Environment, Labor & Safety+ Conference

Predictive Safety Analytics for Worker Safety

FIRST ANALYTICS®

sas

Meat Institute

Protein PACT

Safety Management Systems are Backward-looking

- Incident Reports
- Dashboards
- Compliance monitoring
- Etc.

Are there ways to use safety data in a forward-looking, predictive sense?

Caution: Buzz words and hype!

- Big Data
- Machine Learning
- AI

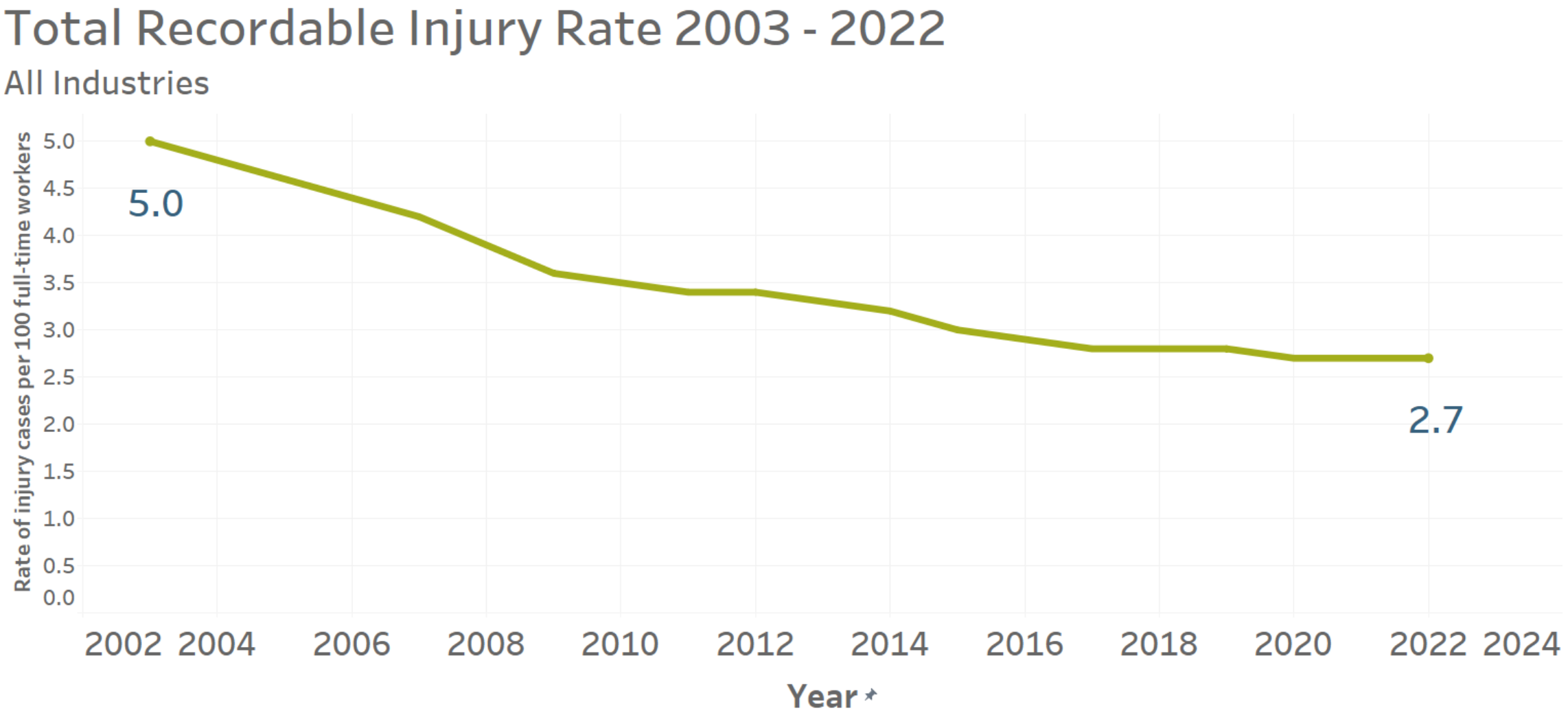
Session Take-aways

- Understand how predictive analytics goes beyond descriptive analytics in assessing risk.
- See how your existing data may be able to identify and quantify risk factors, and to evaluate the effectiveness of safety programs and investments.
- Catch a vision of being predictive, to intervene before incidents occur.
- Understand that, while there may be steps you can take right now to better leverage your data, there are likely some gaps you need to address to get you to a more predictive state

Trends in Safety

TRENDING DOWNWARD BUT ENCOUNTERING THE “PLATEAU PROBLEM”

Rates Have Been Improving for All Industries



Source: U.S. Bureau of Labor Statistics, Survey of Occupational Injuries and Illnesses

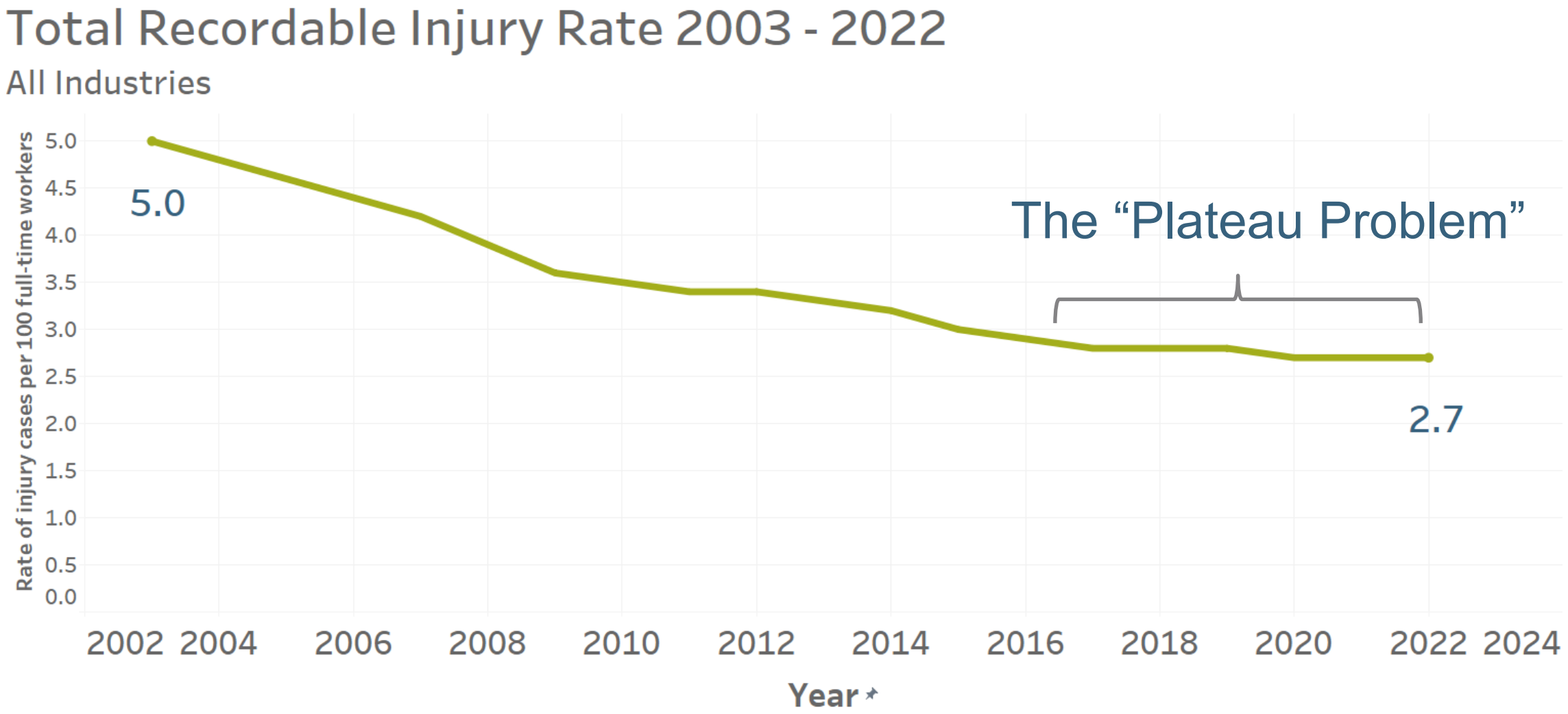
Progress on Worker Safety

“The BLS report proves that year after year, meat and poultry companies remain committed and have invested billions of dollars to reduce worker injuries and illnesses”

- Julie Anna Potts, NAMI president and chief executive officer

Source: National Chicken Council. | GAO-23-105104

But… the “Plateau Problem”



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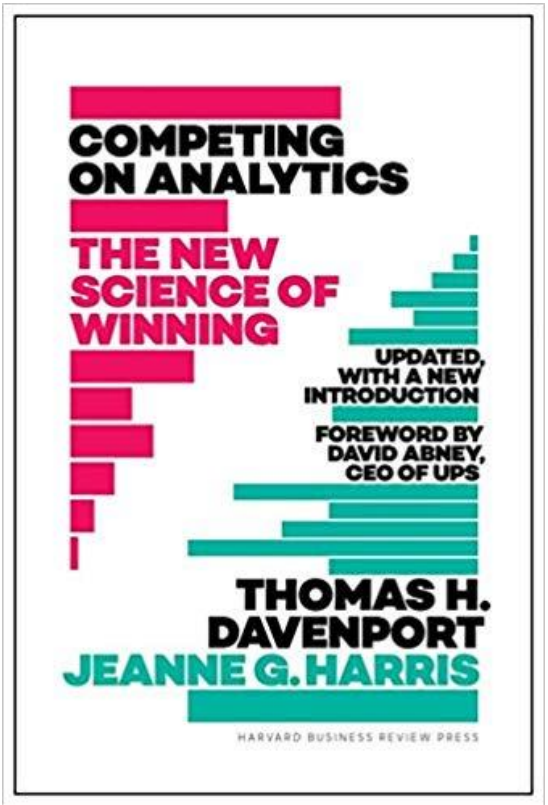
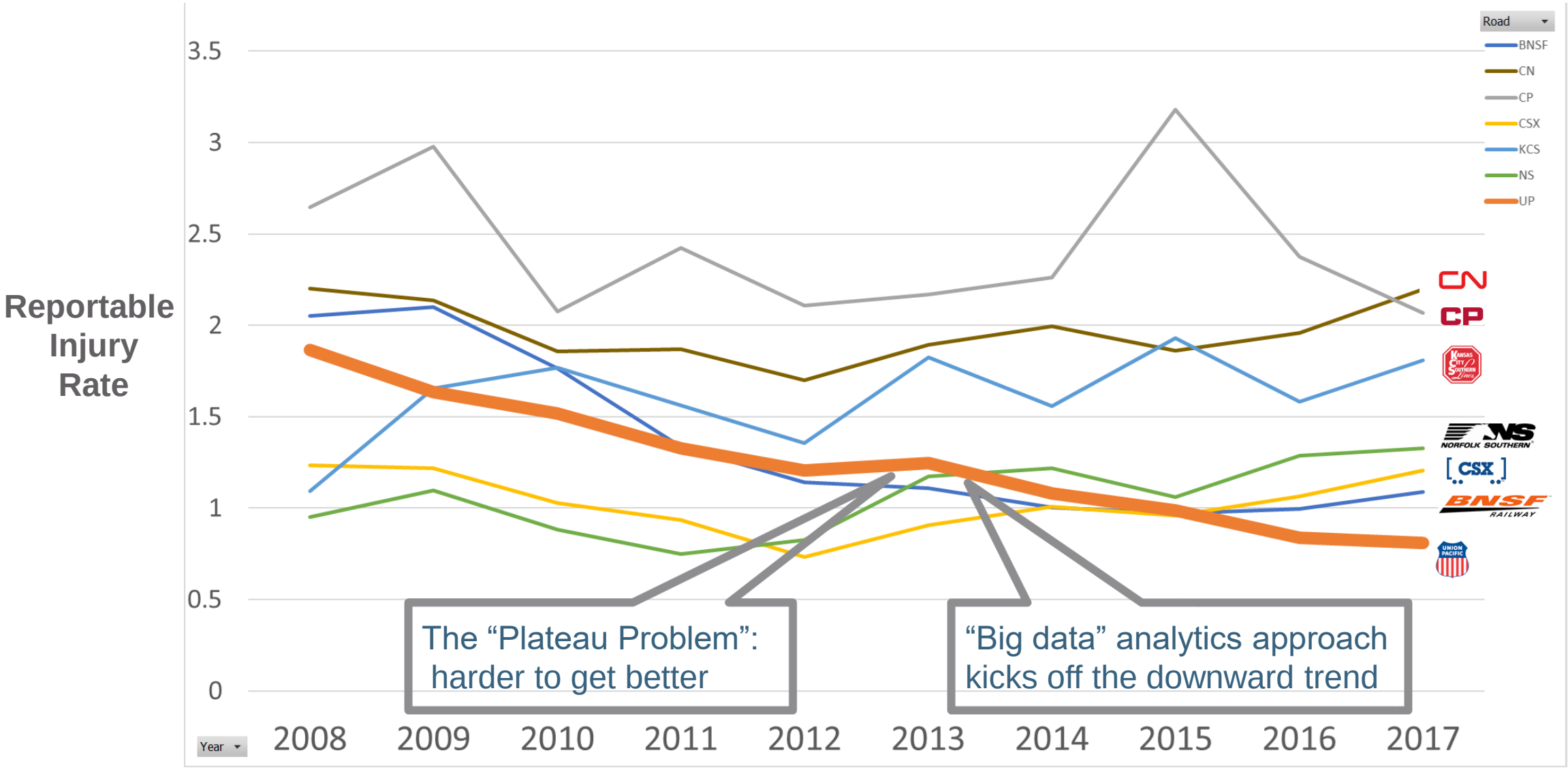
Case Study | **The Plateau Problem**



*The ... manager explained that safety was a top priority for the company and that it had improved considerably on this front, **but it got harder to keep improving**.*

*He said the company had already used some data to identify likely risks, but there was a **lot more that could be explored**.*

Becoming the **Safest Railroad**



Outcome | **Breaking through the Plateau**

28%
reduction in reportable injuries

4
record years

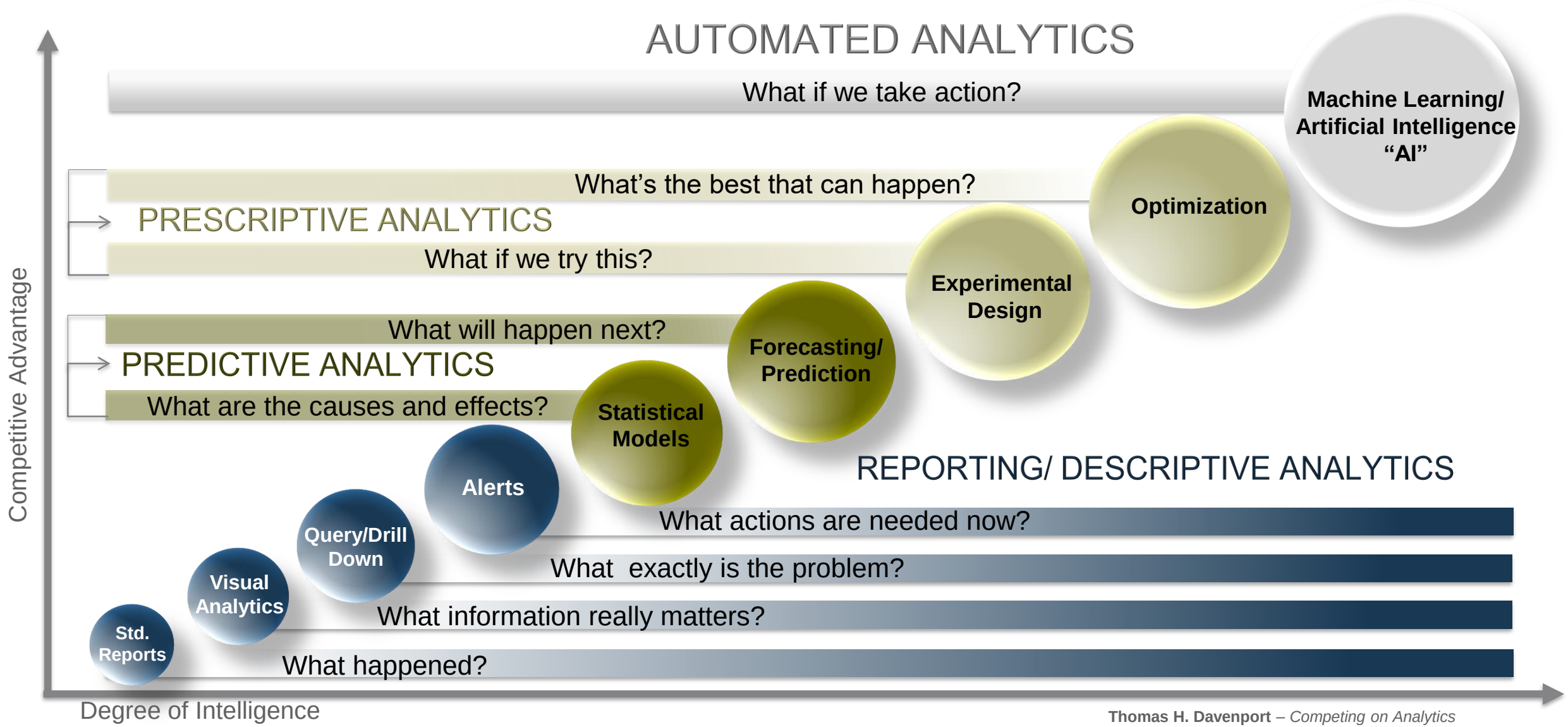
Best industry safety rate 2015-2018

26%
better than closest industry peer

Predictive Analytics

WHAT IS IT AND HOW DOES IT APPLY?

Types of Analytics



Thomas H. Davenport – *Competing on Analytics*

How Predictive Analytics Can Be Applied

Focal Point	Outcomes
People	• Employees • Customers • The public • Managers
	• Reduce incidents, accidents & injuries • Care for your employees • Protect the public • Coach managers
Places	• Facilities • Environments • Fleet • Equipment
	• Reduce lost productivity • Improve facility metrics • Discover where to invest in equipment • Alert to dangerous contexts
Processes	• Policies • Programs • Training • Compliance
	• Measure safety program effectiveness • Design impactful training • Strengthen policies • Foster good employee relations

The 4 Ps of Safety: **P**eople, **P**laces, **P**rocesses, **P**redictive Analytics

The Benefits of Predictive Safety Analytics

- Improve safety metrics such as OSHA or FRA reportable injury rates, DART (days away restricted time), lost time incidents, and near misses.
- Reduce lost productivity and improve operational metrics, like manufacturing OEE.
- Reduce equipment damage.
- Reduce legal liability, litigation and settlement costs, and medical treatment payments.
- Reduce insurance premiums.
- Supply information to assist managers in safety-related coaching.
- Improve management/labor relations.
- Support managers in attaining their safety-related performance metrics.
- Aid safety professionals in measuring safety program effectiveness and in designing impactful policies, programs, and training.

Real-world Examples

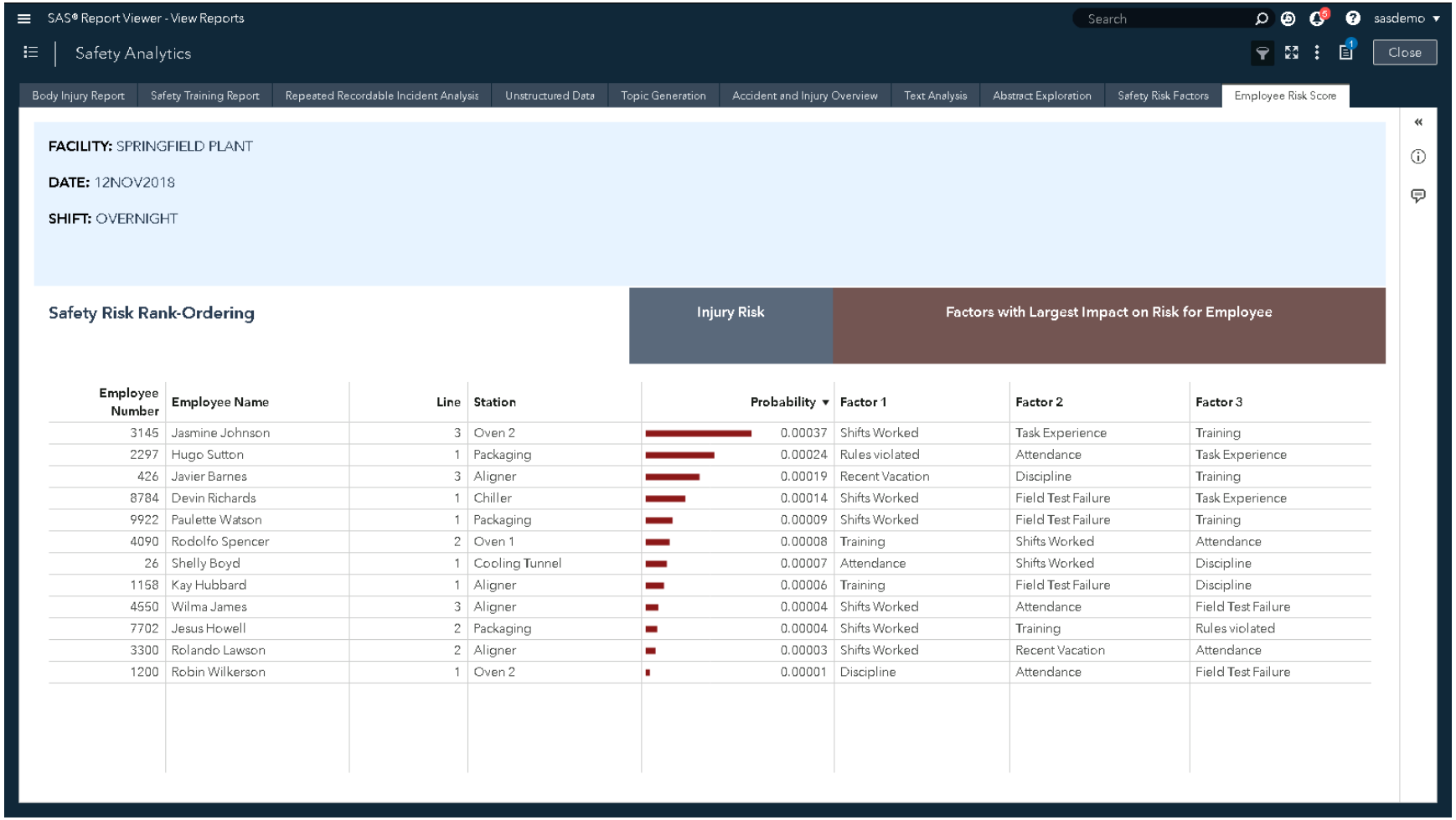
OPERATIONAL/TACTICAL AND ENTERPRISE/STRATEGIC

Who is at risk on this shift?

Food manufacturing industry example

Safety risk rank-ordering of those coming on shift

Operational/Tactical (worker-shift level)



Employee Number	Employee Name	Line	Station	Probability	Factor 1	Factor 2	Factor 3
3145	Jasmine Johnson	3	Oven 2	0.00037	Shifts Worked	Task Experience	Training
2297	Hugo Sutton	1	Packaging	0.00024	Rules violated	Attendance	Task Experience
426	Javier Barnes	3	Aligner	0.00019	Recent Vacation	Discipline	Training
8784	Devin Richards	1	Chiller	0.00014	Shifts Worked	Field Test Failure	Task Experience
9922	Paulette Watson	1	Packaging	0.00009	Shifts Worked	Field Test Failure	Training
4090	Rodolfo Spencer	2	Oven 1	0.00008	Training	Shifts Worked	Attendance
26	Shelly Boyd	1	Cooling Tunnel	0.00007	Attendance	Shifts Worked	Discipline
1158	Kay Hubbard	1	Aligner	0.00006	Training	Field Test Failure	Discipline
4550	Wilma James	3	Aligner	0.00004	Shifts Worked	Attendance	Field Test Failure
7702	Jesus Howell	2	Packaging	0.00004	Shifts Worked	Training	Rules violated
3300	Rolando Lawson	2	Aligner	0.00003	Shifts Worked	Recent Vacation	Attendance
1200	Robin Wilkerson	1	Oven 2	0.00001	Discipline	Attendance	Field Test Failure

FACILITY: SPRINGFIELD PLANT

DATE: 12NOV2018

SHIFT: OVERNIGHT

Safety Risk Rank-Ordering

				Injury Risk	Factors with Largest Impact on Risk for Employee		
Employee Number	Employee Name	Line	Station	Probability ▼	Factor 1	Factor 2	Factor 3
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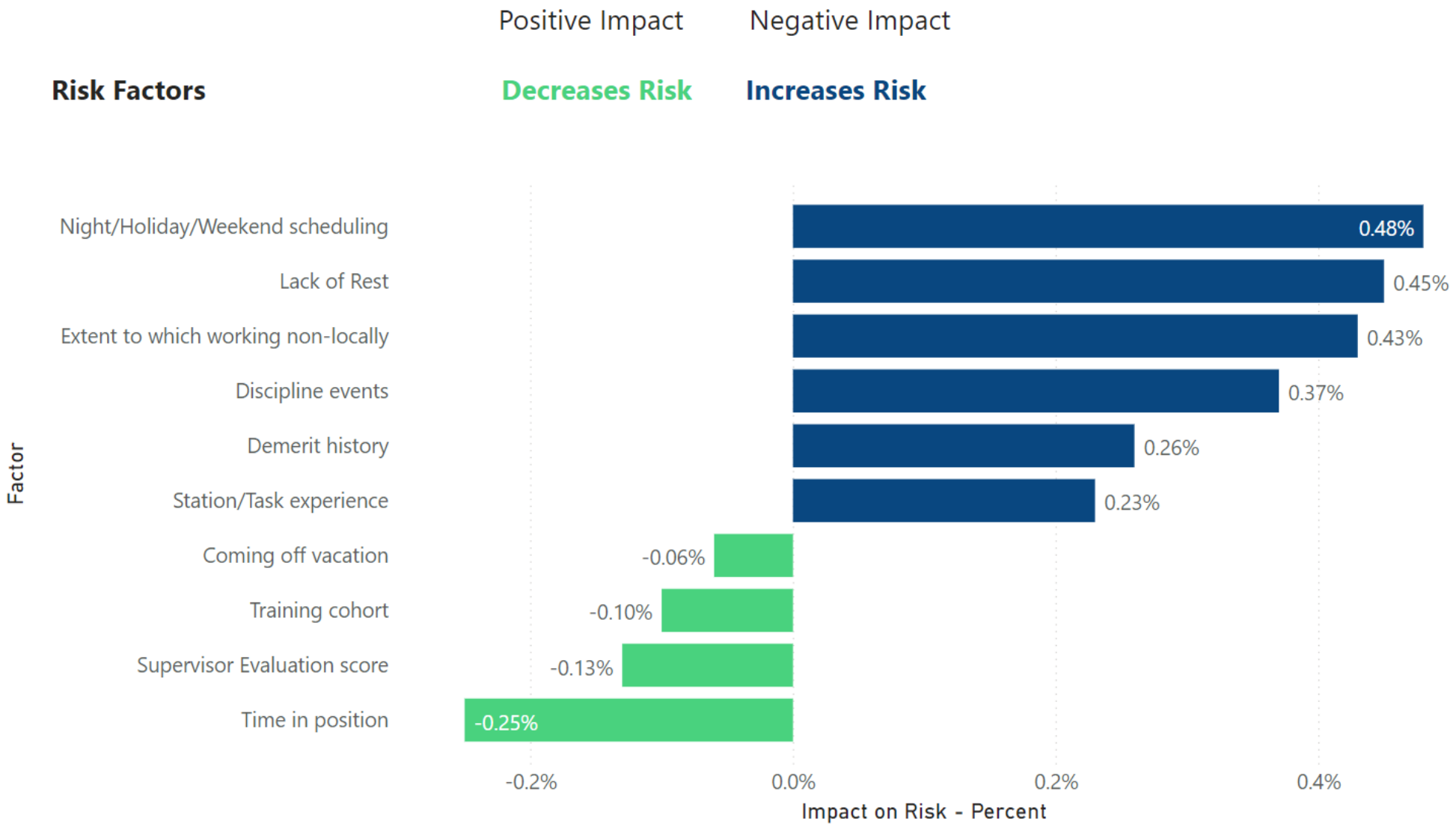
Evidence-based decision-making

- Debunk myths
  - Identify the real risk indicators.
  - Know what's working, what isn't
- Can be the impetus for more analytical, predictive data-driven decision making in general

Quantify Risk Factors

Railroad industry example

Strategic (enterprise level risk mitigation)



What Data Do I Need?

Safety Data Repository

Curated for Safety Analytics

- Reporting and visualization
- Ad hoc analyses
- **Predictive analytics**

Features and Benefits

- Data lake and database schemas tailored for safety analytics
- Integrates with, does not replace, a safety management system (SMS)
- Draws from dozens of data sources in varied formats
- Deals with various levels of aggregation
- Distills text from reports into structured data
- Proprietary data transformation and joining algorithms for predictive modeling and machine learning.

Primary Data

Safety Management System (SMS)

- **Targets**: incidents; injuries; near misses; lost time incidents; DART; first aid; OSHA reportables, process safety events; etc.
- **Leading Indicators**: observations; audits; inspections; behavioral-based safety; compliance; etc.

Ancillary Data

Varied operational systems

- **Work Shift**: Scheduling, time keeping, function; location; craft, tasks, teams.
- **HR/Employee:** attendance; PTO; tenure; demographics; performance reviews; engagement surveys; training; knowledge tests; certifications; fatigue scores; commute time, drug/alcohol tests; discipline; cohort; union membership; management.
- **Assets**: site characteristics; maintenance; downtime; equipment changeouts; vehicle telematics; event recorders; sensors; video.
- **Operations**: processes; rules; policies; PPE use; business velocity.
- **Corporate**: training programs; safety campaigns; legal.
- **External**: weather; macroeconomic.

How Predictive Analytics Can Be Applied

Focal Point	Outcomes
People • Employees • Customers • The public	• Reduce incidents, accidents & injuries • Care for your employees • Protect the public • Coach managers
Places • Fleet • Equipment	• Reduce lost productivity • Improve facility metrics • Discover where to invest in equipment • Alert to dangerous contexts
Processes • Policies • Programs • Training • Compliance	• Measure safety program effectiveness • Design impactful training • Strengthen policies • Foster good employee relations

What if I don't have detailed data to address most of these?

The 4 Ps of Safety: **P**eople, **P**laces, **P**rocesses, **P**redictive Analytics

How To Get Started

SHORT TERM HITS TO LONG-TERM VISION

Safety Analytics Maturity Model

Don’t worry – most companies are stage 1 or 2

Stages	1	2	3	4	5
Decisions & Resource Planning	• Not particularly data driven	• Program analysis: casual, only accounts for 1 or 2 factors	• People: evidence-based allocation of time	• Formal controlled experiments • Places: installations, types of equipment	• Evidence-based analysis shapes most budgets, programs, and processes • All appropriate dimensions (individual/team, instructor/program, task/entire process)
Risk Analysis	• Rare or none • Little or no data used	• Single focal point: e.g. employees • “Gut”, anecdotal • Infrequent • Backward-looking	• Employees, public, business partners • Evidence-based • Multi-factor • Myth busting • Predictive	• Broad adoption • Field feedback • Continuous improvement • More subtle indicators	• More real time: risk scoring, alerts, feedback, and learning • Everything happens closer to “the edge”
Data on Potential Risk Indicators	• Limited • Only capture event history: Injuries Accidents Near misses	• Events • Inspection, compliance, testing	• Core “critical mass” of internal data • Some external data (e.g. weather)	• Expanded core data • Plan to capture new sources	• Tapping into non-traditional data sources (images, motion sensors, etc.)
Skills & Tools	• Excel • Std. databases (SQL) • Static reports	• Interactive dashboards • Query / drill down • Moving towards alerts	• Rigorous statistical analysis • Statistical estimates & confidence • Predictive alerts	• Text mining • Other unstructured data	• AI, Deep learning • Machine learning • Image / video analysis • Streaming data

Start With Data You May Already Have

White Paper

Seven Case Examples Illustrated

- Incident Rate Forecasting
- Detecting an Adverse Upward Trend
- Understanding Seasonality
- Understanding the Trajectory of a Trend
- Drawing Attention to Business Units with Troubling Forecasts
- Triggering Alerts
- Measuring the Impact of a New Process

Incident Rate Forecasting

A model can provide…

Past Perspective

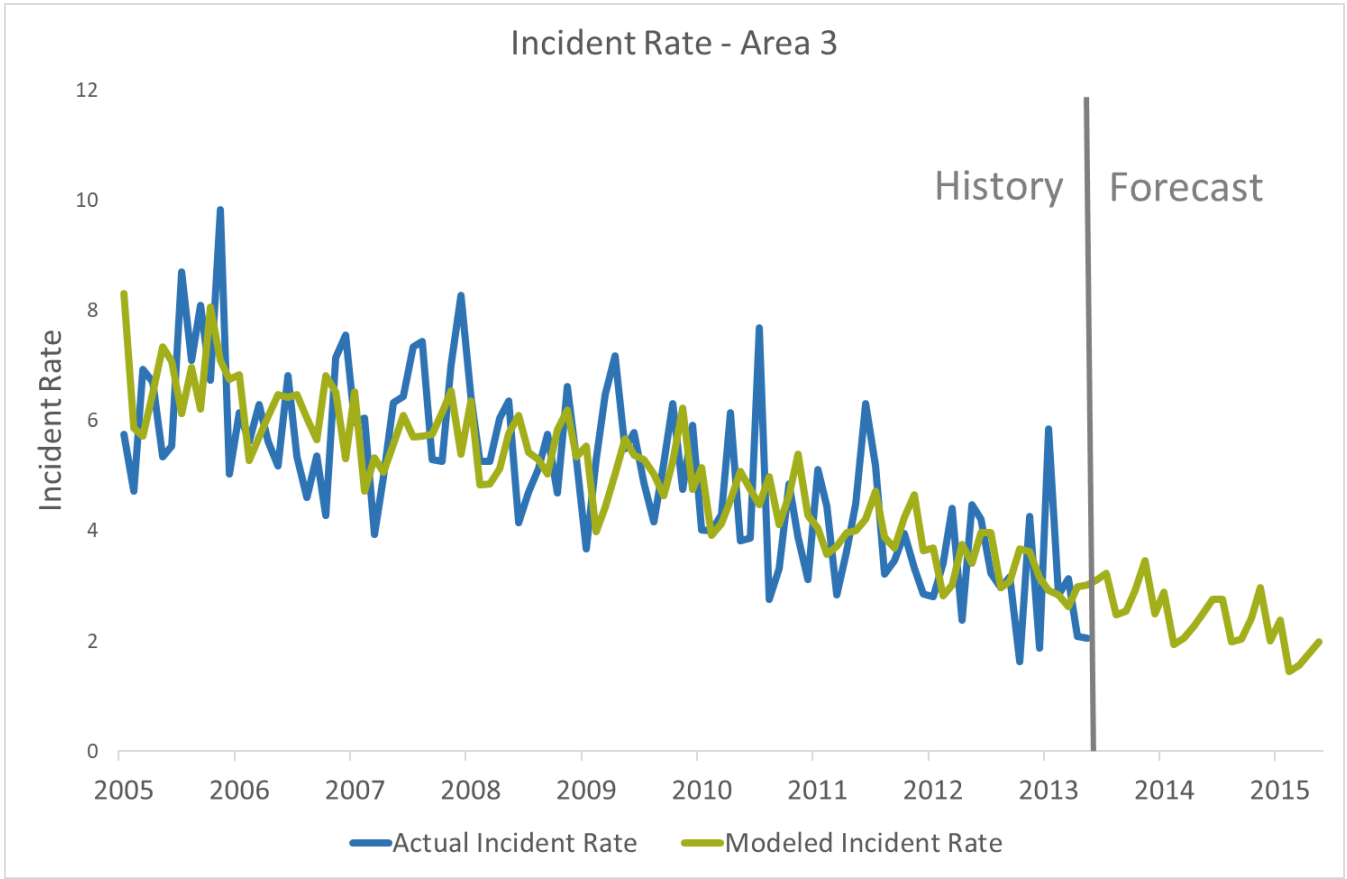
Is there anything in the past that we missed and should better understand?

Current Perspective

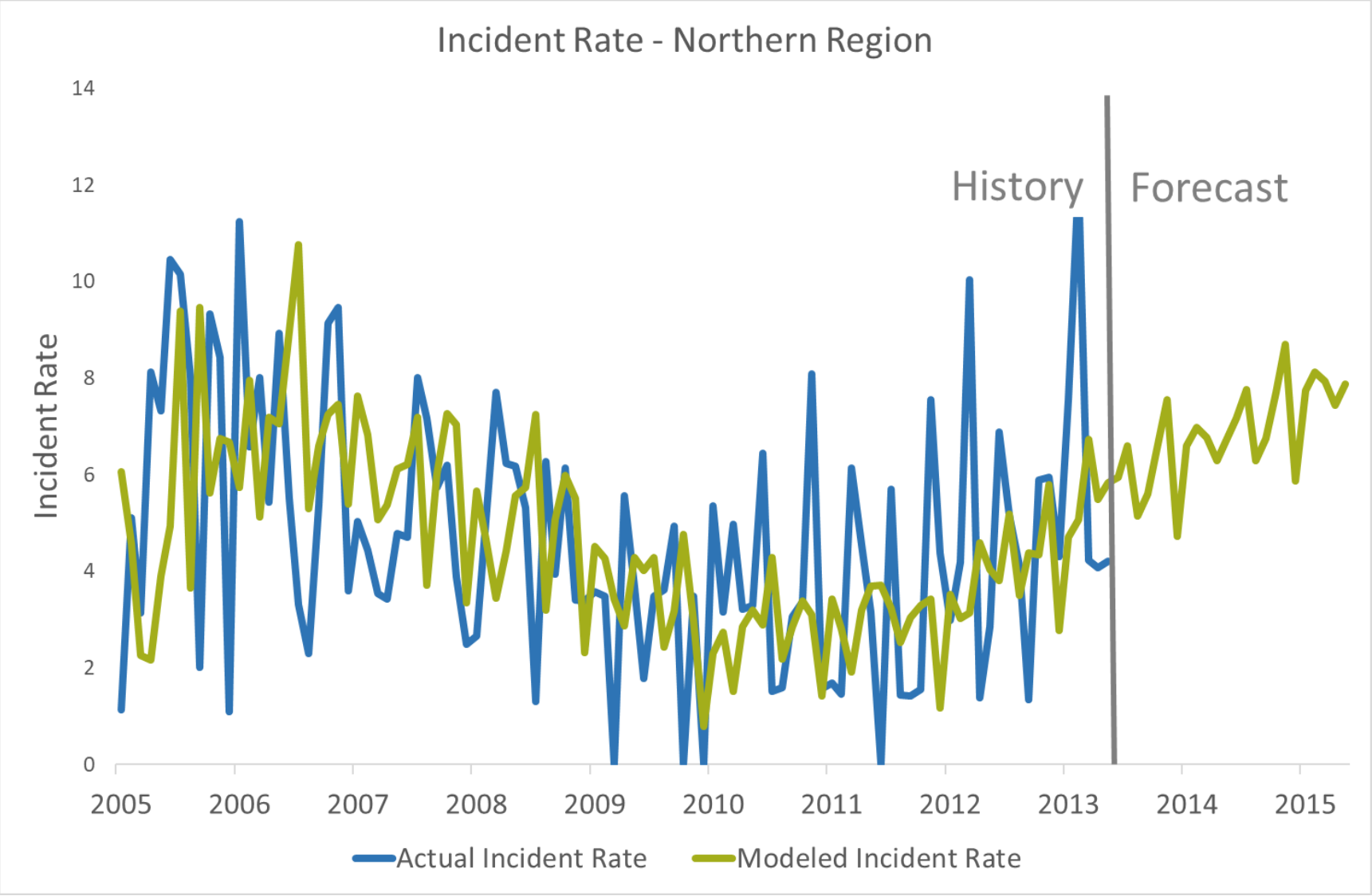
Did anything change last month?

Future Perspective

Will these trends continue?

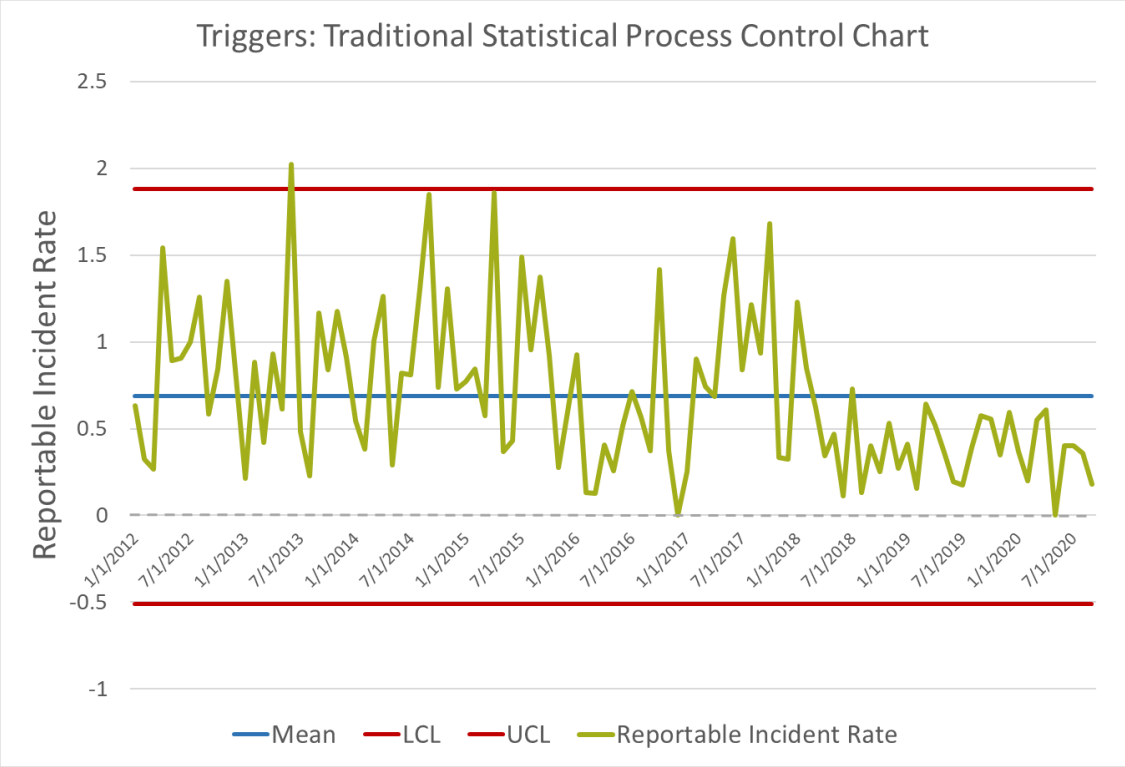


Detecting an Adverse Upward Trend

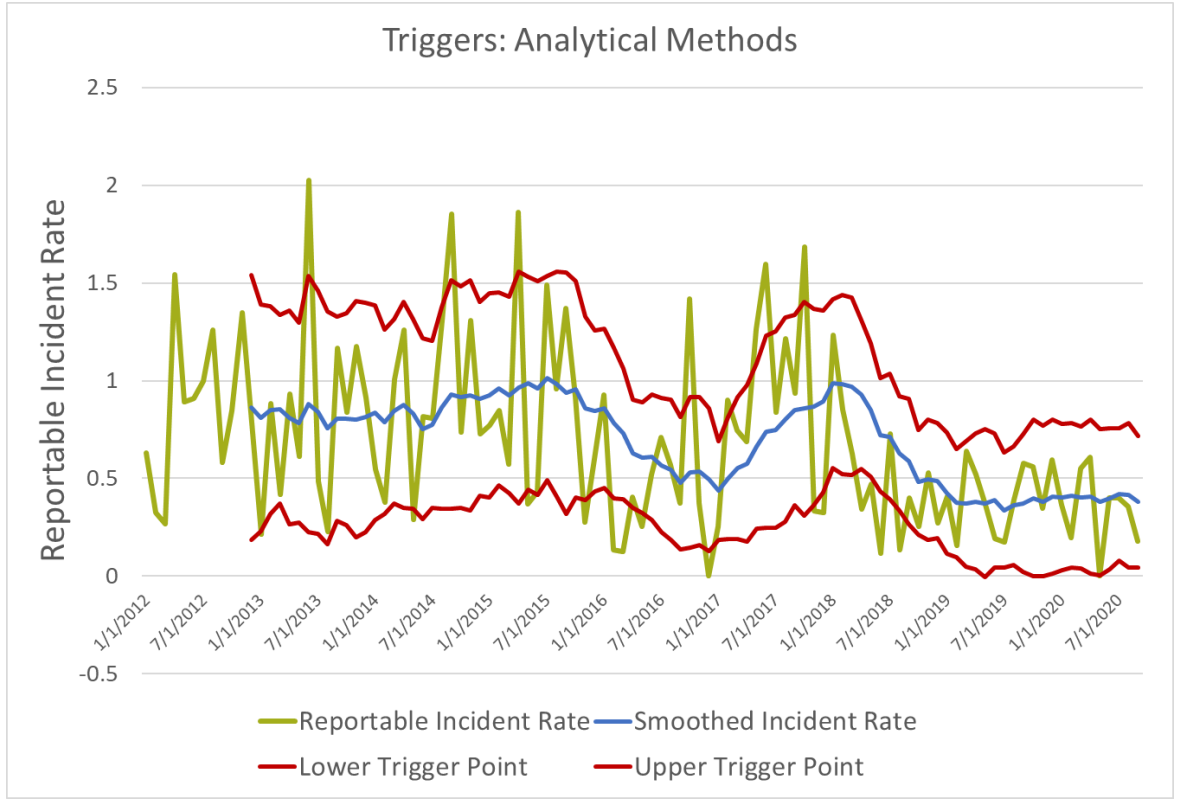


Triggering Alerts | **Better Analytical Precision**

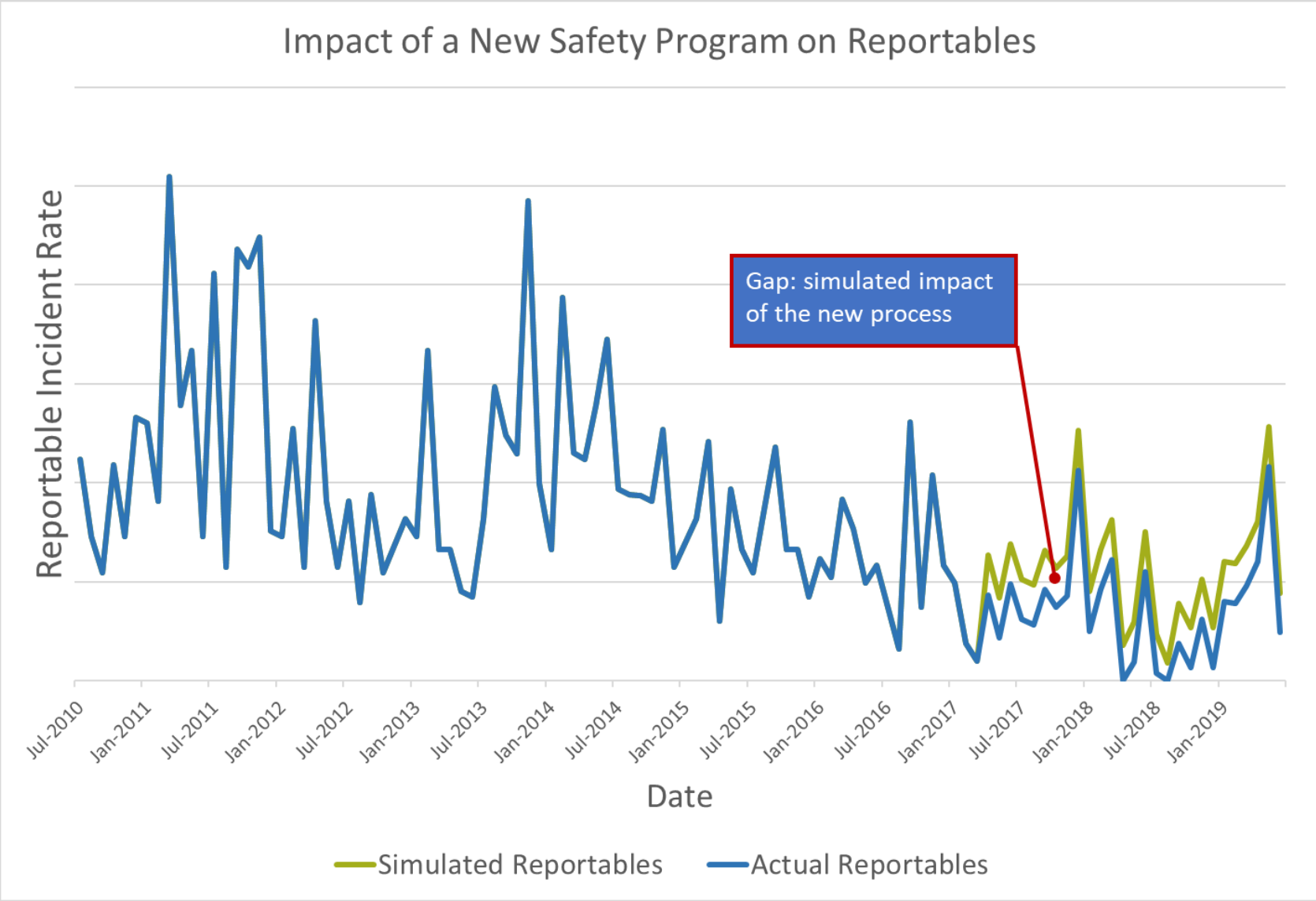
Traditional (Control Charts)



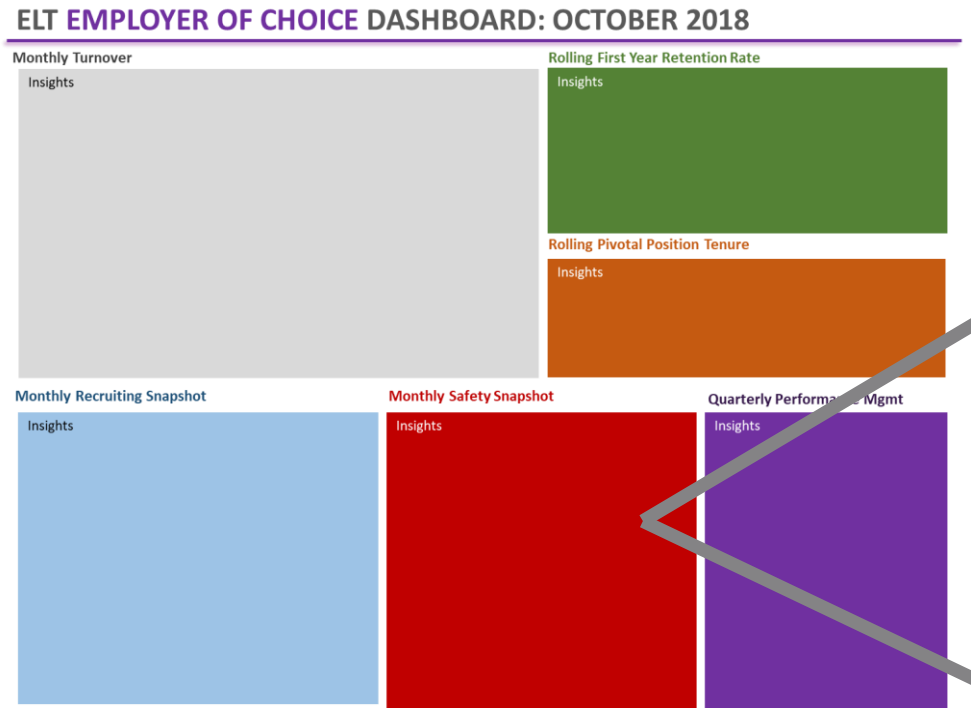
Modeled Processes

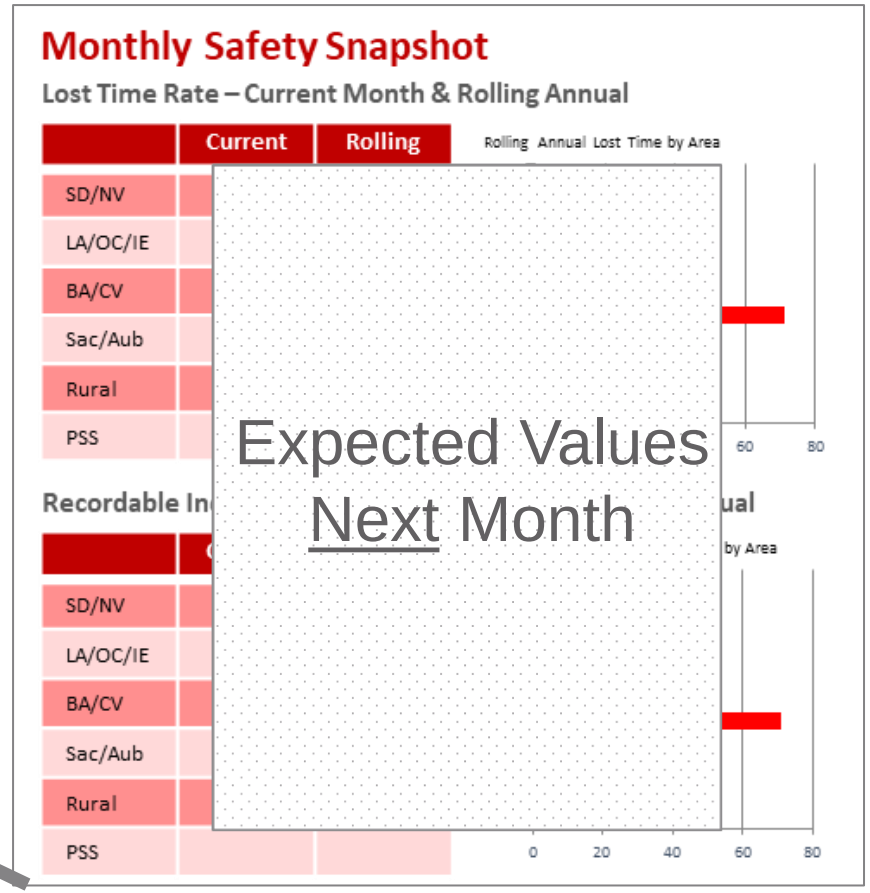


Measuring the Impact of a New Process



Future Perspective | **Forward Looking Dashboards**



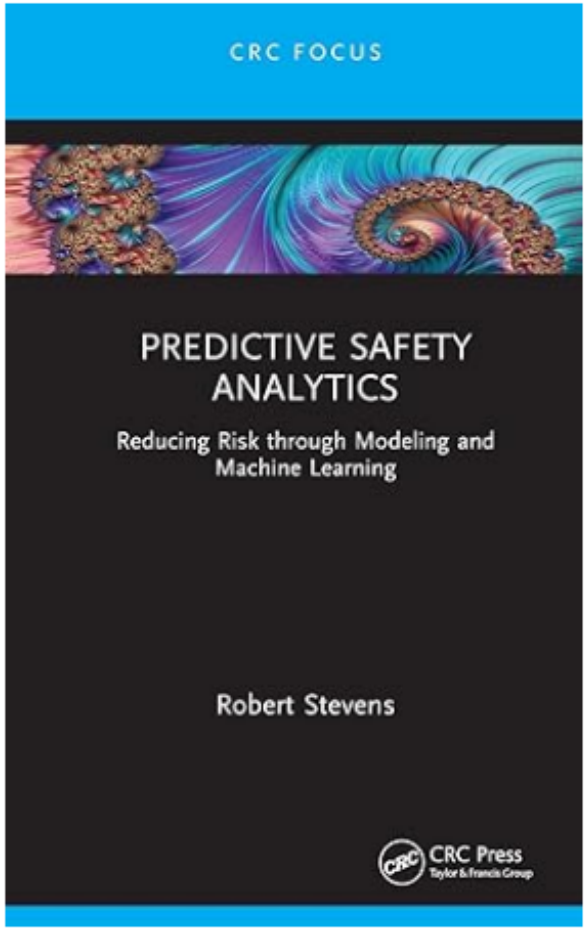


Where Do I Go From Here?

- Take stock of the data you already have
  - Is there simple way to add predictive analytics with high-level data, as shown in some of these cases?
  - For example, look at a dashboard and ask, “can I make this forward looking? Or, “how can I correlate actions with results?
- Undertake a “safety data readiness assessment” with data scientists and data engineers with safety domain experience.
  - Determines feasibility for various applications given the data you have.
  - Identifies gaps to be addressed to meet longer-term aspirations
- Don’t be discouraged – NEARLY EVERYONE is in the same state you are!

We Wrote The Book on PSA

Much more detail and expansion upon what you saw today



Predictive Safety Analytics (Reliability, Maintenance, and Safety Engineering) 1st Edition

by Robert Stevens (Author)

See all formats and editions

Nearly all our safety data collection and reporting systems are backwardlooking: incident reports; dashboards; compliance monitoring systems; and so on. This book shows how we can use safety data in a forward-looking, predictive sense.

Predictive Safety Analytics: Reducing Risk through Modeling and Machine Learning contains real use cases where organizations have reduced incidents by employing predictive analytics to foresee and mitigate future risks. It discusses how Predictive Safety Analytics is an opportunity to break through the plateau problem where safety rate improvements have stagnated in many organizations. The book presents how the use of data, coupled with advanced analytical techniques, including machine learning, has become a proven and successful innovation. Emphasis is placed on how the book can "meet you where you are" by illuminating a path to get there, starting with simple data the organization likely already has. Highlights of the book are the real examples and case studies that will assist in generating thoughts and ideas for what might work for individual readers and how they can adapt the information to their particular situations.

This book is written for professionals and researchers in system reliability, risk and safety assessment, quality control, operational managers in selected industries, data scientists, and ML engineers. Students taking courses in these areas will also find this book of interest to them.

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Thank You!

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