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CNC FOR 2024

A BROAD LOOK AT DIGITAL FABRICATION

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Upgrading to a larger machine • Exploring small-format options

BLACK BOOK

SUPPLEMENT TO WOODSHOP NEWS

CNCs for growing shops

Woodshops that are expanding into higher levels of panel processing have a number of options to consider

BY JOHN ENGLISH

A large industrial CNC can be quite a jump up from a standard 4' x 8' router with manual fixturing and loading. The initial investment is significantly higher, but money isn't always the biggest concern. That would be getting the right machine.

The sales team at **Stiles Machinery** (*stilesmachinery.com*) knows a thing or two about volume processing. The company offers a range of Homag CNCs that are designed in Germany and assembled in the U.S., and its website notes that "there are a few common considerations when purchasing a CNC machine, such as the size and capabilities of the machine, the type of processing tools it is equipped with, and how reliable and user-friendly the software is."

The first of those parameters, evaluating size and capabilities, begins with identifying the full range of parts that a machine will be asked to manufacture, not just now but over its lifetime. The CNC doesn't just need to be able to mill curves and corners, cut to dimensions, or work well in the materials being used. It must also be up to handling projected volume and speed rates, and be ready for a new era of technology.

So, choosing a larger CNC begins with understanding what the shop's needs are, rather than immediately trying to search through all the high-tech options available. Those are the fun part, and that comes later. First, let's look at the basics.

WHAT'S ESSENTIAL

Manufacturers have numerous ways of describing larger equipment. A 'CNC router' is usually just that, a basic flat panel machine with a moving gantry. A 'CNC wood processing center' will have more options available such as the ability to turn, saw, mill, drill, sand or even glue. A 'machining center' can mean the same thing as a processing center, but the word machining is more often reserved for mills than routers. Mills are slower but highly accurate CNCs that generally move the part rather than the tool. They're more often used to machine metals but can be employed to work in wood and similar materials when a high degree of definition or intricacy is required.

The ability to nest is pretty much a prerequisite on larger CNCs. Nesting means that the machine can cut in patterns and arrangements that reduce the amount of waste being produced. The goal is to use material in the most efficient manner, and the math for that can all be done by software. There are two ways to nest. Static nesting is employed when the shop needs to make lots of copies of a few parts, so it would be a good choice for a shop that's building IKEA type cabinetry. Dynamic nesting is a little more complex and is used when the shop is doing lots of shorter, very custom runs. Both take advantage of simple geometry, such as being able to use one toolpath to create an edge for two separate parts. Nesting saves on material waste, tool edges and sharpening cost, power requirements, and employee time spent restacking, moving and clamping parts. If a woodshop is looking at CNCs to handle a higher volume of panels, nesting is an essential part of the picture.

Labeling is almost as critical. A larger CNC must be able to identify parts so that the assembly process goes without a hitch. Labeling can be done with printed stickers, direct ink printing, ink/dye stamps or laser engraving. The more automated the better. The machine software should

The Profit H350R Format4, a 5-axis CNC from Felder, features LED vacuum pod positioning.

Images: Courtesy of manufacturers

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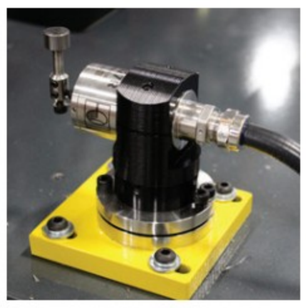

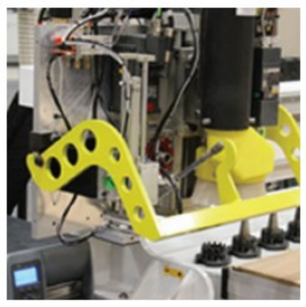

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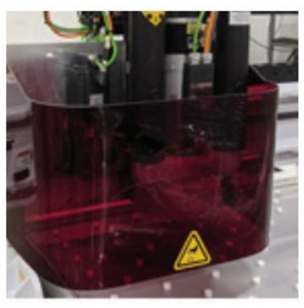

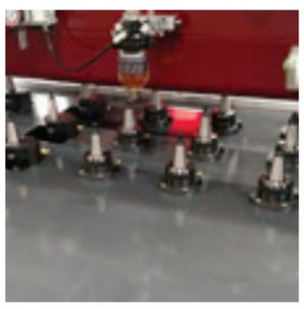

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be able to place labels in non-critical locations, such as the edge of a panel that will eventually be banded or buried in a groove or dado. Some smaller machines can't reach sideways and can only label from the top. It can take a lot longer to remove a label than to place it.

Nesting software usually includes the ability to label automatically, and also to group parts either in sequence or affinity. The latter refers to keeping identical parts together as much as possible, and the former makes parts as they will be used (for example, an entire cabinet at a time so the assembler doesn't need to wait for a specific part to be cut at the end of the day before the casework can be completed). Nesting software on larger machines often gives the operator the option to manually tweak a pattern and optimize so that, for example, a small part for the next job can be cut from the waste on the current job. Nesting software can also be integrated with inventory programs, so that whole sheets aren't the only option. The software can determine that a previously labeled cut-off from another project can deliver a part, rather than using a full sheet.

Sometimes the introduction of a new machine can change the way the shop optimizes. If the bed is a different size or shape, the new machine can probably handle differently dimensioned sheet goods. That can open opportunities such as slightly redesigning established parts to take advantage of the new sizing. For example, a 5' x 5' sheet can deliver differently sized parts than a 4' x 8', so slightly changing a drawer opening or a door size might deliver more parts and less waste. If there are options for differing sheet good dimensions from the woodshop's supplier, the bed shape and size might be a factor in choosing a new machine.

Integrating software becomes more important as the machines get larger. The woodshop owner or manager needs to discuss this with any potential CNC salesperson. If the shop is locked into a specific CAD design program, it's critical that there is a streamlined relationship between that software and the CAM machining software for the new machine. Upgrading to a larger CNC may require changing the cabinet design package in the office computer. That can mean training downtime, or workflow challenges with other software such as project management, or even complicated transfers of libraries from parts and hardware vendors. It's worth having the discussion up front.

Many of the larger machine manufacturers have created their own software bundles for monitoring performance, maintenance, safety and heat issues. Some of these new packages include programs that tie machines together from the same manufacturer (and in some cases from other factories) in a web that becomes systemic across the woodshop. This is intended to take advantage of options such as automatic loading and unloading, tool changes and fixturing (holding parts in place). An operator can use a tablet or even a phone to monitor several machines at once, and spot glitches before they become downtime.

As AI (artificial intelligence) advances in the woodshop, machines are learning to handle the monitoring, too. The impact of AI will be massive in all aspects of industry and production over the next decade, as more shops and factories switch to robots and cobots to replace humans. With larger CNCs, AI is going to be more of an issue with peripherals than basic programs (loading, monitoring, aggregates and so on), so it's another area for discussion with the machine supplier. Ask about what's in the pipeline, what's available now, and how the machine will be compatible with advances in technology.

The Laguna SmartShop 5-axis with an HSD 2-axis articulating head and Fanuc 31i-B5 controller.

AXES, TABLES AND MORE

Nesting machines are the perfect option for routing and drilling. That lets them cut parts to size that are ready to edge band, and to mill edges and faces for connectors and other assembly devices. They can also mortise and drill for functional hardware such as slides, pulls and hinges. As more and more connection systems evolve, the ability of a machine to work in more than one plane comes into focus. Even though a CNC that can only mill in Z can't easily place a slot in a 45-degree miter, aggregate heads and pods that raise parts for edge work have come to the rescue. Because of innovative solutions like those, most standard casework shops can get by admirably with a 3-axis machine.

And your basic 3-axis isn't so basic anymore. For example, the Talent T5D is a 3-axis, high-performance nesting machine from **NewCNC** (*newcnc.com*) that has 1.5 KW servo motors, a 16-hp spindle and Delta CNC controls. Good travel speed and a standard 12-position carousel tool changer cut processing times, but the T5 also offers a 10-position boring block, a panel sweep, automatic panel alignment, and pre-configuration for auto-load and unload as standard features. It comes with 10-hp vacuum pumps and CNC controlled vacuum gates. In fact, all NewCNC routers are pre-

configured with automatic load and unload devices, automatic panel alignment, a table sweep, and optional label printing, so a single operator can keep the machine in continuous production.

Grizzly Industrial (*grizzly.com*) has recently added two large-shop models to its line-up – a 4′ x 8′ table with 4-axis capability (G0933), and a 5′ x 10′ model (G0934) with a vacuum table and an eight-position ATC. The smaller model is a unique machine with a spindle that turns 90 degrees left or right, which gives it the ability to cut in 3D. The larger CNC has six independently controlled vacuum zones and a two-stage air vacuum pump.

While these kinds of versatile 3-axis machines can meet most needs, sometimes a shop needs to do work in more than X, Y and Z. For example, among the offerings from **SCM** (*scmgroup.com*) are machining centers that are specifically touted for the manufacture of chair and desk components. The company's new 5-axis Balestrini Power machining centers use Smart Pro software for CAD/CAM that lets a woodworker draw parts on the computer and automatically optimize them. Then it visually simulates the machine's operations on the screen before any cuts are performed, which helps avoid collisions with fixturing or the gantry when a shop is making complex, shaped parts. The Balestrini also has some very innovative parts-holding options, and it can operate with a single spindle or a 5-axis revolving toolholder.

Versatility is key when ordering a machine, and most of the big toys can be ordered to fit a shop's basic needs and budget. **Anderson America** (*andersonamerica.com*) says it offers "the most comprehensive CNC router line up in the industry from 5-axis to 3-axis, fixed bridge moving table to moving gantry, pod & rail or flat table". The line-up includes sixteen machines including the Stratos Pro XL, which is a large format 3-axis machine. When it comes to options, the table sizes on this machine range from 7′ x 12′ to 10′ x 30′, and a couple of different spindle sizes can be ordered with optional water cooling. The shop can opt for 10-, 12- or 16-unit tool changers, and a Z travel (up and down) anywhere from 350 mm (13.7″) to 600 mm (23.6″). Anderson offers vac pumps in 10-, 25- or 40-hp versions for this machine, and a list of other options that includes bar code reading, a touchscreen, a C-axis for turning, reverse airflow for the vacuum table, a mister for cutting tools, and automated materials

Thermwood's MultiPurpose 67, a 5-axis available with either single or dual moving aluminum tables.

handling.

Speaking of the C-axis, some machines have evolved with specific woodshop tasks in mind, such as the Maverick CNCs from **Legacy Woodworking** (*lwmcnc.com*) that pays special attention to turning. Built in Springville, Utah, the top-of-the-line Maverick comes with a 4'x 8' horizontal table plus a 7" x 20" vertical table and a 79" 4-axis turning center. Its three workstations are designed to handle standard panel flatwork, solid wood joinery, and turning. It's an interesting combination of rotating the part and cutting with a router that is difficult to replicate even on a manual wood lathe.

Thermwood (*thermwood.com*) also offers several machines with an optional rotary axis, including the Multipurpose 45. This is a heavy-duty 3-axis base model with either single or dual spindles that was designed for wood and nested based panels among other materials. The table sizes run up to 7x12, and the standard ATC is a 4-tool holder but a seven-position unit is available. The optional rotary axis will work parts up to 8" in diameter and 56" long. The table is set up for an optional pod system, and that's something that woodshops moving

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up to larger machines will want to ask about (see below).

Castaly (*castaly-cncmachine.com*) makes a rotary axis lathe for CNCs that will look quite familiar to anyone who has turned on a standard wood lathe. The relatively inexpensive upgrade offers quick and easy set-up for the standard 8" diameter and 48" long unit, and custom sizes are available. For larger shops doing more than occasional turning, the company offers an automated free-standing wood lathe and several 5-axis CNC options.

PODS, RAILS AND FIXED BRIDGES

Even though it can be a little slower, a pod and rail fixturing system offers one huge advantage over a flat table: it elevates parts so the edges can be worked either by a horizontal tool or aggregate heads. Instead of a large flat table with mechanical clamping, or holes for vacuum holding, it is a series of bars (consoles) that clamp across the table and can be moved from side to side. On top of the bars are pods, which are small manifolds or suction cups that can slide back and forth along the bars. The net effect is that the pods can be placed almost anywhere in X or Y and suck the part down using vacuum power. Sometimes the vacuum pods are replaced with mechanical clamps that can be moved around and swiveled to grip the edges of irregularly shaped parts. For repeat manual set-ups the pod systems can use LEDs or laser guides to mark locations, and some systems are robotic: software will move the pods into position automatically. The downside is that sometimes the pods get in the way of an aggregate head like an angled trim saw, plus there might not be much support for a large flat workpiece, especially where cut-outs that fall through (like sinks) are involved. Pods can be a challenge with narrow parts, too.

The **Felder Group** (*felder-group.com*) has advanced pod positioning to an artform with its lightPos system. This elegant solution lets a shop quickly and very precisely position pods in a larger production environment. On the company's Format 4 CNCs, more than 6000 LEDs can indicate the suction cup size, position and orientation as the console positions the placement within a millimeter's tolerance. A sophisticated management system means that each vacuum type and its orientation is displayed in well-defined and specific colors. LEDs on the X-axis give information about the processing status, while lights along the X and Y axes indicate both the position and the dimensions of the workpiece. The net effect is remarkably fast set-ups and accurate repeatability.

Flat vacuum tables are more numerous than pod & rail arrangements, but some of those use their bridge and table in a similar way.

Their spindle moves left and right along the bridge for X, while the table moves back and forth to simulate the Y axis. One advantage of a fixed bridge in larger machines is that there can be two tables and multiple spindles. That layout can really speed up flat panel production.

A good example is the LIME series from **Machine Tool Camp** (*machinetoolcamp.com*). The standard 01 unit delivers 5,700 inches per minute (ipm) of travel, and 1,600 ipm for cutting. There's 14" of clearance for Z under the bridge, and two higher bridge options offer 31" and 48". But what's impressive is that the machine can be equipped with two tables, dual cutting heads, ATCs, drilling units, 5-axis machining, multiple table sizes, and either left/right or forward/back orientation for better access, depending on the type of work being done.

Sometimes an existing 3-axis CNC is more than adequate for a woodshop's flat panel volume, but the shop is seeing a need for more advanced machining on some jobs. The answer may not be to upgrade to a full 5-axis machine, but rather to look at solutions such as the ELEV8 from **ProEdge Technology** (*proedgetechnology.com*). This is a boring and doweling CNC that creates all kinds of solid wood and composite joinery, and offers glue and dowl insertion. It has both horizontal and vertical routing capabilities and uses three electro-spindles and 3-axis CNC control. That means it can handle joinery and connector milling for Rafix, Minifix, Maxifix, Confirmat, dog bones, Domino slots, rear panel notching for undermount drawer slides, Soss hinges, and more. The parametric programming can deliver machined louvered doors and Shaker door stiles and rails, plus dadoes and blind dadoes can be programmed to automatically change size and length as the panel sizes change.

Along with the investment in a larger CNC, a woodshop will need to deal with traffic flow, power requirements, vacuum issues, and of course software updates.

Changing out or installing a new CNC also means downtime, so the whole process needs to be treated like any other project and managed as well as possible to avoid glitches. But once the right machine is in place, a new state-of-the-art CNC can revolutionize product levels and the quality of work. **W**

Somewhere in the middle

Small-format CNCs strike a balance between desktop and full-sheet machines

BY JOHN ENGLISH

What exactly is a 'small-format' CNC? The industry has a little leeway in its definition, but a good rule of thumb is that it's larger than a desktop unit and smaller than a full-sheet (4' x 8') processor.

While desktop or benchtop units are well suited to carving and artisan work, a small-format CNC is a better entry-level machine for a cabinet shop. It's big enough to make doors and panels, and rugged enough to do short production runs. The spindle can be liquid or air-cooled, and some can handle an aggregate head or a rotary axis for more complex machining. Automatic tool changers (ATCs) can be optional or included, and that's also true of upgrades such as vacuum tables and automated positioning systems.

As an entry-level CNC, the right small-format model can deliver professional results but there are some limitations. The most obvious one is that full sheets need to be broken down into smaller panels before being processed. That means the shop needs either a panel saw or a sliding table saw, so that's something that might have to be factored into budget and space calculations. It's also a good idea to add an optimizing module with an inventory function to the shop's CAD software, to get the most out of cut sheets. That software keeps track of partial sheets and lets the operator know what's in stock.

A good place to start the search for a small-format machine is in the woodshop's accounting software. Looking at sales over the past couple of years will tell an owner how much production the shop is doing, the patterns of any cycles, and also what kinds of projects are being built. Assuming the CNC will boost production, a sales report will eliminate any machine that can't handle more than the existing workload.

THE BIG PICTURE

Woodworkers who are getting into CNCs for the first time are trying to solve either an employment issue (can't find anyone to hire), a physical space restriction (too many traditional machines eating up floorspace), and/or a volume issue, where the shop simply can't keep up with de-

Tormach's 24R, a 2x4 CNC router with a gantry clearance of 6".

Images: Courtesy of manufacturers

mand. If the wait time for delivery on jobs is closing in on a year, it's definitely time to change the way that things are being done. Even the nicest customers have deadlines.

The instinctive choice for an entry-level machine is a very basic full-sheet platform without the bells and whistles to keep the cost down. The appeal is that such a workhorse won't be overly confusing and will also be reliable. The problem is that it takes up a lot of space and also consumes a lot of power, especially if it's equipped with a full-sized vacuum table. Plus, it will probably cost a lot more than a small-format machine.

Beyond affordability, a less than full-size CNC offers a lot of other advantages. There is, of course, the smaller footprint and the fact that many of these routers run on standard household current. But there's also the lack of intimidation. They are easy to learn and use, which contributes to their popularity among serious hobbyists and busy one-man shops. Plus, individual users and groups of brand enthusiasts have created a wealth of support data online, from workarounds to inventive solutions and routine problem solving.

After a potentially overwhelming few days (as there is with any new machine), most owners become comfortable very quickly with smaller CNCs because the controls are intuitive and quite familiar. That's because we're all so used to cellphones and laptops, and the CNC controls generally parrot that methodology. Making the leap from router tables to CNCs is like riding a bike. At first it's a bit scary, but the learning curve is short and once mastered, there really isn't a whole lot more to absorb. Yes, there will always be tweaks, but a shop can be up and running (and potentially profitable) far sooner than one might suspect.

The downside to a small-format machine is that it may become underpowered and undersized quite quickly if the transition to automation increases passthrough. That is, if the CNC helps production so much that the shop's volume significantly increases, the machine's lack of size might ironically make it obsolete.

Choosing the right small-format CNC can be challenging because a lot of the units look alike but come loaded with different features, and many offer basically the same machine with a range of table sizes or spindles. Plus, each woodshop has a separate agenda. Cabinet and furniture makers produce custom work, and the CNC must be able to support their variety of needs. One size won't fit all.

The easiest way to cover options available in this sector is to take a look at machines offered by a couple of dozen of the main manufacturers:

Axiom Precision (*axiomprecision.com*) is now part of JPW Industries, which is also the owner of familiar brands such as Powermatic and Baileigh Industrial. There are three families of Axiom CNCs: the entry-

CAMaster makes the 4x4 Panther which comes with a 4.2-hp spindle and WinCNC controls.

level 1-hp desktop Iconic, and the 3-hp, liquid-cooled Pro V5 and Elite machines. The Pro V5 is the company's most popular series, and comes in 24" x 24", 24" x 36" and 24" x 48" table models that sit on an optional rolling stand and have 6.5" of vertical Z clearance. Among the available add-ons here are mechanical and vacuum clamping, a rotary kit for a fourth axis (it turns the CNC into a small-format automated wood lathe), and a laser kit for engraving. Axiom sells Aspire and VCarve CAD software for drawing, and the files can be delivered to the machine on a USB storage stick. The latest Pro has 48-volt stepper motors, an improved cooling system, and higher spindle performance thanks to an upgraded variable frequency drive. For shops needing a little more machining space, Axiom's Elite CNC offers 2' x 4' and 4' x 4' open-ended worktables that allow tiling. The larger size can handle pretty much any door or panel requirements.

The Innovator 4' x 4' from **AXYZ** (*axyz.com*) offers a work area of 53" wide, 49" long and 6" high. This Canadian-built industrial machine has a compact footprint, a welded steel frame, integrated servo motors, helical rack and pinion drive, and an optional 3-position ATC. It's guided by an A2MC controller and integrates with most popular CAM software. Other options include dust extraction and vacuum hold-down. AXWY also makes a 5' x 8' Innovator model.

The smallest of three U.S.-made Panther CNCs from **CAMaster** (*camaster.com*) has a 4' x 4' table, a 4.2-hp HSD spindle, helical rack and pinion movement, servo motors with planetary gearboxes, a T-slot table, and a laser for positioning. It can be upgraded to include an automatic tool changer, comes with a WinCNC controller, runs Windows 10 PRO and has a 19" LED monitor. VCarve Pro comes as standard, as does free lifetime tech support.

Shops creating carved panels will be interested in both the 3- and 4-axis versions of the DWC2440 from **Digital Wood Carver** (*digitalwoodcarver.com*). Made in the U.S., both come with an open-ended 2' x 4' table and an optional laser engraver. The fourth axis is used for making 360-degree carvings. These machines are advertised as plug-and-play ready. The 2-hp soft-start variable speed router moves at up to 250 IPM, and the table has T-slots. Controller software (PlanetCNC TNG) is included, and VCarve and Aspire design packages are optional.

Diversified Machine Systems (*dmscncrouters.com*) notes that its Freedom 4' x 4' small-format CNC "is ideal for small, specialty manufacturing... and for shops requiring a very small footprint. With a starting price of $40,000, this is an industrial-duty machine that comes with a Fagor controller and a 17" monitor. It has Ethernet, USB and serial port connectivity, Fagor servo motors all round, a ball screw on each axis, and a phenolic or aluminum table. The spindle runs on 3-phase 220-volt power and both 10- and 15-hp Becker vacuum pumps are options. The standard spindle is 10 hp, with other options available.

The c-express 920 is a Format 4 CNC machining center from **Felder Group** (*felder-group.com*) that only takes up 36.5 sq. ft. of shop space. This is a dedicated machine for casework panels, which are cut slightly oversize elsewhere and trimmed to size and machined here. It drills holes for hardware, shelves, connectors and doweled drawer assembly. A 17-spindle drilling head and a

grooving saw unit are standard. It's equipped with laser technology for high precision, and an optional milling aggregate that can be manually interested into an ER32 chuck. This aggregate is used for routing design features such as cutouts, pockets, grooves and rabbets.

Grizzly International (*grizzly.com*) offers two small-format CNCs for woodshops, the 24" x 36" model G0894 and the 47" x 47" model G0931. The smaller machine has a 3-hp, water-cooled spindle, stepper motor driven ball screws, cutting speeds close to 400 IPM, and the ability to load from a flash drive or connect directly to a PC. It uses an ER20 collet, and a one-shot oiler. It's a 3-phase motor with a built-in invertor so it runs on 220-Volt single phase. The larger G0931 offers 7-7/8" of Z, a RichAuto DSP A11 handheld controller with a USB port and keypad, tool touch-off and an aluminum table with T-slots and PVC padding.

Hermance Machine Co. (*hermance.com*) carries a range of new and used small-format CNCs from various manufacturers.

JPW's Powermatic division (*powermatic.com*) makes the PM-2X4SPK, which is a 3-hp 2' x 4' router with 6" of vertical travel. There's an extruded aluminum table with integrated T-slots, a handheld controller that attaches to the DSP control box via an 8' cable, a touch-off puck to zero the Z-axis with the push of a button, and high-torque stepper motors. There are also a few small details that Powermatic's fans would expect, such as the heavy-duty welded steel cabinet, an included dust shoe, casters, and leveling feet.

The WR-32 is a 2' x 3' CNC router from another JPW division, Baileigh Industrial (baileigh.com). This unit comes with a dust shroud, cast iron base, T-slots, and BobCAD design and programing software. The 18,000 rpm, variable speed, 4.75-hp, air-cooled spindle runs on 220-volt single-phase power, and there are four ER25 collet choices (1/8", 4mm, 6mm, and 1/2"). Baileigh notes that the machine takes about an hour or so to uncrate and get started with the software.

The 4' x 4' Smartshop M from **Laguna Tools** (*lagunatools.com*) is an industrial machine with a 6-hp spindle, an 8-position ISO 30 tool changer, and a multi-zone vacuum table. This smallest member of the Smartshop family offers 12" of Z clearance and 13" of Z travel. The vacuum hold-down table has six zones, and the machine comes with a Syntec control system and a heavy-duty, one-piece, all-steel frame. For shops with a tighter budget, Laguna's family of Swift CNCs may be the answer. The Swift 4' x 4' standard has a 3-hp, liquid cooled spindle, 7-1/2" of gantry clearance, a T-slot table, a handheld DSP controller, helical rack and pinion movement and an all-steel frame. The 4' x 4' Swift Vacuum model table adds four vacuum zones, and the Swift MT is de-

The Freedom 4 from Diversified Machine Systems with a standard 10-hp spindle.

signed for sign-making and vinyl cutting. Both the SmartShop and Swift machines are available with larger tables.

Legacy Woodworking Machinery (*lwmcnc.com*) builds two versions of its 3′ x 5′ small-format machine, the standard Maverick and the Pro. The basic machine comes with manual tool changes but has turning, joinery, surfacing and machining capabilities. This is a 4-axis machine with an optional vacuum system and a 3′ x 5′ table. It includes a 48″ fourth turning axis, a 7″ x 20″ vertical table, an all-steel frame and a user-friendly controller. The new Pro version has much faster speeds and better cut quality, achieved through new motion control algorithms.

The Startech CN K is a compact 3-axis drilling and machining center from **SCM** (*scmgroup.com*) that the company describes as "ideal for all types of milling, decorations, engraving, signboard creation and 3D models prototyping". The worktable is roughly 46″ x 30″, with 6-1/4″ of Z travel. It features an integral cabin with internal LED lighting to protect the operator and keep the surrounding environment clean.

ShopBot (*shopbottools.com*) is one of the most familiar names in desktop CNCs, but the company builds machines for all market seg-

ments including full-size and small-format units. Among the latter are the Buddy, PRSstandard, PRSalpha, PRSalpha ATC, plus the ShopBot 5-axis. The Buddy has a very small footprint and comes with optional casters, so it can be moved around the shop. It has a stationary gantry over a moving table. The PRSstandard is a moving gantry machine that comes in a 4′ x 4′ option and comes with a 2.25-hp DeWalt router, or options that include a 2.2 or 4-hp HSD spindle, or a 5-hp Colombo. The PRSalpha ATC has an automatic nine-tool changer and is available with spindles up to 10 hp.

The RC4 from **ShopSabre** (*shopsabre.com*) has a 51″ x 49″ cutting area, 8″ of Z clearance, and a 3.5-hp, 110-volt router as the spindle. The company's Pro 404 bumps that up to 60″ x 50″ with 12″ of Z and HSD fan-cooled spindles.

TechnoCNC (*technocnc.com*) makes an unusual machine called the HD-II, which is more than a desktop but may not technically be a small-format machine as it's described as 'tabletop'. It has a 2-hp, HSD high frequency collet spindle and a vacuum T-slot table, which allows for either mechanical clamping or vacuum holding. The processing area is 20″ x 30″ with 7-1/2″ of Z, and the drive motors are Nema 34 high-powered brushless, steppers. The controller features pre-programmed buttons to perform certain machine instructions.

A family of 24R CNC routers from **Tormach** (*tormach.com*) can handle any CAD/CAM software and is built on a basic platform that adds various features as needed. Features include a PathPilot controller, an integrated vacuum table, a 24″ x 48″ work envelope, and options all the way up to a 10-position ATC.

Vision Engravers (*visionengravers.com*) offers 16″ x 24″, a 25″ x 25″ and 25″ x 50″ small-format CNC routers. The 2550 S5 comes with the company's Series 5 controller with a touch pendant and proprietary software. It's intended for a variety of applications including milling, drilling, contouring, and routing. It has an aluminum T-slot table to accommodate various work-holding fixtures, a red laser for easy set-ups, and an optional Raster Braille inserter.

Other less traditional options for woodshops to consider when looking at small-format CNCs are the **Shaper Origin** and **Yeti Smartbench**. The Origin (*shapertools.com*), when paired with the company's Workstation, is a superb prototyping machine and a pretty handy joinery tool, too. The Yeti (yetismartbench.com) is a portable CNC that can process full sheets but can be packed small enough to fit in a pickup or van. While neither of these innovative machines might strictly qualify as a small-format CNC, either one can handle most of the tasks such a machine would be required to perform, and quite a few others besides. **w**

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