Computer Aided Design (CAD) Pioneer Workshop
Day 2 Session 7: Applications and Future Developments

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David Brock: We have about 45 minutes remaining. We had envisioned this last portion to be an open discussion of CAD applications from 1980 to 2000. I know Jon Peddie. raised a number of things that he wanted us to touch on at least in this section, such as the whole ECAD [electronic CAD] area. Constructive geometry was also something that he wanted to return to. I'm not quite sure how that fits in under applications. That's more a measure of my ignorance. Then he had an idea about CAD and CNC [computer numerical control] and bulk material. Those were just some of the things that he. had mentioned before that I wanted to resurface, but it's really an open discussion, open to anyone to talk about the things that you think are most important to remark on and capture about the evolution of applications in this time period, from 1980 to 2000.

Volumetric Modeling

Peter Marks: One little footnote I'd put there is that, along with CSG, we mentioned yesterday this Voxel-based stuff. Medical imaging, which was becoming a big thing, is kind of Voxel-based for scanning and things like that. The computing power is getting to the point that we just might see more volumetric-based representations for a lot of applications. So I'll just leave that hanging there as a little stub maybe for the historians to fill out. I mean, you go back to Volker and onward.

Jon Hirschtick: Well, we are seeing volumetric modeling. We see that as part of history.

Dave Kasik: Oh, yes, absolutely.

Hirschtick: Prior to today, we were seeing a lot of volumetric modeling being used as part of generative design. All the generative design systems I know of, including our own, have a volumetric kernel, if you will. I don't know what you want to call it but it uses modeling that is not of the NURBS variety. It might not be Voxel and ACTRI or something like that, but it's a form of volumetric modeling, and finally we're seeing it become more widely used. It's still a very, very small piece of the overall market, but nonetheless, it's there like those models I showed you in the Okado 600. There are literally hundreds of parts in there where the master model is volumetric and not a traditional view with NURBS.

Carl Bass: In the early stages, by my count, there were probably somewhere close to a dozen companies with a volumetric kernel. PTC acquired one. Autodesk acquired at least one, and there's probably at least 10 that I could point to—independent companies, companies like, you know, nTopology and Hypergenic. The list goes on and on, and the field is pretty well documented. This is kind of akin to the call in the early 1980s. You can find all the papers. It's not the same volumetric stuff that was done way back then; it's mostly using a mathematical representation, like sine distance fields. But it's all in the academic papers and well-represented, and people are exploring where the real commercial use is.

I would just second Jon's point: I think at this point it's a tiny fraction, but just like often happens, it's kind of the real cutting edge for people who are trying to do stuff that traditional systems either don't model adequately or the way the computational model works. These things are slow and cumbersome. I just saw a model the other day that computed 700,000 times faster, so 4, 5, 6 orders of magnitude faster than the B-rep equivalent.

Marks: I was going to say that even though it's a niche on the geometry side, whether it's fluid dynamics or structural analysis, that's all volumetric stuff essentially.

Bass: Yes.

Marks: If we're truly talking about a product that you can model and then turn on, I love that description of doing it; it's probably going to need a volumetric representation. Then tie it back to Dave's points: Now we've got these two representations. My God, how do we reconcile where there's NURBS or whatever with the volumetrics? As I think Jon and Carl were saying, we're only part way there, and this is one of the issues that's along the way.

Kasik: So it's a big deal.

Bass: Yes. I would go just one step further and say right now, at the cutting edge, we have a lot of traditional boundary representations. We have these volumetric or sine distance fields representations. And in lots of places, as you start to think about downstream applications, we still have large numbers of meshes.

Kasik: Exactly.

Bass: Measures are used for almost all additives these days, and believe it or not, almost every CAM system on the planet runs off an underlying mesh representation.

Kasik: And so does just about every NURBS package.

Bass: And every finite DOM.

Kasik: A polygonal representation.

Bass: The exchange of info between them continues to be painful.

Marks: I will add a footnote of history. I had the development responsibility, at my brief stint at the PL1 and VM-based PTC, for NC verification. That was actually a very successful product. Steve Wolf said to me, "I want to cover that, dude." Steve Wolf is a great guy. "So let me send a guy down to do that." And Jon Prun came down as a journalist and immediately stole it and created CGTech out of the thing. But that representation was basically a stalk, a series of stalks that you would cut a machine. Pete Atherton was responsible for this.

Bass: CAM to me is porcupine quills.

Marks: Yes. Exactly. Porcupine. It was a very effective way of doing NC verification, and I think CGTech is still doing just fine today.

Spcialized Application Areas

Brock: Any other thoughts about the development of application fields for CAD in this time period? It does seem that it is in this time period that sort of electronic design aids for integrated circuit manufacturers become a sector of its own, distinct from the rest of what's going on with CAD. Is that a true statement?

Bass: Oh, certainly. You start with companies like Daisy and Cadnetics, and you move on to Mentor and Synopsis and Cadence. It was just driven by the complexity. We've seen this tradeoff be complexity of geometry, a number of elements, and stuff like that. In the world of VLSI design, it became essential because the scale of the problem was just enormous. You needed a little bit of algorithmic smarts to start routing millions of wires and transistors. We haven't covered it here in the same way, but just like ECAD separated, what became known as geographic information systems or the stuff that was kind of the heart of civil engineering separated. Remember, there's a company called ESRI. That is a multibillion-dollar company that just does representations of things on Earth. There were a lot of splinters as these things went from, as we talked about, these more generic representations to very specific ones that were part of the language of the people in the domain who really worked it.

Just one more thing. There are a bunch of other products that people haven't covered, but in certain areas, you have products like Rhino and Alias that are incredibly important if you're looking at the history of CAD. They're not in the mainstream, in the competitive flow of these things, but I know for a while every automobile in the world was designed with Alias. Not modeled mechanically, but every bit of styling was done on it. Rhino has been used from buildings to boats to almost every portion of product design, and those all came about in the 1980 to 2000 period.

Kasik: I'll add to that Bentley Microstation.

Bass: Exactly.

Kasik: As for the AEC world, Alias (which became Alias Wavefront) and the like started adding additional modeling capabilities for dealing with the complexities of working in the animation and games business. The irony is there was plenty of surface design. People are glossing over the amount of surface design, not documentation, that was done in the 1960s and 1970s. They were far more generic and got more specialized as the application and use of that geometry became more institutionalized. You added stuff and got specialized systems, and I think the separation and the splintering of the basic early CAD modeling changed significantly.

Marks: Back in the days of wire harness and PCB layout, we had this hope that we'd have one suite, maybe a QALM or an Aplicada would do both of those. But one of the characteristics of the new electronics being introduced is that it’s very different and that every time you go to a new generation, you're looking at finer features, and Intel had to retool every new generation. They literally had to throw away their old CAD system and get a new one to do that, which was a little different from the automakers. It was a little bit more like when you do the next blockbuster visual effects for a movie, all of a sudden now you need a new generation. The whole dynamics of that market, selling to a few large people who every time they go to a generation changes the requirements.

I'm doing a kid's micronaut program. We imagine kids that are like a tenth of an inch tall, they look at the entire world, from 10X to 1000X. When I look at old microscopes, when they were using the ones for semiconductor wafer inspection, the microscopes were basically a 400-year-old product that those vendors literally changed every 6 months. They all looked like erector sets in the 1970s. Now you can't even use a light to look at the features any more it's so small. So it's a very different market structure in terms of integrated circuits and the rest of that.

Brock: I was also wondering if it's more closely tied to the issues of circuit simulation, along the lines of what Carl was saying about running the product. As I understand it, in these design aids for integrated circuits, there's a close tie in with the simulation of that performance.

Marks: I may be wrong, but I think they need to do new simulation tools every generation too.

Brock: Yes. Probably true.

Bass: But it's a way closer tie than we've ever achieved in mechanical. It's integral. You would never design a chip and say, "Well, let's fabricate it and find out if it works."

Marks: I run a kind of seminar series, and we have astrophysicists and people like that. We had a gal who was getting a Ph.D. in wind and wave actions, and these much-abused climate scientists are using finite-element models trying to model what's going to happen with winds and waves. At the macro level, you add energy to a system and it has to go someplace, and they're trying to figure out why. For me, it's like I remember talking to Tom Yu. Some of you may know him. He's from Stanford. He was with the air bag simulation, where you get hard structures and exploding gas; that was incredibly complicated and he thought he could solve it. But however complicated that problem is, climate modeling with finite elements is like 3, 4, 5 orders of magnitude more complicated. To maybe Jon's point, we may be only like 0.001 percent there.

Peddie: Wave motion is being modeled in particle physics, and a big topic in computer graphics right now is how to accurately reflect a wave motion.

Brock: I know Carl has to leave, so goodbye Carl. Thank you. Next we have Daniel

User Interfaces

Daniel Llach. Great. Thanks. The conversation has moved into the question of the data representations, the metric or surface kernels behind the systems. I wanted to ask a question about the interaction part of CAD, which I feel we haven't talked a lot about. This came to mind after Carl mentioned Rhino, and this brought to mind Grasshopper and additional program languages that allow users to operate in a slightly different way than conventional CAD systems. Also, systems with generative components try to expose the history of the model and enable users to work with geometry and do the same processing in a slightly different way. I wanted to get the group's thoughts about those modes of interaction. Do you have any comments on these visual programming interfaces versus the conventional drafting or modeling interface?

Marks: One quick thing I could just put in is that the NC world went from programming machines with APT to graphical interfaces and that's kind of one that was interactive, where you'd sit at the controller and interact with the geometry. If you're looking at a history, what was the progression, when did it change, etc.? That's not the latest and greatest, but it's one example.

Llach: Thanks, Peter, yes.

Brock: Anything else on the user interface [UI] side, Daniel? It's a crude way to point to what you were asking.

Llach: Yes, but that's probably a better way of putting it.

Marks: Let’s ask Jon.

Peddie: There is a debate about UIs. In fact, I wrote a book about this, with regard to how you take a 2D surface IE or screen and represent a 3D model. The answer is you can't, any more than you can represent color on a black & white screen. You need a a 3D model, so you have to come up with tricks and techniques where you fix one axis and move the others, then you fix that one, then you move this one, and then you try to do that. There's an Australian company that made a very clever 3D mouse to help you try and solve this problem. But we're never going to be able to do it as long as we're stuck with a 2D surface.

Augmented Reality

Brock: I guess there is this discussion about advanced forms of visualization that one reads about, like virtual reality or augmented reality [AR].

Peddie: Yes.

Brock: Also this kind of industrial design work. How big of a thing has that been in the CAD world?

Hirschtick: Are you talking about history or the future?

Brock: Both. Maybe we could talk about both.

Hirschtick: We're also doing AR viewing on phones and tablets today. AR, yes. AR viewing. Because you asked about AR, I'm just saying AR viewing of CAD models in phones and tablets is a standard part of our mobile applications.

Peddie: Sure.

Hirschtick: The usage level is relatively small. It's not predominant, but there's some, and there's some companies that are very into it. I had the CEO of one of our customers call me up to personally talk about the potential for AR viewing in an industrial design app. They're using our viewer, but they want improvements to it. By the way, just a point of information here, PTC has a large AR business called Euphoria.

We believe perhaps we are number one in industrial uses of AR. Most of that I would call not particularly CAD-related other than many of the applications use CAD data in some ways to establish a recognition target as content. Take that as you will for how that fits into history. But AR viewing, we believe in a lot, and I'm not going to say we're the only system, but we're the only one I know of that has AR viewing built into the standard CAD usage application. It's not a separate product; it's a mode of viewing the model. In fact if you edit the model, it will change in the AR view. I would show it to you, but I'm not sure I have an effective way to show you.

So that's interesting. We see a future. That's the reason we do this. It's in the market in the hands of many users. We're doing this because, as Jon said, there are many people who believe that there are new devices coming that will be improved over what has been out there, and we believe that the future is going to be that the CAD operator will use AR views as much as they use additional monitors. You'll have your model on, your monitor, you'll have 3 or 4 views of it sitting on your table to look at and strategize on. I think that's quite likely in the not too distant future.

Peddie: In that environment, you can get a pretty good representation of a 3D world, which solves the UI. You can pick up something and look around it, which we can't do on just a screen.

Kasik: Let me add one little historic footnote, and that is that the term "augmented reality" was coined in 1990 by two Boeing guys, David Meisel and …

Peddie: Never misses a chance for a commercial, does he?

Limitations of Virtual Reality

Kasik: There's a substantive difference in virtual reality as an individual design aid, and that certainly has not had significant penetration at least in the environments that I've seen. There are still serious technical problems with using stereoscopic virtual reality that have not yet been solved. That's a whole different conversation.

However, VR is being used certainly at Boeing and in large gatherings to do maintainability reviews and the like. The key factor, and this is something that we really haven't talked about very much, is just how much data you actually need to see it, either on a flat screen, Jon, or in augmented reality or in virtual reality. Boeing has done a large amount of work in looking at entire products, at building polygons, or more.

Peddie: Yes. In engineering, your POV [Pont of View] can be very, very small. Your FOV [Field of View] can be small. Because you just have to see a thing. You just have to see a thing. You don't have to see all the environment around it. You don't have to see people. You don't have to see anything else. Just, what is that thing doing? But in a consumer situation, you have to see everything. You have to have legs, hands. There has to be more than one person. They can't all look the same, etc.

So it's very complicated and I can't remember who said it first—oh, it was Carl—about how the GPU became what it is for us today, as an affordable parallel processor, because of its ability to accelerate games. That tapped into the consumer market, which drove the numbers up to hundreds of millions. In VR, they're trying to replicate that, Meta being the prime example, and they can't get there because it's too damned complicated. You can't get the bandwidth. You can't get the memory. You can't get the cost down. We're probably another decade away before there's going to be a realizable VR experience for consumers.

Hirschtick: Our experience in the CAD world is to see a lot more interest in AR than VR because VR takes you away from the real world.

Peddie: Exactly.

Hirschtick: You can't move around. You can't engage with other people quite so easily. Now there's pass through stuff and so forth, but then it's AR. AR to us is extremely promising because it puts the digital artifacts in your physical world. You can walk around. You can relate to people. You can use other computing devices. We don't have to move the whole modeling experience to an AR gesture world; we can have it open on our computer screen.

Peddie: I totally agree with that. I wrote a book about that as well. AR crosses the consumer-industrial barrier whereas VR doesn't.

Kasik: Two quick comments. One is about the work that John Unterkofler did, a "Minority Report" to popularize the notion of augmented reality everywhere. It's still a classic; if you haven't seen the movie, it's brilliant. Really pretty amazing. The other is that there are certain technical issues with virtual reality that I still have not seen solved, and they've been around for literally for decades. One is the vergence-accommodation effect that causes stereo sickness.

The other is you can't interact with the stuff. And last but by not means least, and this is an homage to you, Jon Hirschtick, wherever you are, is it's damned hard to put a headset on and walk around. Because you can't be mobile.

Hirschtick: A VR headset. An AR headset you could walk around.

Kasik: Exactly.

Hirschtick: Yes. AR, you can walk around with.

Brock: Peter, go ahead.

Marks: So two quick things. One is, Joel, you might remember, there were some people working on holographic interfaces and direct manipulation, probably beginning about 2000. I don't think anything's come of that, but there were some people working on that and maybe somebody else could bring that up.

Mobile Computing

Marks: We haven't talked about the whole 3D scanning, reverse engineering, point clouds reconciling them with regular geometry kind of world. There's a bunch of people in that world.

That's led kind of back into the whole 3D printing. Every kid's running little plastic fiber and making toys and stuff like that. That's an application area that is beginning to take shape as we approach 2000. Anybody have any 3D scanning kind of integration with mainstream stuff?

Peddie: Mainstream, sure.

Kasik: Yes, absolutely.

Peddie: Coming back to Jon Hirschtick's point: You can take an Apple phone right now and go and scan your living room and then say, what would this sofa from Ikea look like in my living room?

Marks: Yes.

Peddie: You can move it around and change its color.

Hirschtick: Jon is absolutely right. The Apple iPhone and iPad can do that. Full CAD modeling apps that run on the iPhone, iPad, Android, and tablet like ours can use that LIDAR data today and scan it right in the model. You had the foresight to integrate that modeling into NURBS modeling like the common set of operations we have.

This is today. This isn't a future thing, it's a history thing. In our OnShape mobile app on the phone, you can LIDAR scan an object, bring it in, and then say, for example, "Drill a precise hole through it." The hole surface stays precise. This is a cylinder or maybe it's a funny bond shaped cutout. The things that are NURBS; some faces are NURBS, some faces are mesh. It's one solid object. We believe this is very much happening. So this is reality for our base today. There's no file export, import, and all that crap. It just happens on the phone because we believe mobile is going to pass. If I may, we believe that here at OnShape, people would say to us in a few years ago, "CAD and the cloud on a phone? You know, how would that work?" Never happen.

Hirschtick: In the future, people are going to say, "You're running CAD on your local computer with just a CPU you have locally? How would that work? How would that be powerful? And what about security? You put all your files in your local computer? We've been told never to do that." What about performance? How could it be fast enough? It won't be fast enough for generative." You're not going to do these 100 generative studies on your local computer. That's not going to happen.

Peddie: That's right.

Hirschtick: Maybe for the next computer you'll have 12 cores. You're still not going to do it. The GPU and graphics card is fantastic, but that's not the answer to all this, at least not with the software algorithms that we have today in these areas. That could change in the future. Maybe it's happening, and I don't happen to know about it. In the future, people won't be saying, "How do you run it on a tablet or phone?" They'll say, "Why do you run it not on a tablet, because the tablet has all these advantages?" The LIDAR scanning, the R view, that's not coming to your laptop, but it is coming to your iPad.

Marks: Let me ask a question. Have you ever thought about the future?

Hirschtick: <laughs> Yes.

Marks: The issue I personally have is reconciling the power of a phone. Right now I'm on a laptop in my library and the words are so small I'm having a hard time seeing stuff. Jon Peddie, how big's your screen? Like a 9 foot by 9 foot?

Payne: That's only a senior problem.

Peddie: I have two meters of screen.

Marks: Somebody has to solve the, "I can do everything on my iPhone except read the type or see the details problem." I wonder how we're solving that. I'm asking the question because Jon probably has figured that one out.

Peddie: I have the answer for you, and it's a classic answer. In fact, I just wrote about this the other day. I'm doing some research now on the history of workstations for my next book. In 1955, they dealt with this and they said, "Look, the users are demanding 3,000 DPI screens. But we can only deliver 512 at the very, very best. What do we do?" The answer was, we zoom into the areas of interest. Here's the big model, but we don't need to see the whole damn model all the time. We just want to look at this one nut, so you zoom into that nut.

Kasik: Yes, right.

Peddie: That concept, by the way, is the basis for NVIDIA's DLSS.

Kasik: That's fine but you need context: Where is the nut? That's different.

Peddie: You zoom out. That's how our brains work. It's the same way. When you go out and look at the world, you don't see the entire world with your vision. You have very selective focus.

Kasik: You have selective focus. That's a different story about how the vision system works, but I don't think I want to go there. That's longer than we have time for here.

Peddie: When you drive your car, your field of view diminishes as your speed goes up.

Kasik: It also fuzzes out on the things that you don't want to focus on.

Peddie: Right. Exactly.

Kasik: That's the issue with virtual reality, the vergence-accommodation problem.

Peddie: No, that’s a different problem’.

Kasik: Well, we’ll talk about that offline, Peddie. I think we’ll bore everybody on that one.

Reverse Engineering and Generative Design

Kasik: To make your point about 3D scanning and real applications for it, older production parts for which there are no drawings turn out to be really nice things if you can get a copy of the part and scan it. You can actually reverse engineer and rebuild that part. Certainly Boeing has done that with older production parts, and there's a whole unit in Salt Lake City that does that professionally and really well.

Peddie: It's also a critical application in AEC. You go and you say, "We want to either repair this or replace it." There are no drawings.

Kasik: Exactly. There are lots of interesting skunk works that take care of that and do that kind of work. I imagine it's pretty prevalent, although it's not advertised very much. That goes to my next point, which is talking about getting to generative design. The whole idea is that we have probably a billion parts or more worldwide that have been designed using conventional methodologies. How do you take that data and move it forward? We have this legacy of existing stuff that may or may not work well with new techniques and new technologies. The same thing's true with additive manufacturing. As has been pointed out multiple times, much of the stuff that we design now targets a specific form of manufacturing. Taking the extant stuff and making it work with additive manufacturing is pretty cool. It's a really difficult problem, and I'm not sure if anybody's really paying much attention to it.

Mid-sized CAD Companies

Brock: We're getting toward the end of our time. We have 8 or so minutes left scheduled. I just wanted to check in with you, Burt. Are there any issues or questions you wanted to try to get in during this last bit?

Grad: Thank you. I have a couple items I'd like to ask. One of you said there were four companies that were really critical during the 1980s and 1990s time period. You named three. What was the fourth?

Kasik: Siemens.

Payne: Siemens VLM.

Peddie: They're huge. They're one of the biggest ones.

Marks: I can talk a little about SDRC, which is now part of Siemens. We talked about Bob, Art, and Tiller and those guys. We talked about the data management system. Unigraphics went through McAuto and a zillion buyouts. You can tell when something's going wrong when a company gets bought and sold a few times. But when Unigraphics software is merged and Siemens is its own model of paying attention to the needs of big customers, that was the closest thing to the factory of the future that GE wanted to do and failed at.

Payne: I would like to add a thing that you may consider controversial. We work on the assumption that the largest of companies has the largest of problems, and in some respects, they do. But the more innovative companies are often mid-sized companies or even small ones. I think what allowed SolidWorks to rise was because it focused on the small- and medium-sized users, and some of them were unbelievably creative and they became larger companies. Typically, large companies only shed jobs. They don't create jobs. Look at IBM. It's a shadow of its former self. Why was that? They weren't innovative.

Marks: If you take the German Mittelstand, since we're in the mechanical thing, these medium-sized companies that were world leaders in their niche, they do have a different kind of CAD requirement that's more in the SolidWorks and PTC kind of a realm.

Special CAD issue of the IEEE Annals of the History of Computing

Grad: I think David Hemmendinger's still on. We talked briefly about maybe doing an *Annals* special issue. If I were to do that, we're going to talk about this history. Are there companies that we haven't talked about here that we should add to our list?

Peddie: Brad Holtz says he has 100 of them.

Grad: I don't want 100, I want 6.

Peddie: To come back to Peter's comment about mid-sized companies, do you want the 6 top or the 6 most innovative? Do you want the 6 fastest growing?

Grad: The answer is yes.

Peddie: That's 18.

Grad: In other words, I was going to ask you guys, are any of you willing to write an article?

Peddie: I am.

Grad: Jon?

Hirschtick: Are you're saying the analysts, not the company guys like me?

Grad: No. I want both. I'd prefer the company guys, personally.

Peddie: You want Jon H. He writes good.

Hirschtick: I'd be happy to probably write something if you tell me what you want.

Grad: I'm sorry. Let's start from the top. How about you, Joel? Are you willing to write?

Orr: Absolutely.

Peddie: He's a master writer.

Grad: Okay. How about you, Peter?

Marks: I'm more interested in that topic that I want to talk with Jon about later, so I'm going to defer on that.

Grad: Would it be a topic that would be interesting to the *Annals* for history or not?

Marks: Probably not for history, but maybe for the future.

Grad: That's a separate magazine. Michael, how about you?

Payne: Oh, I never learned how to write.

Peddie: There wasn't an adverb in there. He didn't say "be" right; he said to do writing.

Grad: Jon Hirschtick, you're very, very communicative. Would you be willing to write? Do you have time?

Payne: That's another thing we don't have a lot of in this world.

Hirschtick: Depends when you need it.

Grad: A year from now.

Hirschtick: I'm interested. I don't know what I'm committing to exactly, but I'm interested in turning the next card, so to speak. Give me a topic and a general length. Tell me what the purpose is and the timeframe you need it done in, and I'll respond to that.

Grad: We'll discuss it. How about you, Dave? You're sure talking a lot.

Kasik: Yes, I do talk a lot. It's a curse.

Grad: You write, or you just talk?

Kasik: No, I write and I edit and other things. I've got at least two articles that would be perfect for inclusion that are already written and published.

Grad: If they're already published, we can't use it. The *Annals* has to have original publications.

Marks: We've missed the entire analysis rules and/or you might be interested in *History of Analysis*, which is kind of a sister to NASTRAN, HKS, SDRC, PDA, tons of these things. I don't know what Harry Schaeffer's doing now, but he would be a source. There's a bunch of people. You could ask me and others about who should we talk to to get the *History of Analysis* if you wanted to do something on that. Then you have the people like Jon. He said, “Listen, we've got to get simple analysis and make it part of the package.” There's a whole history of that, too.

Peddie: The guy who would be perfect for this, but he won't do it, is Steve Wolf. He's done. He won't do anything anymore except raise dogs.

Hirschtick: I thought of calling him for this, but he's not going to do this stuff.

Grad: David Hemmendinger's picture is on here now, so you can see what he looks like.

Kasik: So going back to my comment, I do have reference material that could be used as a source for another article for *Annals.*

Grad: Okay. Good.

Mergers and Acquisitions

Payne: Peter, you wrote about what makes winners and losers, or you wanted questions or answers to that question.

Marks: Yes.

Payne: I think the parallel to that is in the business that we're talking about is what makes mergers work or not work. Most of them don't end up benefiting the acquirer. It hasn't changed from a book I read in the 1970s on mergers and acquisitions. Most don't work in the end for the acquirer. Usually works for the acquired because they get paid.

Marks: I think Siemens might be a rare example of finally sorting it out, mainly because they had some good technical people there to work it. The chance that a company can get bought and sold a zillion times like Unigraphics did or twist and turn like SDRC did and have the whole thing come together and still be relatively successful is pretty rare.

Payne: Yes, I agree. I actually suspect that OnShape is working, and I do believe that SolidWorks was successful. I think the reason why is because they didn't kick all the people out or have them working for the head of janitorial services.

Peddie: I don't know how it works with SolidWorks, but I can comment on this because I observed it from the electronics point of view and from companies like Intel and AMD and NVIDIA and others. Intel has the most deplorable record of acquisitions of almost any company in the world.

Payne: That's not Autodesk?

Peddie: Poured billions of dollars down the drain, and the reason it fails is because they failed to understand the cultural and emotional differences between a startup and their big bureaucratic grinding machine.

Payne: That's exactly right.

Peddie: The first thing that happens when they acquire a company is they start shoving protocol and rules and forms down the throat of these people who are used to getting up and doing whatever has to be done to kill the bear and move on to the next one. They are an example of how not to acquire companies. I think Jon [Hirschtick] has a perfect viewpoint to discuss this because he's been on both sides of the desk.

Brock: In defense of Intel, you could also say that any acquisition is competing with their X86 kind of monopoly position, which is so gigantic that no acquisition is going to move the needle at all compared to that, so they're kind of destined to fail.

Peddie: That's part of it, but when it moves, it goes deeper to the senior managers and their merit of pay on the basis of how they run their groups.

Brock: Yes.

Peddie: If an alien force comes in with better ideas that doesn't suit their payoff, they kill it.

Payne: Yes.

Peddie: So it's short-circuited. Not circuited, it's short vision, greedy managers that do it.

Grad: One of the questions for this issue of the *Annals* would be examining some of the acquisitions made during the period up to 2000 to see which ones succeeded and which ones failed, both for the acquired company and for the acquirer. I was in the business for many years of consulting on acquisitions and working with companies. Some did a beautiful job and grew billion-dollar companies by acquiring other companies, and others fell on their ass.

Peddie: Part of the problem, too, is the big companies hide their mistakes. If the transaction wasn't significant enough that it showed up on a financial statement that they had to report, they'd just say, "We acquired this company," no funds announced, and the little company they acquired disappeared. They become hiring tools, not really technology acquisitions.

Payne: Yes. But one of the few successful ones that Autodesk made, where you still see the product, was Reddit.

Peddie: Oh, yes. Big win.

Payne: It was a long time actually catching on. If Carl were here he'd tell you he wanted to do it, but somebody else called Carol [Bartz] didn't. And Carl will tell you, "Look, I was right," because it's dominant in the AEC design world. They're not repeating that in the construction business.

Peddie: Yes, but they did it in N&E. Their N&E acquisitions were very successful.

Payne: Yes.

Peddie: In fact, they're the leader.

Hirschtick: I'm going to have to sign out. I just want to say thank you Burt and thank you David for organizing this.

Kasik: Thanks very much.

Hirschtick: We appreciate it. It was fun. Let me know how I can help going forward and thank you all, many of you here. Thank you all for helping make my last 42 years an interesting ride with at times some useful results. So thank you.

Marks: Thanks. Wonderful chatting with everyone.

Orr: Thanks very much.

Brock: Burt, any parting words as we close down the meeting?

Grad: I loved learning about CAD, which I knew nothing about. You're a bunch of interesting guys, and I look forward to talking to you further.

Payne: And they have no opinions.

Orr: Best joke I heard today. <laughs>

Marks: Yes. See you, guys.

Brock: Thank you all very, very much.

END OF DAY 2 SESSION 7

