

# Cost Justifying Ergonomics: Methods and Tips for Calculating ROI

Rick Barker, Principal Solutions Strategist, Ergonomics  
Jennie Dustin, Managing Consultant and Ergonomics Engineer  
VelocityEHS



# Learning Outcomes

## Participants will learn how to:

- Define different ways to cost justify ergonomics
- Understand how leadership uses ROI
- Determine ROI using four different models
  - Injury
  - Human Capital
  - Productivity Improvement
  - Quality Improvement
- Identify different estimator calculators



# Agenda

- Introduction to Cost Justification
- Cost Justification Models
  - Injury reduction
  - Human Capital
  - Productivity Improvement
  - Quality Improvement
- Estimation Calculators
- Questions



# Cost Justification Overview



# Cost Justification

**Cost Justification is a broad term that can refer to a wide range in level of detail.**

- Cost justification can mean that "the proposed action is the most cost-effective solution to a problem or need that absolutely must be addressed."



Source: <https://machinerysafety101.com/2012/06/25/the-probability-problem/>



# Cost Justification

**Two common tools used in cost justification are:**

- Cost-benefit analysis (CBA)
- Return on investment (ROI)





Source: <https://theconversation.com/supreme-courts-epa-mercury-ruling-is-a-victory-for-common-sense-regulation-44073>



$$\text{ROI} = \frac{\text{Benefits} - \text{Cost}}{\text{Cost}} \times 100$$

Option A



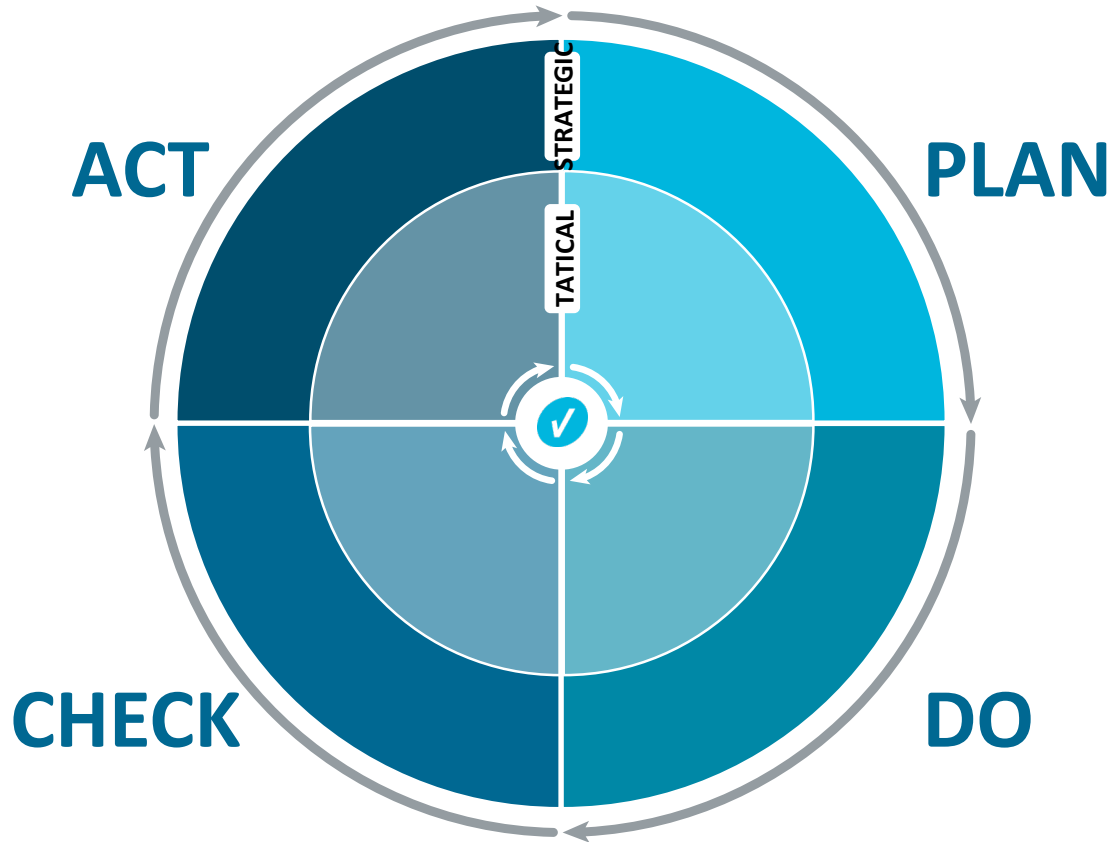
Option B





# Cost Justification

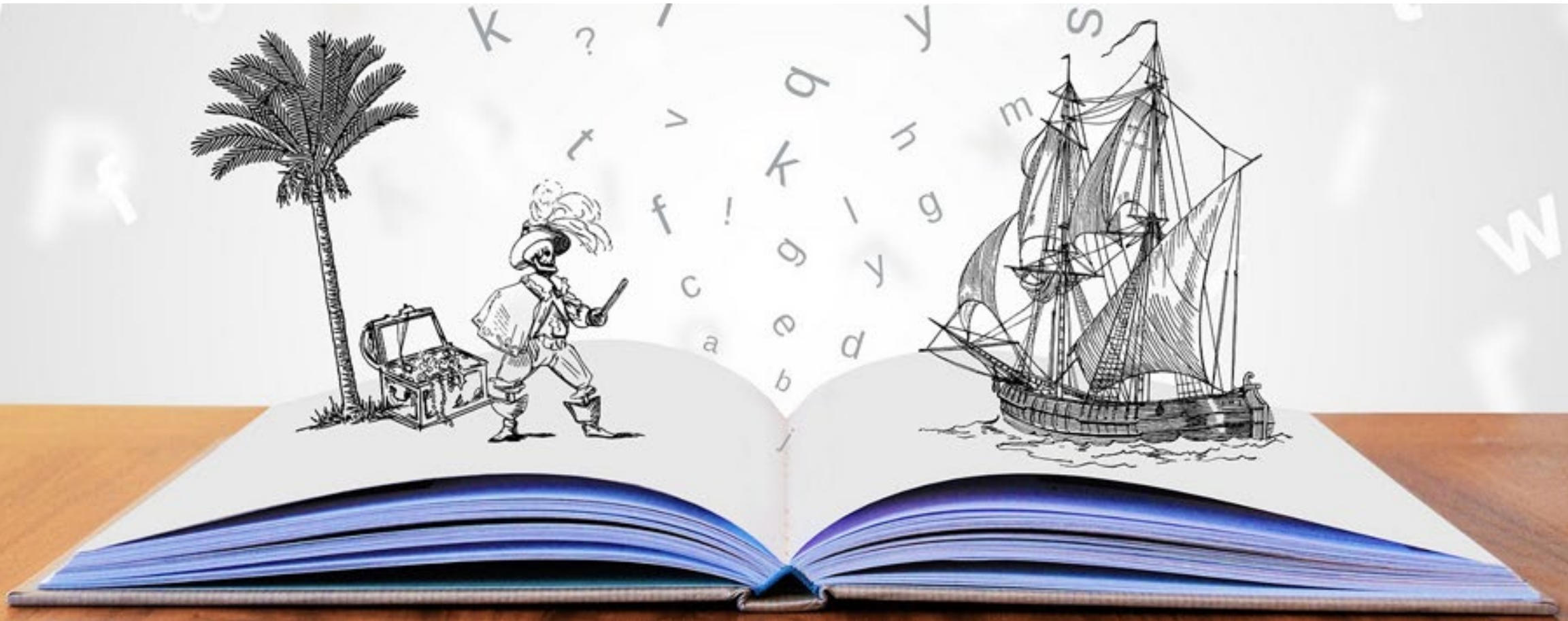
## Program Level



## Job Level



# Cost Justification is a Story



Source: <https://www.liverpool.ac.uk/centre-for-innovation-in-education/resources/all-resources/digital-storytelling.html>

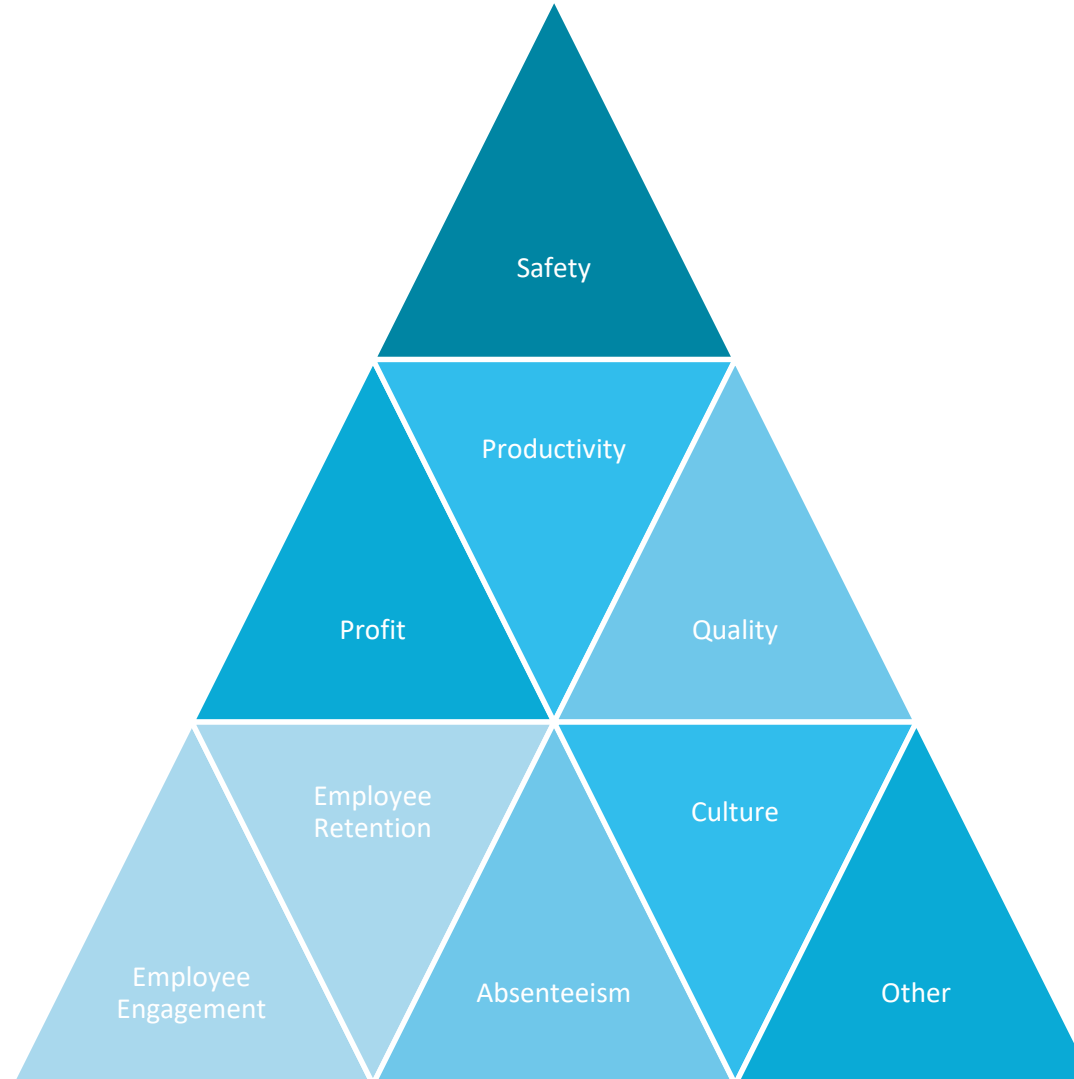


# What Does Senior Leadership Value?

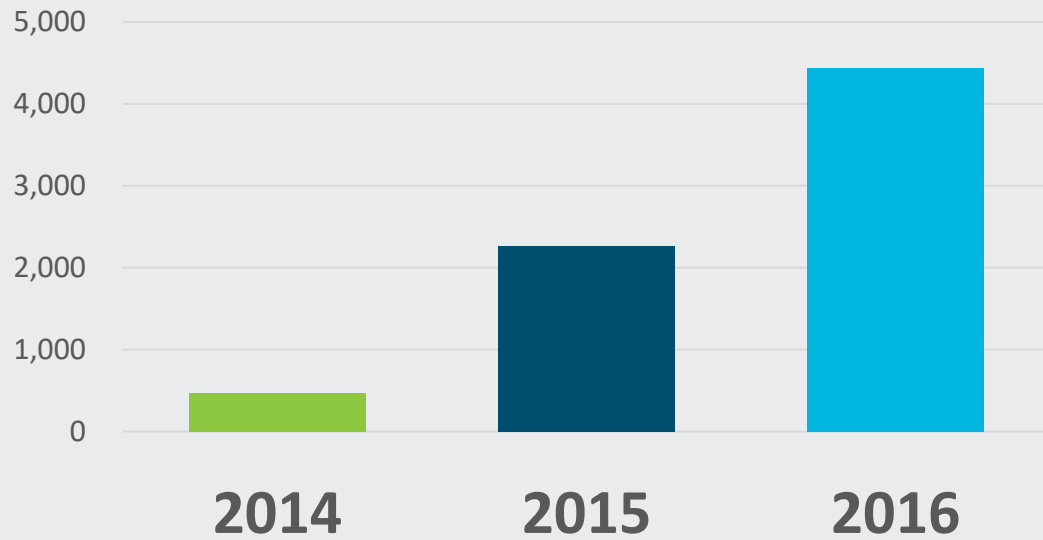
- Overall values
- Results from ergonomics and/or EHS



# What Does Senior Leadership Measure?



## Yearly Assessments:



(1) Represents data for the 2014-2016 period

## Results:



**7,000+**  
Assessments



**\$12M**  
Direct Cost Savings



**230+**  
Cummins Sites



**\$4M**  
Productivity Savings



**85%**  
Incident Rate  
Reduction

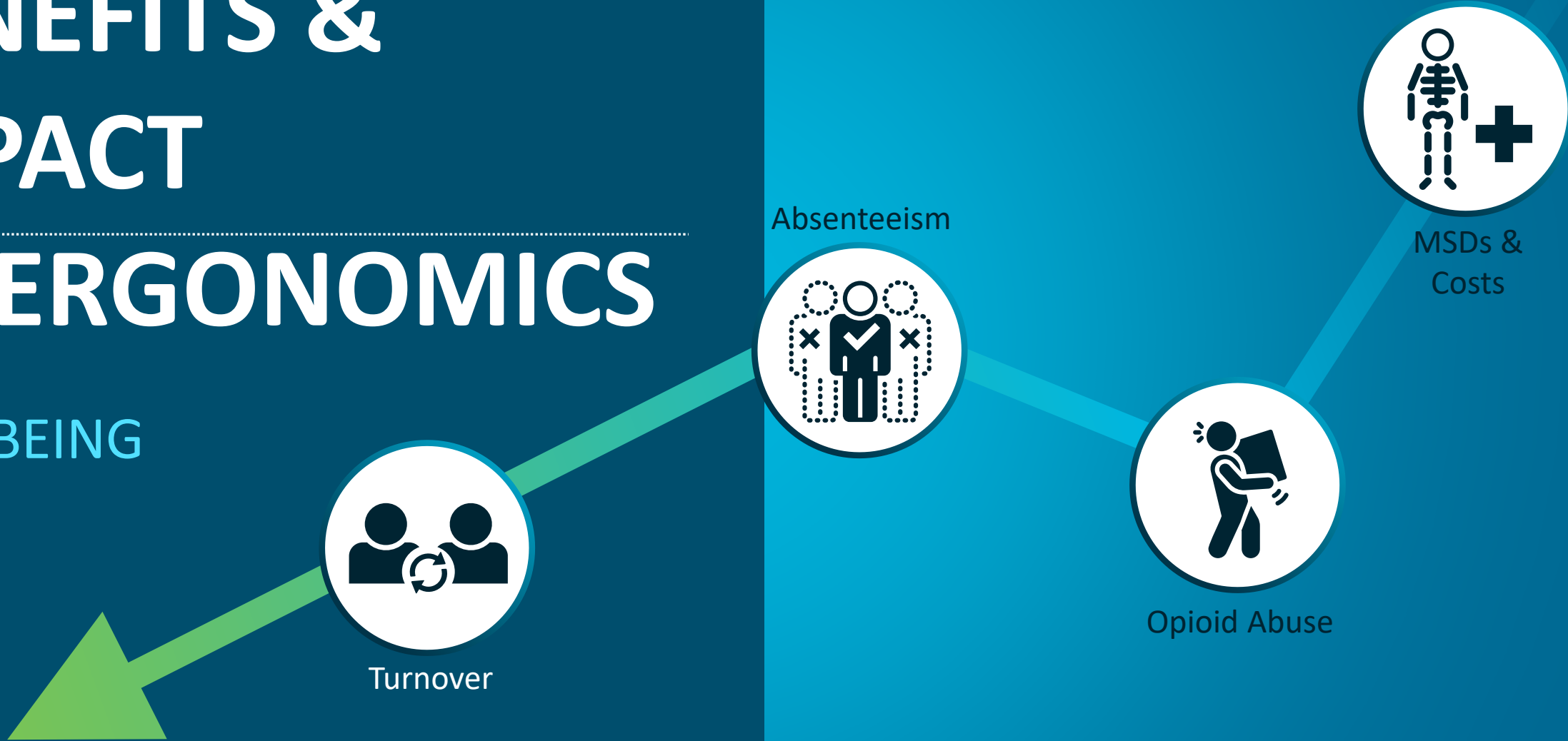


**272%**  
Return on  
Investment



# BENEFITS & IMPACT OF ERGONOMICS

WELL-BEING



# Injury Costs



# Injury Costs

- Relying on injury costs is complicated
- Average cost of injury
  - Misleading if you don't include likelihood
- Historical injury costs
- Indirect costs





# Using Injury Cost Data

## Pros

- ✓ The **primary reason** the company has an ergonomics process is likely related to **injury reduction**.
- ✓ Injury cost **data is readily available**.
- ✓ More useful for overall program justification.

## Cons

- ✗ Emphasizes a **reactive process**.
- ✗ Many ergonomics improvements **can't be justified in < 3 years** using only injury cost data.
- ✗ Injury data has a **high degree of variability**
- ✗ Reinforces the idea that injury reduction is the only benefit of ergonomics.



# Average Injury Cost Example

The average cost of an injury is **\$38,000**. The total cost of purchasing and installing two lift tables is **\$19,000**.


CBA 1:  $\$38,000/\$19,000 = 2.0$

CBA 2:  $\$38,000-\$19,000 = \$19,000$

Simple ROI:  $(\$38,000-\$19,000)/\$19,000 = 100\%$

The results look good. Are there any challenges with this approach?





*Have injuries at  
this job been  
costing us  
\$38,000/year?*



# Actual/Historical Injury Cost Example

The average cost of injuries at this station have been **\$9,500/year** over the last 5 years. The total cost of purchasing and installing two lift tables is **\$19,000**.

1-Year Results	3-Year Results
CBA1: $\$9,500/\$19,000 = 0.5$	CBA1: $\$28,500/\$19,000 = 1.5$
CBA2: $\$9,500 - \$19,000 = -\$9,500$	CBA2: $\$28,500 - \$19,000 = \$9,500$
Simple ROI: $(\$9,500-\$19,000)/\$19,000 = -50\%$	Simple ROI: $(\$28,500-\$19,000)/\$19,000 = 50\%$ or <b>16.6% annually</b>





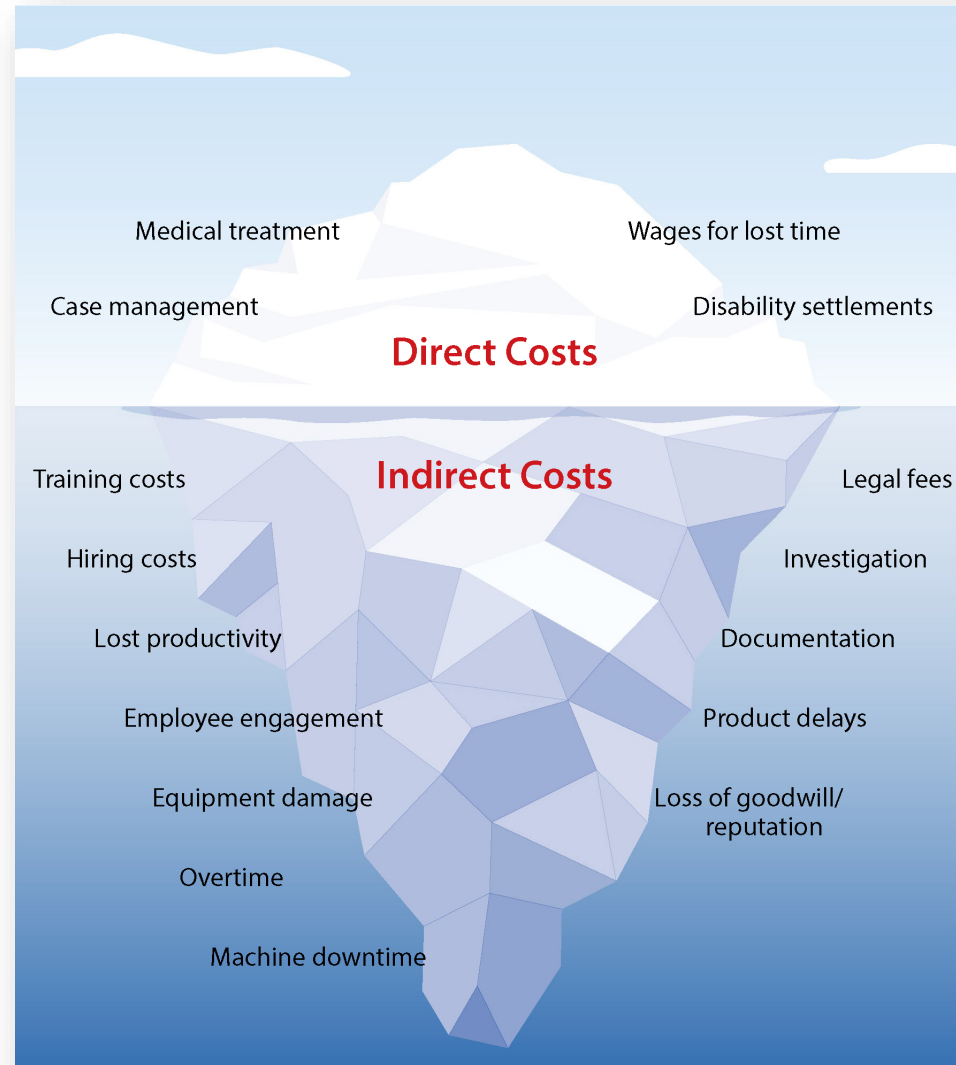
**If you justify ergonomics improvements based on historical injury costs, how do you justify a high-risk job which hasn't had a previous injury?**



# Indirect Costs

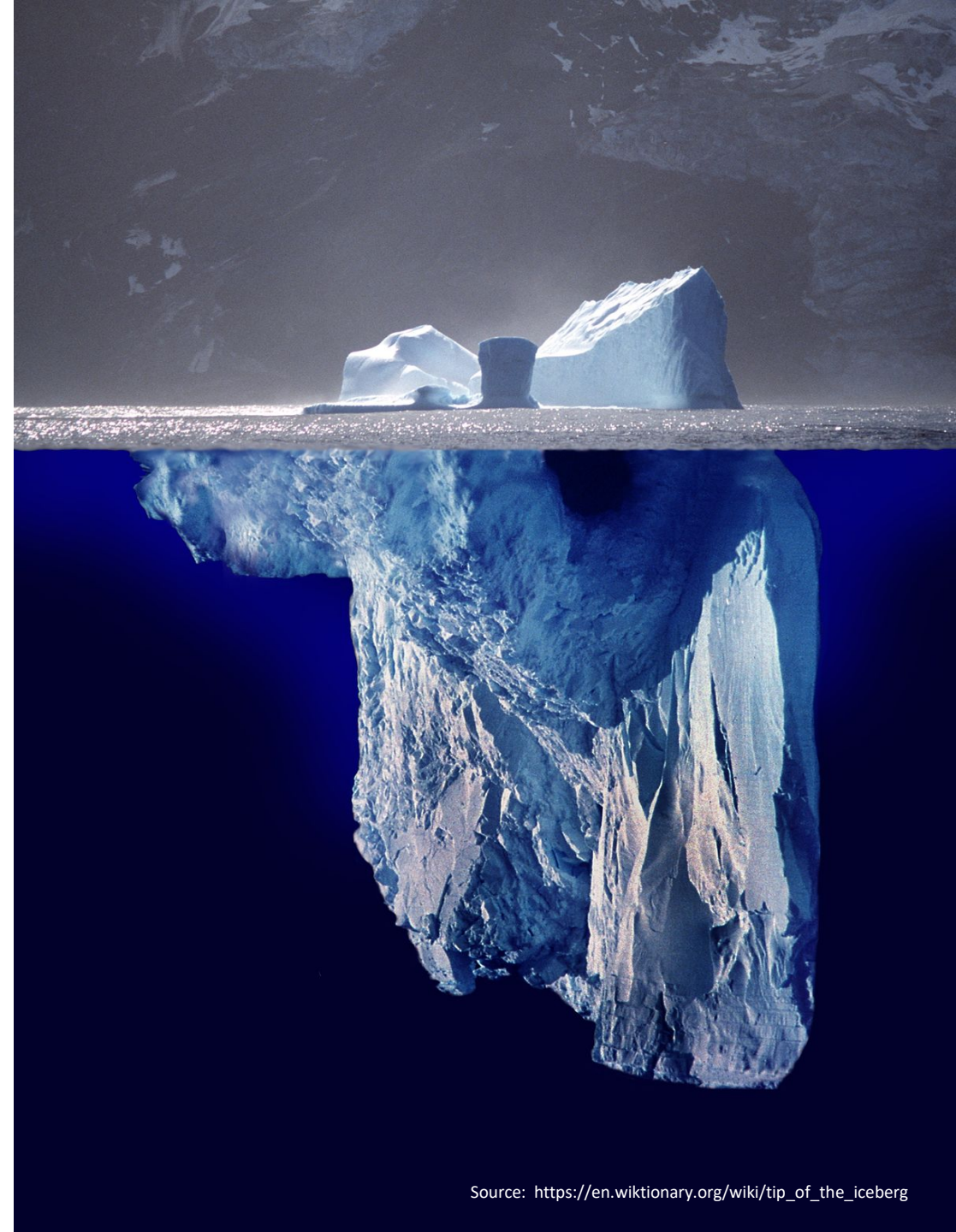


# Indirect Costs



# Quantifying Indirect Costs

- You may need to establish credibility if challenged.
- Breaking down the details:
  - Initial injury report cost
  - Investigation cost
  - Ongoing reporting cost
    - Government
    - Insurance
    - Site Meetings
    - Corporate Meetings
  - Case management
  - Legal costs
  - Production delays
  - Temporary labor/overtime
  - Training



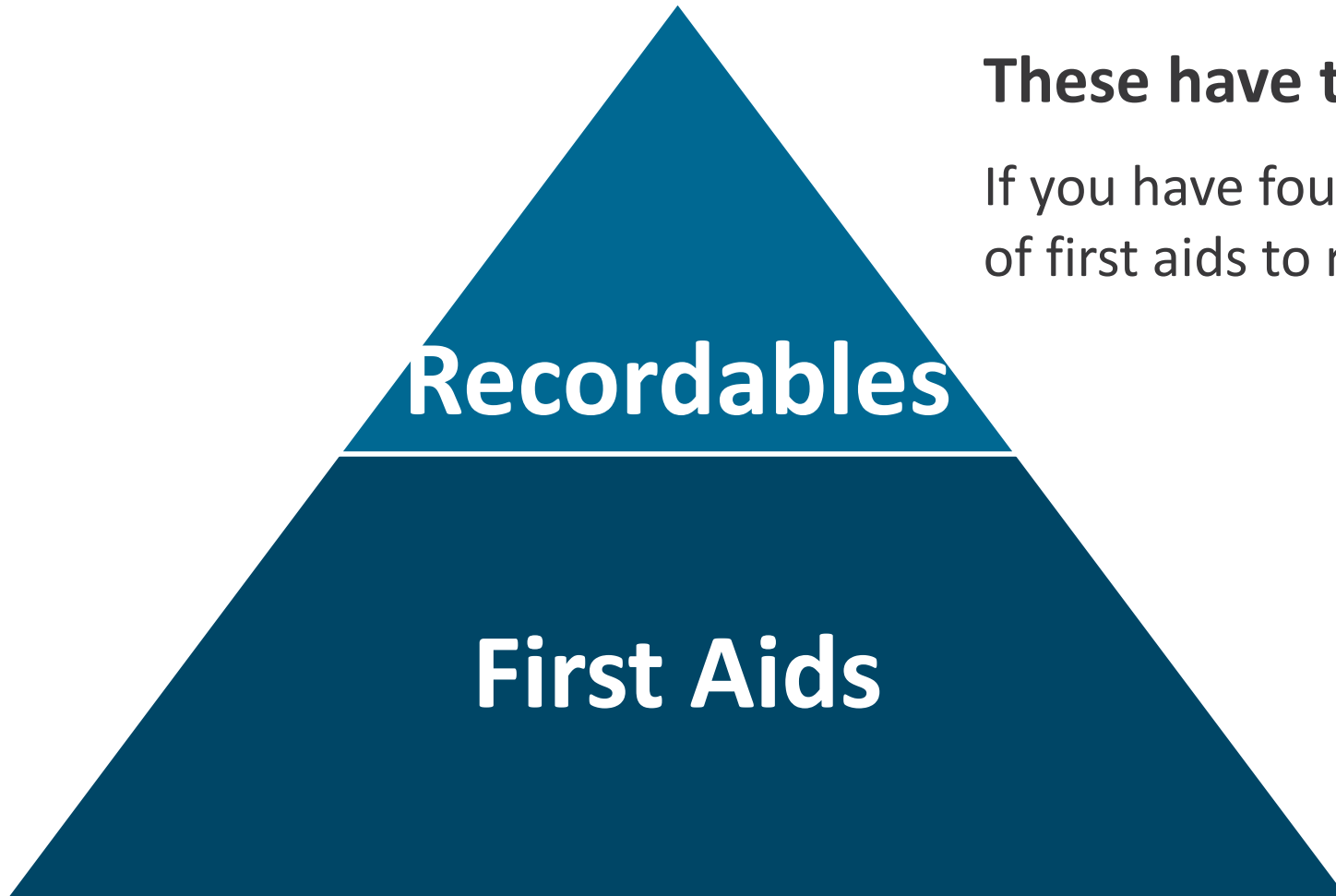


# Injury Reporting Costs

Initial Report of Injury			
Who is Involved?	Time Required	Fully Burdened Wage	Total Wage Cost
Injured Employee	0.5 Hours	\$24/Hour	\$12
Supervisor	2 Hours	\$37/Hour	\$74
Witness(es)	1 Hour	\$24/Hour	\$24
Plant Nurse	1 Hour	\$60/Hour	\$60
Safety Manager	1.5 Hours	\$60/Hour	\$90
			<b>\$260</b>



# Injury Reporting Costs



**These have the same initial reporting costs**

If you have four initial reports, even with a 3:1 ratio of first aids to recordables:

$$\$260 \times 4 = \$1,040$$



# Injury Reporting Costs

Total Costs of Injury Reporting & Management			
Process Step	Total Wage Costs	Other Costs	Total Costs
Initial Report	\$1,040		\$1,040
Investigation			
Recordkeeping & Reporting			
Case Management Documentation			
			<b>\$6,000</b>



# Additional Indirect Costs

Total Indirect Costs			
Elements	Total Wage Costs	Other Costs	Total Costs
Injury Reporting	\$6,000	\$0	\$6,000
Legal Expenses			
Operations Impact			
Equipment Damage			



# Human Resources Costs



# Human Resource Measures



**Turnover:**  
↓ 23-49%



**Absenteeism:**  
↓ 42-116%



**Engagement:**  
↑ ↑ ↑

# As Diners Return, Restaurants Face a New Hurdle: Finding Workers

Owners across the country report a shortage in help, as rebounding business forces them to compete for a shrunken pool of applicants.

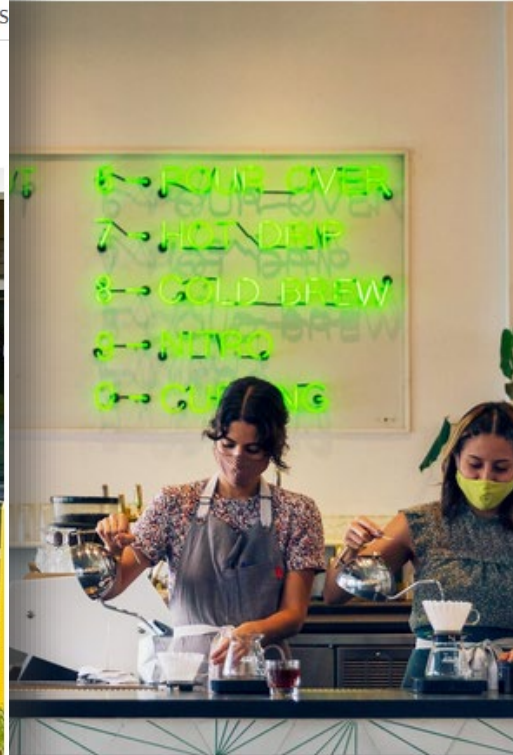


https://www.wsj.com/articles/labor-shortage-draws-attention-of-u-s-lawmakers-11622712602

https://www.npr.org/2021/07/07/1013432190/u-s-job-openings-remain-at-historic-high-giving-jobseekers-options

## Labor Shortage Draws Attention of U.S. Lawmakers

Possible solutions include hiring bonuses for workers, expanded tax credits for employers



BUSINESS

## U.S. Job Openings Remain At A Historic High, Giving Job Seekers Options

July 7, 2021 · 11:31 AM ET

ANDREA HSU



# Turnover Reduction

Turnover in the department with the highest MSD risk is between 3x and 4x all other departments. Median length of employment is 6 months. HR estimates turnover costs (recruitment + training time) as \$3,500/person. Ergonomics improvements to a workstation will improve working conditions and are expected to reduce turnover to plantwide average, saving an estimated \$7,000/year in turnover costs. The total cost of these improvements is \$10,000/year.

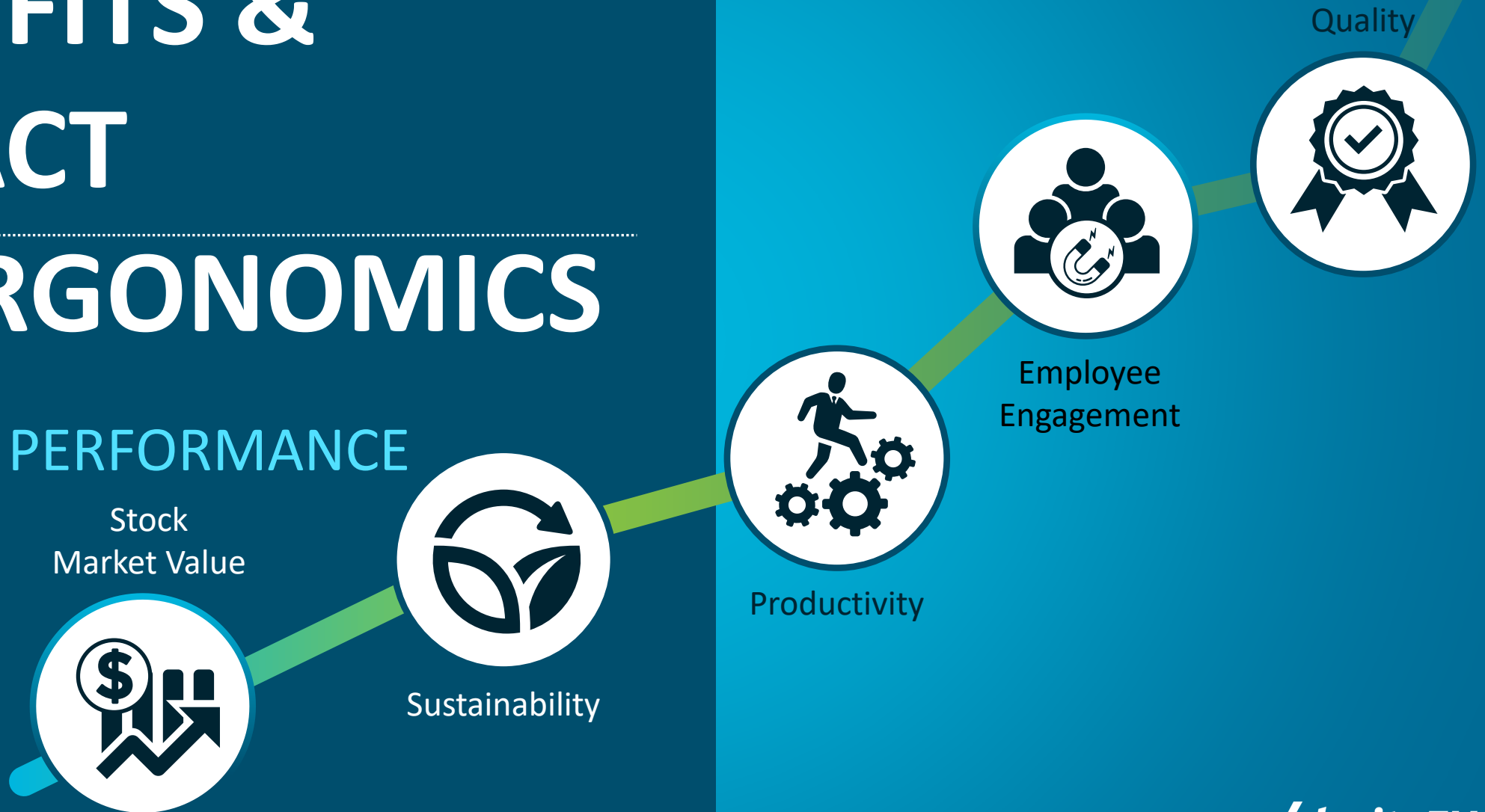
1 Year Results	3 Year Results
CBA1: $\$7,000/\$10,000 = 0.7$ CBA2: $\$7,000 - \$10,000 = -\$3,000$ Simple ROI: $(\$7,000-\$10,000)/\$10,000 = -30\%$	CBA1: $\$21,000/\$10,000 = 2.1$ CBA2: $\$21,000 - \$10,000 = \$11$ Simple ROI: $(\$21,000-\$10,000)/\$10,000 = 110\%$ or 36.7%/year





# BENEFITS & IMPACT OF ERGONOMICS

## BUSINESS PERFORMANCE



# Improved Manufacturing Performance

Participatory ergonomic intervention shows statistically significant improvements in performance outcomes:

**1%**

Increase first-time quality production

**5%**

Increase productivity efficiency

*Tompa E, Dolinschi R, Natale J. (2013). Economic evaluation of a participatory ergonomics intervention in a textile plant. Appl Ergon. 2013 May;44(3):480-7.*



# Productivity Benefits



# Using Productivity Data

- Hard to accomplish without support for industrial/manufacturing engineering
- Worth pursuing. The largest financial impact of ergonomics is on productivity
- The easiest aspect to quantify is eliminating a task
- Reducing the time to complete a specific task within a job requires the most effort to document improvement



<https://www.npr.org/2021/07/07/1013432190/u-s-job-openings-remain-at-historic-high-giving-jobseekers-options>



# Productivity Data Needed

Productivity Savings		
Elements	Source	Total Costs
Time Saved/Part	Time Study (direct) Pre-determined Motion Times	3.7 Seconds/Part
Parts/Year <i>(Parts/Hour or Parts/Day)</i>	Actual Production Volumes <i>Account for multiple stations &amp; shifts</i>	385,000 Parts/Year
Hours Saved/Year	Time/Part * Parts/Year	395 Hours/Year
Fully Loaded Wage Cost	Human Resources <i>IEs usually have this too</i>	\$33/Hour
		<b>~\$13,000/Year</b>



# Productivity Improvement

Installing a **\$10,000** lift table with a rotating top is expected to save 3.7 seconds per part due to reduced walking and reaching. This saves **\$13,000/year** across all 3 shifts.


CBA1:  $\$13,000/\$10,000 = 1.3$

CBA2:  $\$13,000 - \$10,000 = \$3,000$

Simple ROI:  $(\$13,000 - \$10,000)/\$10,000 = 30\%$

The results look good. Are there any challenges with this approach?





*Are we saving  
anything if we  
haven't reduced  
headcount?*



# Using Productivity Data

## Pros

- ✓ Productivity gains generally provide more economic value than safety gains.
- ✓ Standard processes and values already exist in most organizations.

## Cons

- ✗ Productivity-based justifications typically have more stringent ROI requirements than safety-based justifications.
- ✗ Relying too heavily on productivity gains in the justification process may result in departures from the overall goal of the ergonomics process.





# Other Productivity Measures



<https://www.hawkeyecollege.edu/programs/industrial-automation-technology>



Downtime reduction



Set-up time reduction

- May be measured as labor cost savings
- Often measured as production profit gain (how many more parts produced during that time x gross profit/part)



# Quality Benefits



# Quality Costs



<https://pixabay.com/photos/car-rain-copenhagen-wet-weather-2648563/>

---

High forces to insert weather stripping

---

Lack of tactile feedback

---

Employees use mallet to seat weather stripping

---

257 quality claims x \$52/claim  
= **\$13,364**



# Quality Costs

**Positive Experience = Tell 10 People**



<https://www.publicdomainpictures.net/en/view-image.php?image=5520&picture=thumbs-up>

**Negative Experience = Tell 40 People**



<https://technofaq.org/posts/2015/10/6-different-ways-of-dealing-with-diffuse-and-angry-customers-in-a-bpo-industry/>



# Quality Measures



quality failure rates



cost to correct errors

Repair/Rework

Scrap

Warranty  
claims



# Using Quality Data

## Pros

- ✓ You are presenting benefits in a business language that is aligned with important business objectives.
- ✓ There are substantial financial benefits, as well as intangible business benefits, from improved quality.

## Cons

- ✗ This can be difficult data to obtain accurate costing information directly attributable to poor ergonomics.



# Using Quality Data



One of the hardest sets of data to include.



Data from Quality may not be detailed in a manner that can be easily applied to safety or ergonomics.



If the Quality Manager doesn't understand safety/ergonomics, getting the right information is challenging.



Ideal data is general cause x workstation. For example, 55% of rework from station 3 is attributed to operator errors/human factors.



Can be challenging to link realistic operator/production process causes to MSD risk levels.





<https://www.deviantart.com/magicsnowflake/art/Boot-sole-253399634>





# Estimators



# Is Using an Estimator Valid?

Every cost justification is an estimation of the benefits.

Standardized estimations based on industry averages is often more accurate than individual estimations on each project.

A simple, standardized approach can efficiently accomplish one of the goals of cost justification: "Are we selecting the most effective approach?"

A request for more information isn't a negative outcome.



# OSHA Safety Pays Estimator

**Direct Costs**

1. Select an injury type from the drop-down menu OR enter the total workers' compensation costs.
2. Enter the profit margin (leave blank to use default of 3%).
3. Enter the number of injuries (leave blank to use default of one).
4. Select "Add/Calculate" to compute the total direct and indirect costs.
5. Repeat the step to add additional injuries to the list.

**Injury Type**  OR

or

**Workers' Compensation Costs** (annual sum of costs)

**Enter Profit Margin (%)** (leave blank to use default of 3%)

**Enter Number of Injuries** (leave blank to use default of one)

**Using default 3% Profit Margin**

**Estimated Total Cost**

The extent to which the employer pays the direct costs depends on the nature of the employer's workers' compensation insurance policy. The employer always pays the indirect costs.

Injury Type	Instances	Direct Cost	Indirect Cost	Total Cost	Additional Sale (Indirect)	Additional Sale (Total)
Carpal Tunnel Syndrome	1	\$ 30,930	\$ 34,023	\$ 64,953	\$ 1,134,100	\$ 2,165,100 <input type="button" value="Remove"/>

**Totals**

**Estimated Direct Costs:**

**Estimated Indirect Costs:**

---

**Combined Total (Direct and Indirect Costs):**

**Sales To Cover Indirect Costs:**

**Sales To Cover Total Costs:**

<https://www.osha.gov/safetypays/estimator>



# OSHA Safety Pays Estimator

## Pros

- ✓ Well documented research supporting the estimator
- ✓ Standardizes injury cost estimations
- ✓ Simple data inputs
- ✓ Allows some customization

## Cons

- ✗ Focuses on cost, not benefits
- ✗ The indirect cost modifier is a significant portion of the savings estimation
- ✗ Only considers injury costs



# Washington State Estimator

Number of employees in this job/dept./org.:

Average hourly salary for these employees:  per hour

Number of WMSD claims for this job/ dept./ org. per year:

This past year:	Type	<input type="text" value="Back strain"/>	▼	Number	<input type="text" value="2"/>	Typical costs:	\$	17,446
	Type	<input type="text" value="Shoulder strain"/>	▼	Number	<input type="text" value="1"/>		\$	11,565
	Type	<input type="text" value="Back strain"/>	▼	Number	<input type="text"/>		\$	-
	Type	<input type="text" value="Back strain"/>	▼	Number	<input type="text"/>		\$	-
	Type	<input type="text" value="Back strain"/>	▼	Number	<input type="text"/>		\$	-
						Total costs for year:	\$	29,011

The year before:	Type	<input type="text" value="Back injury w/ surgery"/>	▼	Number	<input type="text" value="1"/>	Typical costs:	\$	57,688
	Type	<input type="text" value="Shoulder strain"/>	▼	Number	<input type="text" value="1"/>		\$	11,565
	Type	<input type="text" value="Back strain"/>	▼	Number	<input type="text"/>		\$	-
	Type	<input type="text" value="Back strain"/>	▼	Number	<input type="text"/>		\$	-
	Type	<input type="text" value="Back strain"/>	▼	Number	<input type="text"/>		\$	-
						Total costs for year:	\$	69,253

2 years before:	Type	<input type="text" value="Back strain"/>	▼	Number	<input type="text"/>	Typical costs:	\$	-
	Type	<input type="text" value="Back strain"/>	▼	Number	<input type="text"/>		\$	-
	Type	<input type="text" value="Back strain"/>	▼	Number	<input type="text"/>		\$	-
	Type	<input type="text" value="Back strain"/>	▼	Number	<input type="text"/>		\$	-
	Type	<input type="text" value="Back strain"/>	▼	Number	<input type="text"/>		\$	-
						Total costs for year:	\$	-

Average annual WMSD claim costs: \$ 32,755

Estimated annual indirect costs: \$ 36,030

Option 2:

Purchase cost: \$

Engineering cost:

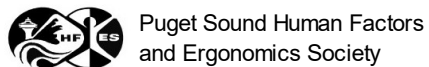
Training cost:

Recurring costs:

Other costs of change:

Total cost of intervention: \$ 5,500

- Eliminates exposure to hazard
- Reduces level of exposure
- Reduces time of exposure
- Relies on employee behavior
- No reduction in injuries expected
- High - speeds up entire process
- Medium - reduces wasted motion
- Low - improves comfort/reduces fatigue
- No productivity gains expected



<https://pshfes.org/cost-calculator>



# Washington State Estimator

## Pros

- ✓ Well documented research supporting the estimator
- ✓ Allows for variations in estimating solution effectiveness
- ✓ Standardizes injury cost estimations

## Cons

- ✗ Justifications are heavily dependent on injury history, potentially encouraging a reactive ergonomics process
- ✗ The indirect cost modifier is a significant portion of the savings estimation
- ✗ Requires substantial data inputs



# Goals for New Estimation Method

- Provides data-driven outputs
- Data is independent of injury history on a specific job
- Utilizes risk levels or scores
- Utilizes conservative financial values
- Minimizes data inputs



# VelocityEHS Estimator

Data Input	
Job Name	Stocker
Job Type	Warehouse
Current Risk Level	High
Type of Improvement	Engineering-Moderate Change
Estimated Cost of Improvement	4000

Projected Annual Savings	
Productivity	\$1,706
Quality	\$2,184
Injury Reduction	\$2,113
Absentessism	\$156
Turnover	\$341
<b>Total Savings</b>	<b>\$6,500</b>
<b>1 Year Return on Investment</b>	<b>63%</b>





# VelocityEHS Estimator

## Pros

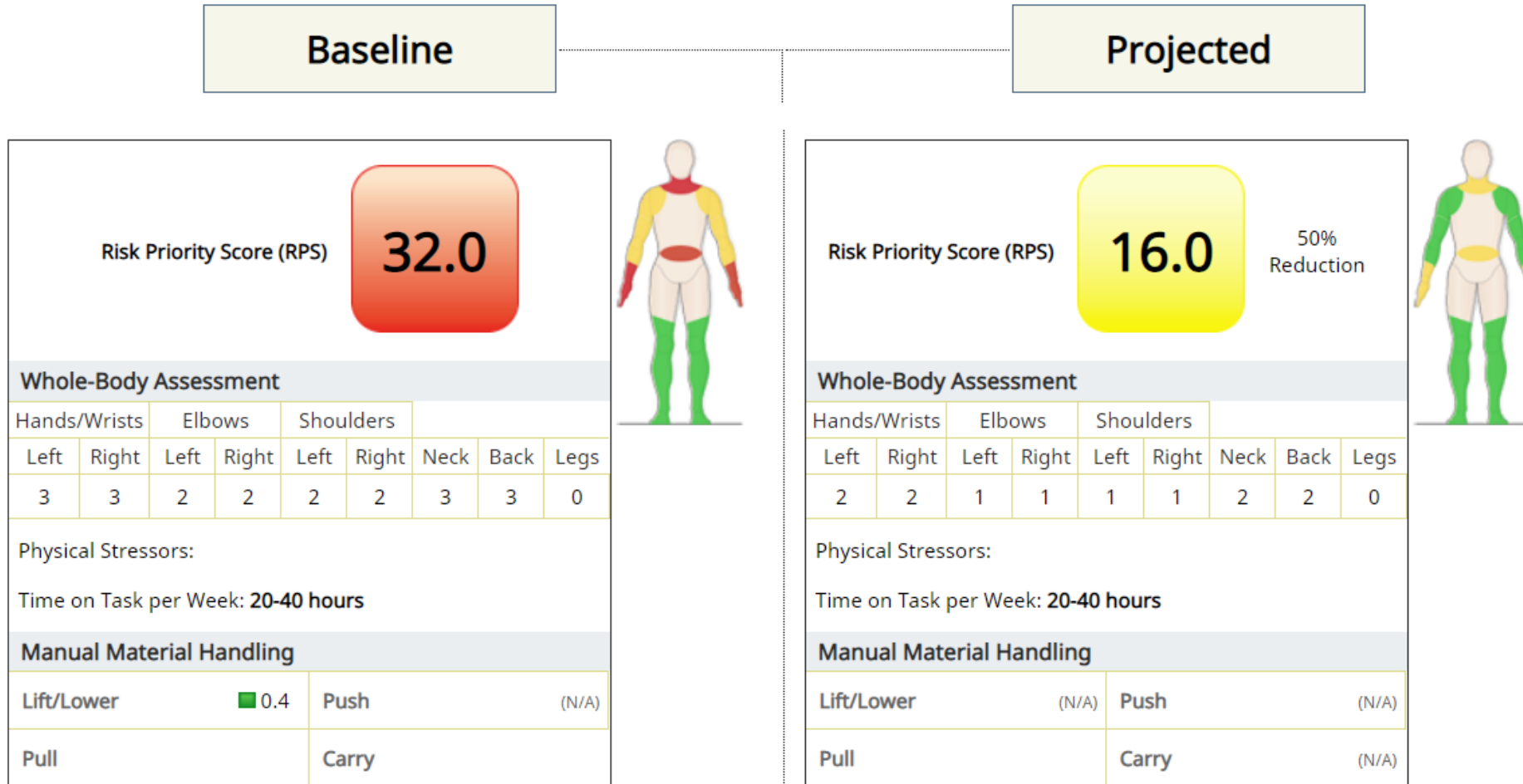
- ✓ **Minimizes data inputs**
- ✓ **Allows for variations** in effectiveness based on injury type
- ✓ **Uses risk** to inform predictions
- ✓ Includes **savings other than injury reduction**

## Cons

- ✗ **No ability to customize** to job/site specific situations, outputs are very generic
- ✗ **Minimal supporting detail**



# Using an Estimator Linked to a Risk Tool



# Using an Estimator Linked to a Risk Tool

	Option 1 Two Person Lift	Option 2 Lift Tables	Option 3 Vacuum Hoist
Anticipated Year 1 Cost	\$6,000	\$10,000	\$25,000
Ongoing Annual Cost	\$6,000	\$0	\$0
Projected Risk Reduction	2 points	5 points	15 points
Projected Annual Savings	\$1,014	\$2,535	\$7,605
CBA1	17%	25%	30%
Breakeven	Never	3.9 Years	3.3 Years



# Using an Estimator Linked to a Risk Tool

## Pros

- ✓ Well documented research supporting the estimator
- ✓ Minimizes data inputs
- ✓ Estimate varies based on effectiveness of improvement.
- ✓ Relies on risk rather than injury to drive estimates promoting a proactive ergonomics process.

## Cons

- ✗ Relies on averages rather than specific data.
- ✗ Does not account for significant injury history.
- ✗ No ability to customize inputs or assumptions.
- ✗ Use is limited to one specific risk assessment methodology.



# Questions?

Rick Barker

[rbarker@EHS.com](mailto:rbarker@EHS.com)

Jennie Dustin

[jdustin@EHS.com](mailto:jdustin@EHS.com)

VelocityEHS

