

## To 3D CAD or Not

It has been interesting reading the recent euphoria and expectation that has resulted from the message on the MEW forum promising the offer of one provider's solution for 3D CAD to the readers of MEW. Reading the feedback comments got me thinking about this and I would like to offer some comments and observations from my own experiences. I have no doubt that some readers will take issue with my thoughts and I have grown to expect and accept this. I am being Devil's Advocate in what follows in an attempt to show prospective investors in the technology the things they might want to consider.

## Why 3D ?

The prime question is why would anyone want 3D CAD ? To my simple way of thinking there are three broad groups.

There are those with an inquisitive mind that like 'playing with software' and wish to add another potentially superficial depth of knowledge to their CV. Something that can be aired when it goes quiet in the clubroom or the snug.

There are those that believe it will be a 'magic bullet' that will solve all their engineering problems and magically allow them to create great things at the press of a button.

There are those that simply want to document their creations in a professional form with the potential for an information exchange with others.

The first and last group's dreams can be answered by any one of many CAD packages out there and the choice will come down to which name will impress the most for group one and which one is the simplest to drive and have wide output formats in group three.

What interests me most is the middle group.

My perception of the model engineering fraternity is that we are a mature audience. We have learned our skills the hard way at the bench and we know what a 'one thou' cut looks and feels like. We have reached the time in life where memory no longer has the fast rise time that it used to have and the grey matter database for remembering things has a fading propagation time. We probably feel that there is a need to keep up with the times in the belief that we have to (more than perhaps we need to). The more elderly in the community are more likely to struggle with the simplest of IT functionality as can be witnessed by some of the postings that appear in the forums. I have a generic theory that those who vividly remember the pop songs of the late 60s and early 70s tend to be at the cut off age of familiarity and comfort with computers. A generation older than this will have suffered from much less experience and day to day contact with the new technology as it evolved during their working lives. This is a general comment and should not be taken too personally.

## **The Learning Curve**

CAD and more to the point 3D CAD is not a simple learning curve for those never having used even a simple computer based draughting system. It is a major investment in time to learn the basics and in my experience it needs constant, almost daily activity to keep the 'how do I do' fresh in the mind. There is no 'easy package' to learn that offers any powerful integrated future resource to the user.

Without doubt the best way to learn (and I believe the only way to learn) is to have a project that makes you have to knuckle down and use the software. This will move you out of the non-productive comfort zone of 'just playing with it'. This really forces you under the bonnet to really stretch yourself and your faculties.

With success brings the question of what to do with this wonderful, coloured, scale model, textured object you have created on screen and how to make it tangible in your hand.

### **Physically creating the Design**

Traditionally the conversion of drawing to model would have been done with CNC machining. Before 3D packages this would have perhaps been a DXF drawing converted into machining code using conversational milling routines embedded in the CNC machine. This evolved into a better route when the CAD package posted the drawing details into a third party product such as SprutCAM which in turn created the GCode necessary to drive the CNC machine. Today professional 3D CAD/CAM products will let you create CNC code directly out of the 3D package. The CAD package will include a CAM section and this will have a dedicated interpretation driver for the particular CNC machine being used.

The conversion of the 3D design into CAM instructions is not automatically done by the 3D software. It needs the skills and knowledge of your days on the bench merged with the new concepts of how you tell the software which tools to use at what feed and cutting speeds, step over distances etc. There is a whole new vocabulary to learn about cutting routines such as 2D profiling, 2D adaptive, 3D adaptive, 3D pocketing etc. The CAM software adds a completely new layer of intense learning to your investment in this new technology.

My impression is that very few of our fraternity have come out of a CNC environment and if they have it will be from a conversational programming world rather than the current direct drive from integrated CAD/CAM programs. There will be little familiarity with GCode and this adds a further learning curve to get to grips with the basics of this to aid editing and debugging. Oh and by the way ....the big name brands all have their own flavour of GCode ...

There is also going to be the need for the investment in a CNC machine and the associated learning curve of how to drive it, reference it, maintain it etc.

### **3D Printing**

A more modern route to a tactile result is to look to 3D printing. At a hobby level this is going to be a plastic based production medium. This will allow a 3D CAD created model to be faithfully created in plastic. Once again the traditional route was for the 3D CAD program to create the object and to then download this into a second program which formatted the data into 3D print language. These programs were known as 'slicers' and did just that – they sliced the designed object into finite layers of plastic which could be built up by the 3D printer.

Modern 3D CAD/CAM programs no longer need this interim step and will export a 3D model in ready formatted code directly to the 3D printer in the same way that a word processor language uses a paper printer and associated setup driver. It is a one click menu step. Usually the 3D printer driver gives an ability to fine tune how the model is printed. To this end the traditional slicer interim step is becoming less necessary.

For the hobbyist with no CAM or CNC experience, the 3D printer offers an easy method of producing a tangible version of the on screen CAD design. Clearly it is limited in the type of material that can be used for the printing (but this is changing by the day). The size of the printer and associated budget constraints will define how large a model can be accommodated. For those needing a metal based item there is the possibility to use the 3D plastic model to make castings.

My experience of 3D printing is that it compliments conventional metal based manufacture. Many jobs that in the past I would have hand made in metal are now produced on the 3D printer. I quite often mock up the difficult parts of a job on the 3D printer before fine tuning the final metal cutting on the mill.

### Where to from here ?

The 3D design in the CAD package is common to all manufacturing processes. It is quick and easy once you have made the investment in time to get up the user learning curve. I emphasise again that there is no 'easy to learn' package. All offerings require you to commit time and effort to get to grips with them and as mentioned earlier there is nothing like having a real project to focus the mind on this. Do not let this put you off !

From my understanding the package that is going to be offered to the MEW fraternity is just 3D CAD – the ability to create quality 3D imagery of an item. Having created the image you then have the ability to export your design from the software for physical creation in a 3D printer or in CNC machining. This will only be possible by exporting the 3D file into a further appropriate third party software package for a 3D print or a CAM environment. There are many suitable programs out there for each of these paths either as freeware or licenced use. These clearly will add to the learning curve (and possible cost) to the new adventurer into this technology. The proposed package does however give you the ability to produce engineering drawings in various formats some of which could be taken to third party manufacturing sources.

Regardless of your choice, what is essential in the learning curve is on-line support either direct from the software supplier or via enthusiastic third party tutors on YouTube. A good gauge of the popularity of a 3D package is to search YouTube to see how much 'stuff' is out there to help you in your learning.

The above details are a top level overview and are based on personal experience having come to hands on 3D activity late in my years. Hindsight suggests that anyone contemplating moving to 3D CAD should be asking themselves the following questions :-

Why do I want to do CAD ? Which of the three earlier groups mentioned early do I fit into ?

Do I have the time and motivation to stick with my choice of package and to get up the user learning curve and have sufficient day to day use to keep me there ?

What do I want to do with the fancy drawings I create ? 3D printing or CNC or just want to view them or send to third parties for production ?

Can I afford to make the monetary investment in a CNC machine and /or a decent 3D printer ?

If I want to go to CNC machining do I have the knowledge (and time) to understand and learn CAM processes and instructions ?

In choosing the package what facilities do I need ? 3D draughting, 2D drawing documentation, sheet metalwork, CAM, direct machine drivers etc

Do I want a Windows/Mac compatible package ?

Am I going to be using it only on one computer at home or do I want flexibility to log on anywhere ?

Do I get involved with collaborative projects and do I need to share my designs with others ?

How good is the online support from the software provider ?

How much other support material is out there on the web ?

Most important – how much is it going to cost for the software, any necessary extra 'in between' programs and of course the output device(s) ?

The most critical of all - how much of my time am I going to be able to commit to this major change to my engineering lifestyle and processes ?

### Conclusion

I first came to 3D activity in my working life having downloaded Alibre in its early guise. It was low cost and as a company we used it and learned the basics. Alibre was bought out and the user prices were escalated by the new owners. Alibre in those days was simply a 3D drawing package with no CAM facility and I believe this is still the case today. We upgraded to SolidEdge, set up our own machine shop and used SprutCAM to translate the 3D models into machine language. It was not a simple process.

Alibre seems to have been progressed by many corporates since then. This does not give an impression of stability. You have to question whether the latest acquisition has come too late to the market to be a sustainable stayer against the competition. Thankfully there is a commonality in the principles of 3D CAD and experience in one package quite often translates to other offerings so all is not lost if a vendor disappears.

In my working life I watched from afar as others used the tools the company had invested in for them to use. I vowed on retirement that I would try to learn the skills I saw them use day in day out to make our products. My home workshop started on retirement with manual machines but with an underlying desire to have CNC. Many months were spent looking at products and packages.

The first step and decision was easily made with the free licencing of Fusion 360. It had integrated 3D CAD, CAM, sheet metal, 2D drawing output, integrated 3D printer driver/slicer, secure cloud storage (so I can log on anywhere and continue with a project), project sharing with others via the cloud, tool table, Mac and PC platform, CNC machine specific GCode drivers etc etc and it is evolving day by day with new facilities. Some regard these regular upgrades as bug fixes and therefore an inherent instability. This is not the case. Any design tool must evolve to provide new facilities. Autodesk has a product road map and marketing approach that has to be admired. Fusion is an amazing package. As a hobbyist it is year on year free of all charges and gives me, as a free user, the same facilities that are available to a large corporate.

I got to grips with 3D drawing in Fusion with the help of many YouTubers. My next step was a 3D printer. This was soon to be followed by a CNC milling machine. It was on the arrival of the CNC milling machine that my comfort zone was rocked. CAM was totally alien to me. My experience of a machine shop had only been from the lofty heights of the Boardroom. A course at NYC CNC cleared much of the mist and I am now much more comfortable with converting my 3D design into mechanical CAM via Fusion.

I now have a set of resources that can deliver a solution to most of my engineering needs. As already mentioned this is often quite different to a metal only solution. Horses for courses. This often means stepping back from a project or need and taking a fresh look at how you might create a solution. 3D CAD and CAM have opened this door to me. It was a steep learning curve but one that I disciplined myself to stick to because I could see where I wanted to be in my future hobby activity.

A word of warning - I thought when I had a 3D printer and a CNC machine I could set a job running and get on with something else .... Not always the case I am afraid. Often you will find yourself standing mesmerised watching the print head or the tool spindle weaving its independent magic.

You know in your heart you should be leaving it to its own devices and getting on with the next job but it is fascinating.

I hope this missive has not dampened your enthusiasm for 3D activity in whatever form. It is written in an attempt to try to show that there is thought needed in what you want to achieve and there is no substitute for investing time, effort (and money) in this new technology. Despite all the bells and whistles that the 3D package might offer, you still have to tell it what you want and tell it in a way that it understands.

There is no 'magic bullet' and no 'magic button' but it is incredibly rewarding when after all the pain of learning you can say 'I designed that and a machine made it doing exactly what I told it to do'.