

Cost of running a CNC router

Editor's Rating ★★★★★

Choosing the right CNC machine based on projected capabilities and costs. November 29, 2000

Q.

I own an 8 man shop, specialising in custom high-end cabinets, millwork and store fixture. We never build the same piece twice. I'm planning over the next six months to add a Thermwood CNC router to the shop. We are starting to learn and use CabinetVision and plan on using it to nest most of our case goods on to the CNC.

This CNC will be used most of the time for my operations. I would also like to offer a CNC machining service to other shops.

So here is the question: As any good business man would, I am trying to put the numbers on paper. Figuring out the cost of operation for offering a CNC machining service is not too difficult. But how is it going to affect my operations? Will it reduce my salaries? For sure it will increase my production, but how can I put it in numbers?

Forum Responses

Before I take a shot at your question I need additional information about your existing operation.

- 1) What size building are you working in?
- 2) List the key pieces of equipment in your shop now and tell us which will stay and which will leave after you get a router.
- 3) What dollar volume of work per production employee are you currently doing? Don't include office or installation workers.
- 4) Are you currently designing cabinets using the 32mm system? If not, will you be going to the system after you get a router?
- 5) What is the top feed speed and spindle speed of the router you are looking at? What feed speed are you expecting to cut at?
- 6) Have you looked closely at the drill head configuration and its table coverage on the Thermwood router?
- 7) What software will you use to generate g-code for your router?

- 8) What software will you use to generate the nested patterns?
 - 9) What type of joinery will you be using on your cabinets? Dowel, mortise, dDado, butt?
 - 10) What size vacuum pump are you planning to buy?
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From the original questioner:

1) My Shop is 10,000 square feet, including 1100 feet for office.

2) List of key equipment:

- 1 SCM350 14 in. panel saw
- 1 SCM 7 hp shaper
- 4 General 12 in. table saw
- 1 Frama Oscillating mortiser
- 1 Blum Inserta Mini-Drill (for hinges)
- 1 28 in. Aldinger thickness planer
- 1 10 x 10 x 8 spray booth

All the cut lists are presently done by the employees on the floor. 7 work tables are configured for assembly with lamello joints and screws. Some of the table saws and work stations will probably be disposed of after acquiring the CNC.

3) As per dollar volume per production employee last year was 120.000/ea. This year is projected at 140.000/ea. (I figure you mean gross sales divided by number of production employees).

4) I am not using the 32mm system and do not plan on using it.

5) Looking at model 40 from Thermwood with Bartoole style changer with 5 tools and a 5 x 10 table. I have been told that the approximate machining time per sheet is about 5 - 10 minutes. The machine also has a 20 hp universal vacuum.

7) We will be using CabinetVision to run the package. It will be doing both nesting and G-Codes with the Thermwood link.

9) We'll be using dado, butt and mortise joinery.

You asked: How is it going to affect my operations? Will it reduce my salaries? For sure it will increase my production, but how can I put it in numbers?

With a router the last thing you will want is your production worker's figuring his or her own cut lists. That will be a non-option. After a job is designed in the design package we use, it takes less than 10 minutes to generate nested part code for the router. A small cut list might be 500 parts cut from three different types of materials. With a router, instead of what you described having now, where employees on the shop floor are coming up with their own cut list, and skilled saw operators are doing the job of a computer, you will now have to have a skilled computer operator using software to tell a router what to do.

The single answer to your questions about reducing salaries and increasing production is yes. To quantify these issues you will first have to get answers to many questions related to router performance and software capabilities and performance. I am looking at a number somewhere between \$150.00 and \$200.00 an hour for router time.

You will need to narrow down your per sheet machining time closer than from 5 to 10 minutes. For nested, normal cabinet parts including parts like adjustable shelves that require no machining beyond the actual part border itself and base cabinet sides with many system holes, a back groove and some sort of joinery machining, there is an average time per sheet that can be determined.

At \$200.00 per hour, 5 minutes of my router time would cost \$16.66, 10 minutes would cost \$33.33. Buy the wrong router or wrong piece of software and what could have been \$8,000.00 week could be \$4,000.00 week.

Also keep in mind decisions about joinery and other construction related details could not only cost unnecessary router time, but they also cost additional assembly time, not to mention the need for additional pieces of equipment and additional handling time.

If you get the right router, and if you get the right pieces of software, you should be able to replace all but one or two of your existing machine operators or turn them into assemblers. The router will take care of cutting, grooving, any special notching like toe space notching, all system holes and all joinery machining except horizontal drilling. For items like melamine doors and drawer fronts and drawer tailgates,

the drill head allowed us to drill for hinges and those dowel holes required for the Grass Zargen drawer system. When the drawer fronts and doors came off the router they went from the edge bander to the assembly area requiring none of the additional machining previously done on hinge machines.

When I looked at which router to buy, my main concern was figuring out how to completely replace the saws, groover, shapers, etc. There are many details related to the router configuration that can prevent you from doing this completely and also from doing the most profitable work. I missed three big details and after a month of getting the post processor taken care of, I had to go back and address these three issues. Listed below is what I found to be the most important issues related solely to the router. The list of details related to software is way too long to go in here.

--Vacuum pump size

--Table size and coverage by the drill head. (Can all bits reach the entire table?)

--Spindle speed and feed speed and can the controller keep up with the machine feed speed and movement in all three axis's at the same time?

--Pin stops and their configuration to the table

--How easy is it to put 0,0 on any one of the four table corners and have the x and y coordinates reading in a positive direction from each of the corners?

--Mirror imaging of a part's code

--How easy is the controller to understand and operate?

--Does the controller use a hardware offset table to deal with accurate tool lengths and diameters?

For me, the key to my education was the software package that I chose for a post processor. To call it a mere post processor is an understatement. I chose CadCode and through it, I was taught what to expect from a router and how to get the most from it. I knew what I wanted the router to do, but without help I doubt seriously I would

ever have gotten everything I wanted and I know I could never have gotten it in one month's time.

If you are going to continue to make unique items for your own shop, and provide routing services for other shops, I think I can safely say you will need multiple pieces of software working together and I don't think you will be able to rely on a "design package" for some of these unique items you will want to do.

Three weeks into the process of getting CadCode to provide accurate g-code to the router, one Monday morning another shop owner called wanting a 40 x 70 oval tabletop. It took a couple of minutes to draw this top in AutoCAD and then using CadCode it took a couple of additional minutes to generate the g-code for the router. It took one and a half minutes to actually cut the top. What is important for me in this entire process is that it shouldn't take 30 minutes to design something in a piece of software that the router can cut in one minute.

With that said about AutoCAD and odd parts, you will also need a design package to handle the bulk of what you do. You will need to automate the process of getting line holes, grooves and notches on normal cabinet parts. The router will allow you to continue to do as you have been doing. You will not have to subscribe to the 32mm system of design. There are two important issues related to this.

The first for me is that I would never want to give up the predictability and systematic approach that the 32mm system brings. I don't want to do some things just because the router and software will allow me to. Neither the router nor a design package can take into account the ramifications of the "do anything, anywhere" approach to cabinet design, at the assembly station or when it comes time to install. When using the system approach and something does go wrong, and it will, the fix is easier for me to figure out if I have stayed in system.

So far in the process of getting the post processor to work properly with the router, there have been several hiccups by the router. Neither the router nor the post processor caused these hiccups. In each case they were caused by my improper tool head setup or issues related to template setup in the CNC link. In each of the instances the fix was a few holes located by a template and drilled with a hand drill. We have had none of these problems in the past 2 weeks and I expect very few of these hiccups in the future, but I would never try the router approach without the 32mm system.

If you are going to go it without the 32mm system, the accuracy and ease of use of a design package will be even more critical. Before you buy, demand the design software company put their package in for a month long trial run. With a router, and my past experience with the 32mm system I can say from experience that the process of setting up the software to work with a router should take no longer than two months. I can't speak from experience about how long it will take to set up a machine and software using a strictly parametric approach to cabinet design and CNC machining.

Up until the past 3 years, design software has been allowed to get by with less than accurate cut listing. By using overrides, and user created standards they have gotten somewhat of an accurate cutlist with flashy graphics. Now because of the demands of CNC equipment, somewhat accurate parts quantities with nowhere near accurate parts geometry won't get it. Only you will be able to decide which one of the two most popular packages will get this type of accuracy for you. You will only be able to decide this after many days of normal use.

I took what might be considered an unorthodox approach to buying a router. I bought the postprocessor first, then the optimization and finally the design/CNC package. By addressing the software first I was able to learn more about what to expect from a router. I only had minimal CNC experience before buying the router. I did not feel qualified to make an important decision regarding a router purchase. My lack of experience and my very specific intended goals for a router led me to work on software first. In hindsight I think this choice minimized my learning curve and certainly minimized the cost of this experience and prevented me from making a bad machine or software purchase.

I think both CadCode and Cabnetware are open to the trial run approach. I can also say that while the learning curve is not easy, I have thrown very few badly machined parts in the dumpster while at the same time I have produced some very profitable non-standard items in what I consider a reasonable amount of design time. This was all done while custom writing a postprocessor and learning the ins and outs of a new router. Knock on wood, I have yet to break a drill bit, crash a router bit or damage any part of the router.

I learned the hard way years ago how to prevent buying mistakes. I don't always get all of the details right, but two months into the router project I can't say that I would buy a different router or redo any of my software choices. I have had no real surprises good or bad in this

process. G-code was not nearly as big an issue as I was expecting and relating to parts in 3d was just as tough as it always has been for me.

You have got to do your homework. Investigate all the information on CNC machines, integration, and software. There is not one of us who made that jump that doesn't wish we had to do it all over again.

Get everything that the salesman promises you in writing on the contract. After he and the manufacturer get paid you have no leverage whatsoever. You owe the bank or the leasing company and all they will say is that you shouldn't have signed off, and defaulting on your loan (lease) will do nothing except ruin your credit.

Ask for a COMPLETE customer list, both good and bad. Check out the ones that are a few years old, but remember you have customers that are just bad apples and he will to, so expect a few negative comments.

Go see a shop with your software (CV) and Thermwood actually doing "custom" nesting and see how well they work together. Almost every shop that I know that has gone this way has had to purchase third party software to do it.

The optimizing package is something to look into very carefully--are the small parts toward the center (better hold down) and the larger ones toward the edge?

How about the cost of tooling? It sure wears a bit down a lot faster cutting a 1/2 slot then a blade and a 1/8 to 3/16 slot. Tooling on any router is an ongoing high cost.

Speed is another--how long does it take to write these programs? Will you be eliminating one man on the saw only to be putting one man on the computer? The problem I have is that my shop drawings are due way before field measurements can be taken and I have to entirely redo them to get a workable cutlist. Another consideration is: will your guys forget how to actually make a cutlist for the smaller jobs that really do warrant all that computer input?

I don't think that anyone of use that made the jump will ever consider going back, but the learning curve for all this is very steep. Don't forget that once you train someone he is a very valuable commodity and likely to jump ship, leaving you where? I know that I am the only

one that is certain to be there tomorrow, next week, and next year, and as such must totally understand every aspect of this type of operation, otherwise I put the entire operation at risk.

Food for thought. By the way, be wary of the Thermwood CV connection--they are both very, very slick marketing departments. Look past the glitter and see what they can actually do for YOUR operation.

NBM may be the ticket for you if you can either group fixtures out of different colors or species and have the patterns work or get a single fixture out of 1 or 2 sheets. Unless you do a lot of commodity type fixtures you may not be able to use the 32mm system. The same criteria that may make you a candidate for NBM may be what excludes it.

Go through the process of a prototype or one off from design to machining and make sure that when you do a store where every fixture is like a prototype, your choice can support your business needs. The joinery of display fixtures does not always lend itself to production joinery systems but you can hybrid multiple systems to make the fixture be a profitable project.

Make sure you test the system before purchase or integrate tests that the system must pass before you will accept delivery. From the first step to the machine make sure whatever method you chose will work for you.

We also do store fixtures and have been doing the NBM thing for 6 years. It is the way to go and it definitely pencils out. The design time is an issue. I'm skeptical that CabinetVision will do what you want. I would have the salesman draw and output a dxf of a typical project and see if it works for you.

A lot of the big store fixture companies are using solid modeling, but this only pays if you're doing the same fixture many times because there is a lot of design time with it. For one offs we just use a simple cad package to create dxfs or plts to get the parts cut quickly. Where this pays off is in jig time and assembly time. Most of the time we use

confirmats for assembly and drill the horizontal holes on a costruction boring machine.

Over time I have seen numerous machines and software come and go and the force behind both has always been the user's need to increase margins while optimizing both output and personnel. With today's fast pace we must all remember what to look for when buying any product and that is the possibility of acquiring a full solution from one supplier if at all possible. This will reduce our need to deal with numerous people to resolve a problem that a single source supplier could respond to with a combined knowledge of your needs. Also, if done correctly, reduce the ramp up period and thus increase your margins in a much shorter time frame.

When a supplier offers a complete solution, in most cases they have invested more time than any of us and will bring this knowledge to the table for our benefit. I can compare this with a simple example of today's computer industry. We the consumer want a computer that will do what we need and rarely review the actual computer specs as we are buying a solution and not a box. This in my opinion will be the same in most industries in the near future.

Regarding justification: I have really changed over some of my calculations to the way that the plastics companies work. They will invest large amounts in equipment and systems (software, material tracking, handling, etc) and run with the least amount of people possible (and better quality people), allowing you to pay better wages.

There are numerous books available on and offline that offer both practical and realistic views and methods of cost justification. One that I have just recently read was by Ken Susnjara and is available to download online or purchase a hard copy. The site is <http://www.thermwood.com>.

I have always believed that a company's foundation is the people behind it and to get the right people that work well within your firm is a task in itself. Today with the production solutions available to us we can design, present, and sell what we will build before ordering the material. The links and technology to make equipment function to your needs is best handled by clearly establishing the do's and can't do today's so that all parties are clear prior to the equipment arriving. You will have the "can't do today" and if you don't you're not dealing with

the right supplier for your company. Make sure that you do make requests of things that you would find beneficial on an ongoing basis as I have found that numerous requests I have made have come into effect.

I strongly suggest ongoing software and equipment training. This will keep you up to date and ahead of the pack with the newest methods and possible upgrades. Too few people spend the time to really get the benefit out of what they have purchased, and too many end up only using the equipment at 50% of its capacity. Small newly available items like tooling have increased output as much as 60%. Keep on top of what's out there and hopefully your supplier can assist you in these areas should they have the experience and people in place.

I own a cabinet shop with my partner. It has just been the 2 of us for nearly 5 years. We build high end cabinetry like yourself. We were faced with the question of hiring employees or investing in machinery to take the place of those employees. I may not directly answer your question on numbers, but I can give you an idea to figure your own numbers.

We purchased the Thermwood model 40 last year. We were already using CabinetVision Solid, but did have to upgrade to Solid Pro with a CNC link. Without hiring anybody we have almost doubled our annual sales.

My partner builds all the cabinets and I draw them on CabinetVision and cut them on the CNC Router. My partner finds that assembly has been simplified because all the holes are pre-drilled for mounting drawer guides & hinges. Cutting time is drastically reduced. 5 to 10 minutes is a fair estimate--it all depends on the amount of operations needed on each sheet. Some sheets may have pieces with holes to drill, which will take longer. Other sheets may have only shelves which require no dados or drilling--cutting time is very minimal.

I would use an average of 10 minutes per sheet when figuring out your cutting time. Remember, that would also include the time you used to have to process those parts after cutting. You no longer need to process after cutting other than edge banding if doing frameless cabinets.

Your shop employees would not need to be computer literate to operate the CNC Router. One person would need to do all drawing on CabinetVision, and they do need to know all about the CNC router. Once the files are sent to the CNC router the operator must call up the file, but after that it is just loading material into the machine and pressing a start button.

I believe you can eliminate some employees, which helps your numbers. The payments on our machine is far less than what you would pay a skilled employee per month.

The comments below were added after this Forum discussion was archived as a Knowledge Base article ([add your comment](#)).

Comment from contributor S:

CNC routers can be purchased for varying amounts and the price varies with quality of the machine and the software that runs it.

Needless to say many within our own organization were hesitant about the purchase of a CNC machine. They weren't sure about the accuracy of the cost - benefits analysis we had performed and they had no experience seeing one in action.

Because I wanted to stick to a \$50K - max - equipment budget, I purchased a CNT Motion 900 series (5' x10') router with an automatic tool changer for 4 tools and run by EnRoute 3 software.

The machine is incredible; it's accurate, fast, glitch free and incredibly strong.

The quality of our output has improved tremendous and materials wasted are greatly reduced. Parts properly designed just fit together as they were intended to do.

And while we expected that we would reduce the costs of labor for several products while improving their quality, we also saved money in another area: cleanup time. Our dust collection system tied into the spindle assembly does a great job of removing dust and so our cleanup time dropped.

And as to the learning curve, I was a little scared that my folks who normally swing hammers might think to use them to control the

machine that I had forced upon them. Fortunately, it was so simple to learn to use that by the end of the first day each staff member had made at least one sign that required automatically changing bits at least 3 times.

Now at the beginning of the first day everyone was quite apprehensive about using the machine. By the end of that same day, all of the staff was excited about using it. It was simply that easy to get started on simple projects.

On my first day of designing I made 4 sign templates and set up the files to make the pressure treated lumber parts for our picnic tables.

For each table we need to cut to length, round the corners and round all upper edges for the 3 boards that make up our table tops. For the two seat boards, we round the corners, round the edges and engrave each with our county's logo and name. Lastly, we add the name of the park.

Not bad for a guy who never ran one of these machines before. There's no doubt that the average person can run one of these and save you time, money, and materials.
