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Computer Aided Design (CAD) Pioneer Workshop
Day 1 Session 1: Introductions

Moderated by:
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Burt Grad

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Table of Contents

Introduction

David Brock: I'm David Brock from the Computer History Museum, and I've been working alongside with Burt [Grad] to try and facilitate this discussion, working with him while he "curated" the participants; this is one in a long series of Pioneer workshops that Burt has organized, and I've been lucky enough to do two with him in the past. One was on desktop publishing. The other on expert systems, and I'm really looking forward to the present workshop focused on the CAD (Computer Assisted Design) industry and its contexts. For these workshops, we like to maintain a more conversational, rather than sort of formal format, where we invite people to ask questions of one another, share opinions about topics, but also giving time in the schedule for each participant to kind of share extensively about their personal experience; and I think with the way that we've structured the outline, most of those individual contributions where people will speak at length about their personal experience will likely happen in the key companies sections of each day's meeting. For the outcome from the workshop, we're hoping that the conversation will yield lots of valuable information for students of history, and also a map for further exploration by historians and others.

Just in terms of mechanics, I will be trying to act as a kind of air traffic controller for the discussion. So, there is a feature in Zoom. I don't know if you're all familiar with it, but it's under the reactions button at the bottom of your screen. It's a raised hand function, and if people are able to use that when they want to make a comment, add something, ask a question, if you can use that raised hand feature, I will do my best to keep track of who's raised their hands and sort of call on people to speak as a kind of general rule of thumb.

For the schedule this morning, after this welcome, we'll move to a section of brief introductions where everybody could give perhaps a five-minute introduction of themselves and their connection to the story of CAD. Then we'll move onto an open discussion of early technology developments, 1960 to 1980. That's the time period where we're roughly hoping to keep the discussion today. We'll take a short break, and then return for discussion of key companies, where we think that'll be a good time for some extended remarks by Dave [Kasik] and Tom [Lazear] before opening it up more broadly. We'll follow that with another break, and then a discussion of key CAD applications, 1960 to 1980, before breaking for the day. Those are my initial welcoming remarks. Burt, are there any remarks that you'd like to make at the outset about your motivation for the workshop, or any thoughts that you may have initially?

Burton Grad: Thank you so much. I apologize for my voice but that's the way it goes. I've had too many years of using it. I'm Burt Grad and I thank you guys for participating. We really appreciate it. We originally thought that we could cover more than CAD. We planned to cover the CAM (Computer Assisted Manufacturing) and CAE (Computer Assisted Engineering) stuff, but that was far too broad. As Jesse [Barker} can point out, when you get into all the graphic stuff, it just brought in so much, and so many things would need to get covered, that those subjects will have to be done separately.

I've been in the [software] industry since before some of you were out of high school. I started in the 1950s with GE on the UNIVAC I, programming manufacturing control applications. I then went to IBM in the 1960s and 1970s, and then ran my own software company consulting practice for 25 years. I've been consulting for my son's life insurance agency for the last 13 years. So I've had a long time in the industry.

As some of you might know, the Software Industry SIG, which is the meeting cosponsor with the Software History Center at the Computer History Museum (CHM). We've been collecting software history since 2000 and we now have over 120 oral histories. We've done 13 Software Pioneer meetings. And we've produced 10 special issues of the IEEE Annals of the History of Computing. And we've collected many thousands of pages of documents about the industry for the CHM archives, and we encourage you to contribute your files when you have a chance to do so.

David has asked me to ask a few questions at appropriate times. Normally, I love to run these meetings, and tell people that I'm in charge, and they have to do what I tell them to do. But in this case, David's in charge, and he's going to tell you what to do. Thank you so much for joining us today and tomorrow. Thank you.

Brock: Thanks, Burt. I don't know if I'll be as prescriptive as all that, since I see myself more as a facilitator. Maybe now we could move to just some introductions of ourselves. I thought maybe I would start with the main discussant, and we could start perhaps first with you, Carl. If you'd like to just tell us a little bit about yourself and your relationship to the CAD story.

Bass, Hirschtick and Kasik

Carl Bass: Sure. Thanks, David. I came to CAD by way of computer graphics. I started a company in 1980 called Flying Moose Systems and Graphics that later got renamed Ithaca Software, and we ended up selling graphics toolkits to a number of people doing scientific, entertainment, and engineering applications. I met many of the people on this call in that context first, and we had a product called HOOPS, which I was amazed to see someone the other day is still licensing it. It's 40 years later, and it says something about this entire industry, that some of these products are still relevant, and some of us still have some relevant things to say about it.

I did that for a number of years, and eventually we concentrated on selling to makers of engineering software, and in 1993, we sold the company to Autodesk. I worked at Autodesk for about half a dozen years in a variety of technical positions, and then I left, and I started another company called Buzzsaw. I worked there for two years, and then sold the company to Autodesk. I went back to Autodesk, and worked there in a variety of executive positions for it must have been about 16, 17, 18 years, something like that, and so was involved in engineering software

for the manufacturing industry, and of course for architecture and construction, as well as software for entertainment.

Brock: Wonderful, thank you so much. Maybe we could just, going alphabetically, go to Jon Hirschtick.

Jon Hirschtick: Okay. Hi, I'm Jon Hirschtick. I started in the CAD field in 1981 as an intern at Computer Vision, and I believe I've worked in CAD continuously ever since. So, it'll be 42 years this month, and I always say to people who ask what was it like in the early days, or what was it like when you were just getting started, and I feel like today are the early days, and we're still just getting started. I think to start at the end that one of my conclusions is that today we're only half done as an industry. I've been at it for 40 years and I think we're about half done. I'm proud of what we've done, but most of the work is still ahead. Anyway, I was at Computer Vision 1981. Other highlights for me. I have more CAD and related things to talk about than I could possibly mention here, but I became the manager of MIT's CAD Research Lab where I also did some research. I got my degree. I wrote a thesis on some CAD research, and was a student of Dave Gossard's, and met many people in the CAD research community then. I probably met some of you then. I don't know when I met Carl, for example, but it might have been then. I don't know. It's hard to remember. But I met a lot of people in the community in that brief time in research. Then I left to start my first CAD startup that probably no one ever heard of. Then in 1993, I founded SolidWorks, and was the longtime CEO of SolidWorks. I ended up staying 18 years. We sold the company to Asset Systems along the way, after four years with Mike Payne, who was my cofounder there, and that's when I met Mike. Then I left and founded OnShape, another venture-backed company, and we sold OnShape to PTC [Parametric Technology Corporation] three and-a-half years ago in 2019, and I am at PTC now. I just recently stepped down as general manager. The OnShape unit has grown a lot since I've been here, many times over, and I made a personal change, as I'd done at SolidWorks, to not be the general manager. I am Chief Evangelist here now, and working on building OnShape and some products that I get involved in. So that's my life story of CAD in a few moments.

Brock: Thanks so much. Maybe we could next move to Dave Kasik.

Dave Kasik: It's nice seeing all of you. I know about half of you which is pretty good. I'm kind of the odd man out in terms of background. I started in computer graphics in 1969 doing computer animation as an undergrad in college. I went off and worked for a research company for five years doing computer aided engineering and software development for that kind of software, and then I moved off to the Boeing Company and spent 35 years there. During that time, I was engaged in all sorts of crazy computer software adventures, especially one that Boeing tried to turn into a commercial product. That was a research program that started in the late 1970s looking at computational geometry, and how to do 3D instead of just 2D drafting. It turned into a commercial product called ACIS that Boeing offered and was totally unsuccessful in the commercial realm. So, I know how to fail really well. I then did a lot of work with Boeing

over the last 25 to 30 years of my career there doing high performance visualization for 3D computer aided design models, software that's still in use today. It has somewhere around 25,000 internal users inside Boeing, and that's a topic that's I think, a little bit outside the scope of this particular conversation.

During that time, everybody on this [meeting Zoom] call wanted to sell something to Boeing. That was one of the big deals. We tried to use HOOPS. We certainly had PTC installations. We had Computer Vision installations. We did a whole bunch of stuff that just basically because Boeing was a company that people wanted to sell to. That gave me a broad view of how early CAD worked. I've been part of SIGGRAPH [ACM] since its inception in 1974, so I've seen the evolution of the graphics industry in terms of its applications. It's really interesting, I think, and I'm glad this call is happening with Burt and David because there are threads that people have, and I'm really interested to hear the threads that you all are able to deal with and have dealt with over your careers. We may have intersections, and we may not, and I'm glad that we're getting a more holistic view. So that's it for right now. Go, David.

Brock: Thanks so much. Tom Lazear, maybe we can turn to you for your introduction.

Lazear, Marks and Payne

Tom Lazear: Okay, thanks. Let's see. It's good for me to be in the presence of all these giants in the industry. So we've got a lot of stories to tell about how to fail in the computer aided design market. I spent 20 years with the Fluor Corporation. It's an engineering construction company specializing in petrochemical refineries and the like, and I was their first CAD coder. I wrote software in 1959 to automate the design of reinforced concrete foundations for vertical pressure vessels and followed that with a whole series of software packages for different objects that were common in processing plants, even up to the point of design of vertical pressure vessels like distillation columns and the like. And the approach was not to do it from a drafting point of view, but to do it from an engineering point of view. To engineer, design, and draft automatically the results from those, and so that went on from 1959 to the mid-1960s, and I kind of rode the wave of computer applications as they hired more people, until I finally got to my Peter's principle when I was MIS director at Fluor, a multibillion-dollar company, and that was an exciting experience.

So, in 1978 my son was a senior in engineering and was quite interested in CAD, and so he and I formed a company, and I worked part time, and he part time, and we wrote software together. We saw the PC revolution coming. We wrote a basic drafting software for Terak, and you all of course, have heard of the Terak personal computer. No, probably not. But we wrote it in the UCSD Pascal operating system, a very sophisticated software language early on, developed by Dr. Ken Bowles at the University of California, San Diego, and a brilliant guy. The software using the Pascal language was based on an interpreter that would be written for each piece of hardware, which made porting the programs written in the language just absolutely a dream. So,

we moved from the Terak to the Apple II in the early 1980s, 1980, 1981. And I think that was the only time we were the dominant CAD supplier in the world. We were the dominant CAD supplier for the Apple II. It was very popular in the education market, and we got little superchargers that you put on the Apple II to make it go faster, and when the PC came out, we just ported it right over to UCSD Pascal on the PC. Concurrently, at the same time, there was a fella by the name of Bill Gates, who paid a pittance for DOS from a little company called Seattle Computing and developed MS-DOS, which was licensed to IBM, as we all know. It just took the PC market by storm. So the brilliant software from UCSD died a sudden death in 1982, and we were riding that pony when MS-DOS took off around the world.

AutoCAD had a couple of advantages on us, so they were two or three years ahead of us. It took us a while to get to MS-DOS, and Autodesk was down the road, and we were never able to catch up. 1985 was the high watermark of the product we called VersaCAD at the time. It was in use by Caterpillar and Carrier Air Conditioning. GE Aircraft Engine had 3,000 seats. AT&T was using it for facilities. Caltrans was using it for highway work, and we were in "fat city," and we were selling through dealers and through private label deals with AT&T and with Staedtler Mars. Actually, Carrier sold it as their own software called Carrier a 2000. But it was about 1985 or 1986 when it became clear that Autodesk had won the battle, like in the sense of a VHS versus Beta [TV color technology], the principle in our world of technology, is that one wins. The other loses. Pascal lost. We were on the losing pony, and we lost out by 1986.

We found a buyer for our company and sold VersaCAD to Prime Computer which was trying to build their CAD arsenal, and they acquired Computer Vision shortly after they acquired us. So we went from the darling little PC CAD company in California to just that other company because all the attention went to Computer Vision. I became general manager of Computer Vision's personal CAD unit in 1987, and I stayed there until 1991 when I left to form a consulting firm.

We called it Archway System. I wanted to have an A name for my company because the A, Autodesk always appeared first in the company lists. My son and I have run Archway ever since. Our primary business now is what's called a channel partner for Bentley Systems, which we have been for 30 years. We're their longest serving channel partner doing consulting, training, and sales of their software to primarily AEC, 99% AEC market, and more towards the technical side. When people say AEC, I think what comes to mind is the architect and a builder, and we don't deal with the architect, builder side. We deal with the process plant design, road design, highway design, dam, civil, heavy civil construction, and the likes. That's my history, or you can read chapter 20 of Dave Weisberg's book ["The Engineering Design Revolution" by David E Weisberg], and you can get all the details.

Brock: Thank you, Tom. Next let's turn to Peter Marks.

Peter Marks: Well, what a pleasure to see everybody here. I met Jon [Hirschberg] just at his post Gossard days when he had his first thing. A venture guy sent me to Boston, and I've watched him create just amazing companies since then, and Carl [Bass] on the HOOPS days, and watched him be the hottest face of CAD for so long, battling hedge funds and everything else along the way. Anyhow, it's just great to see everybody. I put a little bit of a bio together because I've got a little bit of a different background, and it influences some of the questions that I hope we can answer here.

I was a kid who was really interested in product development, and I ran all over the campus. I was in the art and design school. I was in mechanical engineering. I coopted mechanical engineering, doing research on metal cutting. I'd go to one class and dissect sheep's brain to learn about cognitive psychology, and then do thermodynamics, and so on. So anyhow, I had this broad vision of what CAD was and I wanted to fill that out with manufacturing. So, I went to Ford for three years, and I ended up as their youngest manufacturing engineering manager at a plant that was labeled as a "savage "factory. It was a 6,000 people factory and ran amok. But for me, it was a great experience. I started an education company and ran that. SDRC was a client. I moved there to do education, and that was a terrific company.

I've provided some background materials for you guys to look at that and then worked as a general consultant. First, kind of in the CAD area, and then more broadly in new product development. Twelve years ago, I was assured by multiple experts that I was expected to die. I've been out of the industry since then, but I'm happily living past my expiration date. So the thing I guess I'd like to say is that one reason for history is to capture the stories of the people who made it. So we've got a lot of people who made the history of CAD here. But the other reason is to learn from It. To learn the lessons that we can move forward, and so the first thing that I said to you guys, I've got some questions where our experience might still be useful. One is, what kind of culture is a great place to make great software? We know from The Mythical Man-Month [by Fred Brooks] that it's one thing for a Mike Riddle to start making the code for an Autodesk, but something else to turn that into a company that fills out the suite. And then ask the same kind of question in terms of the culture of the company for meeting its customer obligations, balancing things. What lessons have we learned about that?

I thought it might be a little bit useful to talk about factors and rapid adoption, but I'm not so sure about that. I'm particularly interested though, in a question, which I've put as kind of number five, and it's out of bounds for this meeting. But if you have a chance to read it maybe tonight, if there's interest in it, it looks to me that we're living in a world where all kinds of software is hijacking our dopamine, and our brains. Click, click, click, click, like kind of rats, to the detriment of the world, and I think that some of the people here have some ideas or some capability to help that, and so I'm interested in talking about that. So that's it. I can contribute on SDRC. Know a bit about ATP. I have keynoted, I think maybe four of the CAD user groups here. Got a sense of those cultures and worked probably with about 50 companies in the field, helping them select stuff. Pleasure to be here.

Brock: Thank you very much, Peter, and next, maybe we could hear from Michael. Payne

Michael Payne: Hi, thank you. Well, hearing all of that, I realized that my first venture into doing anything in computer aided design was at the end of my undergraduate time. I had to figure out how microwaves reflected off of concrete, and if it might get dried or cured, and so I had to model it on a computer, and, in 1964, I went to a college that had a computer. It was in a house, a whole house, and later, I went to what's now a defunct company called RCA, and there we got a contract to make circuits, and I got put in charge of the circuit design for the Trident missile program because my undergraduate degree was in electrical engineering, and I had to model it, and they had a circuit analysis program, and I go to the CAD department and say, "Would you please do this modeling?" "We don't have time. It's not on the schedule." So I said, "I'll do it." So I had to figure out how to write software and model this stuff. I can't describe what I had to model because it's classified.

After that, I got hired at place that had a CAD department, and I went to the Prime Computer, and they had this CAD department, and that's getting closer to more reality, and I hired somebody there called Vladimir Giesberg, and after I left Prime, I get this call I could hardly understand from a Russian-sounding gentleman whose name was Sam Giesberg, and he says, "I don't know who you are, but my brother said I should talk to you," and that was the beginning of a company called Parametric Technology.

After that, every company gets bigger, and there was a time after eight years when a venture capitalist called Barry introduced me to Jon Hirschtick, who you've heard from, and we created something else called SolidWorks along with the PC world, but there was one thing I missed at PTC. Some tall guy from Rensselaer came and tried to sell me a product called HOOPS, and I can't think about who that was. But when we created SolidWorks, the original prototype had a product called Acis, and I considered it to be awful, and so I threw it out, and for that sin, after Dassault bought SolidWorks, my penalty was to fix Acis. All those B Spline modeling. I'm trying to keep it brief, and then we went on to do something that HP tried to do back in the 1980s, but the computer power didn't allow it. It was called SpaceClaim. That was direct modeling that Acis now has.

Brock: Thank you and I guess next is Jon Peddie.

Peddie, Holtz and Barker

Jon Peddie: My bio goes way back. I came to CAD from photogrammetry. I started out in photogrammetry. I kind of led the revolution, evolution of digitizing photogrammetry, and in the process of doing that, developed digitizers, which were basically up, down counters for XY plotters and XY data capturing devices, and from that, I figured out that there were other relationships, which led me to look at CAD. In those days, it was ECAD, and so again, I was a little bit of a pioneer in the ECAD layout of integrated circuits. I've been a hardware guy all my life, although I've done a fair amount of programming. By the way, the company I started was called Data Graphics Corporation, and I sold that company. I was living in Texas at the time. When I sold that company, that moved me to California. From there, I evolved into taking over a company that did GIS, and so that was kind of a fringe application of CAD since it also involved the same basic constructs and concepts.

Then I started a company called Jupiter Systems where we made high resolution graphics terminals. I worked with a bunch of these old guys here on that project, and in 1981, I thought it was time to quit. I wanted to be a paperback book writer. and so I was going to retire and write fiction. And my retirement lasted almost 30 days when former customers and venture capitalists called me and asked me if I could help them on this project, and help them on that project, and I turned to my wife, and I said, "You know what?" I think I'm in the consulting business," and so I've been in the consulting business as a failed retiree since 1981. I started a company called Jon Peddie Associates and built that up pretty well, and then I sold that to a big publishing company called Penton. That was at the rise of the internet bubble. Talk about good timing.

And then when the bubble popped, I suddenly became unpopular, and they asked me if I could go find some other venture, which I did, and started Jon Peddie Research, and I've been doing that since 2000. We basically track anything that has to do with a pixel, which does include CAD. We actually publish the industry standard report on CAD, CAD Market Report, and I've met just about everybody here, and made them suffer through my stories, and my pitches, and my ill-gotten philosophies.

I wanted to make a comment about something Peter said, build on what he said about what kind of people it takes. In my role as a consultant, I get involved with a lot of startups and spinouts where they seek advice about the market and so forth, and because I'm in the privileged position of being able to choose my clients, I evaluate them on the basis of their passion, and if you look at Carl [Bass], and Jon [Hirschtick], and Michael [Payne], and Tom [Lazear], these are guys who all came to where they were from passion, and they wanted to do this thing. The point I'm trying to make, is that the difference is if I encounter a company that's starting up and getting going, and they're asking for help, and very quickly into the conversation, they start to talk to me about their exit strategy, I exit because these people aren't in it for the passion. They're in it to make a few bucks. I don't mind making a few bucks. I'm very happy doing that. But that isn't what gets me out of bed in the morning, and so I would say that if you were looking for a

common denominator here, and the fact that they even showed up, that's another thing that's pretty damn amazing. If you're looking for a common denominator of this group of miscreants, it's their passion. Not a damn one of them that I know here started by saying how much money can I make doing this. They wanted to prove they could do it, and so I admire them all, and that's the reason I signed up.

Brock: Thank you so much. Brad Holtz, could we turn to you for an introduction?

Brad Holtz: So I'm looking at this screen, and it's incredibly impressive, and then I just did a little calculation. I think cumulatively, I've got about 240 years of relationships on the screen here. I wrote my first very simple graphics program in 1966 at the ripe old age of 11, and did early programming through about 1972, and realized that that was not for me. In 1977, I wrote my first analysis of the CAD offerings at the time for my father's architecture firm, which was about a 200 person firm at the time, and they were going to Calcomp, and Auto-trol, and Intergraph, and a few others, and that basically led me down the road of consulting, and I founded WBH Associates in 1983 as a small consulting firm in the field of CAD. And then in 1999, along with Joel Orr and Evan Yares, we pushed our firms together and created Cyon Research Corporation, and Cyon Research for about 18 years was a consultant to all of the major firms in the industry. We also held an event called the Congress on the Future of Engineering Software, or COFES, which most people here have been to or keynoted, and that was basically a short sandals, t-shirts, and beer around the pool, off the clock, no selling, let's have some conversations environment.

My role in terms of looking at the industry has been tracking and understanding the implications if the companies are actually doing what they say they can do. Others I left to go and figure out whether they are actually able to do what they're saying they do. That was the role that I played. Also, along with Peter Marks, and Terry Wohlers, I was president and chairman of the CAD Society for many years and sort of helped that along, and that's pretty much it.

Brock: Thank you very much. I'd now like to turn to some of the other participants on the call who aren't the prime discussants but are people who I'm very excited are with us, and who I hope will join in with me and Burt in asking questions and raising issues. You've heard from Burt and me. Maybe we can turn to Jesse Barker.

Jesse Barker: Hi there. I'm Jesse Barker, and I guess I have a couple of hats in which I might be loosely affiliated with this group. One of my hats is I'm the chair of the ACM SIGGRAPH executive committee, but I only go back about 30 years. I started at a little computer company that some of you might remember called DEC, which is where I had my first introduction into the X Windows system. Somebody mentioned earlier where they expected something to die quite quickly, and of course, it's still with us. For me that would be the X Windows system, which I started working on the internals of at DEC, and was told don't worry too much about this, it's only going to be around for about another three to five years. For those of you that have peeked

inside a Linux distribution, it's still there. Anyway, from DEC I went more or less to Silicon Graphics from there, and then to ATI. Then they got acquired by AMD. So maybe you're seeing a pattern of kind of low-level graphics system and display system software, and ended up at ARM for a while in their graphics group, and then made my way to Unity Technologies where I have done a bunch of things. At the moment, I'm interested in the management of Shader Systems. So basically, people writing the programs that the GPUs actually execute, and how that works in a creative tool like the Unity editing environment for producing various real time interactive content.

Brock: Great. Thank you so much. Daniel Llach, maybe you could go next.

Llach, McJones and Hemmendinger

Daniel Llach: Great. Thank you. Hi, I'm Daniel Llach. I'm an associate professor at Carnegie Mellon. I teach in the School of Architecture, and my main connection to this group is that I've been doing work on the history of CAD, but particularly on the academic side. So I've looked at the MIT CAD project and looked at things happening in Cambridge, England, and so on. I'm incredibly excited to learn from and have the opportunity to converse with so many industry pioneers whose work I am aware of, but I think this is a unique opportunity to learn more from you. So thank you, David, for the kind invitation.

Brock: Thanks, and Paul McJones, maybe you can go now.

Paul McJones: Okay. I'm Paul McJones and I'm sort of here because I'm a friend of Burt. I've been working with the Museum, and David, and others on software collection for about 20 years or so, and before that, I was a software developer. I started working in interactive computing in the late 1960s. I worked on two different time-sharing systems. Then I was at Xerox in the product group working on the personal workstations that were for office automation rather than for computer graphics. I led a project to build a 68000 based workstation with a bitmap display. But I'm here to learn about CAD and maybe I can ask a few good questions along the way.

Brock: Thanks so much. David Hemmendinger. Please introduce yourself.

David Hemmendinger: I really don't have much to say, except that I'm also a friend of Burt's, and I'm the associate editor in chief of the Annals of the History of Computing, which is the main reason I'm here. I'd like to know more about the subject and see whether we can have any articles coming out of this meeting.

Brock: So I think that's it. That's the end of the first session.

END OF DAY 1 SESSION 1