Ergonomics to the Rescue

A Cost-Justification Case Study

By CLARENCE C. RODRIGUES

The science of ergonomics in the workplace attempts to optimize interactions between humans and machines in order to achieve a set of systems goals. This encompasses a combination of functions, which, if implemented correctly, will generate a system that is both efficient *and* profitable.

Most businesses continuously seek ways to reduce costs that stem from injuries, workers' compensation (WC) and OSHA fines, while increasing productivity and regulatory compliance. For example, eliminating manual materials handling and product spills leads to greater productivity. Reducing manual materials handling—especially the transport (carry) and delay (static holding) functions—is a key rule in classical industrial engineering methods. Minimizing such tasks (lifting, lowering, pushing, pulling, carrying, forceful exertions, static loading) also reduces the risk of musculoskeletal injuries. Product spills reduce ingredient use, increase product cost, and create slip-and-fall and environmental hazards.

This leads to two key observations: 1) Ergonomics can be a money-generating function if a company is committed to implementing it from a systems perspective. 2) Ergonomics becomes an integral part of the business function when integrated with a company's business objectives. When these two principles are embraced, ergonomics achieves the status of "bottom-line contributor" and is no longer viewed as an overhead function.

Although ergonomics can generate savings, some lead-time (from start up) will likely pass before changes are implemented and subsequent monetary benefits are realized. It takes time to acquire and analyze data, set priorities and obtain executive buy-in—particularly in large firms. However, in today's business environment, savings must be generated quickly—the sooner the better.

In the case described here, an ergonomics initiative produced savings during the early stages of its development by helping to justify a systems-improvement project that had been delayed due to economic infeasibility. This initial success was a conrnerstone for a company-wide ergonomics effort.

Operations personnel had recommended a savings initiative primarily designed to improve productivity, with secondary (even incidental) ergonomics and safety benefits. The project involved large capital expenditures (several hundred thousand dollars) and thus had to meet the organization's established standard for minimum return on investment (ROI).

Unfortunately, the project was falling short of this requirement and turned to the ergonomics function for assistance. A cost-justification procedure was initiated, the project was approved, and ergonomics proved to be a bottom-line contributor, leading to greater awareness and acceptance of ergonomics.

PROJECT BACKGROUND

The year the ergonomics effort began, the firm had just completed a major restructuring and was in the process of reinventing itself and changing its approach to business. At that time, the manufacturing conglomerate, whose sales exceeded $4 billion, planned to double its size over a five-year period.

As a result, "find efficiencies" and "cut costs" were the mantras of the day. Every area was assessed for improvement—and the safety and health function was no exception. The firm's total annual WC allocation was $25 million. Analysis revealed that approximately one-third of these costs was associated with back injuries and repetitive-motion-related injuries. In addition, the firm had been fined more than $1 million under the OSH Act's General Duty Clause for alleged "egregious" ergonomic deficiencies.

Faced with these facts, the company recognized the need for an effective ergonomics program. This led to development of a multi-dimensional action plan. Based in part on OSHA's ergonomic program guidelines for meatpacking plants ("Ergonomic Program"), the program featured several key elements:

1) written program and objectives;
2) building system resources and interfacing with internal clients (e.g., engineering, quality assurance);
3) trend analysis (injuries and cost);
4) job analysis and risk quantification;
5) site-specific, project-based training;
6) control strategies (engineering, administrative, medical management);
7) auditing;
8) activity tracking;
9) documentation.

As noted, the company's climate demanded that the program to contribute to the bottom line in the immediate near term. An opportunity to achieve this arose when analysis revealed that WC costs were not always used in project justification—or, when used, the costs lacked basis and were not location-specific.

For example, $4,000 was used company-wide as a savings figure for any ergonomic-type injury that was eliminated. However, since no one could explain the origin of this value, it was often challenged by company controllers. As a result, several system improvement projects had been denied because their ROI ranged between 15 and 19 percent—just below the company's 20-percent minimum. As a result, those involved set out to develop an equitable cost-justification method that would be accepted by the power centers within the company.

COST-JUSTIFICATION CASE STUDY

Due to its size, the company was self-insured, meaning it paid all of its own WC costs. The insurance company handled claims management, which encompassed

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claims reporting, tracking and documentation; developing provider (medical, legal) networks; claims investigation; budgeting and allocation of payments; data analysis; processing and mailing indemnity checks; and claims management training. Individual locations were actively involved in case management as well, due to strong financial incentives tied to returning injured employees to work.

In this setting, a claim was any work-related injury that required medical attention and/or indemnity payments. The company created two categories of claims that were used solely for internal accounting purposes. The first was medical only (MO) claims, which originated from an injury that required no indemnity payments; such claims incurred primarily administrative and minor medical costs. The second was benefit expense (BE) claims; these involved indemnity payments to injured employees to compensate for lost wages, medical expenses, disability, and medical and vocational rehabilitation. Because most back injuries and repetitive trauma injuries fell into this category, BE claims costs were considerably higher that those for MO claims.

The company's accounting system required that a sum of money be set aside (accounting allocation) at the beginning of a given year to cover claims (over the life of the claims) that were projected to occur within that year. This projection was an actuarial estimate based on the previous injury and cost history of the firm's manufacturing locations. It is important to note that the entire allocated sum for an injury may not be spent during the year in which an injury occurs, but may be expensed over a period of years. For example, if a $50,000 back injury occurs this year, only a portion of that total will actually be paid out (cash flow) this year.

Next, a time period and cash flow percentage over which to expense the claim was established. While a period of five years was recommended, the company sought a much-longer period based on the following factors:

1) Many claims were "open/active" for much-longer periods (10 years in some cases). Although true, it was noted that all activity related to those claims had been completed within the first three to five years and that the claims could have been closed within that time. In other words, this was a claims management issue. (In fairness, it should be noted that some claims do remain open longer than average due to lifetime medical stipulations related to permanent disability payouts.)

2) The company justified all capital expenditures for savings projects over a 10-year period. For firms that have been in business for many years, are stable, and whose core business and products are not likely to become obsolete, this period is justified. Therefore, it was necessary to develop a claims cash flow that matched the company's project analysis period.

Subsequently, cash flow percentage distributions (as a percentage of allocated value) by year were established—25 percent in year 1; 20 percent in year 2; 15 percent in year 3; 10 percent in year 4; and 5 percent in years 5 through 10. The allocated value for a manufacturing location was specific to its injury and cost history.

ANALYSIS WITHOUT USING WC COSTS

The project involved purchase and installation of a robotic case palletizer (and associated line modifications) for a hand palletizing operation. Initial investment was $300,000. Annual savings due to labor and cycle time reductions, increased production throughput and other efficiencies totaled $65,000 as follows:

- **Jobs eliminated per shift=1**
- **Number of shifts=2**
- **Labor rate per hour (including benefits)=$15**
- **annual labor savings=1 job/shift x 2 jobs x 2,000 hours/job/year x $15/hour=$60,000**
- **annualized profits generated due to increased throughput=$5,000**
- **total annual savings=$65,000**

Several sources discuss procedures for arriving at such costs (Lyon 33; Hendrick and Kleiner 1+; Brennecke; Getty 6). Using the series' present work formula on the cash flow generated by the project produces the following calculation (Newnan and Lavelle 72):

P=A(P/A, I%, N)
=A[(1+I)n -1]/[I(1+I)n]
Where P=present sum of money=$300,000
A=equal annual end-of-period cash flow= $65,000
I=effective interest rate per period
N=number of interest periods=10
Substituting these values:
300,000=65,000 [(1+I)10 - 1]/[I(1+I)10]
I=17%

Thus, the project's ROI was 17 percent per year over a 10-year period. The minimum ROI was 20 percent. Subsequently, WC costs were used to determine whether the project could be justified.

ANALYSIS USING WC COSTS

By eliminating manual stacking of product on pallets, the automatic palletizer would eliminate one operator per shift and thereby would eliminate the risk of back injuries at this workstation. Investigation revealed that over a three-year period, this workstation had generated one BE claim due to back injuries per year.

In addition, according to the NIOSH lifting equation, this task had a lifting index (object weight/recommended weight limit) of greater than 2.0 (Waters, et al 4). The cost allocation for the manufacturing location in question was $20,000 per injury.

Hence, the starting dollar (allocation) value for this proposed savings would be $20,000. The yearly cash flow generated from this value would be:

a) $5,000 for the first year (0.25 x 20,000)
b) $4,000 for the second year (0.20 x 20,000)
c) $3,000 for the third year (0.15 x 20,000
d) $2,000 for the fourth year (0.10 x 20,000)
e) $1,000 for the fifth through tenth years (0.05 x 20,000).

In addition, a BE claim saving would trigger an MO claim saving of $100 (fixed). Table 1 (pg. 34) presents the cash flow distribution of WC costs for use in project justification.

Present worth calculations were then performed on the "total project cash flow" to determine the effective ROI (Newnan and Lavelle 149). The outcome was 23.6 percent. Additional cash savings generated using WC savings helped increase the original ROI by more than six percent. As a result, the project was approved.

CONCLUSION

As this case study demonstrates, ergonomics can provide a cost-justification factor to system improvement projects. In this case, WC data were used to develop cash flows that were then combined with other cash flow savings (such as labor and/or cycle time savings) to increase a project's ROI.

Not only did this approach help justify the project in question, it helped improve the facility's overall ergonomic conditions as well.

As a result of this success, ergonomics was seen as a major contributor to the company's "systems improvement" movement. This provided a sustainable boost to the ergonomics effort and facilitated future use of cost avoidance and similar initiatives. ■

TABLE 1 Cash Flow Distribution of WC Costs for Use in Project Justification

	Year	1	2	3	4	5	6	7	8	9	10
A		5000	5000	5000	5000	5000	5000	5000	5000	5000	5000
B			4000	4000	4000	4000	4000	4000	4000	4000	4000
C				3000	3000	3000	3000	3000	3000	3000	3000
D					2000	2000	2000	2000	2000	2000	2000
E						1000	1000	1000	1000	1000	1000
F							1000	1000	1000	1000	1000
G								1000	1000	1000	1000
H									1000	1000	1000
I										1000	1000
J											1000
Total BE Cash Flow		5000	9000	12000	14000	15000	16000	17000	18000	19000	20000
MO Cash Flow		100	100	100	100	100	100	100	100	100	100
(BE + MO) Cash Flow		5100	9100	12100	14100	15100	16100	17100	18100	19100	20100
Additional Project Cash Flow = 1.25 (BE + MO)		6375	11375	15125	17625	18875	20125	21375	22625	23875	25125
Total Project Cash Flow (including $65,000)		71355	76375	80125	82625	83875	85125	86375	87625	88875	90125

BE = benefit expense claim
MO = medical only claim

Cell A1: First-year cost of a BE claim (that occurred in year 1) = 0.25 x 20,000 = 5,000
Cell B2: Second-year cost of BE claim (that occurred in year 1) = 0.20 x 20,000 = 4,000
Cell C3: Third-year cost of BE claim (that occurred in year 1) = 0.15 x 20,000 = 3,000
Cell D4: Fourth-year cost of BE claim (that occurred in year 1) = 0.10 x 20,000 = 2,000
Cell E5, F6, G7, H8, I9, J10: Fifth-year to 10th-year cost of BE claim (that occurred in year 1) = 0.05 x 20,000 = 1,000
Cell A2: First-year cost of a BE claim (that occurred in year 2) = 0.25 x 20,000 = 5,000
Cell B3: Second-year cost of BE claim (that occurred in year 2) = 0.20 x 20,000 = 4,000
Cell C4: Third-year cost of BE claim (that occurred in year 2) = 0.15 x 20,000 = 3,000
Cell D5: Fourth-year cost of BE claim (that occurred in year 2) = 0.10 x 20,000 = 2,000
Cell E6, F7, G8, H9, I10: Fifth-year to 10th-year cost of BE claim (that occurred in year 2) = 0.05 x 20,000 = 1,000
Cell A10: First-year cost of a BE claim (that occurred in year 10) = 0.25 x 20,000 = 5,000
Cell B10: Second-year cost of BE claim (that occurred in year 9) = 0.20 x 20,000 = 4,000
Cell C10: Third-year cost of BE claim (that occurred in year 8) = 0.15 x 20,000 = 3,000
Cell D10: Fourth-year cost of BE claim (that occurred in year 7) = 0.10 x 20,000 = 2,000
Cell E10: Fifth-year cost of BE claim (that occurred in year 6) = 0.05 x 20,000 = 1,000
Cell F10: Sixth-year cost of BE claim (that occurred in year 5) = 0.05 x 20,000 = 1,000
Cell G10: Seventh-year cost of BE claim (that occurred in year 4) = 0.05 x 20,000 = 1,000
Cell H10: Eighth-year cost of BE claim (that occurred in year 3) = 0.05 x 20,000 = 1,000
Cell I10: Ninth-year cost of BE claim (that occurred in year 2) = 0.05 x 20,000 = 1,000
Cell J10: 10th-year cost of BE claim (that occurred in year 1) = 0.05 x 20,000 = 1,000

Total BE claim cash flow for a given year is the sum of all cell cash flows in the column for that year.
Additional project cash flow includes a 25-percent administrative charge.
Total project cash flow includes the $65,000 savings due to labor and other efficiencies.

REFERENCES

Brennecke, R.A. "CEOs, VPP and the Bottom Line: Part 1." *Proceedings of the ASSE Professional Development Conference.* Des Plaines, IL: ASSE, 2000.

Getty, R.L. "Ergonomic Improvements are Cost Effective." *Ergo Buyer on the Web.* April 21, 1999: 1-12. <http://www.ergobuyer.com/Getty/gettyb.html>.

Hendrick, H.W. and B. Kleiner. *Macroergonomics: An Introduction to Work Systems Design.* Santa Monica, CA: Human Factors and Ergonomics Society, 2000.

Lyon, B.K. "Ergonomic Benefit/Cost Analysis: Communicating the Value of Enhancements." *Professional Safety.* March 1997: 33-36.

Newnan, D.G. and J.P. Lavelle. *Engineering Economic Analysis.* 7th ed. New York: Engineering Press Inc., 1998.

OSHA. "Ergonomic Program Management Guidelines for Meatpacking Plants." Washington, DC: U.S. Dept. of Labor, OSHA, 1990.

Waters, T.R., et al. *Applications Manual for the Revised NIOSH Lifting Equation.* DHHS (NIOSH) Publication No. 94-110. Washington, DC: Dept. of Health and Human Services, NIOSH, 1994.

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