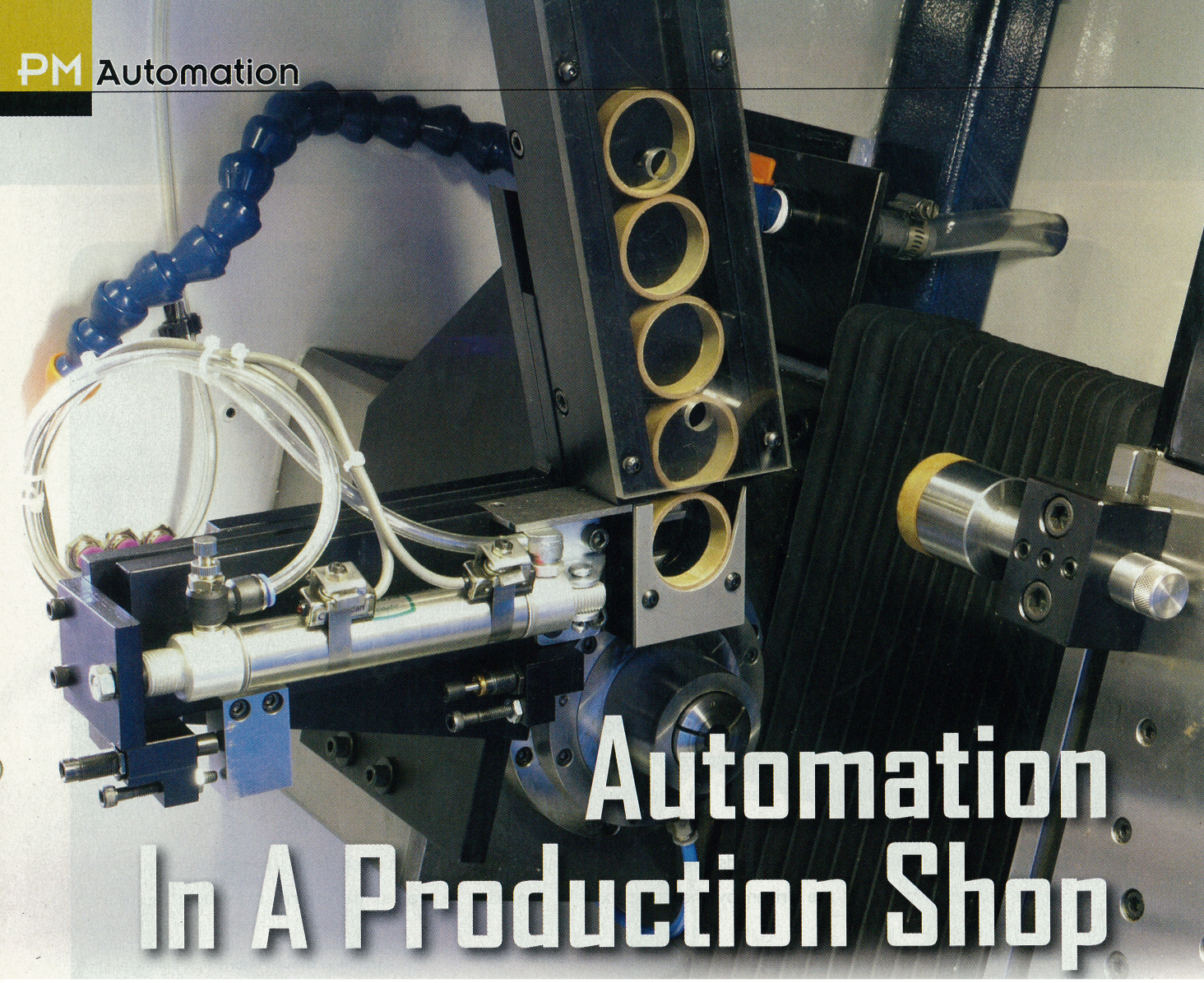


Automation In A Production Shop

With the advent of computer-based tools, applying automation to the production shop floor has become feasible for a wide demographic of metalworking shops. It's affordable, increasingly doable in-house, and in many businesses, it is absolutely necessary for survival.

By Jeff Richlin, President, OmniTurn

The globalization of manufacturing is now well established. With the Internet and "free" world-wide instantaneous communication, we are all competing with everyone for every sliver of business. Survival for production shops means staying ahead of thousands of competitors, not just those within a day's drive. Shops all around the world have access to off-the-shelf machining solutions. If you can purchase a new machine with all the latest features, so can your competitor. Simply having the latest and best equipment does not give you a guarantee of being profitable. It is how you incorporate the tools into your process that enables you to be special and maintain profitability.

Automation is one of these specialties that will set a shop apart from the rest. This means that taking advantage of automation's benefits is essential, not optional. In order to survive, a shop must be the least expensive, with the quickest turnaround and absolutely no errors.

Automation used to be the domain of the largest shops and limited to the highest-volume runs. Automation was constructed with cams, switches, timers and relays. Building a process took months of work, tweaking, testing and redesigning. Automation used to be the area of expertise of an apprenticed craftsman who brought years of practice and experimentation with cams, springs, gravity and humility to the

job. Hard-wired controls and mechanical motions were tough to configure and modify. Once a system was in place, it took a major effort to reconfigure or modify it.

A number of different technologies have changed this. During the last 25 years, advances in motion control, programmable controllers, off-the-shelf automation components, and finally, 3D CAD software have made automation accessible to all shops. The new challenge is to select the correct type of automation that fits an application. For example, if a secondary operation is needed on the end of a shaft, the automation can be very simple.

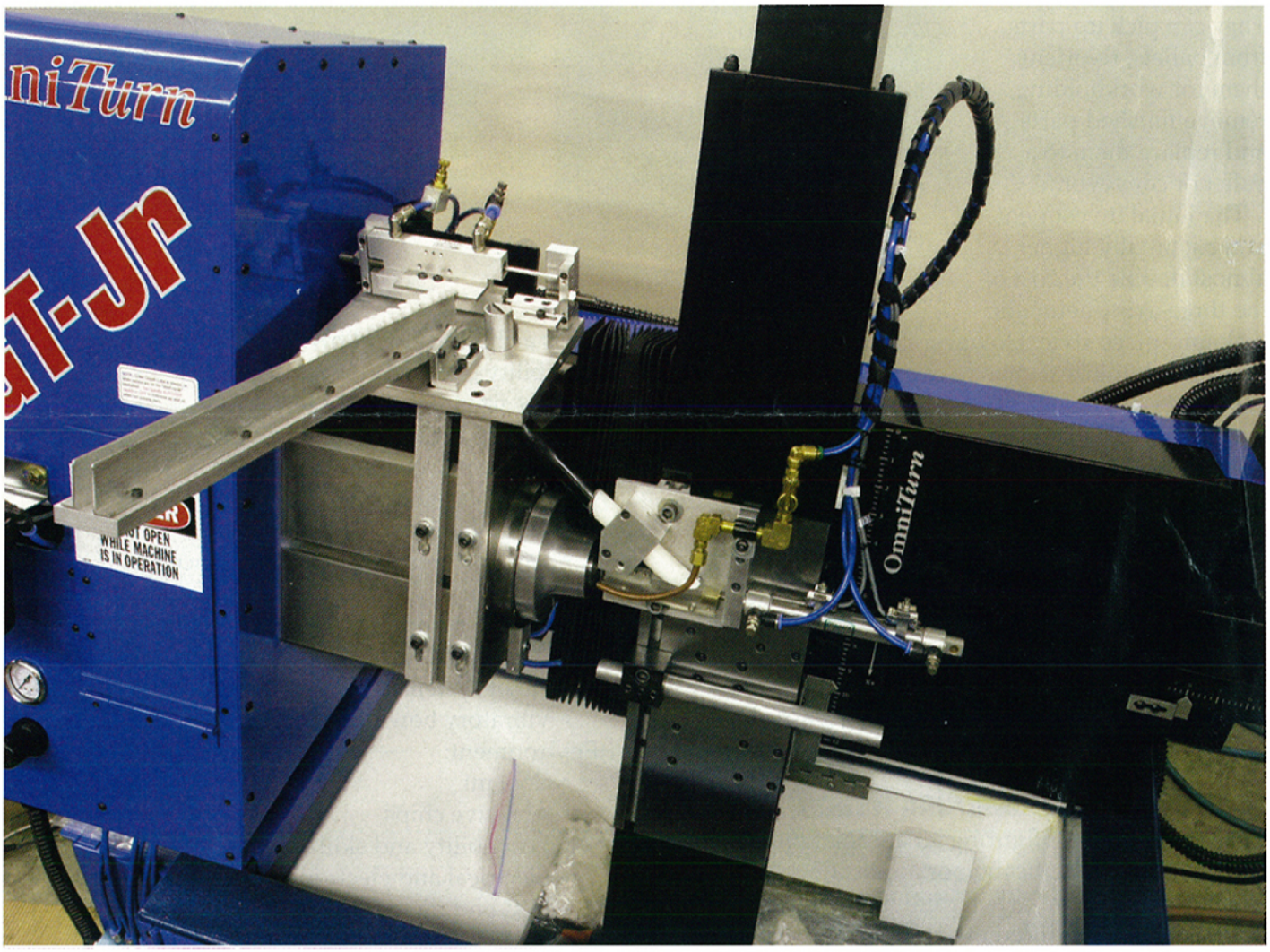
Don't Automate More Than Necessary

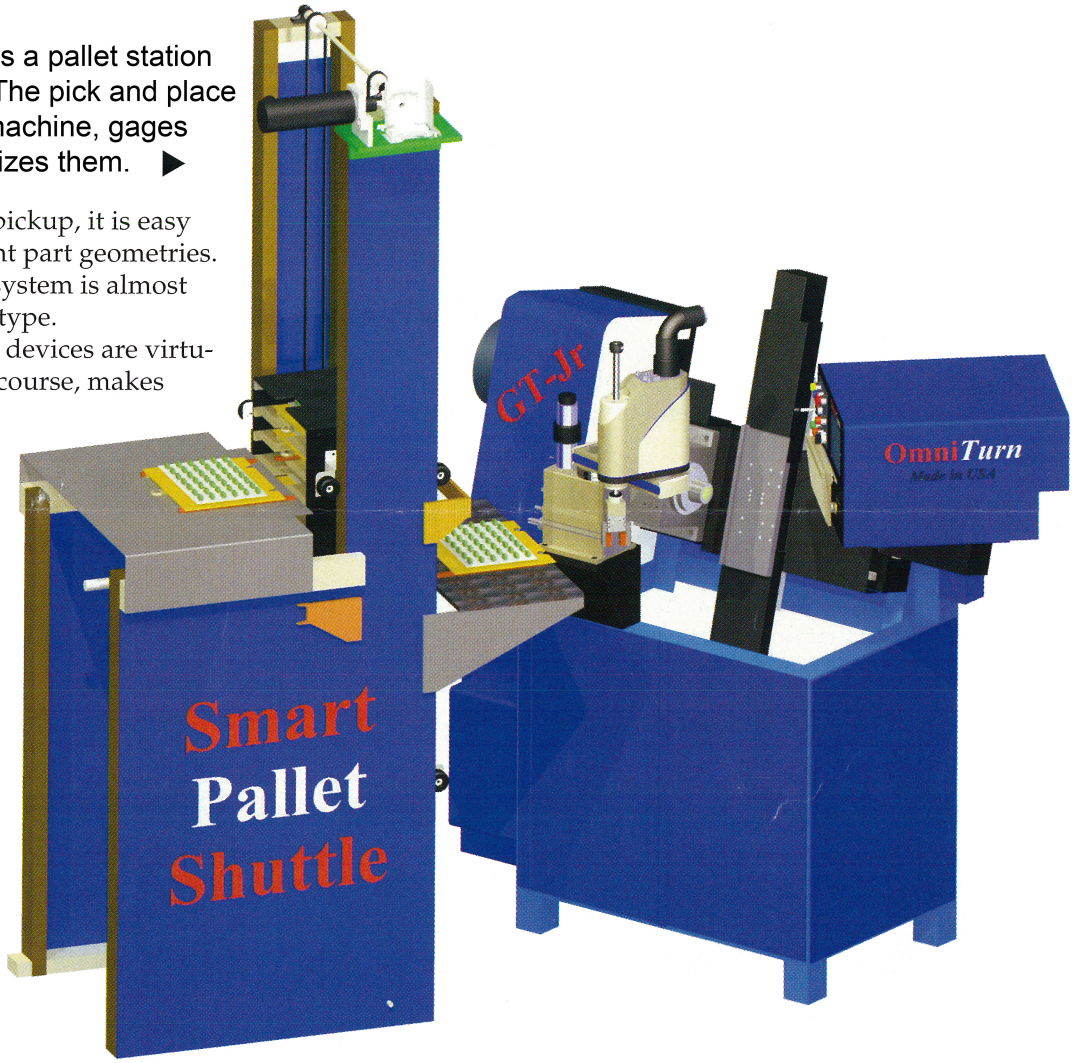
If the setup is simple, it is possible to cost-justify a loader. Instead of a vibratory bowl, fancy electronics, robots or anything programmable, consider a simple in-feed track that operators can feed every so often. This type of "casual tending" loader is probably one of the most profitable configurations. If a shop keeps this process simple, inexpensive and easy to change-over, it is way ahead of the game. If an operation makes a few hundred parts per day with little change-over, a simple track and shuttle will get the job done.

If, however, it is necessary to make 5,000 parts per day, the solution is a little more complicated. And if, in addition, there is a family of parts where the lengths vary from 2 to 24 inches, the complexity jumps another level. Now consider the automation if the diameters vary from 0.25 to 1 inch, or if flats are milled on each end that need orientation to one another. Each variable added to the product makes your automation choices more important. There are trade-offs between price, speed and convertibility.

As the volume grows and the need for speed becomes a major factor, the complexity of the loader grows. An example is a three-axis, pneumatically driven, pick-and-place loader, which is very fast.

This simple loader is designed for casually tended operation. The track is manually loaded, and load/unload time is 4.5 seconds. ▼





This CAD drawing shows a pallet station fed by a SCARA robot. The pick and place unit loads/unloads the machine, gages finished parts and palletizes them. ▶

With the gripper for part pickup, it is easy to change-over for different part geometries. However, the cost of this system is almost double the simple shuttle type.

The simpler automation devices are virtually part specific. That, of course, makes them limited in their flexibility. Change-over of such "hard automation" to accommodate different types of parts will be difficult, if not impossible.

The next step up the automation ladder is either SCARA or five-axis robots. The advantage of these loaders is their speed and flexibility. They can pick up parts from pallets, re-orient them for workholding, remove finished parts and replace them to a pallet or conveyor.

The initial investment is substantially higher, almost double the cost of the three-axis pneumatic pick-and-place style. However, for the most possibilities and quickest change-overs for very disparate parts, they have their place. The benefits of the multi-axis programmable robots, when integrated with stacking pallet systems, can be vast.

Automation systems can be configured so machines can run untended for hours on end. An example of this is a robot integrated into a pallet system that will hold 20 pallets with 30 parts per pallet. That's a run of 600 parts throughout 10 hours at 1 minute per part. At that point, integration of part inspection can easily be done. Since the robot has the part, why not perform basic inspection? There is very little lost time and much more confidence in your finished product.

Analyze Your Automation Needs

In most cases, configuring an automation solution is unique to the application or applications being looked at. Therefore, when thinking about automation, there will be different solutions for each shop.

Here is a checklist to follow:

Flexibility of change-over:
- Lot sizes
- Family variations

Part handling concerns:
- Blank variations
- Workholding issues
- Part cosmetics and fragility concerns

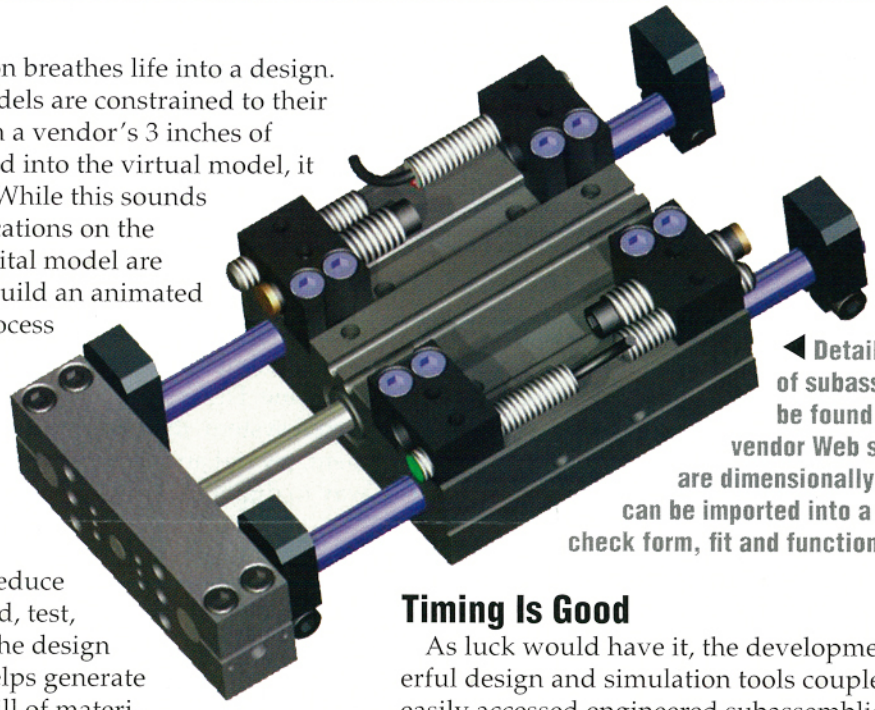
Throughput requirements:
- Simple manually loaded magazines
- Conveyors
- Pallet systems
- Vibratory bowls

Environment:
- Coolant
- Abrasive chips

Shop capability and skill level:
- Electrical and electronic skills
- PLC and motion control axes
- Tool and die custom machining

system using simulation breathes life into a design. Three-dimensional models are constrained to their real-life motions. When a vendor's 3 inches of stroke piston is dropped into the virtual model, it has 3 inches of stroke. While this sounds overly basic, the implications on the functionality of the digital model are exact. It is possible to build an animated working model of a process in a short time.

Once built, it can be tested for form, fit and function. This digital testing will help you fine-tune the process and hopefully eliminate or certainly reduce the costly "design, build, test, redesign" cycle. Once the design is done, 3D software helps generate shop drawings and a bill of materials almost automatically. The back end of the design for the detail generation can be done in a few days, compared to what used to take weeks, and the turnaround for a finished system is now weeks instead of months.



◀ **Detailed models of subassemblies can be found on numerous vendor Web sites. These are dimensionally accurate and can be imported into a CAD system to check form, fit and function.**

Aside from software, component selection and ease of integration has been the biggest change. Everything from PLCs to smart-axis motion is easier to set up and change-over. Now motion control offers off-the-shelf programmable linear slides. In the simplest form, they can be programmed at the unit or from a laptop PC. Locations, speeds and thrusts can be changed, and a setup can be fine-tuned.

Some examples of available subassemblies include the following:

- Pneumatic slides, rotators, grippers and thrusters
- Programmable single-axis motion: pneumatic, step per, servo
- Internal programming or PLC control or a mix of both
- Self-contained robots
- Multi-axis rectilinear guides (for example, gantry types)
- SCARA systems
- Five- and six-axis articulating systems
- Bowls, hoppers, conveyors
- Vision systems

Other "smart" combinations to easy automation might be conveyors and vision systems linked together. With such systems, orientation on the fly, inspection and sorting are available.

Timing Is Good

As luck would have it, the development of powerful design and simulation tools coupled with the easily accessed engineered subassemblies and components coincide with an extreme need for automation in small- to medium-sized manufacturing facilities. The tools are available and getting better constantly. Imagination seems to be about the only limit. ■

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■ **Simplifying Machine Load/Unload Automation**
Increasingly, shops are looking for ways to automate their production capability. In many cases, the object is to help lower costs by allowing untended or lightly tended operation. Automating the materials handling, post-process gaging, deburring and other operations goes a long way toward the automation goal.

For links to these articles, visit *www.productionmachining.com/go.aspx?id=16746.*

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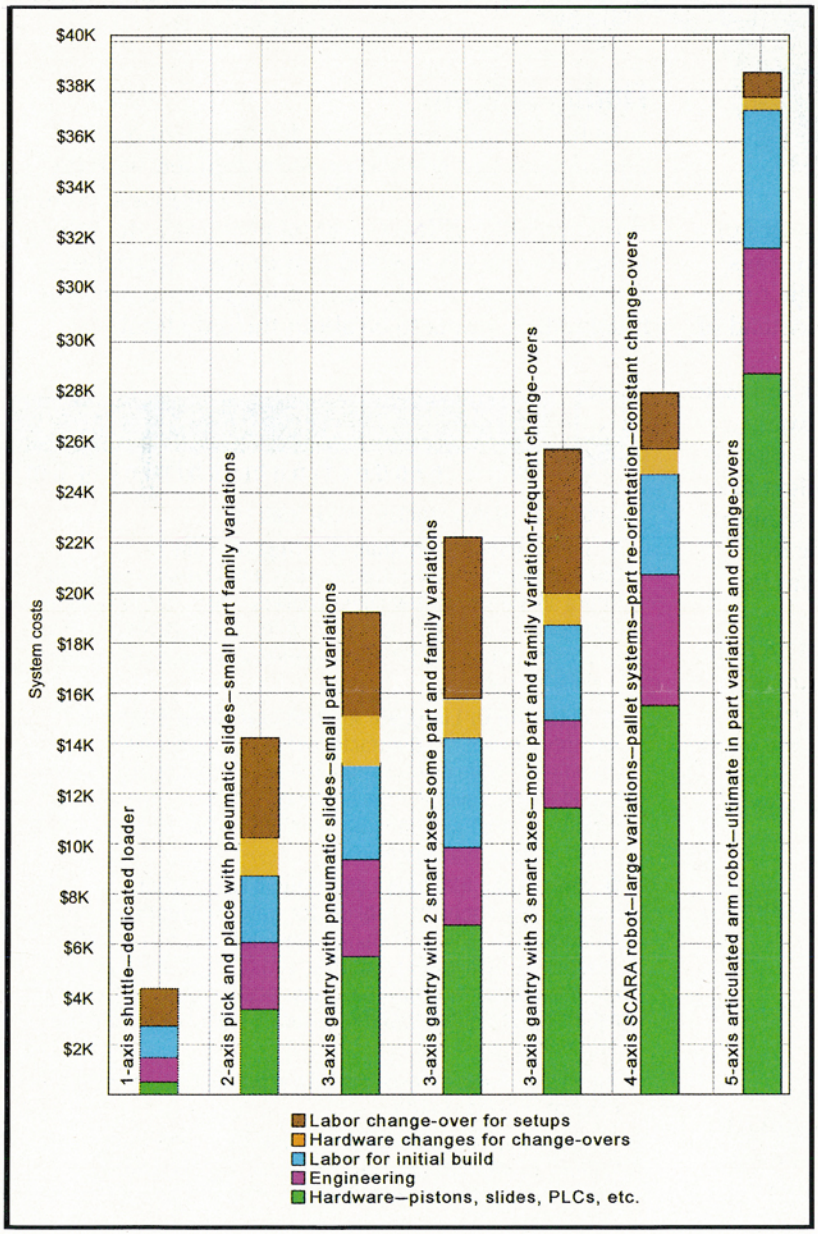
After figuring out which automation direction to go in, its cost is not always simple to calculate. The following chart illustrates how the cost of automation goes up with its complexity. The chart below is based on typical costs associated with automating a small CNC lathe. Mills, grinders, drills and any other shop process may be automated; however, their costs will be different.

The actual cost of the system will be affected by its speed (time per part), cost per change-over, frequency of change-overs and maintenance and support.

This chart plots the relative costs of simple to complex automation for turning applications. ▼



A Sea Change In Automation Tools

The biggest change in automation implementation has been the evolution of 3D modeling software. A common misconception by shops of all sizes is that designing in 3D takes a major investment in capital and time. It used to be that delving into the world of CAD took a fair amount of training and an extended period of practice before applying the investment.

Even then, the difficulty of use and limited tools hampered its implementation by operators on the front line. During the evolution phase of an automated system, the ability of the designer to experiment, try out and research solutions requires an easy way to digitally build test models. With older technology, a CAD translator, also known as an engineer, was needed to turn the shop ideas into working models.

This conversion of 3D ideas from the shop floor to 2D drawings in engineering took time, and time is expensive. Also, the need of an interpreter between the shop and a finished system can muddy the creative process. While engineers are absolutely required to mature ideas and build systems, they are not always welcome during the creation stages. Having to take ideas from the shop and process those through someone else's workstation can put a chill on the founding of a new method.

Current 3D software has come a long way and can have an impact on a manufacturing business. The packages available today are easy to use. Today's 3D software can be put into action by anyone wanting to use it and willing to invest in a few weeks of training. After implementation, it is possible to drag and drop off-the-shelf 3D models of standard components created by vendors. The Web makes finding and accessing these models a fast process.

These available pre-built models are so exact that they emulate working with the actual items. They have the look and feel of their real-world counterparts. Each subassembly from vendors can have built-in functionality, so it will perform just like the real-world equivalent.

As the automation design grows, it can also take on functionality. The ability to "digitally prototype" the automated

OmniTurn Automation

Automation has become an important tool to be used to survive in today's difficult market.
The OmniTurn system has been designed with automation in mind.

Automation can be easy or a nightmare. There are so many issues that must to be taken into account or they can get out of hand if you don't have the prior experience.

- Qualify length from a dimension off the part. This can be from the front - Concentricity - Chips
- Orientation - Change over time for similar parts - Part consistency - Cost - Cycle time
- Finished part unloading - Work holding - Fault resets and automation - Vibratory bowl interface
- Documentation for operator use, setup, and troubleshooting - Schematics and spare parts lists

3 second Load/unload
Held on the OD, drilled 14 holes, bored the ID, Qualified the overall length

6 second Load/unload
Held on the OD, Finished the radius on the face.
$3,500

3 second Load/unload
Held on the OD, Turn, Bore, Drill, Ramp Broach, Deburr.
$6,000

10 second Load/unload
One of a family of parts, load and unload without damaging finish
10 minute change over, $16,000

8 second Load/unload
Thin sheet metal stamping. Work holding was an issue.
$5,500

6 second Load/unload
Very simple track loader. Simple to build and setup
$3500

5 second Load/unload
Universal pick and place that can be changed over in minutes
$10,500

2.5 second Load/unload
Turn radius on end, cross drill
Dedicated loader from bowl
$5,500

6 second Load/unload
Simple track loader, adjustable and universal
$3,500

6 second Load/unload
Unloaded carefully, no marks on finished face
$4,500

8 second Load/unload
End work on shafts, OmniZip with hopper holds 1000 parts.
$7500

3 second Load/unload
Universal pick and place that can be changed over in minutes
$9,500

3.5 second Load/unload
On C axis machine, load off center, drill and tap one hole, drill other.
$8,500

4 second Load/unload
Loader for family of parts, fast load time, simple change overs.
$8,500

12 second Load/ Load/Unload
Both sides of part was machined.
$16,000

Bar fed by OmniZip
Extruded stock loaded by rear end loader, 3 second cycle time per part
$7500

6 second Load/unload
5,000 part run, OD thread only. Built loader in 2 days for almost off the shelf delivery
$4,500

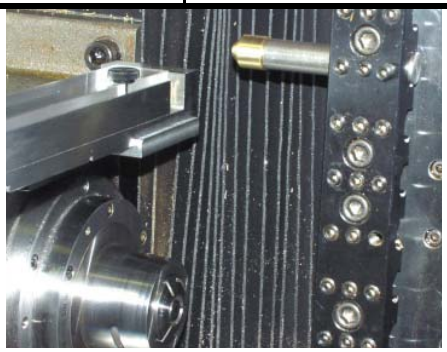
6.5 second Load/unload
Family of parts done with simple loader. Change over time is only 5 minutes.
$3,500

6 second Load/unload
Unloading was critical. They could not touch one another.
$7,500

8 second Load/Unload
Held on ID, turned entire OD. .0003" total all over.
$8,000

OmniTurn's versatile OmniZip loader. A great universal rear end loader as well as a fast short bar feeder. This is an off the shelf product for almost immediate delivery.

Custom built loaders to suit all needs. Speed, universality, reliability, simplicity. Let us quote on your automation needs.



Pick and place loaders are the simplest style we offer. An in feed track and pick up pin or cup on the tooling plate. There are many variations on this style of loader, give us a call.

Visit our website to see most of these loaders in action.
www.omni-turn.com

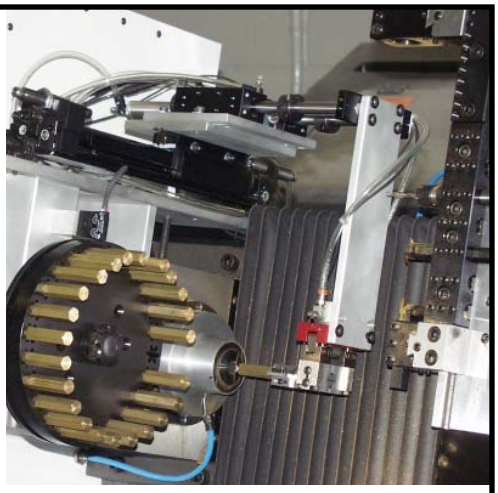
Give us a call for help with automation. We can help you design a system that you will build, or OmniTurn can deliver a turnkey system

High volume, dedicated application:
First off, what do we mean by "High Volume"? We take it to mean any job that will run longer than 6 months without having to change the setup. Notice that we look at the length of the run, not the number of parts. Automation of this type should be considered to be replacing operator costs and increase production rates. The cost of implementing a dedicated loader usually takes the 6 months to offset an operator's salary and overhead charge. Loaders that will be dedicated to one job do not need to be Convertible. This leave us to play with speed and price. Dedicated loaders can be simple to design and implement since they are built around doing only one job. Usually load times are around the 3 seconds. However there are cases where we have been down around 1.2 seconds.

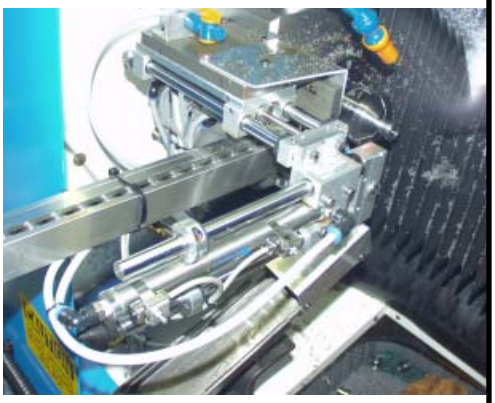
To "Bowl" or "not to Bowl"? Is this a question?
Most customers assume that a bowl is required for long running production automation. OmniTurn wonders how often the bowl is really needed? We find in many applications having an operator once in a while fill an in feed track is more cost efficient. You could make argue that automation is implemented to remove operator intervention. However there are still reasons to keep an operator near the setup: Tool life, tolerance maintenance, part outflow safeguarding, chip removal, etc. While the operator is maintaining the other issues of the work cell, they could fill the in feed track. If the track holds at 30 minutes of parts, it still frees the operator for other duties and still load a number of automated OmniTurns. After a job has been up and running for a while it is a better time to determine if the purchase of a bowl is justified. If your automation is designed to work with a bowl, then the addition of it at a later date is simple!

Similar part automation:
There are many instances where part family production is critical to making a product economically. Here we have a case where automation will be needed for a long time, but must be convertible enough to handle variations in the blank part. This could be variations in lengths, diameters, shapes, etc. If the parts all maintain some basic characteristics it is possible to build automation that can be changed over quickly. Here the 3rd item to be left out could be either the speed or price. In come cases we can build systems that are convertible and fast at a higher price. Or one that is convertible and less expensive but not as fast. The defining issue is usually the lot size and how often the loader will have to be changed over.

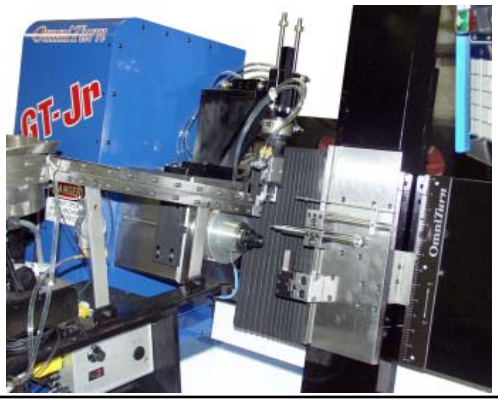
Simple automation:
Here the issues are usually price and delivery. Many jobs will have to be in production and running within a week or two. So speed of getting the loader up and running is important. The other issue is price. In many cases the job will only be on the shop floor for a few weeks or less. This does not warrant spending thousands and taking weeks of a tool maker's time. Here OmniTurn has come up with simple loader ideas and implemented them many times over the years very successfully. With the simple type we are happy to help you build your own, or build a turnkey for you. The most important thought to remember that there is such a thing as SIMPLE automation. A few hours of tinkering can save hundreds of hours of operator's costs.


Pick and place for delicate parts

Simple track loader with in feed bin


High volumn production - FAST


Very simple table mounted system



OmniTurn

.0001” Accuracy
.00005” Repeatibility

GT-75

GT-Jr.

GT-DH

OmniZip

Attachments

Rear End
4 second loader