Practically Speaking

How and where to **focus improvement** initiatives in the (NC) Machine Shop

During a career spanning nearly 40 years, I have worked in--and visited--many machine shops. These ranged from small subcontractors to valve OEMs (Original Equipment Manufacturers) and commercial aircraft manufacturers. Everyone is looking to improve their operations. Those who aren't are either going out of business or already out of business. The real question is how and where does one start?

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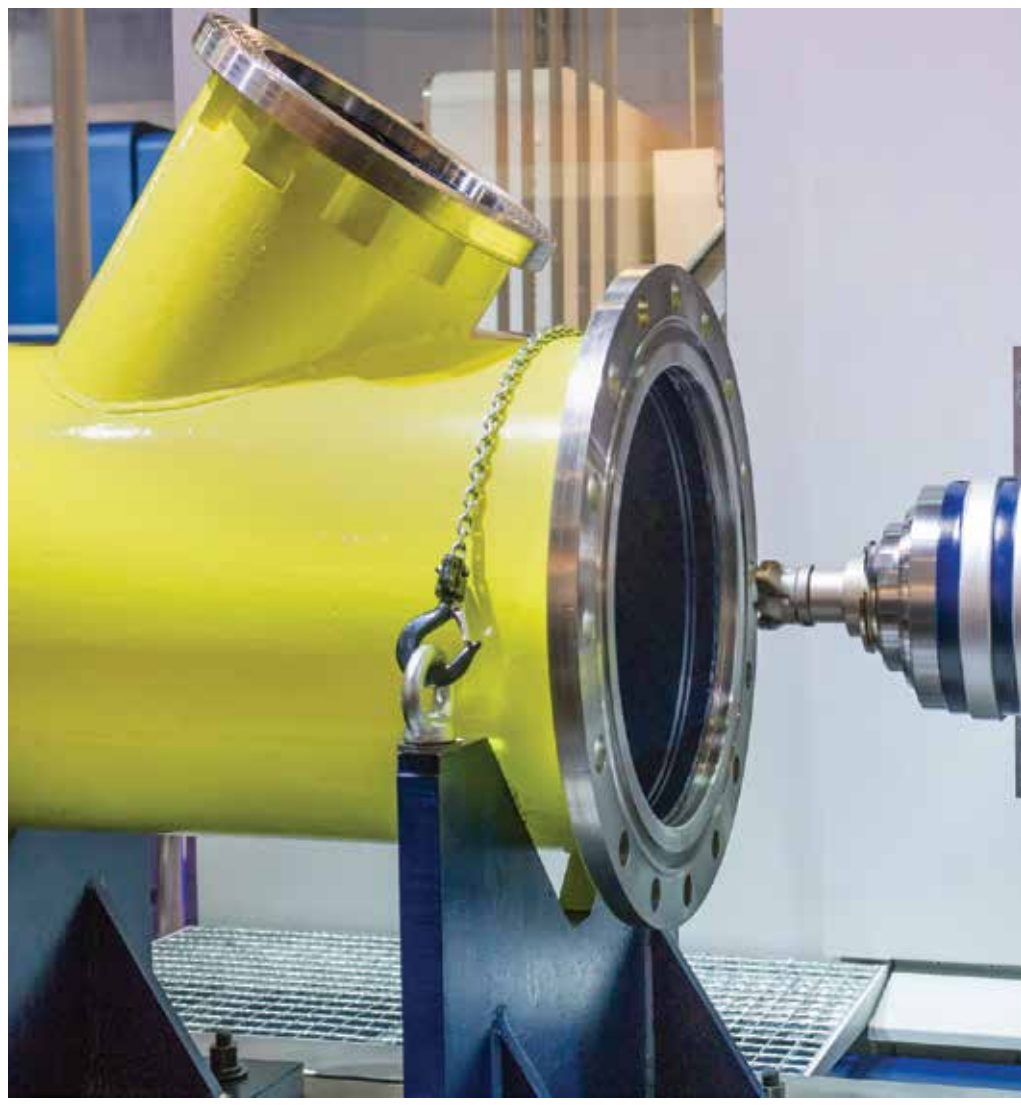


Follow a simple 3-step process

Step 1: Focus

Trying to fix everything all at once will ensure that there will be lots of effort ex-pended with little return in either the short- or medium-term. Start by focus-ing on known bottlenecks. These are usually best identified via regular walks through the value stream (known as a GEMBA walk) and by simply asking employees about trouble spots. A few machines almost always have piles of work in front of them while the work at other machines ebbs and flows. There are other more detailed, and advanced, tools but the foregoing can help you get started on a proof of concept or pilot project.

Step 2: Gather data

This can be done manually in the short-term quite easily. It may involve little more than dutifully recording key information on a chart kept close to the equipment and entering the data into a spreadsheet for analysis. There are even sample data collection forms available online that could be tailored to your specific needs. For firms planning on implementing an IIoT (Industrial Internet ofThings) strategy, just a few machines can serve as a proof-of-concept or pilot project before investing heavily in a technology solution. There are a number of product offerings on

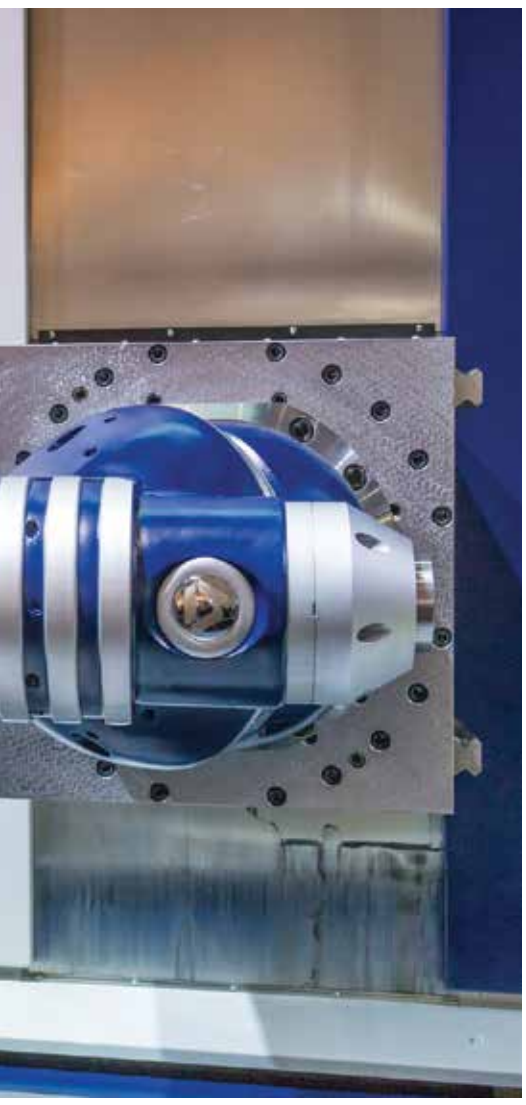
Calculating OEE - Example

Production Data			Calculated Data			
Shift Lenght	8	Hours =	480	Minutes		
Short Breaks	2	Breaks @	10	Minutes Each =	20	Minutes Total
Meal Break	30	Breaks @	1	Minutes Each =	30	Minutes Total
Down Time	20	Minutes				
Ideal Run Rate	0.1	PPM (pieces per minute)				
Total Pieces	35	Pieces				
Reject Pieces	2	Pieces				

Support Variable	Calculation	Calculated Data					
Planned Production Time	Shift Lenght - Breaks	480	-	50	=	430	Minutes
Operating Time	Planned Production Time - Down Time	430	-	20	=	410	Minutes
Good Pieces	Total Pieces - Reject Pieces	35	-	2	=	33	Pieces

OEE Factor	Calculation	Calculated Data								OEE %	
Availability	Operating Time / Planned Production Time	410	/	430	=	0.9535			=	95.35	%
Performance	Total Pieces / Operating Time / Ideal Run Rate	35	/	410	/	0.1	=	0.8537	=	85.37	%
Quality	Good Pieces/ Total Pieces	33	/	35	=	0.9429			=	94.29	%
Overall OEE	Availability x Performance x Quality	0.9535	x	0.8537	x	0.9429	=	0.7674	=	**76.74**	%

OEE Factor	World Class
Availability	90.0%
Performance	95.0%
Quality	99.5%
Overall OEE	**85.1%**



the market including Tulip, Virtual-Process, 42Q and Lighthouse. Some solution providers, such as Forcam GmbH (www.forcam.com), have start-up packages to get automated data collection installed and working quickly on a handful of machines for a fixed cost.

Whether collecting data manually, or through a software application, operators will have to input some of the reasons for, and frequencies of, events that occur. To facilitate this, predefine some standardized reason codes for items related unplanned downtime, low performance and impacts on quality. These can be modified a long the way based on the frequency of occurrence.

Step 3: Analysis

Analyse the data to determine a course of action. Standard techniques, such as histograms and Pareto analysis, will go a long way to being able to see the top few reasons for not achieving goals in one aspect or another.

Don't jump to conclusions

During the above processes, avoid preconceived outcomes or trying to validate existing thinking. Be sure to use the data to drive conclusions and decisions. For example, there is often a management focus on operator performance to standard time. The analysis from most companies show that although standard times could be improved, the BIGGEST improvements are to be found simply in keeping the machine running (productively). By using standardized reasons for downtime, companies should be able to perform a Pareto anal-ysis on the various causes and focus improvement efforts on those with the biggest impact. Take the time to collect solid data and review it to avoid heading down the wrong path.

By the numbers

In general, OEE (Overall Equipment Effectiveness) is a good measuring stick to assess if equipment is effectively used. I'll explain later that OEE is not the be-all-end-all. Back to OEE, this analytical tool is comprised of three separate components:

Availability – a comparison of the time the equipment is actually operating versus the schedule operating time

Performance – a comparison of the speed at which the equipment is op-erating versus the speed at which it is designed to operate

Quality – the ratio of good parts pro-duced to total parts produced

OEE = Availability x Performance x Quality

A worked example of the calculation is shown in the attached image. The boxes highlighted in blue represent the data that users must collect and form ula. The beyond is the calculated figures by operators must be re-cording reasons and frequencies relat-ing to key events (see step 2 above).

OEE can be used as a high-level indicator and, to some extent, as a comparison between pieces of equipment or even between companies in order to identify a starting point. Its real power is in determining direction by allowing you to answer the question – are we getting better?

However, handle OEE with care. Maxi-mizing OEE is not the end goal. If im-properly used, chasing OEE can lead to poor behaviours, such as running large batches to reduce changeovers and trying to hit peak performance inside those batches.

People use Availability, Performance, and Quality as second level indicators of where to focus improvement ef-forts or to determine where to collect more, or more detailed, data for further analysis. These metrics can guide us toward the right approach, whether it be to implement SMED (Single Minute Exchange of Die), 5S, or Kaizen to name a few of the key lean approaches available.

Besides OEE, companies should also look at TEEP (Total Effective Equipment Performance) because it introduces the concept of Loading to the equation. Loading is the percentage of calendar time that equipment is scheduled to run. From total of 7 days of 24 hours in a week, we need to subtract planned non-working days, non-working shifts within a workday, breaks, and scheduled maintenance. This comes together with OEE as per the formula:

TEEP = Loading x OEE

Significant improvement in TEEP and OEE can come quickly by working with employees and supervision to add shifts, stagger breaks, implement TPM (Total Preventive Maintenance), and other approaches.

TAKEAWAYS: Above all, use data to drive decision-making. Look first for the low-hanging fruit. Don't chase the metric to the exclusion of good practice.

TEEP vs OEE

In the OEE calculation, I removed the time for planned breaks and meals from the shift time of 480 minutes to calculate the Planned Production time. Not everyone does this in their OEE formula. I do it because the breaks and meals are typical part of the union or employee work agreements. By removing it, we do not penalize the worker in the AVAILABILITY calculation. But we make up for this In the LOADING calculation of TEEP - we would reduce the time for breaks and meals here and we would see a lowr calculated ratio. TEEP is the real number to look at from a company management perspective to evaluate equipment effectiveness.

Staggering Breaks

This relates to the point regarding TEEP and the loading calculation. In my example, we have 2 breaks of 10 minutes and 30 minutes of meal time as per a sample collective agreement. The meal time is typically because everyone in the plant eats a meal at the same time. This means many machines stop operating because there are no people. So the loading level for a shift would be 430 minutes out of 480 minutes or 89.6%. If management and the workers could agree to cross train their staff and have only half the people eat at each time then for critical machines this could change to 460 minutes out of 480 minutes raising the loading to 95.8%.

ABOUT THE AUTHOR

Stephen Cherlet is a senior management professional with 35+ years of experience across engineering, manufacturing, quality assurance, materiel, information and production technology, project management, and lean transformation. Industry experience includes aerospace, defense, and industrial products. His last role was COO at Velan Inc (TSE:VLN) responsible for global operations, supply chain, and information technology. In 2016, Stephen joined FarStar SAC Consulting to help compa-nies improve their business systems, operations, and supply chains. http://www.linkedin.com/in/stephencherlet/. He can be reached at stephen@farstarconsulting.com.