Improve your Welding Profitability and Productivity: Advice and Real World Examples for Manufacturers

The economic downturn that began in December 2007 has caused significant pain. The manufacturing, fabrication and construction industries shed millions of jobs, many of them welding related, and the Institute for Supply Management's Purchasing Managers Index reached an all-time low.

While manufacturers can't control financial markets, they can better control their financial destiny by actively addressing their biggest welding challenges. These challenges—the things that keep people awake at night—consistently fall into four categories:

1. Justifying new equipment (capital expenses)
2. Improving productivity
3. Reducing cost
4. Simplifying welding processes

Especially in good economic times, but even in bad times, a fifth challenge also arises:

5. Finding skilled welders and/or training new welding operators

These pains manifest themselves in different ways depending on a company's business emphasis, organizational structure and management outlook. Take the example of meeting the deadline for a large order that exceeds current production capacity:

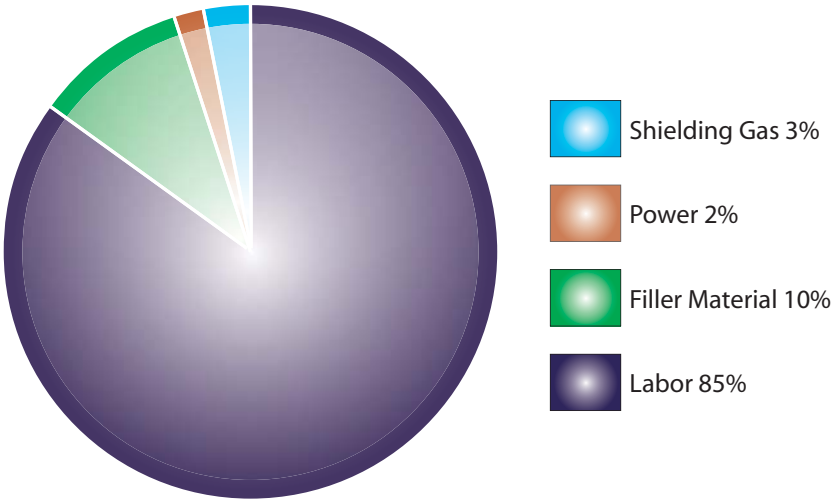
- Acme Company chooses to increase productivity by adding more welding cells, essentially duplicating manpower and existing technology (this is the traditional outlook).
- Baker Company believes it should increase efficiency by eliminating waste (e.g., applying 5S, kaizen, lean manufacturing and similar principles; this is a forward-thinking outlook).
- At Charlie Company, investing in new technology will increase productivity and/or lower cost-per-part, but the welding engineer can't convince the purchasing agent, senior management and possibly the bank that the investment is a sound financial decision.
- Delta Company knows it could increase output if they could only find equipment that reduced or eliminated sources of operator errors.
- And Echo Company, having reduced its staff to manage costs, wants to add personnel but has trouble finding enough welders to operate its advanced equipment.

Welding pains are often interrelated, and the solution to one challenge usually improves other areas. After all, effectively increasing productivity-per-operator ultimately lowers welding costs, provides the basis for equipment investment and offsets manpower requirements.

The next section of this article helps readers gain a better understanding of their true cost of welding, which is an important first step when addressing welding challenges.

Time Equals Money

Many welding-oriented companies claim—and rightfully so—that, "People are our most important asset." The fact is that people (labor) almost always constitute the single largest cost variable (see pie chart) in any welding operation, ranging from 50 to 85 percent of total expenses.



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But if people are so important, why do so many companies spend an inordinate amount of effort on lowering equipment and consumables costs while ignoring the most important cost component: maximizing labor—and welding—efficiency?

The answer can only be that these companies have not measured, tracked, analyzed and improved upon the variables that affect their welding cost and their operator factor (arc time/total labor time = operator factor). The simple fact is that if you don't measure something, you can't manage it.

To that end, here is a list of items and costs that should be measured and tracked over time in order to provide a baseline for managing a welding operation and determining operator factor:

Fixed or "hard goods" costs:

– Labor rate
– Overhead
– Filler metal (includes deposition efficiency)
– Shielding gas (if used)
– Other consumables (gun components, grinding wheels, anti-spatter compound, backing bars, etc.)
– Electricity
– Raw materials (per part, if applicable)
– Materials related to reject rates (significant when working with highly alloyed or exotic metals)

Operator factor or time-based costs:

– Preparing the metal for welding (e.g., shot blasting, degreasing, etc.)
– Preparing the joint (e.g., cutting, beveling, grinding, if applicable)
– Assembling components (e.g., place in fixtures, jigs, etc.)
– Applying anti-spatter compound, if used
– Pre-heating time, if required
– Tack welding components, if required
– Positioning/re-positioning weldment, if required
– Arc-on time
– "Air time" (moving between welds)
– Interpass cooling time, if applicable
– Grinding spatter

– Chipping slag
– Grinding/polishing weld bead to final size/appearance
– Removing anti-spatter compound
– Welder self-inspecting the weld
– QA/QC inspection and tests
– Reworking/repairingf welds and subsequent re-inspection and re-testing
– Time lost due to rejected components
– Changing electrodes (new Stick rod, spool of wire, etc.)
– Process change-over time (e.g., switch between MIG root and flux cored fill passes)
– Cylinder swap-outs
– Post-weld heat treating costs and time, if applicable

Hard goods costs are relatively easy to track (just look at vendor invoices), which is why procurement analysts probably focus on them so much. Time-based costs and operator factor require more effort to measure and track. However, the rewards are worth the effort (as demonstrated below).

On a related note, consider evaluating and compensating procurement analysts for their role in selecting vendors and equipment that improves operator factor or accomplishes key manufacturing or corporate goals. The annual savings realized by achieving these goals can easily reach six or seven figures in even a modest-sized facility. The purchasing department would gain a significant financial incentive if it could earn up to 5 percent of the savings they brought to the company (instead of being rewarded based on lowering purchase price). Further, both purchasing and plant personnel would now work toward a common objective and evaluate equipment using the same criteria.

How to Spot Waste

To find waste in a system, ask yourself this key question:

> Is Step B in a process true preparation for Step C, or is it compensation for the inefficiency of Step A?

If you spend time on activities such as grinding spatter, chipping slag, grinding welds down to final size or reworking/repairing parts, you are not truly preparing the part for the next step in your manufacturing process. You are actually compensating for the inadequacies of, or undesired result of, the previous step. The labor time wasted by compensatory activities reduces operator factor to 20 percent or lower in many operations. Efficient companies have an operator factor of 20 to 30 percent or higher, and they realize significant financial savings as a result.

Here's a real example: one world-class equipment manufacturer used to dedicate two employees per shift for the task of post-weld grinding and weld repair on a particular production line. That's a total of 16 man-hours per day. Using a conservative labor/overhead rate of $25/hour, this post-weld activity cost the company $400 per day, or $2,000 per week. However, after switching to a welding system that minimized spatter and improved first pass weld quality, one employee working one hour per day can complete all grinding and rework activity (for a cost of $125/week). Not only did the new system reduce welding costs by $1,875 per week, it freed up 15 man-hours per day to apply to other activities.

At another world-class manufacturer, excessive grinding coupled with unplanned downtime due to equipment failure reduced operator factor to 10 to 15 percent and increased labor costs to more than 80 percent of total weld costs. Miller experts evaluated this facility and estimated that investing $120,000 in new equipment would increase operator factor to 50 percent and reduce labor costs to about 65 percent of total weld costs. This move would save the company more than $1 million dollars and provide an equipment payback in six months—and do it all without changing the labor force.

Miller Economic Evaluation Summary—Reducing Post-Weld Activity

1.	Annual Savings (previous minus current costs*)	$93,750
2.	Investment (capital expense for five systems)	$50,000
3.	Annual Depreciation (Line 2 divided by 5 years)	$10,000
4.	Annual Savings After Depreciation (Line 1 minus Line 3) (assumes straight line depreciation)	$83,750
5.	Profit After Taxes (66% of Line 4)	$55,275
6.	Annual Cash Savings (Line 5 plus Line 3)	$65,275
	Return on Investment (Line 6 divided by Line 2 X 100)	**130.6 %**
	Payback Period (Line 2 divided by Line 6 X 12 months)	**9.2 months**

*Previous post-weld costs were $2,000 per week x 50 weeks = $100,000. Current costs are $125 per week x 50 weeks = $6,250. $100,000 - $6,250 = $93,750.

The above situations are not unusual. Many companies accept "compensation" activities as a fact of life because of, "That's the way we've always done it" syndrome. Fortunately, the companies discussed above chose to go through the "pain of change" and upgraded their equipment and processes.

To help you make a decision regarding an equipment investment, process upgrade or procedure change, compare your current cost of welding to the projected cost of the new method (contact your welding supply representative or Miller District Manager for additional help). Then, use the formula in the Miller Economic Evaluation Summary to determine your ROI, which is always expressed as a percentage and your Payback Period, which is always expressed in months or other time unit.

Addressing Welding Challenges: Case Study Examples

This section of the article provides some quick-read tips for addressing welding challenges and showcases real world results from companies that took action to improve productivity and profitability.

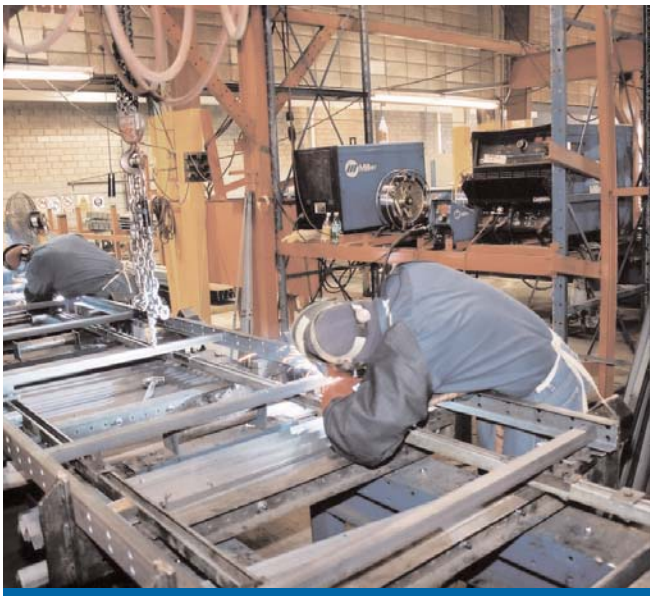
Tips for Reducing Welding Costs:

- Understand true cost of welding and react accordingly
- Reduce weld metal volume (e.g., prevent over-welding)
- Minimize reject, rework and scrap rates
- Eliminate pre-weld preparation steps (e.g., applying anti-spatter spray)
- Eliminate post-weld grinding of spatter and excess weld metal
- Avoid paying overtime
- Reduce wasted effort, unnecessary motions and delays
- Reduce arc time

Example #1: OEM Fabricators produces components for world-class construction and agricultural equipment companies. OEM reduced weld costs by more than $2,000 per day after switching to Miller's Axcess® pulsed MIG welding system. OEM now uses one type of machine, one wire and one gas for nearly all of its welding. In the process, the company eliminated grinding, spatter, chipping slag and gas change-over time. They also reduced weldment reposition and improved operator-to-operator consistency.

OEM's Scott Exner says, "Anytime I see a weld with grinding marks all over it, the first thing I look at, as a manufacturing engineer, is how much we paid a guy to do that. Anytime we back up in the process, we've already spent that time once, and now the operator is doing it again, so it costs us twice. Additionally, the operator is not getting done what he should be getting done, which equates to three times the labor for a given weld section. The ease and efficiency of the Miller Accu-Pulse® process over short circuit transfer and FCAW has allowed us to substantially reduce waste in our manufacturing process. I calculated that a lot of our welding cells [used to lose] up to 2.75 hours of productivity per 10-hour shift due to the older welding technology and its inherent disadvantages." Read the whole story and view the video.

OEM operator Brad Henze says, You can control your arc length more effectively with AccuPulse. The technology in this machine far outrates older pulsing technology. Its very easy to learn.



Operators for Frazier Industrial weld cross beam sections for the company's storage rack systems. The welds have tight tolerances because they must meet strict standards for high seismic areas.

Example #2: Aaron Evans, quality assurance manager for Frazier Industrial, says Miller's 70 Series wire feeders play a key role in quality control and lowering the cost of welding. "Our procedures are such that we need to control both the width and the penetration of the bead so that we get good tie-in on both plates involved with the weld. The reason we use the Miller wire feeders is because they help us control part of that process," Evans says. Further, because programmable feeders eliminate the need to spend 10 minutes calibrating the equipment at the start of every shift, "I can pay for this feeder in less than three months" through time savings.

Finally, another major cost savings results from fewer welds being rejected during final inspection. "Inspecting product after it's built is too late from the standpoint that the damage is already done and rework costs time and money. In a high-speed production environment, you can pretty much control your destiny with the equipment you choose. You can either build a lot of high-grade quality product, or you can build a lot of garbage in a hurry," Evans says. Read the full story.

Tips for Increasing Productivity:

- Reduce cycle time and arc-on time
- Improve operator factor (arc time/total labor time = operator factor)
- Increase deposition rates/travel speed
- Minimize reject and rework rates by welding it right the first time
- Eliminate unnecessary/unplanned downtime
- Understand sources of bottlenecks and eliminate them
- Eliminate activities that do not add value (e.g., implement Kaizen)
- Implement Lean Manufacturing techniques

Example #1: Vermeer Manufacturing Company's lean welding journey involved more than 300 Axcess® multi-MIG welding systems and speaks volumes to the power of lean welding. Here are just a few examples, or read the whole story:

– A production rate increase of 37.5 percent on its "model line," which is the line that best exemplifies lean principles. It produces brush chippers.

– The ability to turn raw materials into finished goods in days, not weeks. Vermeer has shown year-over-year improvements of 200 to 300 percent for four consecutive years on some lines.

– Year-over-year safety incident and severity rate reductions of 10 to 15 percent.

– Zero long-term corporate debt. The company paid cash for all its new welding systems.

The welding area for Vermeer's model line. Notice how boom-mounted feeders enable the operator to weld at several stations.

– After implementing Axcess systems and lean principles on its terrain leveler line, the number of non-conforming welds caught by internal audits dropped by 500 percent, from 6.68 to 1.36 welds per measurement period.

Neil Vesco's welds are like a signature on every VMC chair. Most of VMC's customers comment on the high quality.

Example #2: On a much smaller scale than Vermeer, Vesco Metal Craft (VMC), the leading manufacturer of rugby wheelchairs, increased productivity by 30 to 50 percent after switching from two conventional TIG welders to two Dynasty® 350 inverters. The Dynasty's advanced squarewave AC TIG output decreased welding time, which enabled VMC to produce an additional 1.5 to 2 chairs per week while improving weld quality and bead appearance. Read the whole story and view the video.

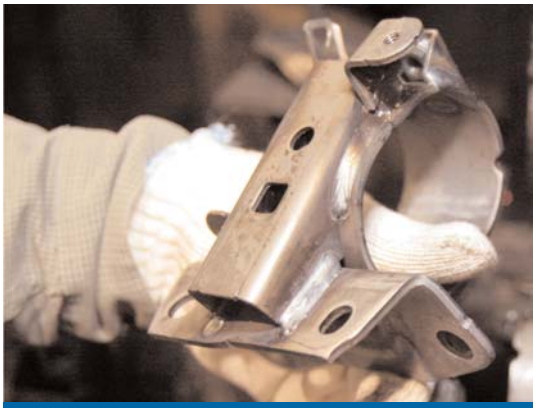
"We set a new standard on the market, and our chairs are substantially better crafted than the next guy's out there. The welds are phenomenal on our chairs, and that's one thing that stands out," says co-owner Tom Vesco. Further, "Now we have time to do other things. If we're constantly trying to keep up with orders for rugby chairs, we really can't grow and expand. Now we can devote some time to R&D for other products. The Dynasty 350 has freed up time to do that."

Justifying New Equipment:

- Understand payback and ROI calculations used by owners, senior managers, accountants and banks
- Analyze and understand true sources of welding costs
- Obtain energy efficiency and utility rebates
- Decrease maintenance costs/time
- Minimize unscheduled downtime

Example #1: DTR Industries, Inc. retrofitted the five Fanuc robots on its anti-vibration engine mount line with Auto-Axcess® systems from Miller. This move eliminated spatter, reduced reject and scrap rates, and decreased cycle time. Now the company meets or exceeds its production target every day.

Tim Taylor, production engineering assistant manager, says that, "The net effect over a six-month period has been a productivity increase of 25 percent. We also cut 19 seconds from the welding cycle and cut arc-on time by 50 percent, which also reduced shielding gas use by 50 percent. I calculated a return on investment of 143 percent and a payback time of .43 years. This easily justified buying the Auto-Axcess welding systems." Read the whole story.



This anti-vibration engine mount is DTR's highest volume, most difficult to weld part. Any spatter in the main ring (where the thumb is) prevents a bushing from fitting properly.

Example #2: By working with local utility Puget Sound Energy, Bellingham Technical College (BTC) received a $1,000 per welder financial incentive that help offset the cost of 26 XMT and Maxstar welding power sources. The new inverters draw one-third to one-sixth less amperage than BTC's old welders, eliminated nuisance circuit breaker trips and reduced utility bills by an estimated $200 per year per welder. Read the whole story.

"Any undertaking that helps a business reduce energy consumption is worth exploring," says Rebekah Anderson, Program Manager, Corporate Communications for Puget Sound Energy. "Industrial companies should contact their utility company and see what types of programs are already in place. By starting a dialog with their utility company representative, they may find that there are other opportunities on which they can collaborate."

Don Anderson, a Welding Technology Instructor at BTC, states that, "We were able to give the college evidence of the inverter's energy savings. We showed them how inverters would produce a return on their investment over a 10-year period, so they bought into the concept of replacing all of our welders at one time."

How to Improve Operator Efficiency and/or Address your Welder Shortage:

- Use machines that are easier for operators to set-up and understand to minimize training time
- Use machines that maintain/ensure optimum welding parameters (e.g., machines with parameter limiting/lockout features)
- Increase operator productivity/efficiency to help eliminate the need to hire additional welders
- Implement programs and procedures to grow operator skills and improve consistency

Example #1: Iron Grip, the only manufacturer with a line of exclusively American-made free-weight equipment, upgraded from conventional MIG welders to Millermatic 350P pulsed MIG welders. As a result, Iron Grip increased production by about 16 percent, reduced scrap by 20 percent and removed a potential source of weld defects. Read the whole story and view the video.

An arm rest supports the operator's arm while a turntable turns the part in place to eliminate a potential source of variability.

"There are a lot of elements involved in achieving a good weld," says Winter Douglas, manufacturing engineer. "With the previous machines, the operators needed more training and to use more caution when they welded. Now I really have peace-of-mind, and I don't have to worry about whether or not the operators are doing what they're supposed to do or if the weld is a little hot or the weld is a little cold. If I had my choice and a welder walked in the door today, I'd much rather train him on a Millermatic 350P than any other machine."

Example #2: Josh Holtz, senior manufacturing engineer at Greenheck Fan Corporation, states that, "We had a hard time finding welders, so we started our own internal training program. We hire people who will be good employees for us,

or take some of our existing good employees who are interested in becoming welders, and we train them to weld. If they already know how to weld, that's a positive. But regardless of welding experience, all welders go through the training program and learn what they need to know to weld at Greenheck." Read the whole story.

In addition to its training program, Greenheck also implemented new pulsed MIG welding technology from Miller. "We found that the [new technology] has a much more refined pulsed arc and we can control the amount of penetration and weld size. With the better arc control, we can keep the weld size small and the louvers are more cosmetically appealing. Now we can hit weld size where before we couldn't." As a result of these changes, Greenheck saved 10 percent in rework time and lowered filler metal use on its aluminum louver product line by 25 percent.

By switching to the Millermatic 350P on its aluminum louver line, Greenheck saved 10 percent on rework and 25 percent on filler metal.

Extra Reading

For more information and guidance on the economics of welding, consider reading Chapter 10 of the Certified Welding Supervisor Manual for Quality and Productivity Improvement[1], available from the American Welding Society (www.AWS.org). The chapter, titled, "Welding Economics and Variables," covers the following:

1. Reduced Weld Metal Volume
2. Reduced Arc Time Per Weldment
3. Reduced Rejects, Rework and Scrap
4. Reduced Work Effort
5. Reduced Motion and Delay Time

The information on the cost of over-welding alone should open some eyes with regards to sources of possible welding improvements. For example, if the leg of a fillet weld should be 3/16 in. but the welder over-welds and makes a 5/16 in. weld instead, the joint would require a 177 percent increase in weld metal deposition and take 177 percent more arc-on time to complete!

1 Jack R. Barckhoff, Kenneth M. Kerluke, Don L. Lynn, Certified Welding Supervisor Manual for Quality and Productivity Improvement (Miami: American Welding Society, 2005)