How to Increase Profits with Ergonomics

20 Ways to Cut Costs, plus One Way to Increase Revenues

by Dan MacLeod

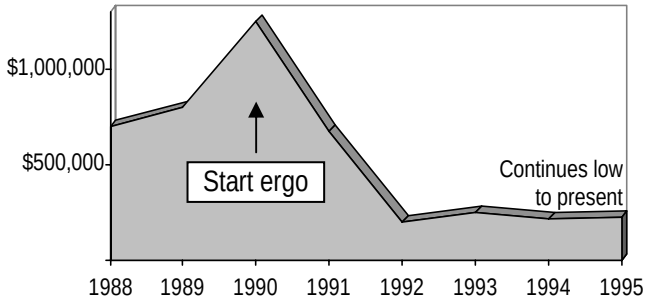
Ergonomics has gained visibility in recent years because of its value in preventing costly Musculoskeletal Disorders (MSDs — see Appendix). However, the tools of ergonomics are broader than "just" injury prevention and can benefit employers in many ways.

This paper is a summary of Part I of The Ergonomics Kit for General Industry *by Dan MacLeod (Taylor & Francis, Second Edition, 2006). Supporting documentation is provided in the book. MacLeod is one of the most experienced professional ergonomists in North America (www.danmacleod.com).*

1. Dramatic reductions in workers' comp costs

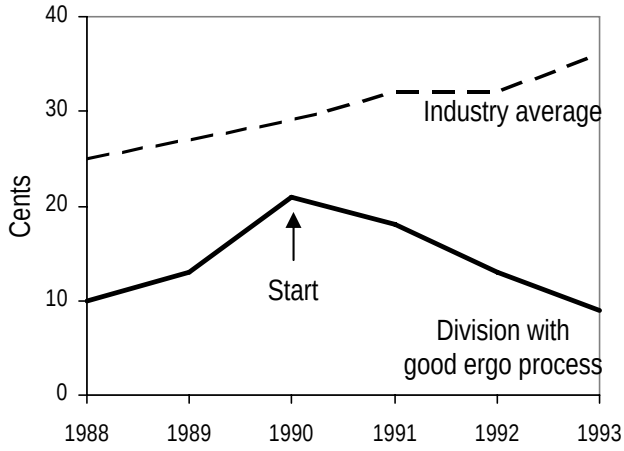
Good ergonomics programs have cut workers compensation costs an average of 60% and up to 90% in some cases. The book on which this summary is based provides several examples, including both bottom line results and descriptions of the process of how these companies got there. One brief example is as follows:

Workers' Compensation Costs
Total Costs for Division



The above graph shows total workers' comp costs for one division of a major manufacturer that employed roughly 4000 people in eight facilities. The division estimated that it saved about $12 million dollars in the first five years compared to the projected costs if they had done nothing. The investment costs for equipment purchases, maintenance modifications, and meeting time were not carefully tracked, but were certainly no more than $1 million, and probably much less.

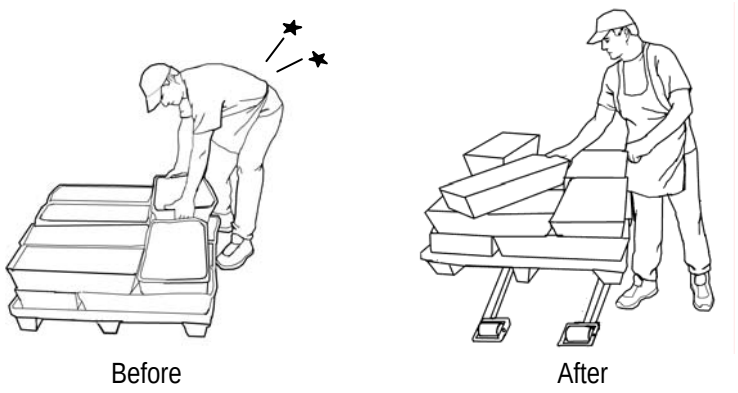
Costs per Hour per Employee

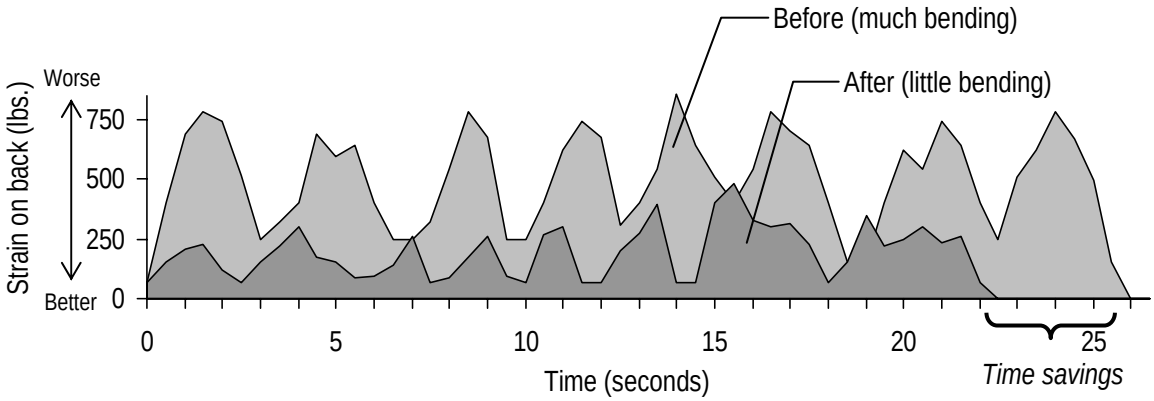


This graph shows the same data for the division in cents per hour per employee, plus equivalent data for the industry. The graph shows that the division had costs that were initially lower, but rising faster, than the industry average. After the division started the ergonomics program, its costs dropped while the rest of the industry continued to rise. After three years the savings was at least $0.25 per hour per employee compared to what it probably would have been if the division had done nothing.

2. Time savings — Example: Using an ordinary pallet lift

One of the most ordinary examples of good workplace ergonomics is using a lift to raise pallets off the floor. The follow study from a distribution center shows how a pallet lift reduced cycle time by 14 – 20% plus reduced the load on the spine by 66%. The implications are universal and support the use of all types of pallet lifts and tilters — they can eliminate wasted time and motions as well as reduce wear and tear on employees.





This graph displays on the vertical axis the strain on the lower back. The time involved is on the horizontal axis. Thus, the higher the peak, the worse the strain on the back; and the wider the peak, the more time it takes.

The graph clearly shows the benefits of the pallet lift and raising the boxes off the floor: (1) The peaks are lower and have less area, indicating lowered risk of injury, and (2) the time to perform the task is less — specifically, eight trays are lifted using the pallet lift in the time it normally takes to lift seven.

The time needed to complete these eight lifts was reduced from 25.5 seconds to 22.0 seconds, thus a savings of 13.7%. Additionally, a time study performed on a full pallet-load of trays showed that the time savings was about 20%, from 6.5 minutes without the lift to 5.2 minutes with the lift. The average load on the spine for these eight lifts was 494.7 lbs. without the pallet lift and 166.1 lbs. with the pallet lift, that is, 66.1% less.

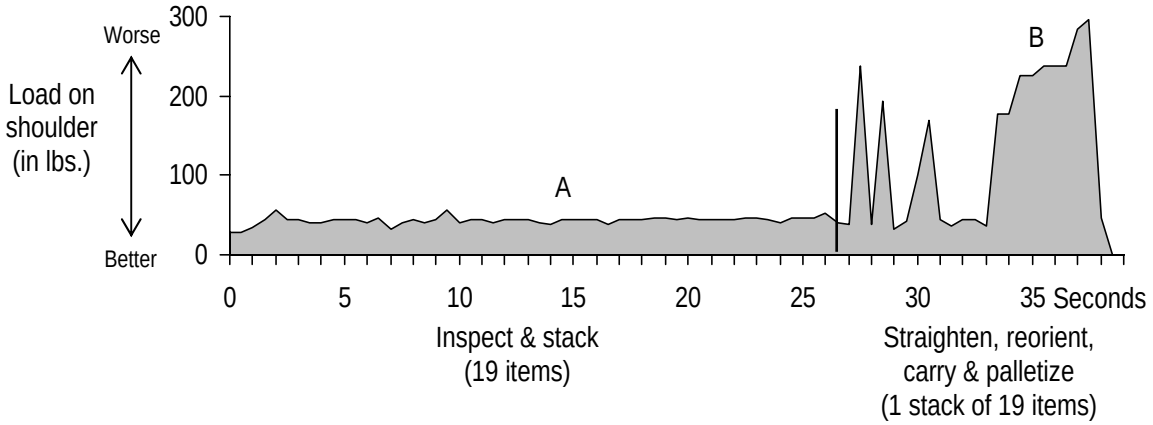
The point has profound implications for productivity:

Reducing physical demands can reduce time requirements.

3. Identifying waste (and resolving plant conflicts)

The following is an example from a company that inspects and repairs bags and other small containers for a major distribution company. There had been an argument whether or not the job was "too fast" and should be slowed down. The ergonomics evaluation revealed that (1) about *one-third of the work cycle involved unnecessary double handling* and (2) this wasted work involved the highest physical demands of the job.

It was possible to both increase production as well as reduce the physical workload. Thus more containers could be inspected with less effort — very much a win-win situation.



This task basically involved two parts: inspecting and stacking the containers (A in the graph above), then straightening and reorienting the stack and carrying it to a pallet on the floor (B above). The argument had been about the time it took to perform step A, which indeed involved highly repetitive arm motions.

However, the ergonomics evaluation (using the same technique as that on the previous page[*]) showed that part B was the source of the exertion and fatigue in the job. Moreover, it was possible to eliminate almost all of part B by purchasing a pallet lift and stacking the containers directly onto the pallet.

This circumstance happens so routinely that it deserves to be turned into a maxim:

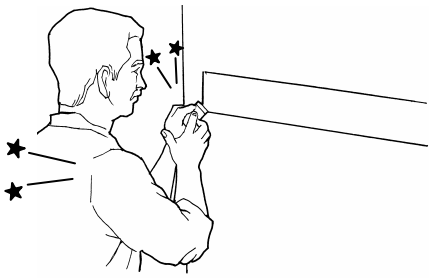
To discover wasted work, deliberately seek out tasks with high physical demands.

That is, supervisors and plant teams should be trained to look for issues like long reaches, awkward heights, and excessive bending. Furthermore, a process should be established to enable a systematic review of all tasks for these ergonomics issues.

[*] It is not necessary to perform a formal study and create a graph like this. All that usually needed to identify a problem is a trained eye or plant ergonomics team armed with a good checklist.

4. Getting people to think

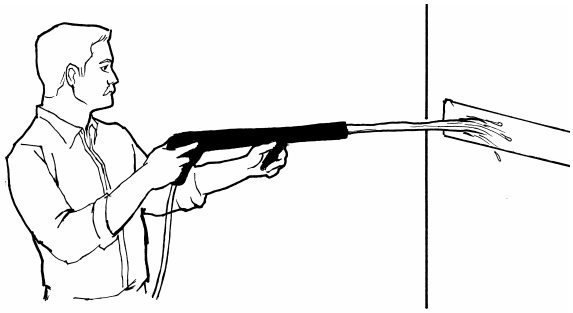
The following story is an excellent illustration of the business value of the workplace ergonomics process. The bottom line is that an employee, after attending a class in ergonomics, came up an idea that was cost-free, eliminated a painful activity, and yielded 90% reduction in time needed to complete the job.



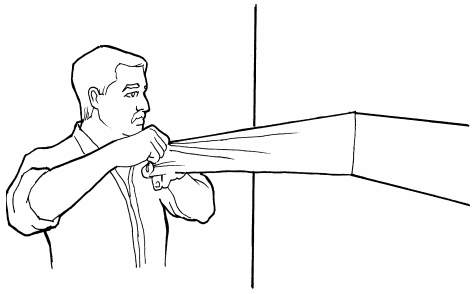
Before — Scraping the decals with a razor tool.

The company was a distribution operation with a large truck repair facility. Every year, some of the older delivery vans were cleaned up, repaired, and sold. The job involved removing the decals that covered much of the surface of the vans. The procedure — "*The way we've always done it"* — was to take a small razor blade tool and start scraping. Normally it would take a day or two to scrape a whole van. The task was unpopular and was traditionally assigned to the person with the lowest seniority.

One morning, an employee was told to start scraping off the decals from a series of vans. By noon, his shoulder and hand were aching. By quitting time, he had almost completed one van and he was in pain. He looked at the work order and he discovered that he had 19 more vans to clean — he was going to be scraping all month.



After — The power wash heats the surface of the van. . .



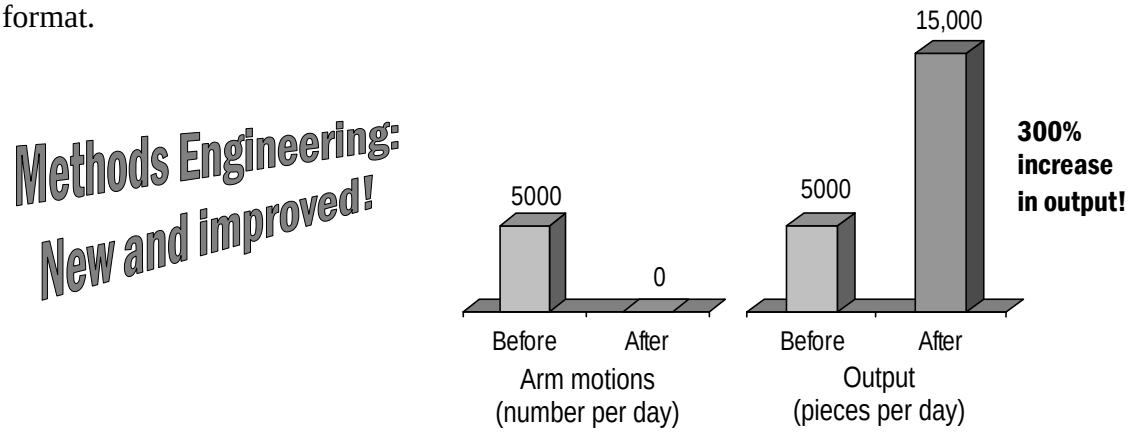
. . . and the decals peel right off.

Then he reflected on his class in ergonomics and sought out the Ergonomics Team member for the shop. The two remembered, "The ergonomics guy said that the most important thing to do is *think.*" So they walked to the scraping area and started brainstorming. After a time, one suggested using the power wash (that they normally used to clean the truck) to soak the decal and maybe to loosen it. They discovered that the hot water heated up the aluminum surface of the van and made it easier to remove the decals. So they turned up the heat of the water, played it on the van for a few minutes, then were astonished to find that the decals easily peeled off.

The time needed to remove the decals fell from one or two days per van to one or two hours. Moreover, the solution was *free*, since the power wash was already on hand.

5. The rebirth of Methods Engineering.

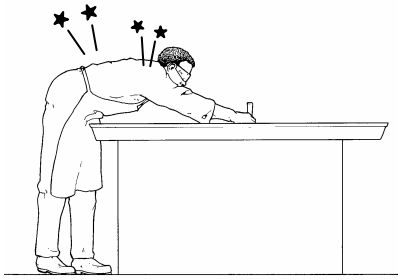
Much of industrial ergonomics is similar to old-fashioned Methods Engineering, a practice that has been neglected in recent decades. Perhaps because of our fascination with computer chips and high tech developments we have forgotten some of the basics. Ergonomics brings these techniques back into the workplace in a new and improved format.



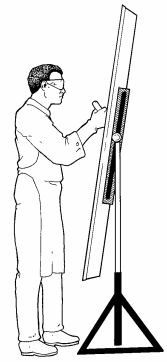
It is common for ergonomic task improvements in manufacturing to increase productivity 10 – 15% because of eliminating awkward postures, excessive force, wasted motions, and unnecessary fatigue. One of the more rigorous studies showed a 25% increase in output at computer workstations when using ergonomic furniture, while concurrently improving employee feelings of well-being. The book on which this summary is based contains an example from a printing facility where productivity increased 300%, simultaneously with reducing physical demands on employees (see graph above).

Improved efficiency because of better working posture.

Working in awkward postures can directly reduce efficiency in three ways that ergonomics can help remedy:



- *Reduced strength* — Think of bending at the waist and reaching out across a large object and then trying to exert. You have little or no strength in an outstretched position like this. Consequently it takes you longer to complete a task than it would be if you were working in a proper position.

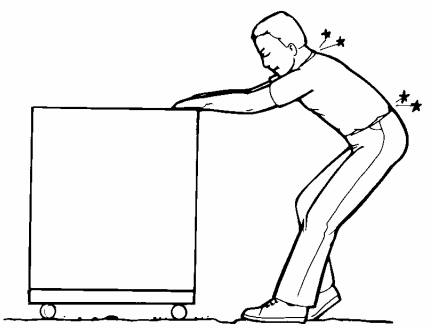


- *Less accuracy* in your motions — Again, think of reaching out across a large object and trying to do something intricate. You make a lot of mistakes and it takes a lot longer time, if indeed you can do it at all.

- *Increased fatigue* — When you work in an awkward posture, you tire much more easily, which slows you down.

Improved efficiency because of less exertion.

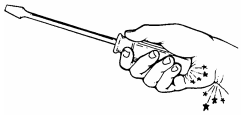
In general, the more exertion it takes to perform a task, the longer it takes. Think of opening a jar of jam; once the jam starts to build up on the lid, it requires more force and it takes longer time. Likewise, a screw that is hard to turn takes longer to insert than one that moves easily. Moreover, muscles under a heavy load are harder to move with precision. Thus accuracy of movement is reduced, which has consequences for both quality and efficiency.



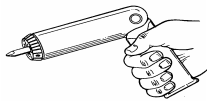
The higher the exertion, the slower the production.

Improved efficiency because of fewer motions.

Repetitive motions are a waste of time . . . literally. The more motions, the longer it takes to perform a task. A good ergonomics analysis seeks to identify the types of motions required for different steps of the job. With such focus, it is possible to identify instances where it is possible to improve the type of motion being used or reduce the number of motions, if not eliminate them entirely. Repetitive motions should be viewed both as a source of injuries and as a red flag for wasteful work.



More hand motions: slower and harder

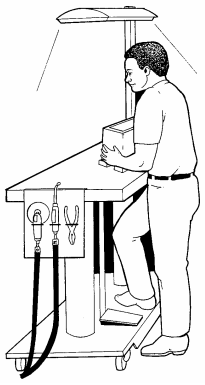


Fewer hand motions: faster and easier

Improved efficiency because of better heights, reaches, and clearance.

Poor heights and reaches can affect productivity in a couple of different ways. If you can't reach an object at all, you may need to stop productive work and fetch a step stool or take time to remove an obstruction. If the inappropriate height or the long reach causes you to work in an awkward posture, you end up losing productivity for that reason.

Before: inefficient



After: efficient

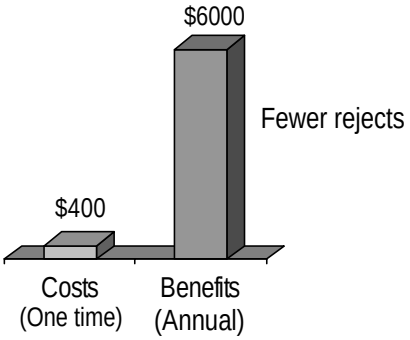
Improved efficiency because of less fatigue

There is a direct link between fatigue and lost productivity. The efficiency experts of a century ago understood this, but the concept needs to be re-emphasized today. One of the core areas of ergonomics is studying the causes of excessive fatigue and ways to effectively reduce or eliminate these causes. An example is fatigue caused by working in static positions, a problem that has increased in recent decades.

6. Improving quality — fewer mistakes and less scrap.

People working in awkward and uncomfortable postures are not in a position to do their jobs right the first time. There are routine instances where employees inadvertently create defects because they become fatigued or plainly cannot reach or otherwise perform the task. Mistakes are more common.

Task evaluations for these physical issues can provide the benefit of leading to increased accuracy and greater alertness. Again, the book contains an example where a $400 mechanical device eliminated a $6000 annual loss in scrap, which was caused by employees simply not being able to perform a tedious, physically demanding task properly all the time. That's a *1500% return-on-investment in one year* because of good ergonomics.

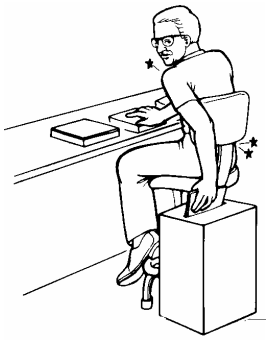


7. Optimizing the Lean Process

Whenever humans are involved, using the tools of ergonomics is a prerequisite for lean operations. The two concepts overlap heavily, but three points are especially crucial:

- **Non-value-added** — The activities that are hardest on people tend to be non-value-added actions: bending, reaching, lifting, pushing, pulling, carrying, orienting, etc.
- **Understanding exactly what tasks require** — A good ergonomics task analysis penetrates into operations step by step. By evaluating items such as fatigue, motions, and exertion through a task step by step, it is possible to identify wasted activities.
- **Fresh insights on your operations** — Almost any new perspective on your workplace can help you identify ways to improve. But the tools of ergonomics are especially useful because they focus on ways to eliminate difficult and time-wasting problems.

Bending and reaching is a waste of time

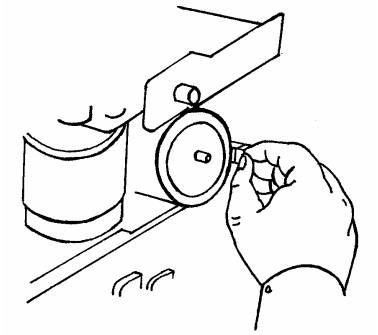


Searching systematically for activities that are hard on people often leads directly to sources of waste.

8. Optimizing Design-For-Assembly

Another technique of manufacturing that cannot be done well without knowing ergonomics is Design-For-Assembly. If a human is involved in doing the work, then designers must know about human dimensions, strengths, weaknesses, and the host of other considerations that make up the field.

Many of the concepts of the two techniques overlap, although the jargon is very different. However, perspective of ergonomics tends to provide insights from the assembler's point of view, thus increasing the sophistication of the analysis.

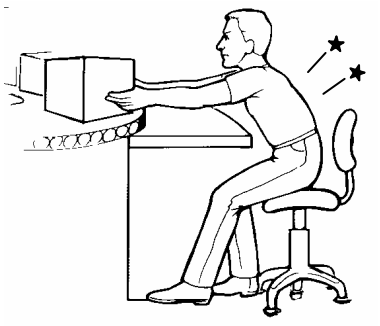


Example: If designers don't provide finger clearance, you certainly can't assemble the product easily.

9. Everyone benefits from the "rules of work."

The term ergonomics was coined from the Greek words *ergon* (meaning "work") and *nomos* (meaning "rules"). So the literal meaning is "the rules of work." We all need to know the "rules" for optimizing work.

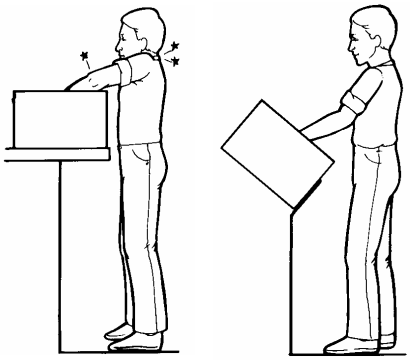
The formal definition of the field is "optimizing the interface between humans and systems." This interface can be as simple as that between a human and a chair (such as the back rest, the cushioning, or the height) or a much more complex relationship between an employee and an entire production line.



The goal of ergonomics is to make things more human compatible.

Additionally, there are a number of catch phrases that are used to describe the field. One is "work smarter, not harder." Although it is a cliché, it does capture a good concept nicely. More importantly, although almost everyone wants to work smarter, how one actually goes about doing so is left unstated. Ergonomics remedies this by providing a *method* for finding smarter ways of performing manual work.

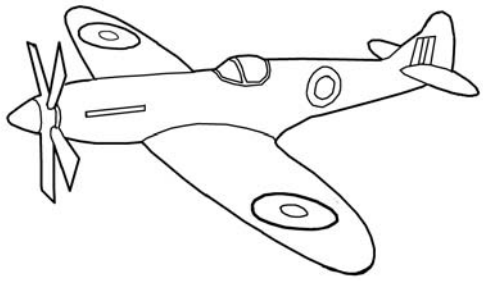
Another such catch phrase is "user-friendly." Anything that can be described as user-friendly can also be said to be ergonomic. Conversely, unfriendly items are not ergonomic. User-friendly means that things are easy to understand and apply, that mistakes are reduced, and that the human is treated well in the process.



Ergonomics provides a *method* for finding smarter ways of doing manual work.

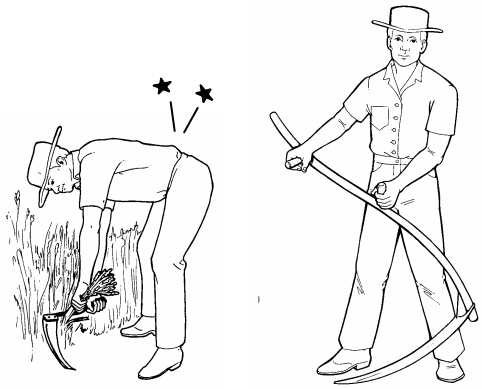
10. Optimizing the human-system interface.

The term *ergonomics* was coined by aircraft designers for the British Royal Air Force in the Second World War. Their goal was to create a cockpit that was more human compatible, that is, to make sure that the pilots could physically reach all the knobs and switches as well as understand the increasingly complex array of dials and indicators. Their objectives had nothing to do with preventing back injuries or Carpal Tunnel Syndrome. It was all about efficiency, using the special focus of studying the interface between humans and systems (or, to use the jargon of the time, "man-machine" systems).



11. 40,000 years of progress.

In a certain way, ergonomics is nothing new. Humans have been doing "ergonomics" for a long time (that is, reducing the physical demands of jobs). We can say, tongue-in-cheek, that good ergonomic improvements include the stone ax, the wheel, and even sliced bread.



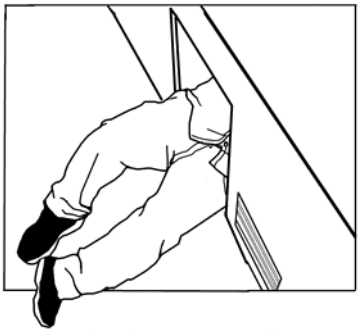
Old-fashioned ergonomics

A good example is a great ergonomic product invented in the 19th century — the long-handled scythe. Note the ergonomic features of the scythe compared to a one-handed sickle: You can work upright, the grips adjust for your height, and the very shape of the scythe takes advantage of the larger muscles and mechanical structure of the upper torso. The ergonomic device is clearly easier on the human and much more productive than the non-ergonomic device.

The promise of modern ergonomics is that we can take this natural tendency to modify our surroundings and turn it into a conscious approach to management and design. Today we have the scientific method and are better able to be systematic. We can measure, use analytic techniques, and refer to a growing database of knowledge.

12. Reduced downtime from maintenance and changeovers

All the tools and techniques of workplace ergonomics can be applied to maintenance tasks. You can eliminate barriers and thus speed the time in which operations can be brought back on line. It's about providing clearance, reducing exertion, and reducing motions.



Poor ergonomics increases maintenance and changeover downtime.

Lean manufacturing often involves increasing the number of changeovers of machines and equipment. One consequence is that a task previously done perhaps only once a week may now be performed several times per day. If that changeover involves awkward or hard-to-do steps, it may not have mattered much previously because it was done infrequently. But if it is now performed more often, the changeover task may create problems. Thus it may require an ergonomics evaluation and improvements to avoid unintended repercussions.

Simultaneously, reviewing the changeover from an ergonomics perspective can help identify smarter methods for that changeover. Examples of improved ergonomics that have cut time requirements for changeovers include:

- Using quick-release latches for panel doors (reduces motions)
- Rerouting pipe lines to give better access to valves (provides clearance)
- Using permanently mounted supports to lift and remove routinely changed heavy items (reduces force)
- Using portable booms to lift heavy items (reduces force)
- Designing equipment so that needed items or heavy items are not buried deep within the equipment (provides clearance)

Similarly, ergonomics evaluations of maintenance tasks can reduce the length of downtime. The ergonomics of maintenance tasks is often referred to as *maintainability*. As with other types of work, the most opportunities for improvement are when designing the equipment. However, it is still possible to retrofit equipment after it has been installed.

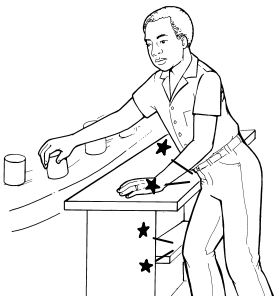
Typically the biggest issue is lack of clearance. Additionally, it is common for maintenance staff to be using suboptimal tools as well as needing to manhandle heavy loads.

13. Protecting irreplaceable human resources.

The smaller your organization, the greater risk you have of disruption due to the loss of a key person — even if this loss is just a few days because of back pain. Furthermore, you may not be able to replace that person, even temporarily. Even if a replacement is found, skill levels may not be the same or the learning curve may be extended.

14. Improved morale.

Frustration, aches, and pains, caused by inadequately designed equipment can easily affect morale. Often it is the little things that create dissatisfaction, for example the hard edge on a piece of equipment that the employee continually bumps into and no one will fix. These are the kinds of issues that can emerge with a focus on ergonomics and can often be resolved relatively cheaply.



Ergonomics can eliminate sources of dissatisfaction

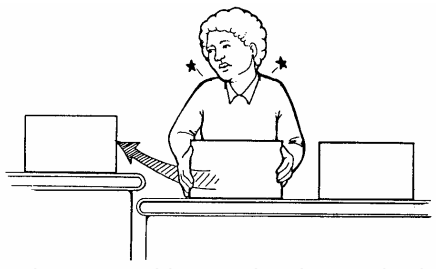
15. Reduced turnover and absenteeism.

Dissatisfaction caused by fatigue, working in uncomfortable postures, and the pain and discomfort created by overexertion injuries may easily lead to increased employee turnover. The most dramatic examples of improvement because of ergonomics can be found in the meatpacking industry, where costly turnover has routinely been cut in half.

Similarly, one reason why workers are absent is that they are experiencing early stages of a musculoskeletal disorder. Work that hurts doesn't exactly encourage people to come ever day.

16. Ergonomics can offset the limitations an aging workforce.

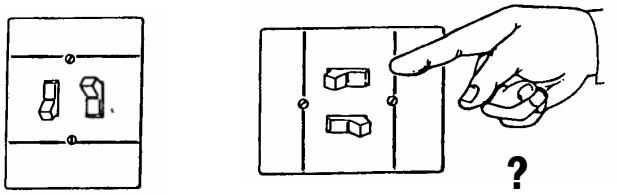
Older employees have more experience, tend to be more reliable, and are already trained and educated. When ergonomic adaptations are made, older workers can be as productive as younger workers, if not more so.



Good ergonomics can enable an aging, but productive workforce

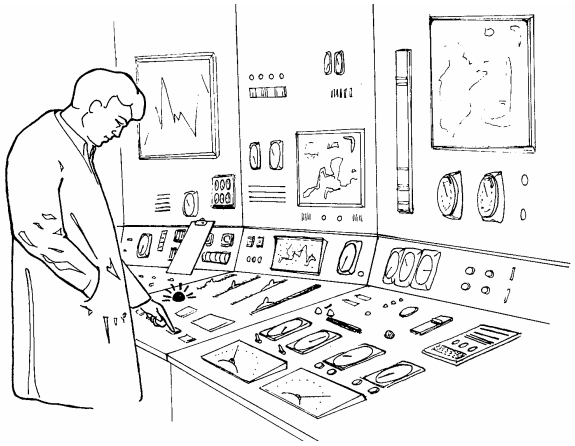
17. Reducing errors and waste with *cognitive* ergonomics

Cognitive ergonomics addresses how we conceive information, process it mentally, and decide on correct responses. By designing displays and controls — and in fact every type of information that we handle mentally — to take into account human perceptions and expectations, it is possible to reduce errors and improve performance.



A good example is the common light switch. Most North Americans would expect that if you want to use the switch illustrated above left to turn lights *on*, you would flip *up* the switch. The design conforms to our expectations.

However, when confronted with a non-standard design, such as that above right, we get confused. The design is void of any feature that helps us decide which way to flip the switch. Moreover, people in other countries may react differently or have completely different types of light switches, which is part of the issue.



Cognitive ergonomics is an untapped area for improving workplace design.

The application for cognitive ergonomics in designing things so that they are not confusing is incredibly broad. Examples include: control panels, activation switches, directions, signage, forms, and sets of instructions.

There are obvious safety issues involved with poor cognitive design of equipment (lack of standardized controls, unclear directions, etc.), but the impact for the lean process may be even greater. Making things understandable and user-friendly helps avoid mistakes, shorten reaction times, and lower learning curves. These are obvious benefits for a lean and effective organization.

18. Promoting employee involvement.

Ergonomics fits well into current efforts to involve and empower people. If you have never established formal mechanisms to involve employees, focusing on ergonomics is a good place to start. The concepts are relatively simple and result in direct benefit to the employees themselves, which both serves as positive reinforcement for contributing ideas and provides a base for expanding to other issues.

Ergonomics provides a good way to involve people

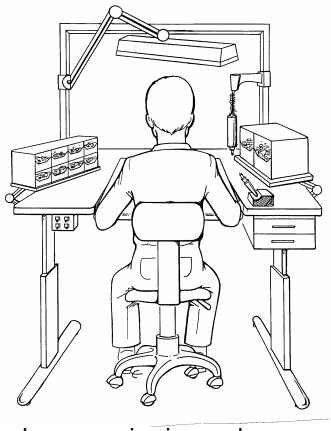
19. Improved labor relations.

Ergonomics issues are often good ones for joint problem-solving between management and labor. Redesigning the workplace using the principles of ergonomics is a "win-win" situation for management and labor.

20. Saving yourself from OSHA.

Some of the largest fines ever issued by OSHA have been related to musculoskeletal disorders and the absence of any effort to reduce the risk factors for these disorders. This item is last on the list because in the author's view, OSHA is the least important motivation for investing in good ergonomics.

You probably have heard mention of Federal OSHA's failed attempts to promulgate an ergonomics standard. The author *opposed* this standard because it was impossible to enforce, given the practice of regulation as it has developed in the U.S. during the past few decades. However, many elements of the standard amounted to good management practices.



Good ergonomics is good economics

Increasing revenues:
Improving the design of products and services

Customer Appeal — It should be self-evident that increasing the friendliness of any product or service improves its customer appeal. A better design achieved through good ergonomics can provide a tremendous edge over the competition.

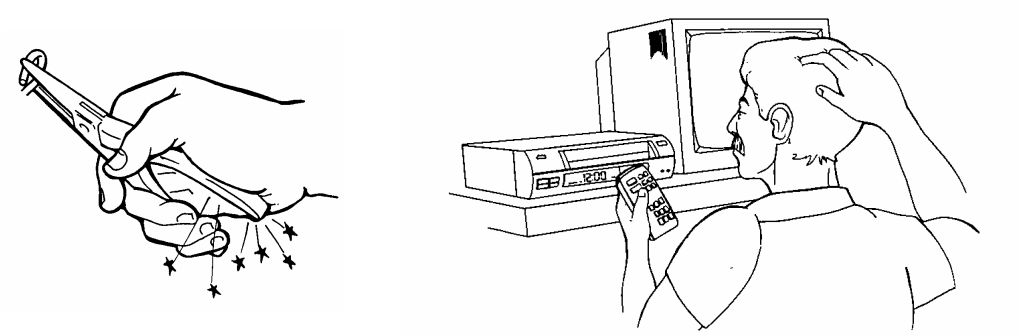
There are almost always ergonomics issues involved in the use of products, issues such as comfort, exertion requirements, potentially confusing controls, and so forth. When ignored, these issues can sometimes be fatal to the product. Note that these concerns do not necessarily involve musculoskeletal injuries, rather center around a broad set of questions that have to do with human-product interface:

1. How is a human involved with this product?
   - Is it easy to use?
   - Is it easy to service and maintain?
   - Is it easy to install?
   - Is it easy to learn how to use?
   - Is the way that people actually use the product the same as you intended?

2. Are there physical issues?
   - Exertion, reaches, contact stress, lack of clearance, etc.?
   - Vibration or noise?

3. Are there cognitive issues?
   - Confusing instructions?
   - Non-intuitive operation of controls?
   - Knobs and dials not standardized?
   - Long learning time?
   - Poor labeling or signage?

Formal review — Every product and service should undergo some type of review from an ergonomics perspective. This evaluation can be simple or very complex depending on the needs, but it should be done formally.

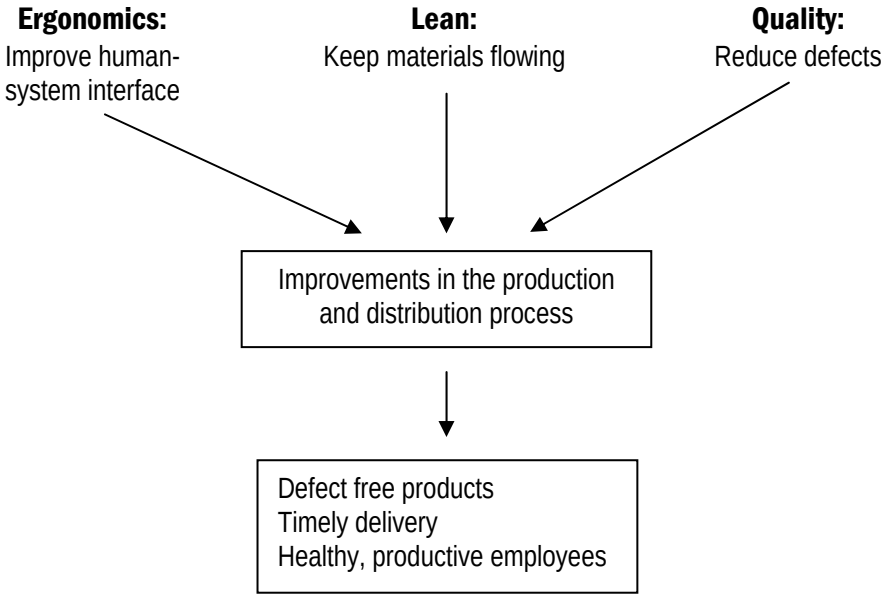


Does your product or service have an optimal human interface?

Summary:
An Additional Tool for Management

In short, ergonomics provides business with an additional tool for problem-solving. The conceptual framework is improving the interface between humans and systems and it integrates seamlessly with many current initiatives in general industry.

Any of the modern techniques of workplace improvement, if applied intelligently, can provide benefits for product quality, efficient flow, and healthy employees. For example, defect-free parts take less effort to assemble and help promote safety. Each of the tools lends a certain viewpoint and all combine to improve the production and distribution processes. The schematic below helps show the point:



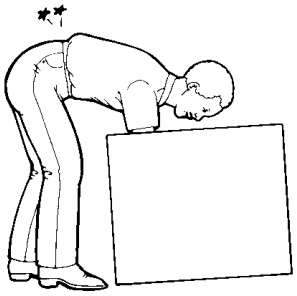
This line of reasoning is made especially clear if you contrast today's workplace philosophy with that of the past. The outdated mentality was that productivity results from getting employees to work harder and faster. This obsolete attitude was part and parcel with the view of "get the product out the door" as fast as possible without regard for quality.

The outdated system was bad for quality, bad for response time to customers, and bad for employee well-being.

Today we have seen the rise of quality, the lean philosophy, and ergonomics — all in reaction to the problems of the past. Each provides a critique of the old system, thus showing an inherent link in philosophy connecting these three newer methods. The important point is that when all the modern tools for industry are applied in concert, the results undoubtedly are better.

Appendix:

What managers should know about "wear-and-tear" injuries



- Musculoskeletal Disorders (MSDs) are very common. You yourself may have experienced lower back pain from time to time or have had a sore elbow or shoulder from tendonitis. MSDs can be thought of as the effects of everyday wear-and-tear.

- Many MSDs are sports-related. We use the term tennis elbow for swelling of the tendons in the elbow from overuse. Almost every long distance runner suffers from MSDs in the legs: shin splints, sore knees and ankles, etc. One of the occupations with the highest rates of these types of injuries is professional baseball.

- These occurrences in sports help us understand the nature of the injuries. First of all, athletes tend to be in excellent condition, but still have problems. So these disorders are not simply caused by being out of shape. Additionally, athletes have no incentive to fake injuries to get out of work. So the underlying problem is deeper than just malingering (although clearly some employees take advantage of the system).

- Most of the time, these ailments heal themselves with a bit of rest. But sometimes they can escalate into disabling injuries, especially when continually aggravated.

- Although we may not be able to prevent all the minor ailments that come with everyday life, we *can* keep the little problems from becoming big ones.

- MSDs can be easily treated when identified in their early stages. When recognized early, these disorders can be treated cheaply with ibuprofen, ice packs, and rest. Moreover, the likelihood of fully returning to normal is increased. But if you wait too long, permanent damage may occur, which may then require surgery, which is expensive and sometimes painful. Worse, the likelihood of full recovery is less.

- MSDs typically account for about one-third of workplace reports of injury. But more importantly, they often account for about 75% of workers' compensation costs.

- The costs of various types of MSDs that require surgery approximate the following:
  - Wrist Disorder: $15,000
  - Shoulder Injury: $20,000
  - Back Injury: $40,000

  Although these figures are rough averages, they give an indication of how quickly costs can add up.

- Good ergonomics can be effective in preventing MSDs. Also, recognizing employees with problems at early stages and providing conservative treatment is important.

- The risk factors for MSDs are the same issues that can reduce productivity — primarily awkward postures, excessive force, excessive motions, and static working positions.