Cost Justifying Ergonomics

Methods and Tips for Calculating ROI

Presented by:
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- Blake McGowan, Director of Ergonomics Research for the Humantech brand of VelocityEHS, leads the Ergonomics Research group to incorporate the latest technical and scientific data into Humantech's software solutions. He also consults with academia to transfer the latest research knowledge into the Humantech approach, systems, assessment methods, and guidelines.
- Achieved recognition as a Certified Professional Ergonomist (CPE).
- He is a member of the:
  - Advisory Panel for the IISE Transactions on Occupational Ergonomics and Human Factors journal,
  - National Occupational Research Agenda (NORA) Musculoskeletal Health Cross-sector Council,
  - American Conference of Governmental Industrial Hygienists (ACGIH),
  - American Industrial Hygiene Association (AIHA),
  - Human Factors and Ergonomics Society (HFES).
- Past Chair and Officer of the AIHA Ergonomics Committee.

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Seek & Aggregate Research Information

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Translate Information into Knowledge

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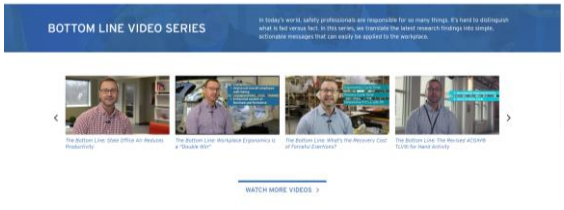
Translate Information into Knowledge



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Transfer Value to our Software & Services

Motion Capture Technology

Advanced Tool

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Unique Knowledges, Insights & Key Learning's

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Cost Justifying Ergonomics

- Value of Ergonomics
  - Reminder: Ergonomics Optimizes Human Performance
  - Benefactors & Benefits
- Cost Justifying Ergonomics
  - Overview of Cost Justification
  - Approaches to Cost Justification
  - Using Cost Justification Estimators
  - Projecting Savings Based on Risk Reduction

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Reminder: Ergonomics Optimizes Human Performance

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Fundamentals - Definition of Ergonomics

Ergonomics (or human factors) is the scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data and methods to design in order to **optimize human well-being and overall system performance**.

International Ergonomics Association (IEA) and Human Factors & Ergonomics Society (HFES).

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Optimized Human Performance

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Is this Part of the Problem?

The goal of ergonomics is to **prevent soft tissue injuries and musculoskeletal disorders** (MSDs) caused by sudden or sustained exposure to force, vibration, repetitive motion, and awkward posture.

Centers of Disease Control and Prevention (CDC) and National Institute for Occupational Safety and Health (NIOSH).

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Is this Part of the Problem?

An ergonomics program is a systematic approach and a management system that is designed to **reduce risk from ergonomic hazards in the workplace**.

Canadian Centre for Occupational Health & Safety (CCOHS).

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Benefactors & Benefits

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Benefactors & Benefits

Dul J, Bruder R, Buckle P, Carayon P, Falzon P, Marras WS, Wilson JR, van der Doelen B. (2012). A strategy for human factors/ergonomics: developing the discipline and profession. Ergonomics. 2012;55(4):377-95.

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Overview of Cost Justification

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Cost justification

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

- Cost justification "can mean simply that the proposed action is the most cost-effective solution to a problem or need that absolutely must be addressed."
- Two common tools used in cost justification are:
  - Benefit-cost analysis (BCA)
  - Return on investment (ROI)

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Benefit Cost Analysis vs Return on Investment

Benefit Cost Analysis	Return on Investment
Emphasizes financial feasibility	Emphasizes financial return
More flexible	More stringent
Multiple formulas	Specific formula
Longer-term benefits	Time sensitive
More comprehensive – includes intangibles	Focused on tangible costs and benefits
Benefits to affected parties	Benefits to investor

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Safety/Injury Reduction

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Average Cost of a Musculoskeletal Disorder (MSD)

The average cost of an MSD is $38,000. The total cost of purchasing and installing 2 lift tables is $19,000.

BCA1: $38,000/$19,000 = 2.0

BCA2: $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?

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Average Cost of a Musculoskeletal Disorder (MSD)

Question the CFO/Controller might ask:

"Have injuries been costing us $38,000/year on this job?"

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Historical Injury Cost

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 2 lift tables is $19,000.

1 Year Results	3 Year Results
BCA1: $9,500/$19,000 = 0.5 BCA2: $9,500 - $19,000 = -$9,500 Simple ROI: ($9,500-$19,000)/$19,000 = -50%	BCA1: $28,500/$19,000 = 1.5 BCA2: $28,500 - $19,000 = $9,500 Simple ROI: ($28,500-$19,000)/$19,000 = 50% or 16.6% annually

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Historical Injury Cost

If you start justifying ergonomics improvements based on historical injury costs, how do shift that justification when a high risk job hasn't had a previous injury?

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Using Injury Cost Data in Cost Justification

Pros	Cons
The primary reason that the plant or company is doing ergonomics is likely to be the reduction of injuries. Cost data linked to this reason is very relevant. Injury cost data is readily available within safety but rarely considered by others in the organization.	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 both in the likelihood and severity of injury. Using only injury data can reinforce the idea that injury reduction is the only benefit of ergonomics.

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Productivity Improvement

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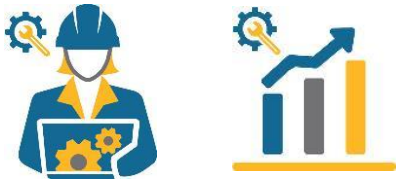
Improved Manufacturing Performance



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Productivity Improvement

Cost Justification Worksheet — DESCRIPTION

Job Name:	Box Belt 4009	Current Cycle Time (Sec):	60.0
Station:		Working Time (Hrs):	8.0
Location/Dept.:		Daily Shifts:	3
Product Type:		Alike Jobs:	5
		Hourly Labor Rate ($/hr):	$35.00

Job Improvement - Reaching	Current STEP Zone		Proposed STEP Zone		Times per Cycle	MOTION TIME SAVINGS (seconds/unit)	
	Reach From	Reach To	Reach From	Reach To		Projected	Conservative
Narrow table	Neutral	D	Neutral	E	1	0.40	0.26
Sorting Area	Neutral	C	Neutral	A	1	0.40	0.26
No more Staging Transfer	Neutral	E	Neutral	Neutral	0.2	0.08	0.05

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Productivity Improvement

Having 1 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. The total cost of purchasing and installing a lift tables with a rotating top is $10,000.

BCA1: $13,000/$10,000 = 1.3

BCA2: $13,000-$10,000 = $3,000

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

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Productivity Improvement

Question the CFO/Controller might ask:

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

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Using Productivity Data in Cost Justification

Pros	Cons
Productivity gains generally provide more economic value than safety gains. Standard processes and values (like the loaded labor rate) already exist in most organizations.	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.

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Other Operations-Centric Measures

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Operations-Centric Measures

- Quality improvement
- Repair/Rework
- Scrap
- Warranty claims
- Downtime reduction
- Set-up time reduction

quality failure rates

cost to correct errors

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Ann-Christine Falck, Roland Örtengren and Dan Högberg. (2010). The impact of poor assembly ergonomics on product quality: A cost–benefit analysis in car manufacturing. Human Factors and Ergonomics in Manufacturing & Service Industries, Volume 20, Issue 1, pages 24–41, January/February 2010.
Ann-Christine Falck, Roland Örtengren, Mikael Rosenqvist. (2014). Assembly failures and action cost in relation to complexity level and assembly ergonomics in manual assembly (part 2). International Journal of Industrial Ergonomics 44 (2014) 453–459.

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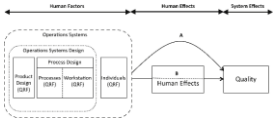
Impact of Fatigue on Manufacturing Quality

Fatigue is an intermediary factor between HF and manufacturing quality.

- Fatigue accounts up to **42%** of the variance in quality deficits.



Yung M, Kolus A, Wells R, & Neumann P. (2019). Examining the fatigue-quality relationship in manufacturing. Applied Ergonomics. Volume 82, January 2020, 102919. https://doi.org/10.1016/j.apergo.2019.102919

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Using Quality and Other Operations-Centric Data in Cost Justification

Pros	Cons
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.	This can be difficult data to obtain accurate costing information directly attributable to poor ergonomics.

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Human Resources Impact

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Human Resource Measures

Turnover
Absenteeism
Engagement

Turnover:
↓ 23-49%

Absenteeism:
↓ 42-116%

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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
BCA1: $7,000/$10,000 = 0.7 BCA2: $7,000 - $10,000 = -$3,000 Simple ROI: ($7,000-$10,000)/$10,000 = -30%	BCA1: $21,000/$10,000 = 2.1 BCA2: $21,000 - $10,000 = $11 Simple ROI: ($21,000-$10,000)/$10,000 = 110% or 36.7%/year

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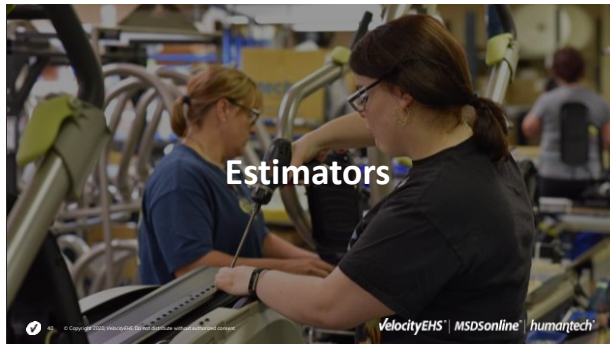

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Is Using an Estimator Valid?

Every cost justification is an estimation of the benefits.

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.

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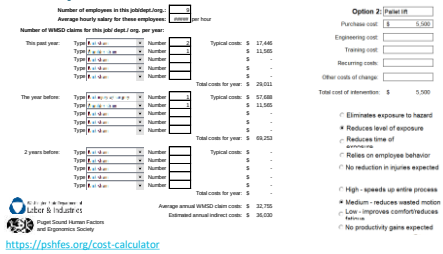
Example of an Estimator



https://pshfes.org/cost-calculator

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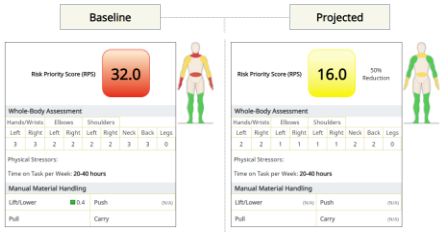
Basing Savings Estimates on MSD risk



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Risk-Based Estimator

Pros	Cons
The research supporting the values in the estimator is well documented.	Relies on averages rather than specific data.
Very little information needed to complete.	Does not account for significant injury history.
Estimate varies based on effectiveness of improvement.	No ability to customize inputs or assumptions.
Relies on risk rather than injury to drive estimates promoting a proactive ergonomics process.	Use is limited to one specific risk assessment methodology.

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Estimator Content: Injury Data

Overall IR = 2.8/100 FTEs

Over-exertion is > 25% of incidents; all injuries due to poor ergonomics is more like 33% of incidents

Industrial/manufacturing jobs typically assessed for MSD risk have a substantially higher injury rate. Estimated as 2.5 % (about 3x higher than overall working population).

Average direct and indirect cost of MSD injury used is rounded to $60,000

Average injury cost improvement is 68%.

Improvement Averages and CI based on Goggins et al (2008)

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Estimator Content: Productivity

Based on a fully loaded hourly rate of $15/hours

Average productivity improvement after ergonomics improvements is 25%

Estimator equation uses an ultra-conservative number of 8% productivity improvement (because individual station productivity gains are hard to realize in overall gains until many stations have been improved)

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Estimator Content: Scrap & Rework

Based on a conservative average of $3,000/year/workstation

Average quality savings after ergonomics improvements is 67%

Estimator equation uses a conservative number of 47% scrap and rework cost reduction (80% of the LCI)

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Estimator Content: Turnover

Based on 25% turnover rate in manufacturing jobs

Average cost for worker replacement is $5,500 including recruiting, hiring, and training costs

Average turnover reduction after ergonomics improvements is 48%

Estimator equation uses a conservative number of 32% reduction in turnover (80% of the LCI)

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Estimator Content: Absenteeism

Based on 1% average absenteeism

Average cost for absenteeism is based on $700/year/employee

Average turnover reduction after ergonomics improvements is 58%

Estimator equation uses a conservative number of 34% reduction in absenteeism (80% of the LCI)

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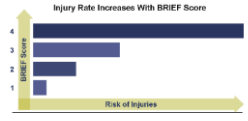
VelocityEHS Specific Data

Average and distribution of MSD risk scores

Injury rates associated with different MSD risk scores

Average MSD risk score change associated with engineering improvements



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Risk-Based Estimator

Current		Projected		Anticipated Savings
RPS Score	# of High-Risk Body Areas	RPS Score	# of High-Risk Body Areas	
32	4	16	0	$5,885

**Cost savings are based on averages reported in research literature for jobs with similar risk reductions. Individual projects will vary in actual savings. This data is intended to guide decisions about the appropriate next steps, which may include conducting a formal ROI.*

Breakdown of Anticipated Savings	
Injury Costs	$1,088
Productivity	$2,560
Scrap/Rework	$1,510
Turnover	$469
Absenteeism	$257

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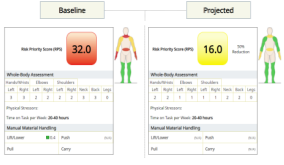
Using a Risk-Based Estimator



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Applying a Risk-Based Estimator

	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

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Applying a Risk-Based Estimator

- Company X improved and completed follow-up assessments on 53 jobs
- The average RPS improvement on these 53 jobs is 15.2 points
- The number of high RPS score jobs was reduced from 48 to 0
- Based on this reduction in risk, Company X has achieved an estimated annual savings of $355,672 or just under $7,409/job improved
- The detailed breakdown of this savings estimate is:

Annual Projected Savings				
Injury Reduction	Productivity Improvement	Quality Improvement	Turnover Reduction	Absenteeism Reduction
$52,227	$211,552	$62,143	$19,172	$10,578

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Questions?

Cost Justifying Ergonomics Methods and Tips for Calculating ROI

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