How and where to improve 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 OEM's 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?

*By Stephen Cherlet **

My advice would be to follow a simple 3-step process. First, don't try to fix everything all at once. This will ensure that a lot of effort will be expended with little return in either the short- or medium term. Start by focusing 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.

The second step is to record relevant data. This can quite easily be done manually in the short-term. 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 online sample data collection forms available that could be tailored to your specific needs. For firms planning on implementing an IIoT (Industrial Internet of Things) strategy, just a few machines can serve as a proof-of-concept or pilot project before investing heavily in a technology solution. 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.

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 to unplanned downtime, low performance and impacts on quality. These can be modified along the way, based on the frequency of occurrence.

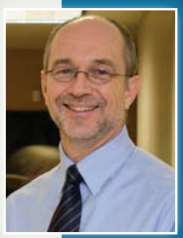
Finally, the 3rd step: analysis. Analyse the data to determine a course of action. Standard techniques, such as histograms and Pareto analysis, will go a long way to being able to see the top few reasons for not achieving goals in one aspect or another.

Don't jump to conclusions

During the above processes, there are several pitfalls that can be avoided. I had an experience where there was a big emphasis from executive management to focus on operator performance to standard time. Fortunately, I was able to hold off and wait for the results of an initial period of data collection. The analysis showed that although standard times could be improved, the biggest improvements were to be found simply in keeping the machine running (productively). Without the data, we would have been going down the wrong path.

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 and end-all. Back to OEE, this analytical tool is comprised of three separate components: availability (a comparison of the scheduled operating time that the equipment is actually operating), performance (a comparison of the speed at which the equipment is ▶

About the Author



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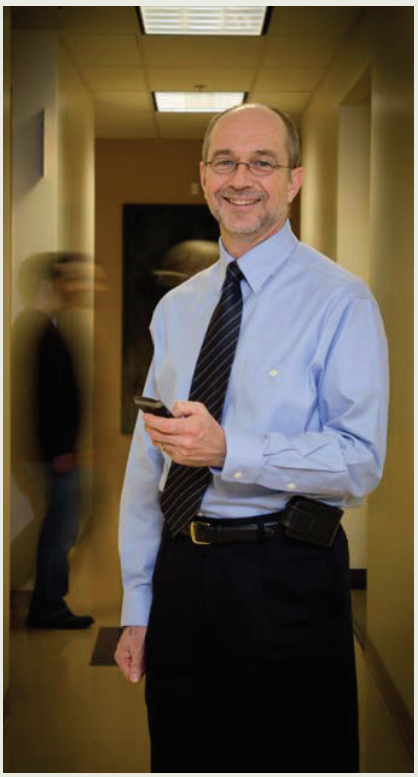
CALCULATING OEE - Example						
Production Data			Calculated Data			
Shift Length	8	Hours =	480	Minutes		
Short Breaks	2	Breaks @	10	Minutes Each =	20	Minutes Total
Meal Break	30	Breaks @	1	Minutes Each =	30	Minutes Total
Down Time	20	Minutes				
Ideal Run Rate	0.1	PPM (Pieces Per Minute)				
Total Pieces	35	Pieces				
Reject Pieces	2	Pieces				

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

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	Avaliability x Performance x Quality	0.9535	x	0.8537	x	0.9429	=	0.7674	=	**76.74**	%

In the OEE calculation, the time for planned breaks and meals has been removed from the shift time of 480 minutes in order to calculate the planned production time. This is because breaks and meals are typical part of the union or employee work agreements. By removing it, we do not penalize the worker in the calculation of availability. 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 lower calculated ratio. TEEP is the real number to look at from a company management perspective to evaluate equipment effectiveness.



Stephen Cherlet: "However, handle OEE with care. Maximizing OEE is not the end goal. If improperly used, chasing OEE can lead to poor behaviour, such as running large batches to reduce changeovers and trying to hit peak performance in those batches."

operating versus the speed at which it is designed to operate) and quality (the ratio of good parts produced to total parts produced). The equation is as follows: OEE = Availability x Performance x Quality.

Handle with care

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 enter. The rest is calculated by formula. Apart from these figures, operators must be recording reasons and frequencies relating 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. Maximizing OEE is not the end goal. If improperly used, chasing OEE can lead to poor behaviour, such as running large batches to reduce changeovers and trying to hit peak performance in those batches. People use Availability, Performance, and Quality as second level indicators of where to focus improvement efforts 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 a 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.

Conclusion: use data to drive decision-making. Look for the low-hanging fruit and, first and foremost, don't chase the metric to the exclusion of good practice.