Despite the aviation industry's competitive environment, data- and information-sharing alliances are vital. So, it's important for every organization to understand when and where sharing data across businesses makes sense and apply a similar approach.

The more data gathered, made sense of, and shared, the better and safer our world becomes. To succeed in this quest, companies need to expand their data-science capabilities beyond a core team, and foster a data-centered culture across the entire organization. Taking a data-centered approach to quality and safety improvement is within reach, thanks to advances in business intelligence offerings.

Business Intelligence Software

INTELEX

From Data to Decisions

Unleashing Your Inner Data Expert

To move the needle on performance and positively impact EHSQ outcomes, business decisions need be made faster, smarter, and more proactively than in the past. This means using the mass of misspent data in your EHSQ software system to inform decisions that solve the problems of today, and prevent those of tomorrow.

Become a data-driven EHSQ organization

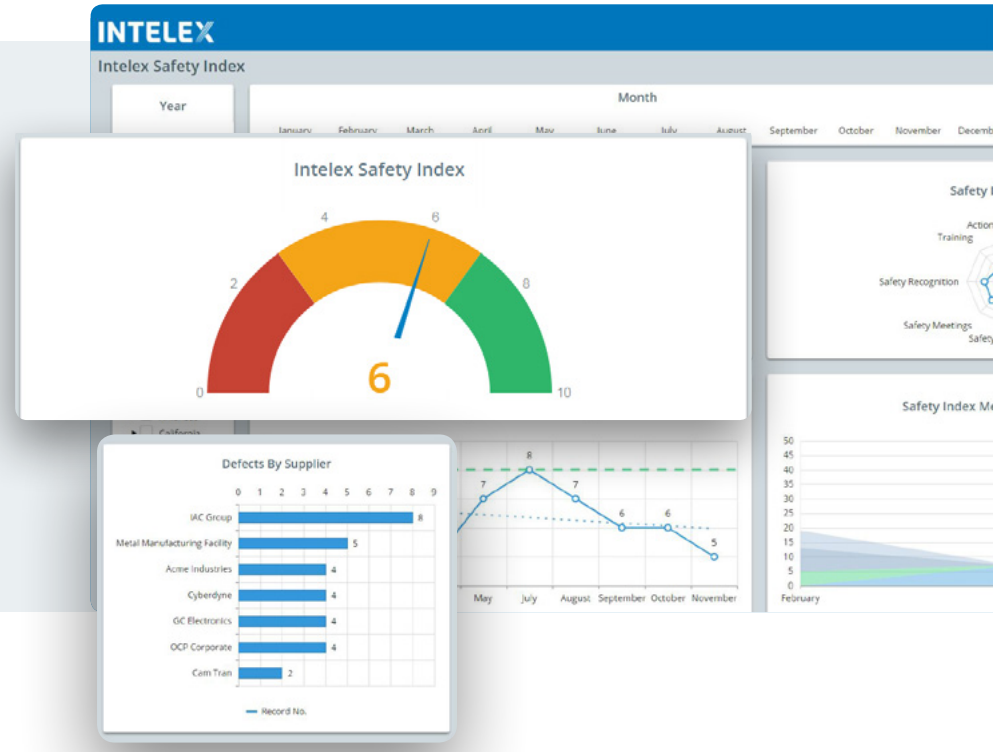
View and share comprehensive reports across teams and departments

Slice and visualize data using dashboards that bring insights to the surface

Use insights to make sophisticated business decisions that incite action

Enabling non-data users

- **Take the fear out of analytics** with BI tools that are embedded within your EHSQ software
- **Start your data journey off** with out of the box reports and dashboards to see value immediately
- **Get a personalized experience** using data slicers to create unique views and drill into data to achieve the level of detail you require to quickly take action or influence a decision



Features

Self-Service Tools

Allow business users that don't have data expertise to access, navigate, and visualize data independently. Easily design, analyze, and share reports and dashboards within an approved and IT supported environment, allowing your data experts to focus on advanced analytics initiatives rather than daily support activities.

Embedded Workflow

Intelex BI is integrated with your Intelex platform and available within every Intelex application. Simply add a dashboard or report tab to any application to save time and effort by streamlining reporting, dashboarding, and data analysis into your day to day workflow.

Unparalleled User Experience

Leverage best in breed BI experiences that are tailored to EHSQ management system best practices. Built with the EHSQ user in mind, Intelex BI gets you up and running quickly with out of the box reports, dashboards, and intuitive data slicing capabilities that make uncovering insights fast and easy.

Configurability

The Intelex platform leads the market with unmatched configuration capabilities. The platform, and all Intelex solutions, can be configured at any time to fit the needs of your organization. This includes the ability to quickly and easily configure reports and dashboards to meet your particular business needs.

Data Service

Using the Intelex Data Service, connect directly to external BI tools such as Excel, Tableau, Cognos, and many more to pull live data from your Intelex platform into your existing BI investments.

"The Intelex Business Intelligence platform is a very important tool at LB Foster. Our view has always been that Intelex should be the "1-stop shop" for all LB Foster's data acquisition and analysis needs. The latest releases have brought about many valuable enhancements, and with the addition of Slicers and Summary Widgets, we can now combine and show data in ways we never imagined. Our users love the flexibility of dynamically filtering and viewing data, which has drastically reduced the volume of dashboards necessary to quickly locate the information you need and effectively take action."

Scott Hernishin
Global Quality Systems Manager
LB Foster Company
LBFoster

Contact Intelex Today

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BI for EHSQ: Realizing the Benefits of a Data-Driven Journey

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