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 cornerstone 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 ergonomics 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 qualification;
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 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—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...
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 expended 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 recommended, the company was established. While a period of five years was suggested, the company determined that a 10-year period (accounting allocation) at the beginning of the project in question, it helped improve the facility’s overall ergonomic conditions. 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.

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.

**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 $65,000 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

<table>
<thead>
<tr>
<th>Year</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>5000</td>
<td>5000</td>
<td>5000</td>
<td>5000</td>
<td>5000</td>
<td>5000</td>
<td>5000</td>
<td>5000</td>
<td>5000</td>
<td>5000</td>
</tr>
<tr>
<td>B</td>
<td>4000</td>
<td>4000</td>
<td>4000</td>
<td>4000</td>
<td>4000</td>
<td>4000</td>
<td>4000</td>
<td>4000</td>
<td>4000</td>
<td>4000</td>
</tr>
<tr>
<td>C</td>
<td>3000</td>
<td>3000</td>
<td>3000</td>
<td>3000</td>
<td>3000</td>
<td>3000</td>
<td>3000</td>
<td>3000</td>
<td>3000</td>
<td>3000</td>
</tr>
<tr>
<td>E</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
</tr>
<tr>
<td>F</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
</tr>
<tr>
<td>G</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
</tr>
<tr>
<td>H</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
</tr>
<tr>
<td>I</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
</tr>
<tr>
<td>J</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
</tr>
<tr>
<td>Total BE Cash Flow</td>
<td>5000</td>
<td>9000</td>
<td>12000</td>
<td>14000</td>
<td>15000</td>
<td>16000</td>
<td>17000</td>
<td>18000</td>
<td>19000</td>
<td>20000</td>
</tr>
<tr>
<td>MO Cash Flow</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>(BE + MO) Cash Flow</td>
<td>5100</td>
<td>9100</td>
<td>12100</td>
<td>14100</td>
<td>15100</td>
<td>16100</td>
<td>17100</td>
<td>18100</td>
<td>19100</td>
<td>20100</td>
</tr>
<tr>
<td>Additional Project Cash Flow = 1.25 (BE + MO)</td>
<td>6375</td>
<td>11375</td>
<td>15125</td>
<td>17625</td>
<td>18875</td>
<td>20125</td>
<td>21375</td>
<td>22625</td>
<td>23875</td>
<td>25125</td>
</tr>
<tr>
<td>Total Project Cash Flow (including $65,000)</td>
<td>71375</td>
<td>76375</td>
<td>80125</td>
<td>82625</td>
<td>83875</td>
<td>85125</td>
<td>86375</td>
<td>87625</td>
<td>88875</td>
<td>90125</td>
</tr>
</tbody>
</table>

**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: Tenth-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


Clarence C. Rodrigues, Ph.D., P.E., CSP, CPE, is an associate professor in the newly created safety science degree program at Embry-Riddle Aeronautical University, located in Daytona Beach, FL. A member of ASSE's Cape Canaveral Chapter, Rodrigues holds a Ph.D. in Industrial Engineering from Texas A&M University.

READER FEEDBACK

Did you find this article interesting and useful? Circle the corresponding number on the reader service card.

**YES** 31  
**SOMETIME** 32  
**NO** 33