



Machining

A Definitive Guide to Lights-Out Manufacturing

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It's a challenge to find highly qualified machinists. Demands on production are almost always increasing. "Lights-out" manufacturing seeks to take advantage of today's technology in the hours reserved for human downtime and talent shortages. But there's plenty to understand to make it work efficiently and effectively in shops that aren't used to automating. Here's a primer on what you need to know.

Manufacturers are grappling with how to handle production demands today and in the near future. Throughput, cycle time, *OEE*, process engineering, *machine programming*—these are the methods and metrics driving today's metalworking industry while many of the most experienced machinists are retiring.

It can leave a shop's management with important talent and technology decisions. Do we automate or let machines and tools sit idle more than three-fourths of the available working hours?

Many shops are leaning toward automated "lights out" manufacturing for evenings and weekends when employees are at home or when shift work ends.

There are caveats. There has to be enough work for the machines and equipment to justify the investment. Not all parts being made are suitable for unsupervised machining—though most are with the right approach and execution.

Yet, even with those constraints, the more you know about how to automate, the more potential output there is to help the bottom line. Here are the questions you need to ask to plan for and make lights-out manufacturing a reality.

Do We Have the Right Part Mix for Automated Manufacturing?

The first question should be whether it's suitable for automation. You might think that unattended machining is only possible for shops producing relatively simple, loosely tolerated parts by the thousands, preferably of aluminum or other free machining material.

Not so. There are plenty of shops that have turned out the lights on close-tolerance, highly complex titanium and Inconel components—even in one-off quantities. The recipe for success in these environments isn't based so much on what metal you're cutting or the tolerances you're holding. It's

more about the steps you take to conquer the variables of machining.

If the process is stable and predictable, most parts are candidates for some level of automation provided the following is intact:

- Chip-control mechanics
- Tool-life management
- In-process metrology

A family of parts or a frequently repeated part is an excellent place to start on any lights-out initiative.



Get under the surface of production in the article “Cycle Time vs. Takt Time: Why the Differences Matter.”

Do We Have the Right Machine Features and Tools for Lights-Out Manufacturing?

Any CNC machine tool can be automated, although it is decidedly easier with certain equipment types. For example, lathes come standard with hydraulic workholding, a prerequisite for any automation.

Many are also equipped with chip conveyors and high-pressure coolant systems that help assure wayward chips won't cause a problem during the night.

Bolt on a magazine-style bar feeder and an in-process probing system to keep an eye on things and chances are good that you can keep the machine running unattended for an extra shift or two.

It's a little different for a vertical machining center. It's not impossible, nor even terribly difficult, but it does require a bit more effort. A VMC needs:

- A robot to load and unload parts
- A conveyor to move raw material in and machined parts out
- An automated vise or pallet system
- An effective way to get chips out of the work area

Horizontal machining centers are the most automation-friendly of all. An HMC eliminates many VMC shortcomings, especially when equipped with a pallet pool or linear pallet system.

Whatever the machine type or brand, however, it should have: the spindle power needed to remove metal effectively, be accurate enough to meet part tolerances without babysitting, and be extremely dependable.

Newer machines are also equipped with Ethernet-based networking capability. They also often come with advanced sensors that make it easier to monitor machining conditions and analyze events that may have occurred during the night.



Another way to cut costs and increase efficiency is by recycling coolants and fluids. See how in “Recycling MWFs Can Help Reduce Machine Coolant Disposal.”

Do We Have the Right Automation-Friendly Tooling and Workholding?

To maximize a machine's lights-out capabilities, it should have plenty of extra tool stations along with some sort of tool life management function.

The objective? Make it easy for CNC machine programmers to call up replacement cutting tools at predetermined intervals or when the probing system indicates the tool has worn. This is less of a concern when cutting materials like mild steel or aluminum, but the need for redundant tools becomes increasingly important as one strays into the stainless steel and superalloy territory.

This presents another strong argument for an HMC: Most machine builders provide options for massive tool magazines and centralized tool storage systems. A multitasking lathe with tool-changing capabilities is a much better choice for lights-out work than a basic turret lathe.

What's the right tooling? It's somewhat irrelevant from an automation perspective, although investing in dual-contact Capto, HSK, KM or equivalent **toolholder** systems is always a good idea for shops that value machine uptime and efficiency.

Other tooling types that matter for lights-out manufacturing include: quick-change zero-point-style clamping, quick-change jaws and fixtures, and hydraulic or pneumatic vises. All of these tooling areas will increase shop floor flexibility and reduce machine downtime.

Do We Have the Remote Monitoring, Software and Machinists On Call?

Spindle or turret-mounted probing is critical for broken tool detection, workpiece placement validation and in-process measurement. These systems are now standard on many machine tools.

Gone are the days of complex macro programs. Today's monitoring systems and software are much easier to use than they once were.

Probing is a necessary component of any unattended machining strategy, but shops should also have some level of remote-monitoring capabilities. This might be something as simple as a notification from the CNC to the cellphone of the on-call machinist for the week about a machine going down.

Take note: There has to be some human intervention in a lights-out approach. These monitoring systems require that information be sent to a person in case of a machine stoppage, tool failure or other problem. The last thing any shop wants is complete work stoppage that affects daytime production. The goal is to still avoid downtime, so having a rotation of machinists on call is imperative.

It's also feasible to mount cameras inside each machine and log in to the machine control through the company's virtual private network. This way the on-call machinist can peek in and diagnose a problem remotely or determine the severity level of the fix needed.

Machinists should also have access to machining simulation software to make certain that no surprises will occur in the post-processed toolpaths. They also need a well-organized tool crib,

Don't Take Lights-Out Manufacturing Lightly

It may seem easy—and you may already be using some of the timesaving tools and technologies to help your shop run well today. But it's important to understand that real engineering effort is required in process development and validation, setup and management of the probing routines, tool life management, robots and grippers, and remote monitoring systems.

On top of all that, the machine tools themselves must be kept in excellent working order. Give special attention to routine machine and tool maintenance, coolant management and shop floor organization so that late-night surprises are kept to a minimum.

Going lights-out is an all-encompassing journey. It maximizes available machining hours and a shop's

potential.

Does your shop do lights-out manufacturing? What do most shops not realize about it? Speak your mind and ask questions in the metalworking forum.

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