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Connecting Technology

It could change dental laboratories forever
so why isn't everyone doing it?

Connecting Technology

By Severino Gómez

CAD/CAM open architecture hopes and reality.

In listening to folks talk after a dental show that I attended, I was mesmerized by how many people were totally confused about CAD/CAM, open architecture and the technologies' significance to our industry. It was not only the visitors that were baffled, but the exhibitors also.

The first step to eliminating the confusion is to define the terms and buzzwords that people tend to use so we can better understand each other.

- **Computer Aided Design (CAD)** — From an engineering point of view, this would be the software that helps you model in 3D the dental units. However, in our industry we usually refer to the scanner as the CAD as well.
- **Computer Automated Manufacturing (CAM)** — This includes the software and hardware to manufacture a part. For example, in a zirconia coping this would include the milling machine and the software that generates the milling file.
- **Rapid Prototyping (RP)** — Also called additive technology, it's part of computer automated manufacturing. Remember, just because it is not milling it does not mean it's not CAD/CAM. Examples of rapid prototyping would be wax printers, laser sintering or laser melting equipment.
- **Generic Zirconia** — Not a brand name zirconia. There are a several manufactures of zirconia in the world. Dental manufactures purchase the zirconia from these companies and place their own label on the blocks or alter the formula slightly to create their own unique brand of zirconia. Not all generic zirconia is the same. We need to make sure that if we decide to purchase generic zirconia that this is isostaticaly pressed. When the zirconia is in powder state and it's going to be turned into a solid part, it is pressed with equal pressure all around it. Some manufactures use a vertical press for their zirconia. The problem with this is that your zirconia will have great strength in one direction but will not have the same in the others directions. We want our zirconia to have the same strength in all directions. *Editor's Note: For an in-depth look at zirconia please refer to JDT's August/September 2008 issue, which you can find on JDT Unbound (www.jdtunbound.com).*
- **Open Architecture** — A technology platform that is compatible with systems from different manufacturers, much like your computer printer does not have to be the same brand as your computer for each piece of technology to work together. With open architecture in dental laboratory computer aided design and computer automated manufacturing, we can generate files that are not encrypted or proprietary. Also, milling machines that can accept or are not locked into using one single material supplier are considered open architecture.

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Now that we're all talking the same language, let's tackle some of the common questions laboratory owners and technicians have about open architecture.

What is open architecture?

In one word, compatible. For our purposes it means that the different components of a dental CAD/CAM system (scanner, printer, milling unit, etc.) would work together regardless of which company manufactured each component. That's

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Photo Credit: Ragle Dental Laboratory, CDL

Scanning Demonstration

what happen in the computer world more than 15 years ago. Can you imagine buying a Dell PC and getting home and your printer not working because it's an HP?

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What will happen as open architecture becomes more widespread in the U.S. industry is that you will buy a scanner X and Z brand machine. Then you will received a digital impression from C company and you will be able to produce a coping from any material you would like and from the material company you prefer. No strings attached.

Open architecture exists in many industries. What we are asking is for standardization. In the milling industry one standard is the G Code. For rapid prototyping the standard file to work with is STL. Would you buy a ceramic furnace that you could only use one type of porcelain? For most of us the answer is no. Then why do we have to do the same for CAD/CAM?

What types of files are used in open architecture equipment?

In the dental industry the most common file used is STL (stereolithography).

According to Bastech, Inc., an engineering and rapid prototyping/rapid tooling service bureau, an STL file is a triangular representation of a 3D object. The surface of an object is broken into a logical series of triangles. Each triangle is uniquely defined by its normal and three points representing its vertices. The STL file is a complete listing of the xyz coordinates of the vertices and normals for the triangles that describe the 3D object.

What are the advantages and disadvantages of open architecture?

Flexibility is a major advantage of open architecture. With a scanner that is open architecture, you can send your STL files to any milling center in the U.S. or the world because you are not locked into one brand of CAD/CAM technology. In addition to STL files of fully designed restorations, open architecture can be used with digital impressions — as with two scanners available now you can receive the digital impression and import it directly. So whether you're using fully designed restorations or digital impressions, with open architecture you could use Company A's scanner but use the STL file with the digital image to any company's CAD/CAM technology not just Company A's CAD/CAM technology to produce a restoration.

Another advantage of open architecture is dental laboratory owners can significantly reduce material costs. For example: The material cost for one coping of zirconia from a commonly-used closed system is $32 per unit. Now, if we bought that same material directly from the manufacturer or a third party, the cost would drop by half, according to my experience.

The other advantage is that we can drop the price of equipment because we go directly to the manufacturer to purchase equipment. There's a few cases in the dental industry where the name brand manufactures do not produce any equipment. Their scanner is produced by another company that is not linked. Their milling machine comes from a different manufacture that does not belong to dental. Then to top it off some dental manufactures share the same supplier of materials. In the rapid prototyping industry where equipment is extremely expensive, I have seen companies drop their distributors and sell directly. There is no room sometimes for dealers. Otherwise the cost would not be competitive and the final sales would hurt.

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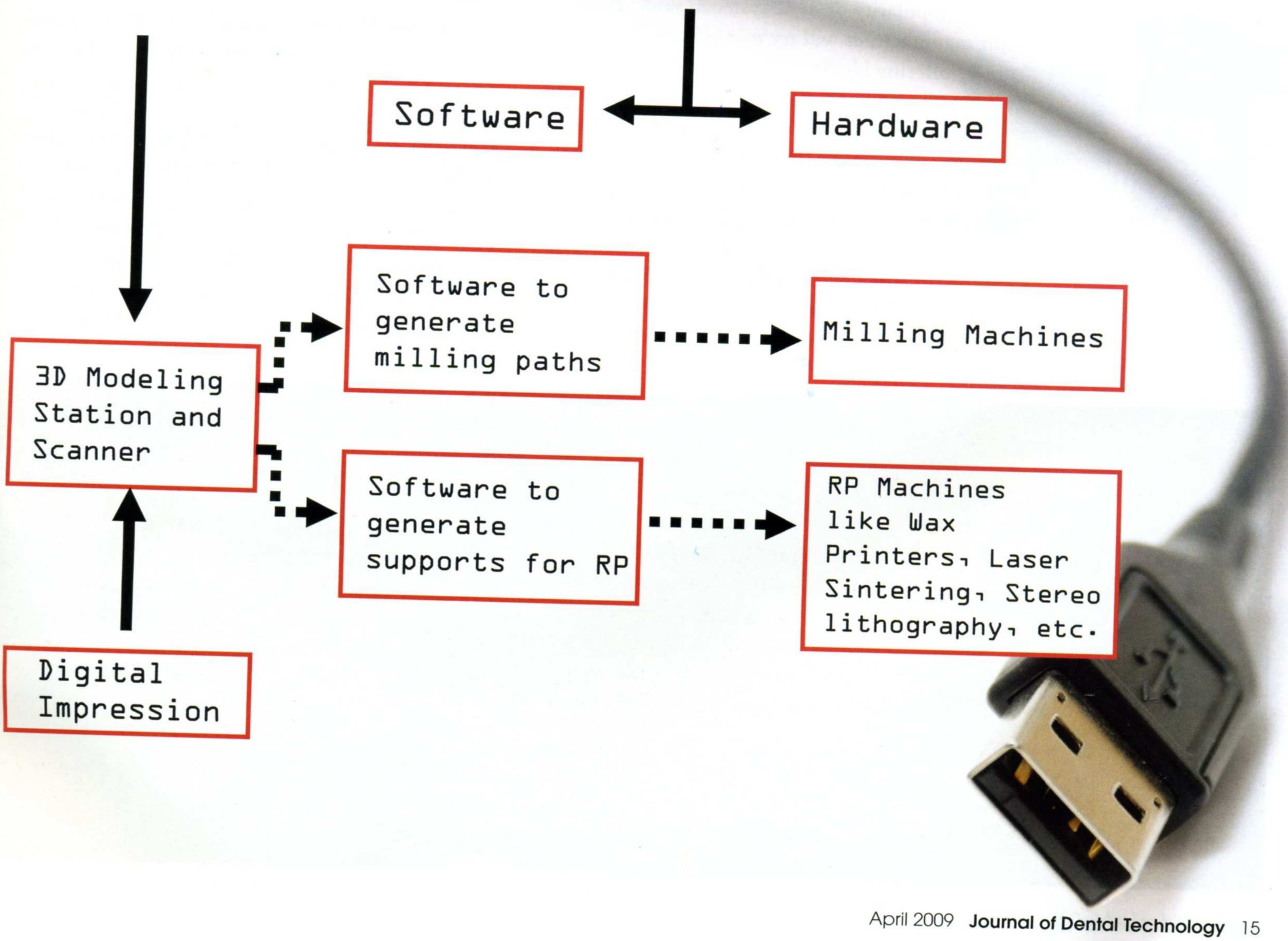
Furthermore, if a new technology comes along you do not have to throw away what you have. How many things have we bought in the past that we have used for a while and after a year or two we did not use again

Digial Workflow



is us, the users, who re demanding open rchitecture.

because there was something bigger, stronger and better? Well, with open architecture, we will usually be adding new software. Also, we'll be able to use our current scanner to manufacture a restoration using the latest, more expensive milling unit.

The main disadvantage to open architecture is that eventually you will have to deal with the unavoidable technical glitches that arise from integrating different CAD/CAM systems.

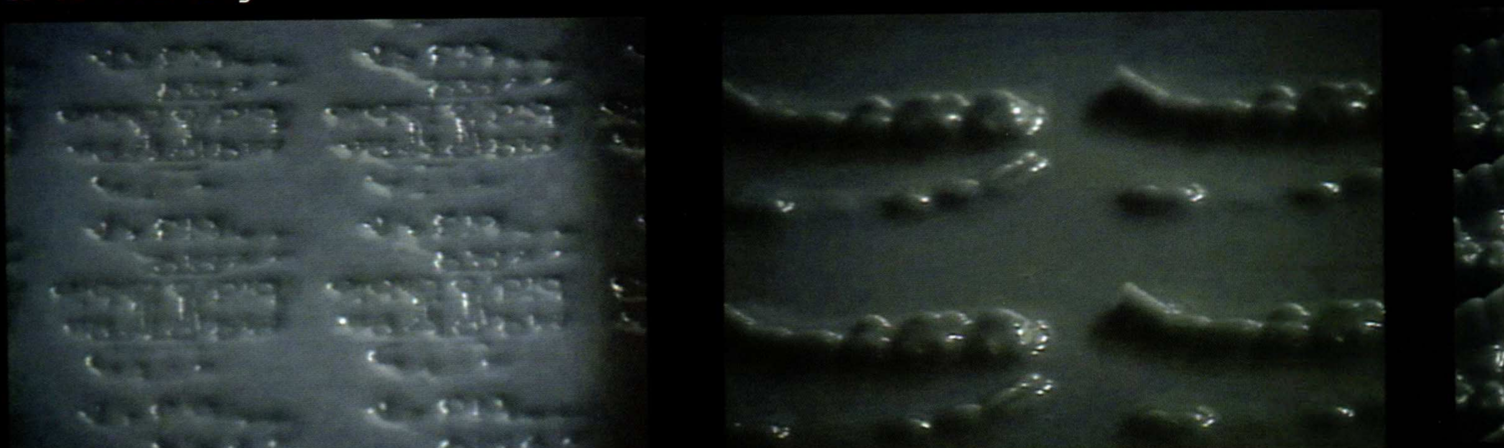
Another disadvantage to owning an open architecture system, is that you cannot offer some of the big-name brand materials. However, due to the growing popularity of these systems, some of the major manufactures will try to maintain market share by offering blocks to fit a variety of popular machines. Third-party zirconia manufacturers may rally with marketing support to differentiate their block from the competition.

Open architecture is not without faults. All scanners that claim to be open architecture generate an STL file. This is fine if you are milling a coping because you can take it and process it through a CAM milling program. You would think because rapid prototyping systems work using STL files, the same process would apply. However, for rapid prototyping the manufacturing process doesn't always work that way. Some scanners are designed specifically for milling and when these are used for rapid prototyping the fit of a restoration is not always the same from one scanner to another. It's not a problem with the accuracy of the scanner, but how it generates the STL file.

When you mill a coping, for example, with one of the milling-specific scanners you are removing material. Some scanners leave invisible, virtual holes inside the walls of the STL file. The user cannot see them, but they are there. When the rapid prototyping machine, which works by adding material instead of taking it away, using an STL file produced by the milling-specific scanner tries to place a layer that is actually one of those virtual holes it will crash and not produce. I have seen this happen in several rapid prototyping systems.

Another example would be that some scanners do not join (merge) the surfaces of a digital file. Imagine a three-unit bridge. Scanners that have been specifically designed for milling will generate five parts — two copings, one pontic and two connectors — but the technician will see these multiple images on the computer screen as one. When he or she mills the file, it will be manufactured as one part. But if he or she uses rapid prototyping, the technician might end up with the five parts separately. So instead of having

3D Wax Printing



a three-unit bridge, he or she will have a puzzle of a three-unit bridge. There is nothing he or she can do at this point. The bridge is a failure and the technician has lost time and money.

Who wants open architecture?

It is us, the users, who are demanding open rchitecture. Few laboratories can afford to have ix different brands of scanners or other type of ligital technology. It is the dental CAD/CAM nanufactures that encrypted their systems and lecided not to make them compatible with all ystems from other manufacturers. There are a ew scanners that work with many CAM systems, ut in the majority of cases the systems are closed rchitecture. It doesn't have to be that way. All of he rapid prototyping systems I have worked with re open architecture that work with STL files.

What are the pros and cons of systems that are open only for select partners?

The pros for selected open architecture are ne same as for a closed system. The process has een tested and it's controlled. However, you are mited by the manufacturer. Again, you are locked nto their materials and process. In addition, you ave to use their software and hardware.

So the next logical question is: Why haven't all CAD/CAM manufacturers jumped on board with open architecture? Initially, they all launched closed systems. Some have opened their systems to selective partners, but others are still closed tighter than Fort Knox. Many CAD/CAM manufacturers believe that closed systems are the only way to control the quality of the final product.

With open architecture a laboratory can afford a scanner that can work with the CAD/CAM system of the laboratory owner's choosing.

Open architecture can apply to milling and rapid prototyping systems that utilize many materials including zirconia, cobalt chrome, titanium, wax, acrylic and, soon, the future generation of composites and ceramics. It's the scanner that is the key to open architecture. If we have a scanner that is truly open, then we can purchase or outsource to the milling or rapid prototyping machine that we want. We have to be careful in this regard. I have seen milling centers in Europe that sell open system but have managed to close them. This way they guarantee the flow of work.

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The need for open architecture will only increase as dentists' use of digital impression systems increases. Digital

Photo Credit:
Ragle Dental Laboratory, CDL

impression systems are playing an enormous role with open architecture.

Open architecture can, will and in some places already has changed the way dental laboratory technicians work and how dental laboratories operate. It has already done so in Europe and can do so in the U.S. as well. It can help laboratories to be more efficient and more cost effective. It can help laboratories that cannot afford a capital investment for CAD/CAM milling and rapid prototyping systems. But do they really need them? After all there are several outsource milling or automated centers that are willing to do that work.

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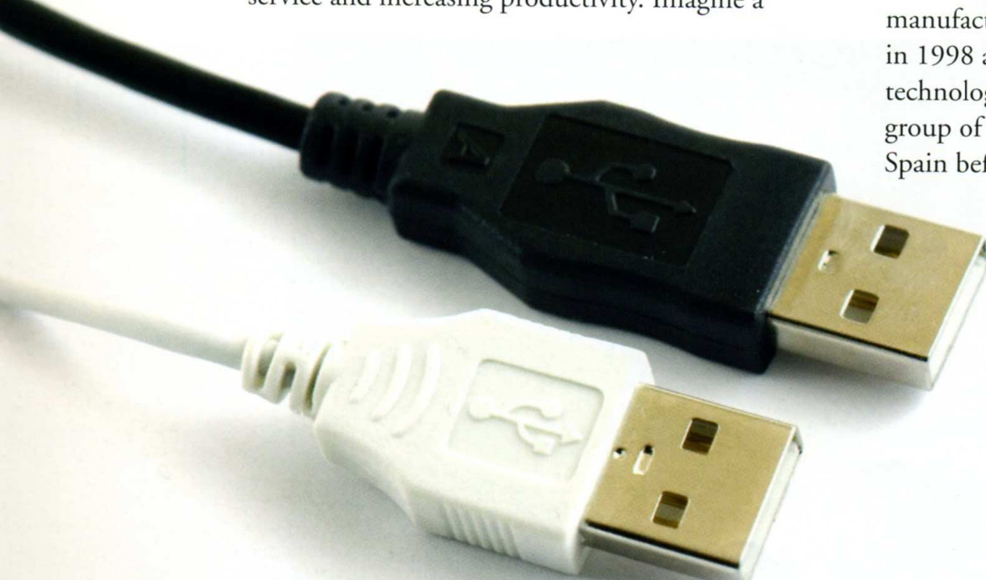
With open architecture, a laboratory can afford a scanner that can work with the CAD/CAM system of the laboratory owner's choosing. This opens the possibility for him or her to outsource the models, the frameworks and custom abutments. This allows the laboratory to spend more time adding value with more customer service and increasing productivity. Imagine a laboratory with two dental technicians who do models, frameworks and porcelain. If they start outsourcing the models and the frameworks, they could both be doing porcelain and increase their production.

I believe that in these economic times, open architecture compatible scanners linked to outsourcing will help the small- and medium-sized laboratories. Because CAD/CAM systems will not eliminate these laboratories but, instead, will help them survive.

In the dental laboratory profession, we have come a long way in the last five years when all systems were closed. Today, open architecture is a reality for milling and rapid prototyping in other industries, allowing the user to purchase the scanner that he or she feels most comfortable with while incorporating a milling unit and being able to select the materials manufacturer, thereby reducing cost significantly. We can only hope it won't take another five years for that to become a reality for dental laboratory technology. **JDT**



About the Author:

Gómez is a dental laboratory consultant. He was chief technology officer at Dental Services Group from 2006 until January 2009. He graduated from Boston University with a bachelor's of science in manufacturing engineering in 1998 and began his career in information technology, became chief technology officer for a group of dental laboratories and a supply house in Spain before joining DSG.