CONSTRAINT AND STABILITY

Eliminating the former and striving for the latter will promote efficiency and productivity in your fabrication shop.

BY JAMES SMELSER

AFTER 35 YEARS in the steel fabrication business, I am continually surprised at how little has changed. I visit present-day shops that are almost identical to the shops I ran in the seventies. The good news is that it does not take a lot of effort to achieve major improvements in these operations.

Early in my career I was told a story about how geese were fattened up for market. The first step was to make a rack out of wood. A two-by-six was laid flat and two troughs were attached to the front edge of the board, one for food and one for water. A gaggle of geese were attached to the board by nailing roofing nails through the webs of their feet. All day long the geese had food and drink directly in front of them. When the food and water ran low, more was added to the troughs.

After listening to this story, I realized that this is how a steel shop ought to work (roofing nails aside). The fitters in the shop should always have what they need in front of them, all day long. The needs for the fitters are main members, parts, drawings, and the equipment and tools needed to do his or her job. Once one piece is completed, another is ready and waiting for the fitter's attention. This process doesn't make anyone work harder; it just removes lost time and frustration. This philosophy is not limited to the fitters; every department and process needs to be fed. No one wants to search for the things that they need to do their job. Bottom line, do not frustrate the geese. Give them what they need, express the company's expectations, and let them do their job. And don't try to use roofing nails with your fab shop employees; it doesn't work.

Keeping main members, parts, and drawings in front of the fitters at all times can double their productivity. Controlling weld parameters and eliminating oversized welds can double a welder's output. Every operation in the shop can experience major productivity gains once the emphasis is placed on eliminating non-productive tasks.

James Smelser is vice president of SME Steel Contractors (AISC Member) in West Jordan, Utah.

Ongoing Improvement

According to the Theory of Constraints (TOC), every organization, (or in this case, every fabrication shop) has a limiting constraint—a bottleneck—that limits the shop's performance. Production volume (throughput) cannot increase until steps are taken to eliminate the constraint. When one constraining process is eliminated, another is created. The process of finding and correcting these constraints is commonly referred to as *continuous improvement* or the *process of ongoing improvement*. This is a straightforward process in manufacturing operations that consistently produces a standard product.

Steel fabrication shops present a more complex challenge to this process. This is caused by variations in the *mix of work* released to the shop. The mix of work is the percentage of the total hours that each department or process is allocated for the work released to the shop at any given time. Some work mixes may need more fitters and less welders; or individual operations such as a burn table or shear may have to handle a larger percentage of the workload. Simply put, the equipment and personnel in the shop needs to match the requirements of the work being released to the shop.

Stabilizing Factors

This is not as complicated as it first appears to be. A flexible work force, back-up processes, and controlling shop releases can, in many cases, stabilize the impact of a bad mix of work. Once the effect of the mix of work is stabilized, it is much easier to identify the location of the constraint. Without stabilizing the mix of work, the constraint moves from station to station and department to department without adequate time to react to the problem. This is called a *floating constraint*.

A flexible workforce is accomplished by cross-training employees. A good example of this is developing the role of fitter-welders. By training welders to fit and fitters to weld, it no longer matters if the mix is 10% fit and 40% weld or 40% fit and 10% weld.

Other disciplines that should be cross-trained are shipping and receiving, CNC operators, the drill line, saw and camber machine operators, and equipment operators in the parts department. Not only does cross-training allow employees to broaden their skills and increase their value to the company, it also helps minimize the impact of vacations, sick leave, and turnover.

Back-up processes are necessary to supplement a flexible workforce. Shop equipment requirements should be based on being able to handle all but the worst mixes of work. After all of your TOC and mix-of-work issues have been addressed, what's left is called *variation*. This variation has to be handled by excess capacity. How well we are able to control the mix of work and implement TOC practices determines how much excess capacity is required to run a highly productive shop. In the parts department, this may mean that there is an extra ironworker or plate duplicator that is underutilized until he is needed to stabilize an unusually high demand for parts. In the main member prep department, this may mean that there is an extra saw that is underutilized. This over-capacity requirement is essential in developing an efficient shop. The shop should never have to stockpile parts or main

Have an opinion you'd like to share in "Topping Out"? Send your feedback to Keith Grubb, managing editor for MSC, at grubb@modernsteel.com.

members. The main member prep department should not be over one day ahead of the shop, and the parts department should not be over a week ahead of the shop. Going beyond these time periods causes secondary non-productive operations. I am aware that this just-in-time process causes anxiety with shop managers and may be one of the hardest concepts to buy into. However, the big gains in productivity are often counterintuitive.

Combining shop releases is the last chance for controlling the mix of work going into the shop. Shop management must have the flexibility to pick and choose what is released next. In order to do this, three things have to happen: there must be adequate lead time, several releases to pick from, and the proper materials to fabricate the work. Without lead time, managers are forced to release work to the shop to meet schedules. Without sufficient releases to pick from, managers are forced to release what they have. The main function of managers is to evaluate the available options and pick the best course of action. Shop managers need to be able to make choices; if they only have one release, they don't have a choice to make. And if there are no choices to be made, you don't need managers.

One more way to effectively fine-tune the effects of a bad mix of work, that's worth mentioning: schedule overtime by workstation.

All of these factors point to the fact that stabilizing the impact of the mix of work is important to the TOC. Without this stabilization, the constraint moves every time the mix of work changes. This makes finding and correcting constraints almost impossible.

Identifying Constraints

When looking for constraints, we need to look closely at the time between operations. Most of the time spent in fabricating steel is for tasks that add no value. When we think of fabricating steel, we think of receiving, sawing, burning, drilling, welding, fitting, loading, etc. All of these functions add up to less than half of the hours expended on a project. The real productivity gains are in the lost time in between operations. Once a constraint is identified, research needs to be done to determine why there is a bottleneck at this point. There are several questions we need to ask to define the cause and nature of the constraint:

- Have we done everything we can to control the mix? (Review the above steps concerning the mix of work.)
- Is this a temporary or permanent constraint?
- Can I solve this constraint by improving productivity?
- Is this constraint at the workstation, or is it a result of poor flow in and out of the station?
- Do I have to add people to eliminate the constraint?
- Do I have to add equipment to eliminate the constraint?

Whether a constraint is permanent or temporary is sometimes a judgment call. In these cases it is better to have a temporary solution to a permanent constraint than a permanent solution to a temporary constraint. Shops can get bogged down with permanent solutions to temporary problems. After the temporary constraint goes away, the shop may have to live with changes in production procedures, additional employees, and equipment. This is the opposite problem of a constraint. This can be an overstaffed, over-equipped, nonproductive part of your operation. Shop supervisors are quick to point out what they think are constraints, and they may hide an area of the operation under their control that has an overcapacity.

Consider the example of a shipping department that is not getting the load list in a timely fashion, forcing double-handling. The solution is to get the load list when it is needed. (The temporary solution is to lease additional forklifts and to add forklift operators.) After the shipping department starts getting the load list, they hold on to the forklifts and forklift operators to make sure that they never become the constraint again. This becomes a permanent solution to a temporary problem.

Another example is an inspection department faced with a prolonged project requiring special fabrication and inspection procedures. New fabrication and inspection procedures are compiled, inspectors are trained, and shop employees are trained in the new requirements. Everything is done to avert a potential constraint caused by fabricated material not meeting specifications. When the job is complete, is an equal effort taken to return to standard fabrication and inspection methods, or is the shop saddled with all or part of this added cost forever?

When faced with a constraint, we should first evaluate our production procedures, a step-by-step written document on how we want to process material through a workstation. These procedures should be developed with strong input from the workstation operators and shop managers. Once a procedure is developed, it should be followed. Without follow-up work, station operators can revert back to the way they have always done it. Production procedures are an important tool in implementing a constant improvement program. Shop employees should be encouraged to improve these procedures. Shop management needs to review suggestions and make a determination about revising the production procedures. Implementing these suggestions is a powerful tool in establishing operator ownership of the procedure. This ownership lets operators know that management is listening to them and values their input.

Flow in and out of a constraint is important. Adding buffers and handling equipment can often eliminate the constraint. Most saws are actually cutting metal about 30% of the time. The other 70% of the time, the operator is discharging the piece, waiting on the next piece to cut, or aligning the next piece in the saw. It makes a lot more sense to concentrate on the big piece of the pie. Reducing the 70% to 40% will increase productivity by 60%, while buying a saw that cuts twice as fast only increases productivity by 18%.

Staffing workstations is part of having a flexible workforce. Employees should be moved with ease from an overstaffed station to a constraint. Hiring new people to eliminate a constraint should be done with care.

Adding equipment to eliminate a constraint should also be done with care. This should only be done after all the above steps have been taken.

Upping the Standards

On May 6, 1954, Roger Bannister became the first person to run a mile in under four minutes. Since then, this feat has been accomplished hundreds of times. All of a sudden, the standard changed and all of the top runners knew that not only was a four-minute mile possible, but they now needed to meet this new standard in order to even remain competitive.

Someone will raise the standard for productivity in the steel fabrication business, and everyone will have to follow suit to stay competitive. If it's not your company, you need to hope it's not your competition. The truth is that some shops have already embraced these simple yet forward-thinking principals of production. MSC