Ergonomics

Return On Investment, Made Easy

Ergonomics
ROI Made Easy

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The Economics of Ergonomics

AIG

The total additional revenue required to cover the costs of these 3 incidents is estimated to be $1,315,425

MSDs Injury: Muscle Strain

Average Direct Cost:	$5,945
Average Indirect Cost:	$7,134
Estimated Total Cost:	$13,079
Net profit margin for this company is	4 %
The ADDITIONAL sales necessary to cover Total Costs are:	$326,975

MSDs Injury: Carpal Tunnel Syndrome

Average Direct Cost:	$8,305
Average Indirect Cost:	$9,966
Estimated Total Cost:	$18,271
The net profit margin	4%
The ADDITIONAL sales necessary to cover Total Costs are:	$456,775

MSDs Injury: Cumulative Trauma

Average Direct Cost:	$9,667
Average Indirect Cost:	$11,600
Estimated Total Cost:	$21,267
The net profit margin	4%
The ADDITIONAL sales necessary to cover Total Costs are:	$531,675

Return On Investment

Basics:

Calculations such as ROI, Total Cost of Ownership (TCO) or Net Present Value (NPV) are used in finance to approve a Capital Expenditure or Negotiate the Terms of a contract.

- Internal ROI
- External ROI
- Social ROI

Use a Variety of Case Studies

• **Assembly job redesign:**
10.76% first year ROI & 30.10% subsequent year ROI
(Lyon, 1997)

• **Workstation redesign:**
15% increase in productivity
(Hendrick, 2003)

• **Robotic case palletizer:**
17% ROI over a 10 year period
(Rodrigues, 2001)

• **Log truck redesign:**
$6900 investment & $65,000 return = 1:9.4 first year cost-benefit ratio (Hendrick, 2008)

• **Electric utility tool replacement:**
$300,000 capital investment paid back in 4 months
(Seeley & Marklin, 2003)

• **Motherboard redesign:**
$581,495/year factory savings & $142,105/year customer savings
(Sen & Yeow, 2003)

Use a Variety of Metrics

Metric	Measurement / Method
SAFETY	S1 - Incident Number S2 - Lost Work Day Cases S3 - Lost and Restricted Work Days
QUALITY	Q1 - First Time Through Capability (FTC) Q2 - Customer Satisfaction Audit (CSA) Q3 - Vehicle Severity Index (VSI) Q4 - Expense Per Unit Sold (EPUS)
DELIVERY	D1 - Throughput / Schedule Attainment
COST	C1 - Hours Per Vehicle or Unit (HPV) C2 – Repair Cost C3 – Scrap Cost C4 – Tooling or Material Cost
MORALE	M1 - Symptom Survey

SAFETY

S1. Incident Number:

Show the raw number of OSHA recordable cases *related* to the risk factor(s) in question. Indicate the time period in which the cases fall.

Example – This operation had 5 and 1 cases, for the 6 month period before and after the fix, respectively.

Cost Avoidance for OSHA Cases:

Use the raw number from the metric above and multiply by $15,800 for each case.

Example – Using the scenario above:
4 cases x $15,800 Equals = $63,200 in cost avoidance / 6 months = $126,400 in annual cost avoidance

Note: The NSC Guideline for the cost of a recordable injury = $15,800

SAFETY

S2. Lost Work Day Cases:

Show the raw number of OSHA lost work day cases. Indicate the time period involved.

Example – This operation had 4 and 1 LWD cases, for the 6 month period before and after the fix, respectively.

S3. Lost Work Days (LWD) #:

S4. Restricted Work Days (RWD) #:

Indicate the number of LWDs / RWDs and the the time period in question. (related to the concern)

Example – This operation had 42 and 6 RWDs for the 6 month period before and after the fix, respectively.

QUALITY

Q1. <u>(FTC) First Time Through Capability</u>:

Direct run first time capability

A percentage of throughput is created using the number of defects found, compared to the number of vehicles or products for given period of time.

Example – Percent FTC for 6 months time frames.

65% vs 85% before and after the improvement, respectively

Defects in this case are the problems found at the end of a line that can be attributed to the job station involved. FTC data is tracked at the job station level on an individual PFS website.

QUALITY

Q1. (FTC) First Time Through Capability:

Stamping (FTC)

In 2005, the stamping division will start using a raw number for scrap and reworked pieces.

Example – Amount of scrap and reworked pieces went from
100 to 50 / month (average) before and after the improvement, respectively. The piece cost is $30, which lead to a $1500 cost avoidance per month or $18k annually.

QUALITY

Q2. (CSA) Customer Satisfaction Audit:

Q3. (VSI) Vehicle Severity Index

This metric is available on the plant's scorecard.

QUALITY

Q4. (EPUS) Expense Per Unit Sold:

Dollar ($) amount based on conditions (c's) found in the field. The EPUS formula is as follows

EPUS = Warranty Costs (WC) / Units Sold

WC = (c's / 1000 **x** Average Cost Per Condition) x 1000

In order to determine this information at the job station level, a manual search into the key words or part numbers tracked in conditions per 1000 will be required. Warranty added c/1000 for 2005. C / 1000 = (# of conditions / units sold) x 1000

Two month - EPUS and C/1000 is also tracked.

DELIVERY

D1. Schedule Attainment in Line Hours:

Information that may be found within the throughput management wall of your facility, using bar / trend charts to display the data.

The formula used is as follows:

$$\frac{\text{Actual Production}}{\text{Scheduled Production}} \times \frac{\text{Scheduled Hours}}{\text{Actual Hours}} = \textbf{\% Schedule Attainment}$$

Job station data may be difficult to find for this measure. Review the balanced scorecard data or PFS to obtain actual production numbers per job.

Note – Data related to this throughput measure can be obtained from your local industrial engineering and or finance departments.

Cost

C1. <u>(HPV-HPU) Hours Per Unit or Vehicle</u>:

HPV or HPU, is typically a number tracked by the industrial engineering dept. at every facility. However, if you must do the calculation on your own you would obtain the following numbers from (budget supervisor) finance MY budget:

$$HPU = \frac{\text{\# of hours (hourly + salary)}}{\text{\# of units (projected volume)}}$$

$$HPU = \frac{3{,}944{,}197 \text{ hours}}{656{,}832 \text{ units}}$$

$$HPU = 6.00488$$

Cost

C2.Repair Cost:

If the workstation does not attain 100% FTC, there may be an annual repair cost associated. You would need to collect the average cost per repair, plus the actual number of units based on the percent of non-FTC for that workstation:

Note – Cost Savings from the above measures can be added to any annual savings amount, obtained from HPV or HPU.

Cost

There are a few other measures that may attribute to an improvement in the cost of a certain process. Depending on the facility and their specific tracking mechanisms for these items, you may be able to include data from the following categories:

C3. Scrap Cost:

C4. Tooling or Material Cost:

The above measures are not tracked on the balance scorecard, but do benefit the plant's bottom line.

Note – Cost Savings from the above measures can be added to any annual savings amount, obtained from HPV or HPU.

MORALE

M1. Operator Input:

Since the latest version of the ErgoPAL checklist was launched in March of 2004, there is a section of the database to report operator input related to the ergonomics of the operation in question.

Each ErgoPAL document will have an overall score + quotes from the individual operator, using answers to the following published questions:

If discomfort is present, what tasks or elements can you attribute it to?

What recommendations can you make to improve the ergonomics of the operation?

Case Study #1

One Page Summary

SAFETY - $ 94,800 Annual avoidance from 6 OSHA Cases

QUALITY - $12,000 in EPUS ($0.06 improved x 200,000 units)

DELIVERY - $ 20,000 in Schedule Attainment (%50 improvement)

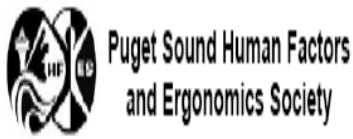
COST
- $ 49,000 in HPV (0.00299 HPV improvement)
- $ 230,850 in Annual Repairs ($90/repair x 2,565 units)

MORALE - M3-23 to M0-10 ErgoPAL / Operator Involvement

TOTAL COST IMPROVEMENT **= $376,650 for the first year, post fix**
($406,650 savings / avoidance - $30,000 cost of tooling)

Note: All data normalized for 1 year

Ergonomics, ROI Made Easy



- Utilization of the Spread Sheet
  - Work through an example
  - The instruction document and working model will be posted on the OCHOW website for use after the RSI-Day

Articles of Interest:

Beevis, D. (2003). Ergonomics – Costs and Benefits Revisited. *Applied Ergonomics 34,* 491-496.

Goggins, R.W., Spielholz, P., & Nothstein, G.L. (2008). Estimating the effectiveness of ergonomics interventions through case studies: *Journal of Safety Research, 39,* 339-344.

Hendrick, H.W. (2003). Determining the cost-benefits of ergonomics projects and factors that lead to their success. *Applied Ergonomics, 34,* 419-427.

Hendrick, H.W. (2008). Applying ergonomics to systems: Some documented "lessons learned." *Applied Ergonomics, 39,* 418-426.

Kerr, M.P., Knott, D.S., Moss, M.A., Clegg, C.W., & Horton, R.P. (2008). Assessing the value of human factors initiatives. *Applied Ergonomics, 39,* 305-315.

Lahiri, S., Markkanen, P., & Levenstein, C. (2005). The cost effectiveness of occupational health interventions: *American Journal of Industrial Medicine, 48,* 515-529.

Lyon, B.K. (1997, March). Ergonomic benefit/cost analysis: Communicating the value of enhancements. *Professional Safety,* 33-36.

Maudgalya, T., Genaidy, A., & Shell, R. (2008). Productivity-quality-costs-safety: A sustained approach to competitive advantage – a systematic review of the national safety council's case studies in safety and productivity. *Human Factors and Ergonomics in Manufacturing, 18,* 152-179.

Rodrigues, C.C. (2001, April). Ergonomics to the rescue: A cost-justification case study. *Professional Safety,* 32-34.

Seeley, P.A., & Marklin, R.W. (2003). Business case for implementing two ergonomic interventions at an electric power ultility. *Applied Ergonomics, 34,* 429-439.

Sen, R.N., & Yeow, R.H.P. (2003). Cost effectiveness of ergonomic redesign of electronic motherboard. *Applied Ergonomics, 34,* 453-463.