Predict and Prevent Workplace Injuries

Learn how the team that helped design Watson – the Jeopardy show winning super computer – can help you predict workplace injuries

April 20, 2011

Predictive SOLUTIONS

Today's Presenters

Griffin Schultz
General Manager – Predictive Solutions Corporation
- MBA, The Wharton School at the University of Pennsylvania
- Experienced in leveraging technology solutions across business functions

Dr. Raghu Arunachalam
Director of Emerging Technologies – Industrial Scientific Corporation
- Ph.D. degree from the University of Warwick, United Kingdom
- Research faculty at the School of Computer Science, Carnegie Mellon University

Agenda

I. Overview of predictive analytics
   - How it helps achieve safety results
   - The data that fuels the analytics

II. Detailed review of predictive models
   - Comparison of Watson to our models
   - Practical insight from our models

III. Q&A

Predictive SOLUTIONS

Predictive Solutions' Vision:
Eliminate death on the job,
in this century

Predictive Solutions' Strategy:
Save lives,
by ***predicting*** workplace injuries

What is (Predictive) Analytics?

The process of:

1. taking in large quantities of raw data
2. turning that raw data into actionable information …
3. …from which inferences about future outcomes (predictions) can be made

We Predict, so our customers can Prevent!

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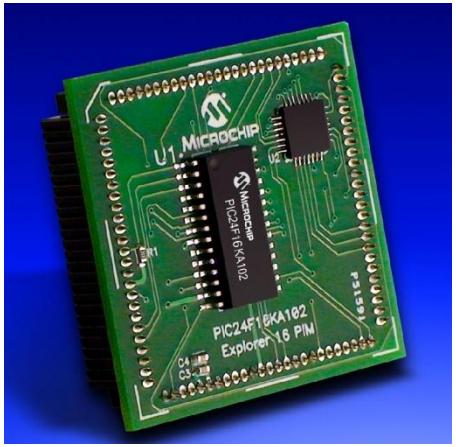
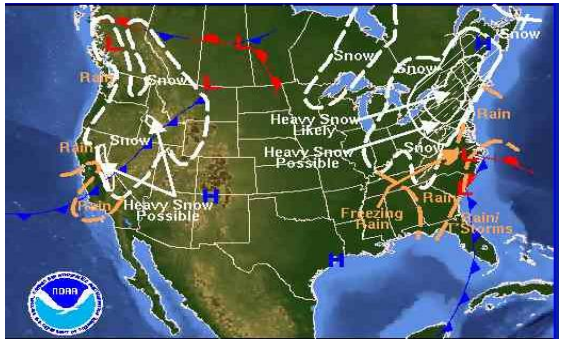
Who does Predictive Analytics?

Animals predict the weather

Humans predict everyday outcomes



Machines/computers predict outcomes when data becomes too vast or complex



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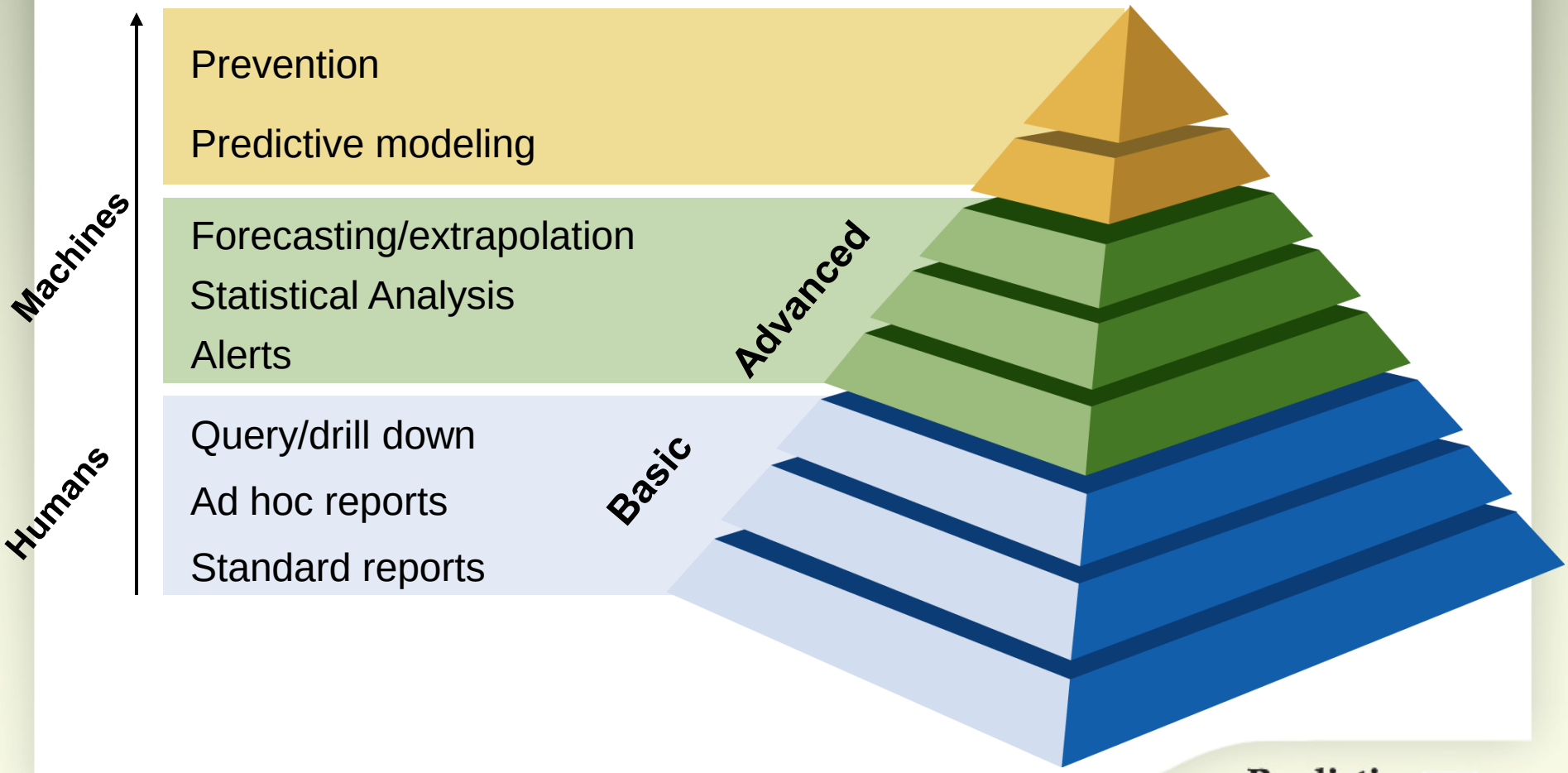
Value of machine-based Predictive Analytics in Safety



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* Adapted from the book Competing on Analytics by Thomas Davenport and Jeanne Harris

The benefits of Predictive Analytics in safety

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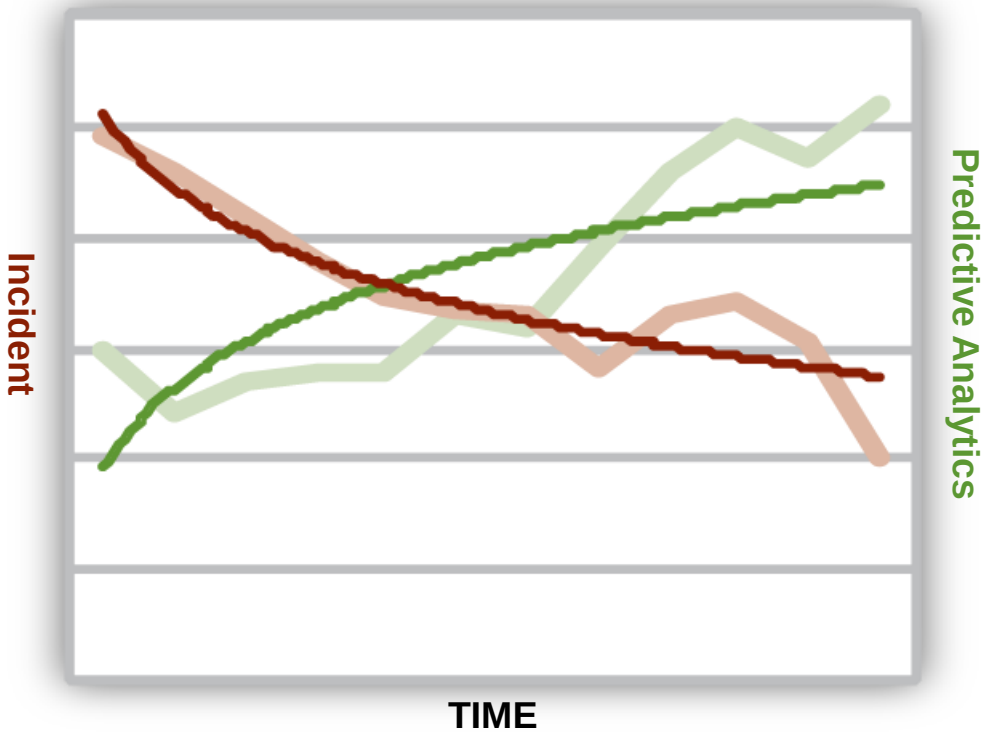
The benefits of Predictive Analytics in safety

Incident/Injury Reduction



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The benefits of Predictive Analytics in safety

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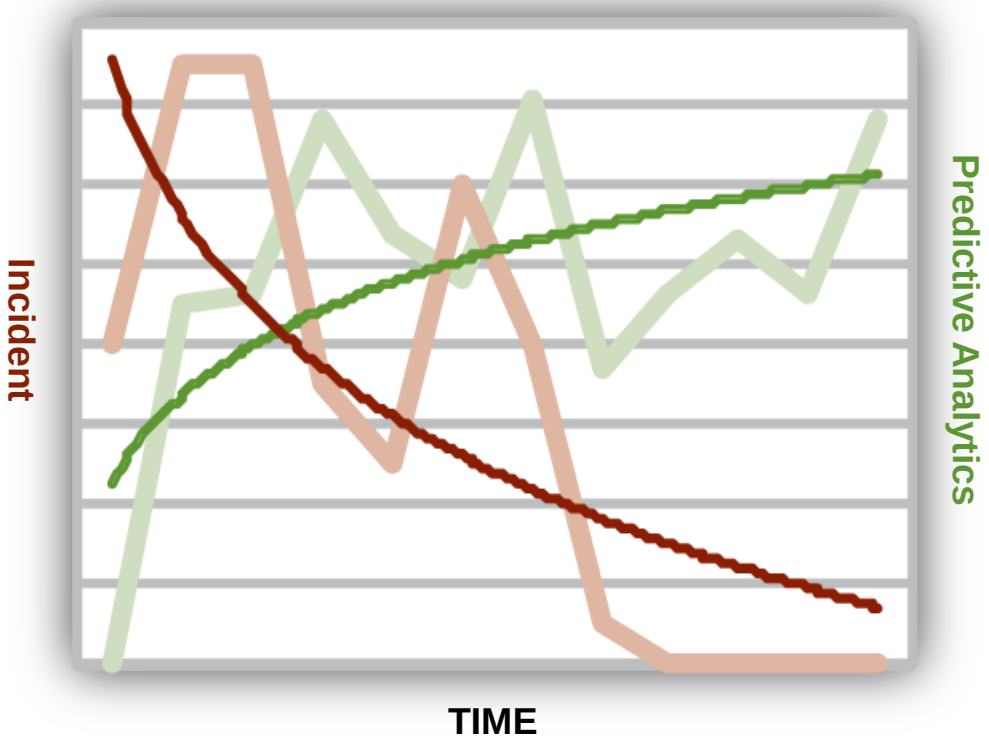
The benefits of Predictive Analytics in safety

Incident/Injury Reduction



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The benefits of Predictive Analytics in safety

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Real-world data is the fuel for Predictive Analytics work

Data Collection

Advanced Analytics

Predictive Models

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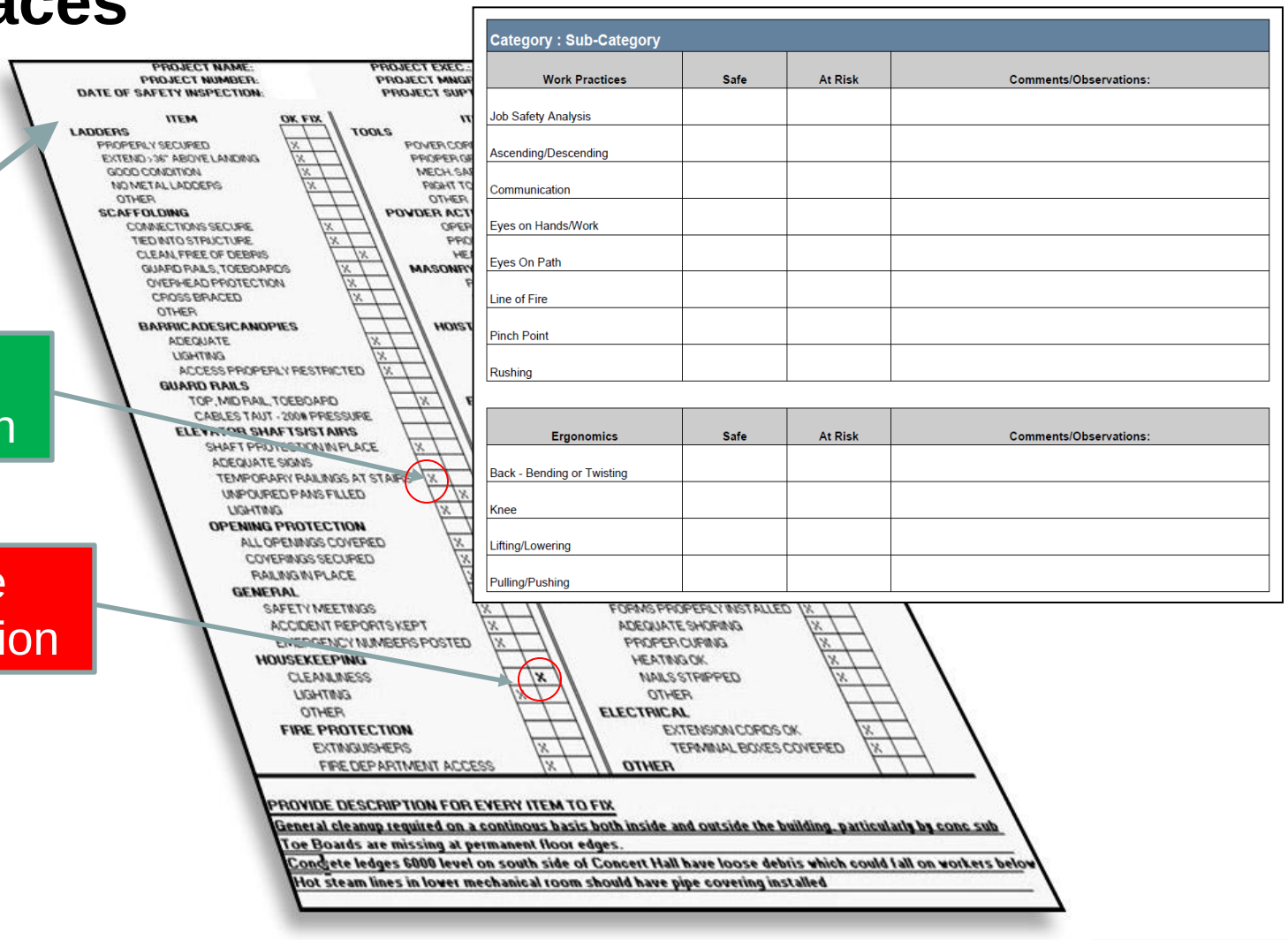
Customers collect the data directly from their workplaces

Inspection

Safe Observation

Unsafe Observation



PROJECT NAME:
PROJECT NUMBER:
DATE OF SAFETY INSPECTION:

ITEM | OK | FIX

LADDERS
PROPERLY SECURED
EXTEND >36" ABOVE LANDING
GOOD CONDITION
NO METAL LADDERS
OTHER
SCAFFOLDING
CONNECTIONS SECURE
TIED INTO STRUCTURE
CLEAN, FREE OF DEBRIS
GUARD RAILS, TOEBOARDS
OVERHEAD PROTECTION
CROSS BRACED
OTHER
BARRICADES/CANOPIES
ADEQUATE
LIGHTING
ACCESS PROPERLY RESTRICTED
GUARD RAILS
TOP, MID RAIL, TOEBOARD
CABLES TAUT - 200# PRESSURE
ELEVATOR SHAFTS/STAIRS
SHAFT PROTECTION IN PLACE
ADEQUATE SIGNS
TEMPORARY RAILINGS AT STAIRS
UNPOURED PANS FILLED
LIGHTING
OPENING PROTECTION
ALL OPENINGS COVERED
COVERINGS SECURED
RAILING IN PLACE
GENERAL
SAFETY MEETINGS
ACCIDENT REPORTS KEPT
EMERGENCY NUMBERS POSTED
HOUSEKEEPING
CLEANLINESS
LIGHTING
OTHER
FIRE PROTECTION
EXTINGUISHERS
FIRE DEPARTMENT ACCESS

TOOLS
POWER CORD
PROPER GU
MECH SAF
RIGHT TO
OTHER
POWDER ACT
OPER
PROC
HE
MASONRY
F
HOIST
F

FORMS PROPERLY INSTALLED
ADEQUATE SHORING
PROPER CURING
HEATING OK
NAILS STRIPPED
OTHER
ELECTRICAL
EXTENSION CORDS OK
TERMINAL BOXES COVERED
OTHER

PROVIDE DESCRIPTION FOR EVERY ITEM TO FIX
General cleanup required on a continous basis both inside and outside the building, particularly by conc sub
Toe Boards are missing at permanent floor edges.
Concrete ledges 6000 level on south side of Concert Hall have loose debris which could fall on workers below
Hot steam lines in lower mechanical room should have pipe covering installed

Category : Sub-Category			
Work Practices	**Safe**	**At Risk**	**Comments/Observations:**
Job Safety Analysis			
Ascending/Descending			
Communication			
Eyes on Hands/Work			
Eyes On Path			
Line of Fire			
Pinch Point			
Rushing			

Ergonomics	**Safe**	**At Risk**	**Comments/Observations:**
Back - Bending or Twisting			
Knee			
Lifting/Lowering			
Pulling/Pushing			

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We have one of the largest safety observation data sets in the world

Data Set:

- Nearly 100 million observations – nearly 5 million in Q1 2011
- Over 2 million inspections
- Over 27,000 unique observers
- Over 15,000 workplaces

Learn From the Data

What does the world's largest data store of safety inspections tell us?

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Partnership

Our partners from the Language Technology Institute, Carnegie Mellon University, who helped build the Watson and Deep Blue super-computers

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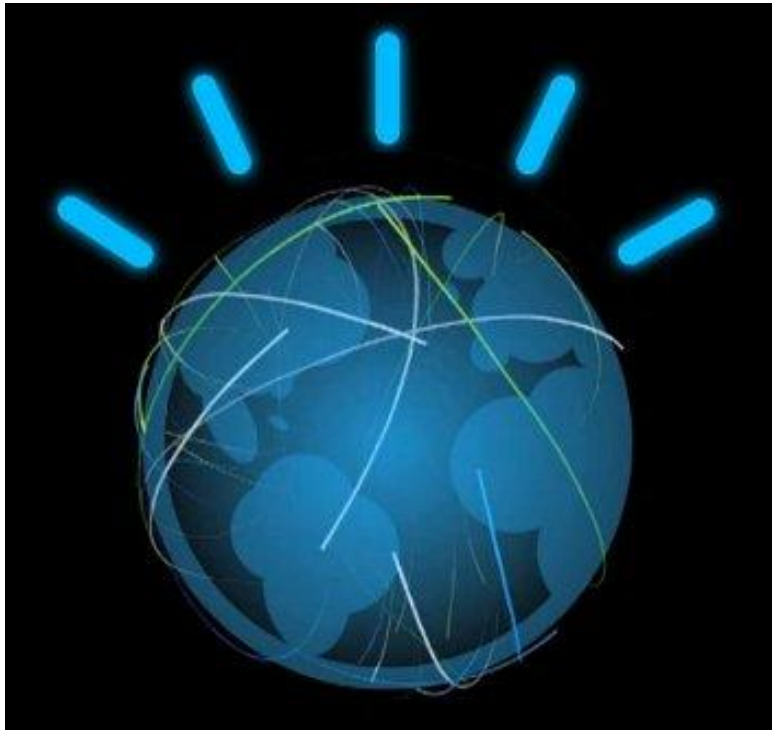
Two Predictive Models

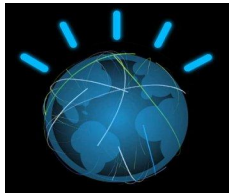


Watson (IBM)

Holmes (PSC)

Predictive SOLUTIONS

Watson Versus Holmes



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VS

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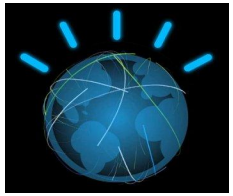
Watson Versus Holmes



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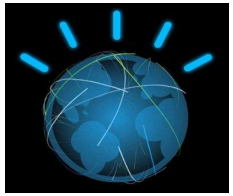
Watson Versus Holmes



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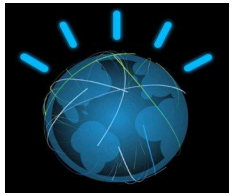
Watson Versus Holmes



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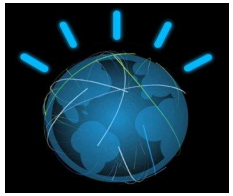
How does it do it	**Breaks questions into logical constituents and matches to patterns in its database**	**Breaks inspections into constituent observations and matches to patterns in its database**

Watson Versus Holmes



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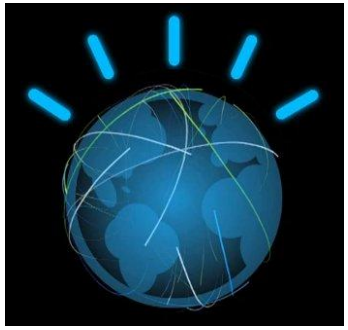
How does it do it	Breaks questions into logical constituents and matches to patterns in its database	Breaks inspections into constituent observations and matches to patterns in its database
How does it get good at it	**Train and validate on large and diverse data sets**	**Train and validate on large and diverse data sets of safety inspections**

How Good is Watson

- Beat the two most prolific Jeopardy champions



- Wins over two thirds of its games
- Is correct 95% of the time when it knows the answer

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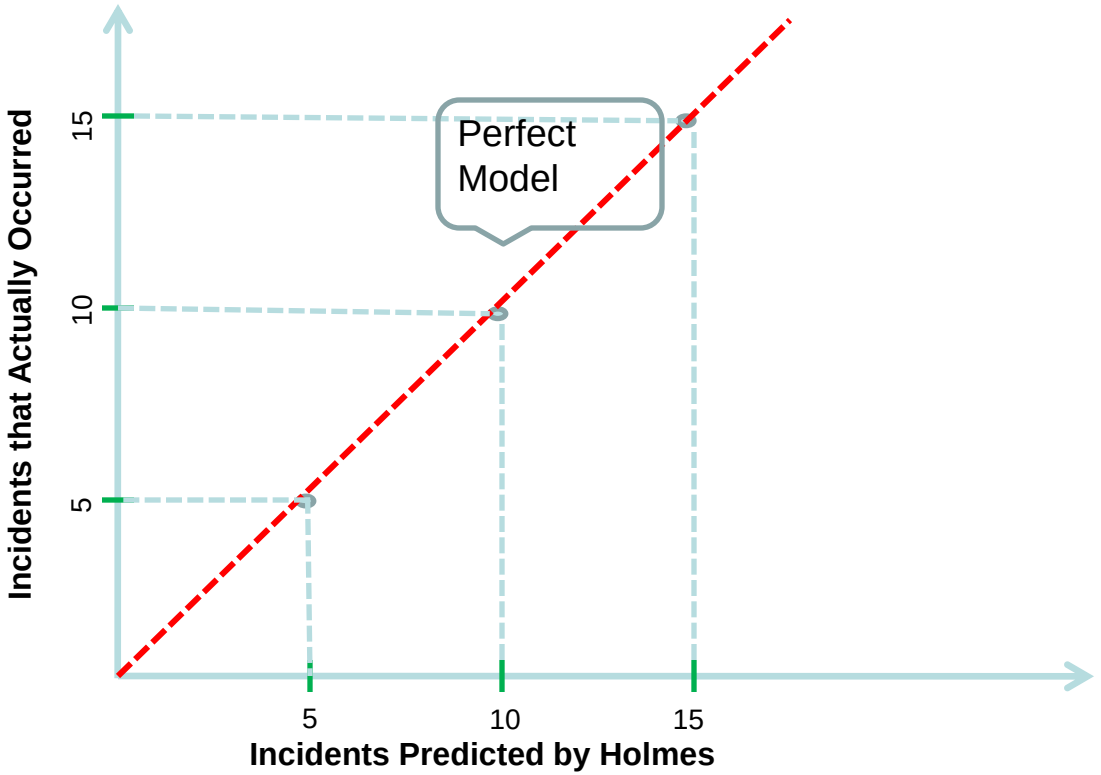
How Good is Holmes?



- If Holmes were perfect its predictions would lie on the red line

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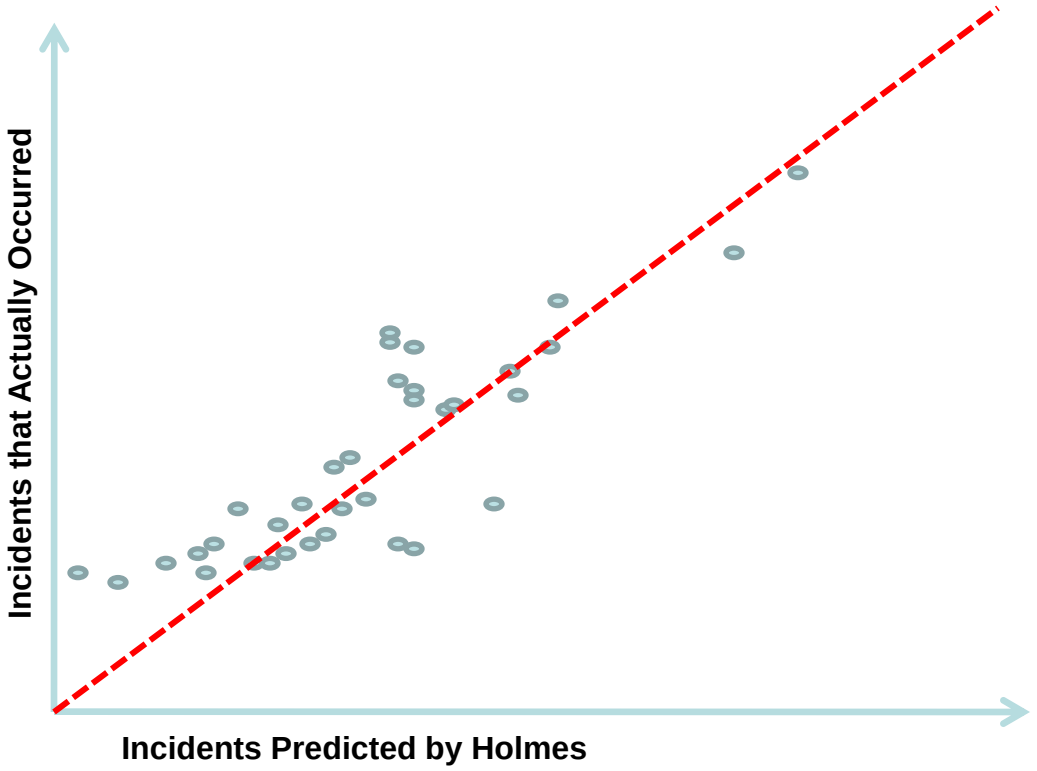
How Good is Holmes?



- Accurate over 85% of the time
- R^2 of 0.75

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How Does Holmes Do It?

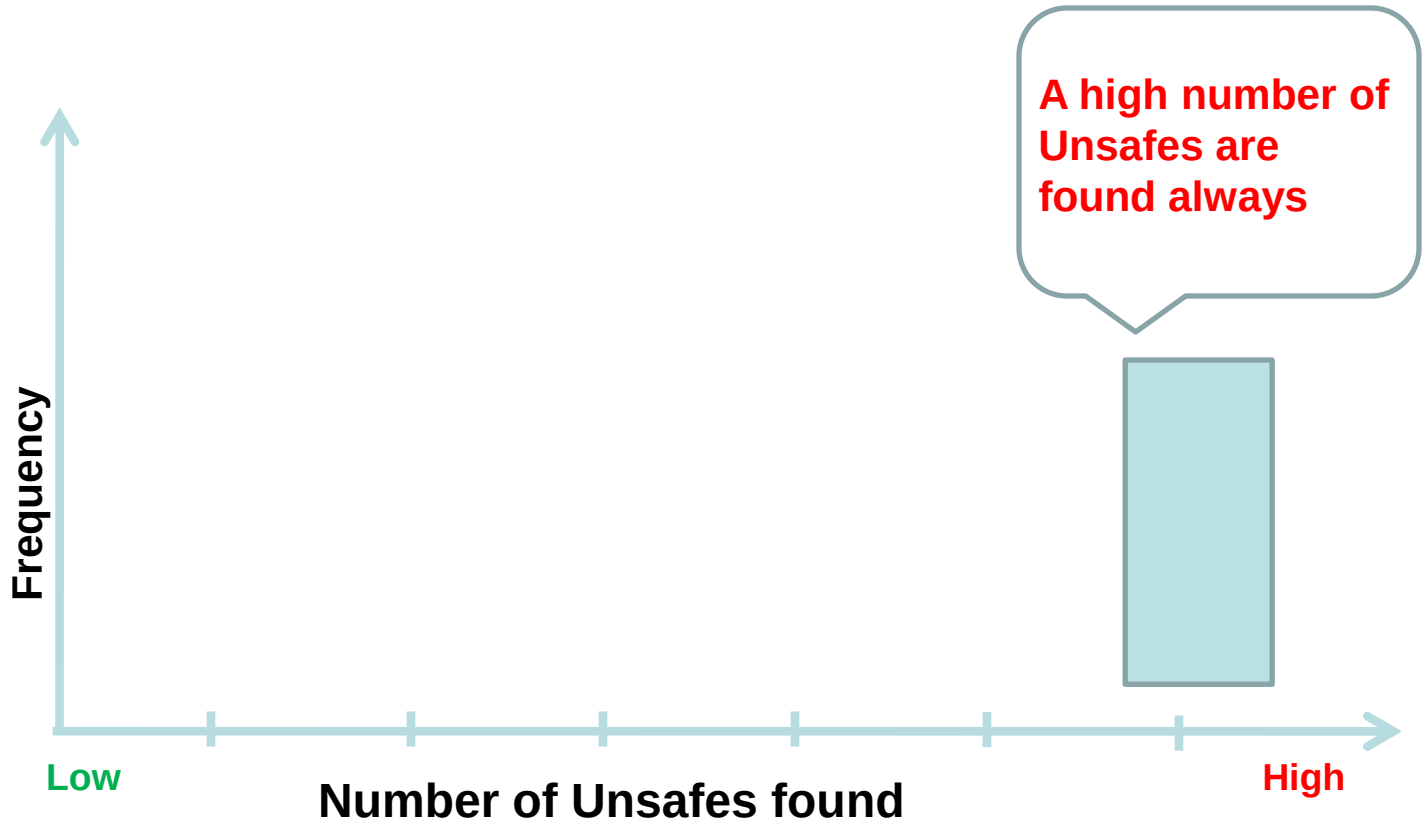
Holmes creates a profile of a workplace

Predictive SOLUTIONS

How Does Holmes Do It?

Predictive SOLUTIONS

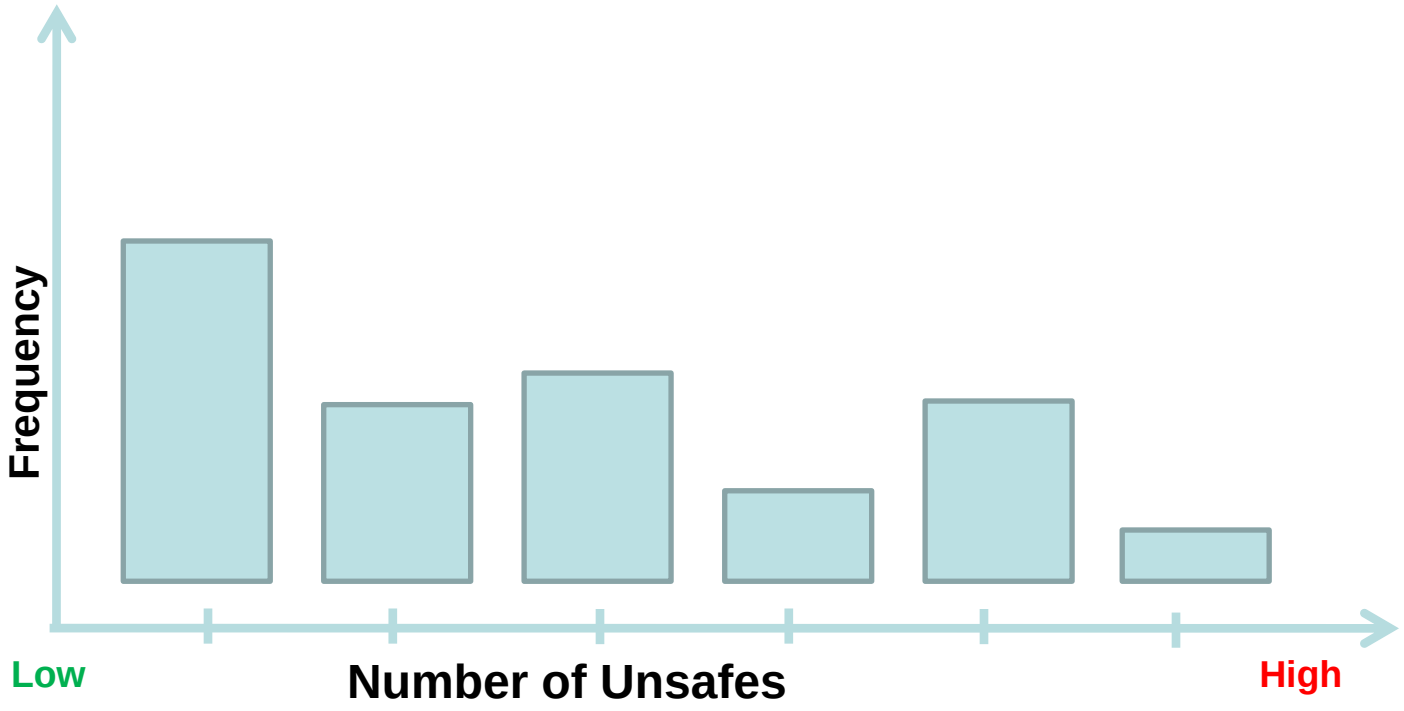
How Does Holmes Do It?



Predictive SOLUTIONS

How Does Holmes Do It?

More typically



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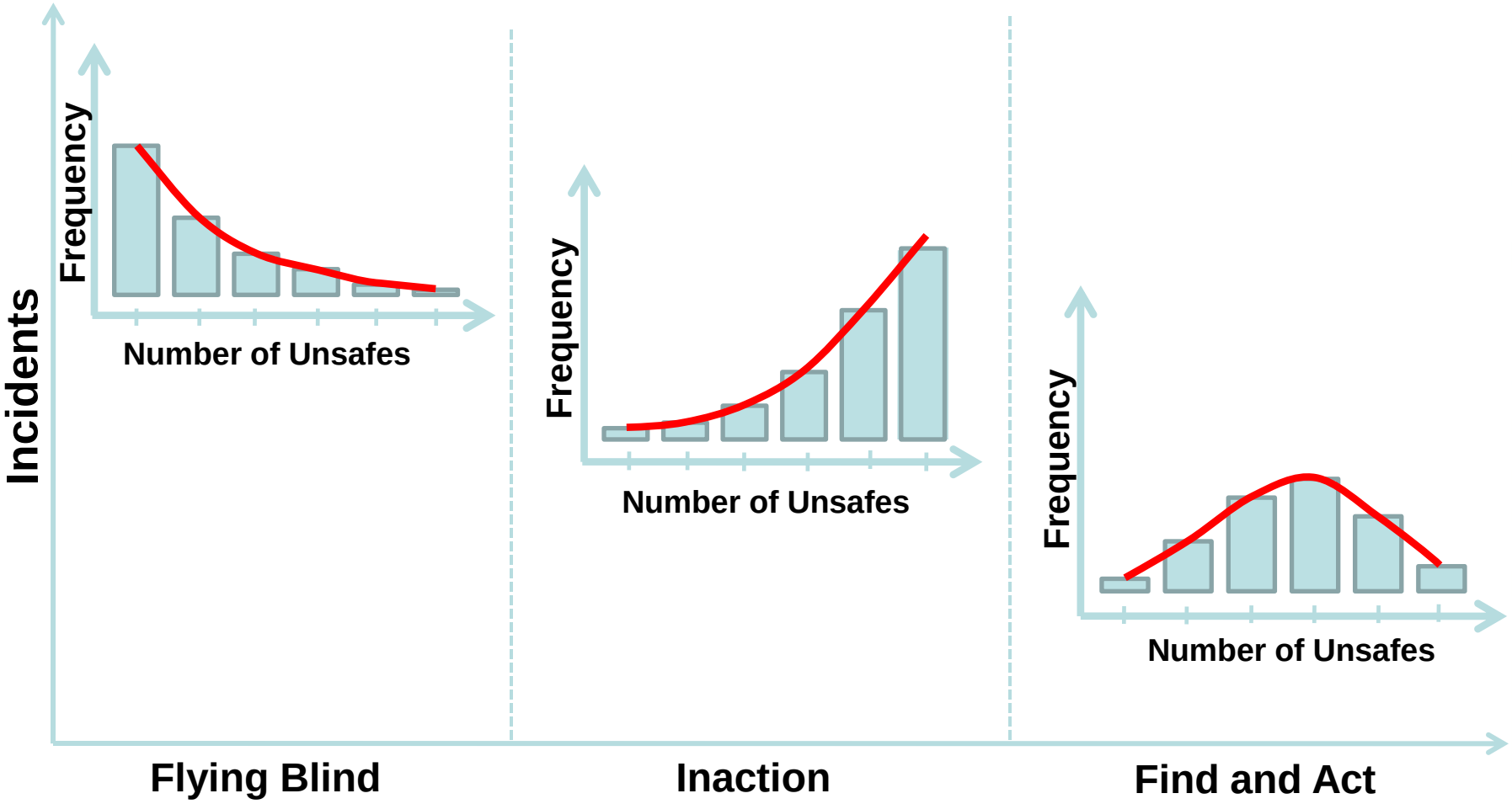
Safety Profiles



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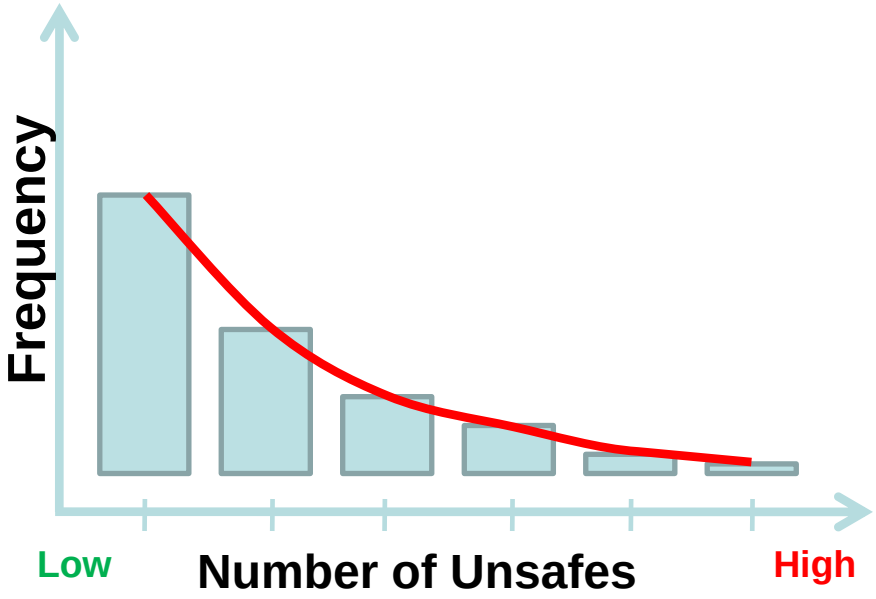
Flying Blind

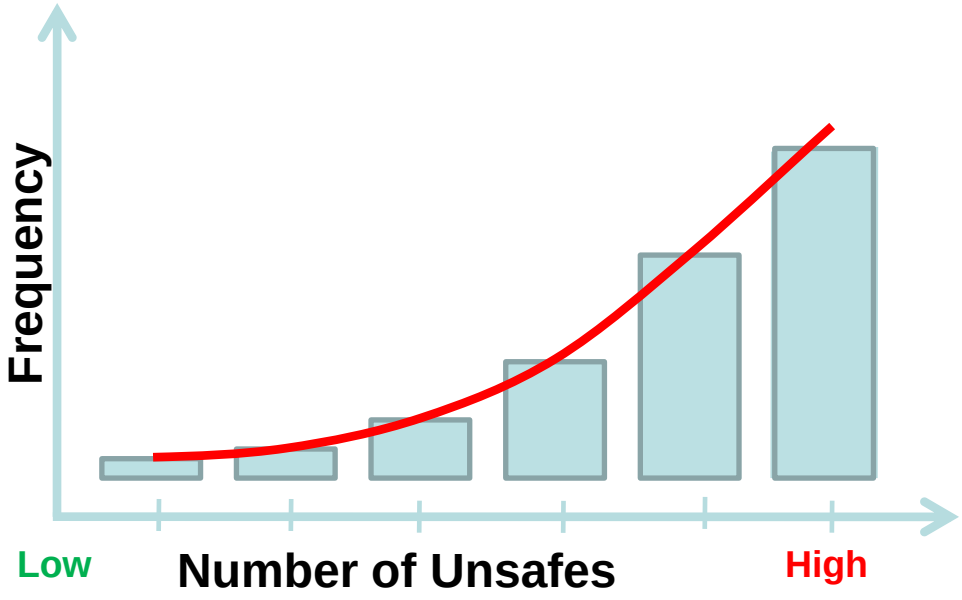


Highest Risk Sector – Flying Blind

- **No Knowledge** – Leadership won't fund training to create a knowledgeable culture
- **No Trust** – Leadership doesn't allow "speaking the truth" so Culture is to NOT report unsafes

Predictive SOLUTIONS

Inaction



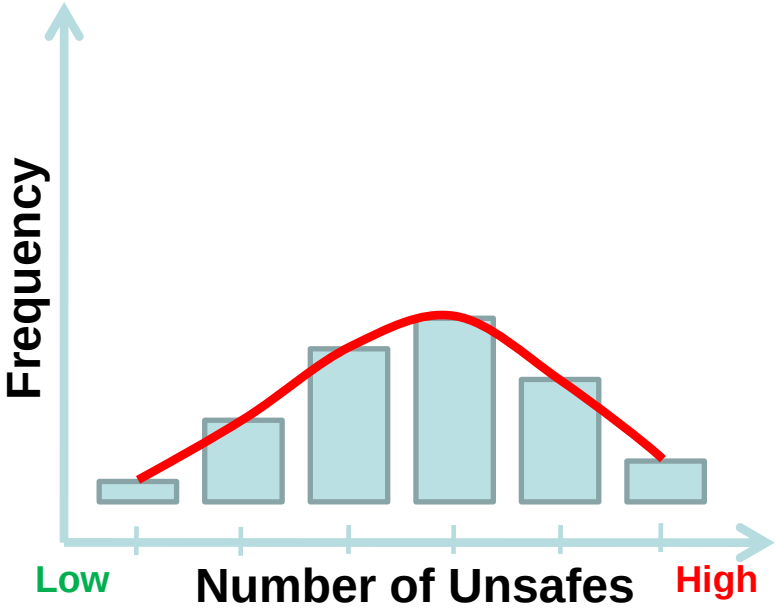
High Risk Sector – Inaction

•No Leadership Accountability – front line workforce identifies unsafe occurrences but management does not invest in fixing them

•Lack of Process and Tools – leadership wants to fix the unsafe occurrences, but the process/tools are inadequate

Predictive SOLUTIONS

Find and Act



<u>Low Risk Sector – Find and Act</u>

•Knowledge – people know what to look for

•Tools & Process – people have the process and tools to fix unsafe occurrences

• Trust , Accountability & Credibility – frontline trusts that leadership wants to know about unsafe occurrences and will do something about them

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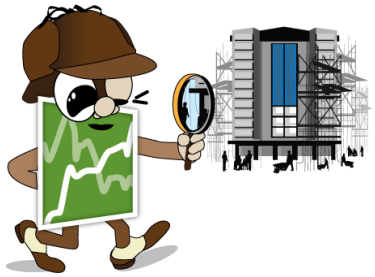
How Can Holmes Help Me Today?

- The best way is get



- Do inspections
  - The very act of doing safety inspections improves safety

- Use the inspection data
  - Am I flying blind?
  - How is the leadership empowering people
  - Process

Predictive SOLUTIONS

Can Holmes do it all?

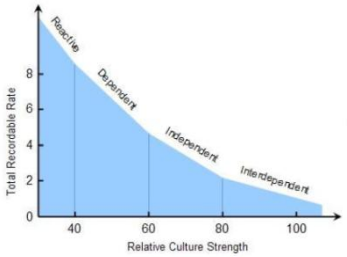
- The need for multiple models
  - Watson uses over a hundred different ones
  - SafetyNet lets you analyze your safety culture in many different but related ways
  - Indices
    - Looks for sudden change in observations and other inspection counts

Predictive SOLUTIONS

An Example: Need for Multiple Models

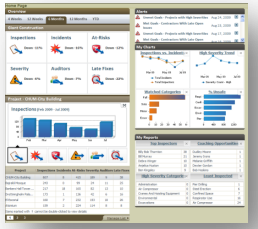
Hierarchy of Prediction Models

- The Bradley Curve
  - The DuPont safety indicator
  - Multi-year
  - Culture takes a long time to change



- Holmes
  - Multi-monthly
  - Safety process do not change overnight

- SafetyNet Indices and other advanced analytics
  - Daily to weekly



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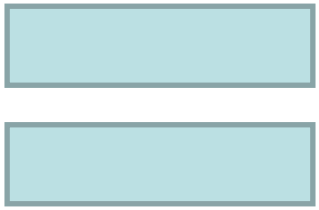
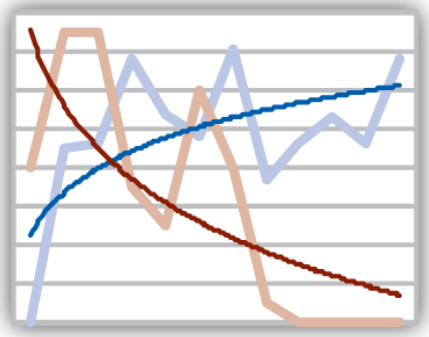
The Most Important Element

Models

***Human* experience**





Results

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Thank you and Questions

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