Oral History of Jeff Hawkins

Interviewed by:
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Donna Dubinsky: I'm Donna Dubinsky and I'm here with Jeff Hawkins who's graciously agreed to be interviewed for the Computer History Museum. It is July 30, 2007. Start by giving us an overview of where you grew up and how your childhood might have influenced your ultimate career choices. I know certainly you got some of your creativity from your father for example but your childhood reminiscences.

Jeff Hawkins: Sure. I grew up in Greenlawn, New York. That is on the north shore of Long Island. I was born in 1957, and I have two brothers and a father. We're all sort of engineering types of people so there was my mother and four men that sort of dominated and set the tone for the house. My father was what you might call a consummate inventor mostly in the marine world and the marine trades. We had boats and boating things and we had more shop space in our house than we had living space. So our garage was better equipped than our living house and I was brought up in an environment where we were constantly building things, very unusual boats, strange types of nautical things, lots of foam and fiberglass and wood and metal machines and so on. So that's the environment I was brought up in. I learned a lot of mechanical trades and skills in my youth and I also was exposed to a lot of crazy things most of which didn't work but still were interesting.

Dubinsky: Do you have any recollections of your early education, grammar school, high school, and did that have an influence on you or was it really your home life that was more influential on you?

Hawkins: When you say "influential," somehow influencing what I ended up doing ultimately in life?

Dubinsky: Yes.

Hawkins: No. My education was pretty normal I suppose and nothing particularly unusual about that. I think the really unusual thing about my home life was that my father was doing these crazy inventions. We would spend all our weekends in shipyards. The biggest, most unusual project my father built was this big, round houseboat which had a floating cushion underneath it and it had eight legs and looked like a spider and we toured around Manhattan with an orchestra on top, and my father was always in the news. He was on the cover of Look magazine. I remember in third grade he was on the cover of Weekly Reader which every kid in third grade got and there was my dad talking to dolphins with a microphone. This influenced my life more than anything else. He would involve us in the projects and at the time it wasn't always a lot of fun because we'd get up in the middle of the night because one of the boats had crashed or something, and we'd have to go out in the storm and try to salvage everything. And a lot of the projects didn't work very well so you had a lot of businesses, none of which really were successful, so there was always that kind of struggle. My mother kept the family going as a kindergarten teacher so that's where most of the income came from in the family. So it wasn't an easy childhood and our house had lots of problems. We had very little heat in our —house. I lived in an attic, a little attic with my three brothers. I had no windows in my room because we had a very small house and this was where we fit. But all the energy was going into these projects ….even our vacations were projects. We'd take one of these boats on trips and there was a lot of stress in this so it wasn't this ideal home. There was a lot of stress but through it all you had a lot of experiences which other kids just didn't have.

Dubinsky: How did you end up at Cornell? How did you choose Cornell? It's not obvious that that would have been a place for you to go.

Hawkins: I was brought up in New York. We didn't have a lot of money. I had state scholarships from New York so I was looking for a New York State school. Cornell is one of the best New York State schools and then on top of that, although I was going to study engineering, my major criteria was being able to take music theory classes and certain types of other classes which are not engineering related. So I probably could have even gotten into MIT but it wasn't as a broad an education as I wanted and so I think I only applied to two schools, Cornell and a safety school, and that was that.

Dubinsky: How did you know you wanted to be in engineering? What led you to that conclusion so early going in?

Hawkins: I didn't know I wanted to be in engineering. My father studied engineering. My brother-- … we were doing engineering type of work. In hindsight, as soon as I got to school I figured out I should have been a physicist because that's what I really loved but I'd just gone down this path of doing this kind of work and electrical engineering was interesting. Originally, I thought I was interested in alternative energy. I said, "I'm going to work in alternative energy." And my father went to me one day and he said, "This microelectronic stuff… It looks pretty interesting. Maybe you should look at that." And that was my first inkling of saying, "Oh, I'm going to look at microelectronics." I didn't really know much about it at all. I think I was a senior in high school so I started doing computer stuff and I just sort of fell into it. It wasn't a chosen path for me.

Dubinsky: But it was selected pretty early. A lot of kids don't know what they're going to do until much later in college.

Hawkins: Well, but most kids that go to engineering school for whatever reason … they have to know that when they're entering college. It's not something you decide later and it's a typical choice for kids who have either mechanical or other attributes that are suited for it and you don't know what you're going to until-- It's almost a vocational training type of thing.

Dubinsky: Did you end up doing the music theory and everything you wanted to do?

Hawkins: —I did. I took several years of music theory, I can tell you lots of stories about that which we won't get into here because it was actually very difficult. They didn't want me to take these classes as an engineer and I had to go to the highest levels of the university to get into the music program. So I studied music theory and I took agricultural classes with Janet [ed: Janet Strauss, Jeff's wife] it actually turned out. I spent a lot of time doing other things at Cornell.

Dubinsky: You met your wife at Cornell—

Hawkins: I met my wife at freshman orientation and she was in my dorm.

Dubinsky: After college your first job was at Intel. Is that correct?

Hawkins: That's right.

Dubinsky: Tell us about your experience at Intel.

Hawkins: My experience at Intel was …. they had a new campus outside of Portland, Oregon - Hillsboro, Oregon - and I was one of the first people to occupy this new campus. I was working in the part of the company that made single board computers so this is the first time that people were starting to take microprocessors and memory and make a computer on a board and they were putting these into industrial control machines and processes and so on. I started out as a support engineer basically, debugging problems and so on, but very much with a field focus. So I was writing a newsletter. I was traveling to customers. I was more on the sales side of it than on the engineering side of it. My first manager there was a guy named Juris Brempelis who was an absolutely crazy man. He was Latvian and he set the tone for the place but that's another thing I'm not going to tell you but it was a very unusual experience because of Juris. I think he's still in the Bay Area.

That was my first job. At Intel I did that for one year and then I moved to Boston for two years because Janet and I were separated but were still maintaining our relationship so she was going to go to Harvard Business School so I said, "I'm moving to Boston," and I said to Intel, "Do you want me to still work for you?" So I went out there and for two years I worked in their sales office doing training. I was writing courses and teaching courses on microprocessor design and how to implement microprocessors and software in computer systems.

Dubinsky: This is also the time when you fell in love with the brain. Right? Do you want to tell us that story?

Hawkins: Yes. I remember the exact time I fell in love with neuroscience. It was September of 1979, which is actually just three months after I got out of college and I read the September issue of *Scientific American*. It was all about the brain and I was fascinated by it and the last piece in there was by Francis Crick (that's Crick of DNA fame). Francis Crick wrote this piece about how we have all this data about the brain but we have no theory behind it. There's no explanation for it. And he was kind of saying, "Hey, people are writing as if they understand how the brain works." But no one admits that they have no clue how this thing works and I thought that was great. I saw that there was a truth in that. I said, "We have all this data and we should be able to figure this out." I said, "What a great thing to work on." And so at that point in time, even just starting my career at Intel, I started working at making a career out of neuroscience. It just took me a long time.

Dubinsky: You tried to get Intel to work on it.

Hawkins: I first tried to get Intel to work on it. I wrote a letter to Gordon Moore, very presumptuous for a kid right out of college, but I explained what I wanted to do. He put me in touch with Ted Hoff and I met with Ted. I flew out to California and met with him and talked to him about it and he had a lot of knowledge about early neural network theory. He told me he didn't think it was possible to figure out how brains work within our lifetime and so he said Intel had no interest in doing that. I was disappointed but then I applied to MIT because I was living in Boston and they rejected me. I wanted to study brains and

they wanted to build intelligent machines without thinking about brains, and I said, "No. You have to understand neuroscience first." I started this long process of multiple attempts to get into theoretical neuroscience with the ultimate goal of building machines that work like the brain works.

Dubinsky: Then you went to GRiD. Right? How did that come about? How did you end up at GRiD instead of staying at Intel?

Hawkins: Yes. So I was in Boston. I liked Boston. We were working there. I was trying to find a place to do neuroscience in Boston. Janet was graduating from her business school and she said, "Hey, I've got an interview in California. How would you like to live in California?" I said, "I don't want to live in California. I like it here in Boston," but she said, "Well, I'm going for the interview anyway." So I called up my old original boss, Juris Brempelis, who happened to be starting a new job in California at a startup company called GRiD. I said, "Juris, what are the job opportunities like in California?" And he says, "We need you right now. I have a job for you. If you get here within two weeks, you can start." And I was just putting out feelers and I had a job offer I had to accept within two weeks because they were about getting ready to introduce the original GRiD Compass. I had to make a decision: What do I do? So I got on a plane and I moved to California. Janet hadn't even finished her schooling yet and I started working out here and sleeping on Juris Brempelis' living room floor for a couple months and then Janet and I got married back east and then we both moved out here and she didn't have a job originally. That's how we ended up out here.

Dubinsky: You accomplished an awful lot at GRiD. Why don't you tell us a little bit about GRiD, what it was trying to do, what you thought your most significant technical or product achievements were there?

Hawkins: When I joined the company I was very junior. They had already designed and were about to ship the original laptop, the GRiD Compass, so I had a marketing role. I was doing technical training. I was putting together materials, putting together training courses for end users and so on, but very quickly I started doing some engineering work. I created a product, a tool to let you completely control the computer to make demos so you could have it run through all its different applications, download stuff online and so on. This tool became a programming language called GRiDTask and it was what we called at the time a fourth-generation language. It was fairly high level, basic, but fairly sophisticated and it kept growing and growing. It also became really critical to the success of the company because people were starting to implement very large applications and company applications on GRiDTask. So they had no choice but to move me over into engineering which originally the marketing team didn't want me to do. I said, "I want to go to engineering." They said, "No. We like you here." But they had to because I was creating this very large programming language. Then I created a compiler for it and it became instrumental for the company's ongoing success.

Dubinsky: Did you actually write these yourself?

Hawkins: I wrote the programming, yes.

Dubinsky: --as well as designing them--

Hawkins: Actually, yes. You may not know this— [laugh]

Dubinsky: I wondered whether you actually ever did any programming.

Hawkins: No. I did. To give credit, there was a guy there named Tim Wiegman who had created a little kernel of the beginning. I took that from him and I had never written a programming language before but very quickly figured out how to do it. So that was going along and I was in the middle of this. Then I left GRiD to go to Berkeley to study neuroscience and I said, "I just have to do this." I got myself into a Ph.D. program in biophysics at Berkeley. I quit my job at GRiD completely. They begged me to stay on at some level so I did some consulting for them while I was away and then I continued to do the GRidPad while I was away and I came back-- I said, "Well, I'll come back if I can do the GRiDPad." It's a long story there but "I'll come back if I can do the GRiDPad." So I came back then as a more senior person in charge of building a whole new computing product.

Dubinsky: Let's get to GRiD but just to go back quickly to the Berkeley interlude-- It did not meet your goals there at Berkeley or how did you feel about the Berkeley experience?

Hawkins: Again, this is after a point I had tried to do my neuroscience work at Intel. I tried to go to Wang actually because they were a big company back in Boston at that time. I was rejected from that. They were starting to have problems. Then I tried to apply to MIT. I got rejected there . So now I'm out in California and I said, "I've got to keep going at this." So I then said, "I will try to go to Berkeley. I'd rather go to Stanford." I would have applied next to go to Stanford but Stanford had nothing close to anything I could possibly do. They didn't even have a biophysics program. They had two graduate students in biophysics and they were medically oriented. Berkeley had a big biophysics program. At the time there was no theoretical neuroscience. And I said, "Okay. So I'll study the biology." So I had to take all the exams and everything. I worked at it for about a year to get myself to apply. I got in. Then I went there. In my first six months at Berkeley, they wanted me to take all irrelevant classes like biochemistry and things. I wanted to take neuroscience classes. I had a little bit of a run-in with them on that but we came to an agreement so I was taking some neuroanatomy classes.

Then I wrote a paper on what I wanted to do for my graduate thesis and I did this for the chairman of the graduate group of neurobiology, a man named Frank Werblin. He's still at Berkeley. This was a 60-page paper about the beginning ideas I had about how cortex would work and arguing why we can solve this problem. He read it and he had the other faculty in the neuroscience department read it. He said, "This is really great. You ought to do this but you can't." And I said, "What do you mean I can't? I just spent a year and a half getting to this position and multiple years if you consider all the other things I did." And he says, "Well, because as a graduate student you really don't get to do what you want to do. You have to work for a professor in their lab doing the kind of work they want you to do and there are no professors at Berkeley doing this kind of work. In fact," he said, "I don't know of any professors anywhere doing this kind of work. It's great. You have good ideas. I have no recommendation for you of how you go about this." Well, he did have a recommendation. His recommendation to me was "Continue your graduate education doing something in neuroscience related but different than what you wanted to do. And then after you get your degree you do a post doc. You probably still won't be able to do what you want to do. After you become a professor, you might be able to do what you want to do."

I looked at this process and I interviewed a bunch of people and I realized this would never work because once you become a post doc and a professor, you've already committed yourself to a line of work and you can't change. It just wasn't going to work. I was really disappointed. At first I was elated because I was starting to make progress on this problem, and then the second time I was disappointed because I had worked so hard to get here, and I was commuting an hour a day to go to Berkeley and I was putting up with so much crap, and then I was told, "Man, you can't do it." I felt like a fool to go through this whole process.

Then I took a total of two years off where I maintained my student status on leave so I could use the library. I'd go up to Berkeley to the library and read papers but I wasn't taking any classes. I wasn't interacting with much faculty up there. I was trying to figure out what to do, so I was still consulting for GRiD. I was working on some ideas and I worked on this handwriting recognition software because I saw a demo made by a company called Nestor where they were trying to sell handwriting recognition for a million dollars and I said, "Well, that's ridiculous. They're using neural networks." I said, "I can do that. That's not hard to do." I played around with that and then I came up with an algorithm for doing that. I started thinking about building pen-based computers and then I realized you could build a pen-based computer, and this would be kind of cool. I could do that at GRiD or I could do it elsewhere.

So the way this all went is I said, "Well, I can go back into the computer industry. I'll have something to work on, doing this pen-based stuff, and I'll just do it for a few years because I really don't want to do that. I really want to do neuroscience." So I said, "Four years." I said, "I'm going to give myself four years and in four years I'll meet four criteria. I will mature … new ideas will come to me about how to pursue this neuroscience thing." I figured that neuroscience would mature, that it'd become more open to people doing theoretical work, which at the time they weren't. I figured I'd make a little bit of a name for myself so it was an explicit goal in order to have some credibility so I could come back in and say, "I really could do this stuff. Give me a shot." And then the final thing was I figured I'd make enough money that I could afford to be a student again because I wasn't making anything and I was starting to raise a family, and I needed to put a little of a nest egg together. So I said, "Well, I'll make enough money so I can basically fund myself to do this research." Those were my four goals. I gave myself four years, and I went back. I actually looked at working at GO Corporation. They tried to recruit me to GO, but I decided not to do that. Instead I decided to go back to GRiD and started what became the GRiDPad project.

Dubinsky: You did what we ended up calling PalmPrint, the handwriting recognition, on your own, brought that back to GRiD and licensed it to them.

Hawkins: Yes. That's right.

Dubinsky: That was in the GRiDPad. Right?

Hawkins: Yes.

Dubinsky: Why don't you tell us about the GRiDPad and how you came up with the idea for it and what it was meant to accomplish.

Hawkins: Well, I definitely got the inspiration from seeing this demo at a booth in a trade show shown by Nestor.

They were a startup company. This was in the beginning of the neural network craze and they had a Nobel laureate on their staff. They were promoting themselves as the most technology advanced neural network and they were not showing a tablet computer. They were showing a pen on a regular tablet. It wasn't a screen. And so they were showing that you could enter text in a computer by writing like this. Well, I wasn't very impressed with that but it did give the idea about a stylus- that was the first time I had ever seen a stylus as an input device for a computer. They had existed before, but I never had seen it before. And so I said, "That's interesting and the handwriting's interesting and I think I can do this and someone thinks it's worth a lot of money."

I started thinking about it and of course I had a heritage at GRiD of working on laptops and I knew the mobile computing space a little bit. I knew that there would be a market for tablet computers that were designed for corporate applications because GRiDTask had prepared me for that because we were selling laptops, not general purpose business machines because it was hard to do that at that time. We were selling them into vertical applications so the laptops were being deployed by salespeople and by field forces of various types. I said, "Hey, we could build a machine which was keyboard-less because you could hold it in your hand and you could be more interactive and it'd be easier to use." You have to bear in mind in the early 1980s, the idea of using a keyboard by a business person was very odd. They didn't want it. They didn't like it. You showed them a laptop like a GRiD Compass and they'd say, "Take that way from me because I can't type. My secretary types. That doesn't belong in my office." It was a big obstacle then - things have changed completely now of course. So the idea that you could have a computer that you didn't have to type on and you could just touch things with a pen would overcome a lot of the problems we were having at GRiD. So I said, "Yes, there's a market for that." And so I said, "I can build the whole thing end to end". I knew all of the components and so I pitched this idea to GRiD. I said, "Look. You're not thinking of doing this at all but this would be a good product for you to build. I could run it. By the way, I have some technology and you have to license it from me". This was very tricky because now I was coming back in as an employee, running a project with their funding but I have a special deal, which is that as the product sells I get royalties from it. This was an unusual situation and there were a lot of difficult negotiations to make it all come about. It took a while but in the end it came about and then I formed a team and we started building what became the GRiDPad.

Dubinsky: How successful was the GRiDPad?

Hawkins: It was successful. It was good and bad. This is one right here in case you haven't see it. It was a $2500 tablet computer. It had a pen at the top here and you could tap on the screen. This wasn't the very first tablet computer. There was another one that never really made it to market but someone actually built a few of them but this is the first one that ever went into production. It success was good and bad. First of all, it generated a tremendous amount of interest. It was a really major launch for GRiD. It was in all the papers. We got a lot of PR [public relations] on it. We had a tremendous number of trials going on with it. At its peak, I think we did 30 million in revenue with it, which actually was not bad back then. That was a lot of money back in those times. This is 20 years ago. But it wasn't a huge success either. It wasn't a runaway success and it had issues but what really helped was it provided something for the company to galvanize behind. It provided a future direction. When the company was ultimately bought by Tandy, it was one of the major reasons they bought it because the company had forward-looking

products. So I think from an investor's point of view, the company was very successful. Did the business last forever? No. The company got absorbed but they built several follow-on products - smaller ones - and it continued on for many years so it wasn't a huge success but it was a success. Definitely, from an employee and an investor perspective at GRiD, it was a success.

Dubinsky: Is this the same environment where GO is out there generating all this noise and hype? You mentioned that you didn't go there but how did you see them and how were their products different? What was the difference?

Hawkins: I interviewed at GO right after they formed. In fact, Celeste Baranski was there. They had six employees at the time and they were just getting started. I came in and I had already been designing the GRiDPad. I'd been thinking about it. I hadn't started at GRiD yet but I had been thinking about this quite a bit, and I came in and I had very definite ideas about where the market for tablet computers was going to go and what the pen was all about, and how to do handwriting recognition. I'd been designing this stuff. And they started painting this picture of this huge nirvana of replacing Microsoft with pen-based computers and it's all about getting the operating system right and integrated applications and I was listening to this and I said, "This doesn't sound like a startup to me. This sounds like people dreaming." And they didn't seem to have any sort of market reality to the whole thing. They weren't interested in my knowledge about handwriting recognition. They weren't interested in my knowledge about how to design mobile computers. They basically thought I would be a good evangelist and so they said, "Well, we'd like to hire you as an evangelist," and I said, "No. That's not the right job for me. I should be a product designer." And they said, "No, no. We have all the good product designers we need. We just need an evangelist," and I said, "Well, I'm not going to do that," and I told them this. "I'm going to go back to GRiD and I'll do a competitive product that will really be different. I'm going to focus on vertical markets and you guys are going to focus on end user consumer products." That's what they were going to do. It was a little bit odd, a little bit tense, strange relationship at that point because I went off and competed with them in some sense.

I'm sure they dismissed GRiD completely because they were doing the big, grand vision and GRiD was doing this narrow, DOS-based tablet computer. The GRiDPad came out before the GO computer did. The original GO computer never shipped. We actually built the business and somewhere in my archives I have a letter from Jerry Kaplan congratulating me on getting the industry going. There was a whole wave of pen-based hysteria, incredible, just multiple companies, investments and VCs [venture capitalist] and conferences and they're all pursuing what I thought was an unrealistic dream, and GRiD was viewed as a poor, sad, little old-school company but we were the only company that sold anything. We were the only ones who sold product and made money and had profit and almost everything else that was invested in was a waste.

Dubinsky: It's amazing to me that still today Microsoft is producing products like this that are not succeeding. What is the fundamental thing that all these guys missed through all this time and they continue to miss? Why do they keep getting this wrong?

Hawkins: Well, it's a complex question - why do they get this all wrong? Definitely one mistake, early on, they were focusing on the pen as the primary reason for doing new computing platforms. GO's tag line was "The pen is the point."

Dubinsky: That was the name of the OS [operating system]. Right?

Hawkins: Yes, PenPoint. That's right. They are saying the pen is the point, it's all about pen computing. I remember getting up at one of the conferences after John Doerr got up because he was an investor in GO and said, after Jerry Kaplan presented, "Isn't this great that the pen computing industry is getting going? I want to applaud everyone working on it," blah blah blah. I was in the audience and I got up and said, "I'm sorry, John." I said, "I just disagree." I said, "There is no pen computing industry. You guys are all wrong. There is mobile computing and the pen is part of that, but as long as you keep thinking that pen computing is what it's all about, you're just going to miss it." And I was the bad boy because I was the only one speaking a different tone there. Everyone was into this hysteria.

I think that was one of their major distractions. They thought it was all about handwriting recognition. They thought it was all about entering text with a pen. Everyone kept talking about how good is your handwriting recognition algorithms, and using gestures and all this stuff, and my experience was that wasn't really what was going to make it fly. Those are shortcomings of the product. The advantage of having a stylus interface is it allowed you to introduce a product that was smaller and didn't have a keyboard. That was the advantage of it. Using a pen enabled that smaller product but it also introduced problems. It wasn't the main point about it. So we tried to minimize the amount of text entry using handwriting recognition. We tried to focus on capturing ink and other things that were going in the opposite direction. They all got carried away in this hysteria about pen computing.

Dubinsky: That's funny. This whole issue of handwriting versus keyboards and text entry and all this has been such a theme in your career—

Hawkins: Yes, I know. It's a little unfortunate.

I'll show you this product. This was the first convertible laptop and I designed this at GRiD. We were doing the tablet, the GRiDPad, and then we had some customers who said, "Well, sometimes I need a laptop. Sometimes I need a tablet." So I said, "Well, let's design a computer that's both." So this was a tablet computer that was also a laptop and I came up with this hinging mechanism myself with another guy named Jack Daly and it was really clever. It worked. It really worked so you could use this as a stylus computer like this, and then when you wanted to you can open it up like this. We introduced this and at the time Microsoft had Windows for Pen Computing, so we had our own environment plus Windows for Pen Computing running on this. Bill Gates talked about this at one of his Comdex speeches and said, "See, all you skeptics. This is a great new product," blah blah.

This product was a complete failure. I thought it would do well because it was a great design and it met the requirements of what we were trying to do, getting a tablet and a laptop together, but it was a failure. I learned from that lesson that the two really don't mix, mobile computing and laptops, and also that when people buy laptop computers they don't want to compromise. So people would say, "Well, this is a fine product but I wanted one that had a slightly bigger disk drive" or "I wanted one that had a slightly different port" or whatever it was and they weren't giving much value to the pen/keyboard combination. Anyway, it was surprising to me that it didn't do well and so I said, "This is not a good idea," and then of course, as you asked me a minute ago, they are still building these things and they're still trying over and over and over again, and I gave up on it long ago. This was 15 years ago. I said, "This is not going to make sense."

Dubinsky: So it wasn't that the technology wasn't ready and that more time could get you there. It was that the fundamental need wasn't right.

Hawkins: It wasn't right. The idea that you had a laptop and you want to write on something-- it's too big for a mobile computer, for a little handheld computer and then it had some compromises as a laptop. We got away with this because there was nothing else at the time. It was too big but there was nothing else at the time. This was the only game in town so we sold these but very quickly realized people wanted smaller, smaller, smaller. And so this of course is too big for the tablet. GRiD was making tablets that were half this size at that time. It was a combination of things but I said, "Hey, the convertible idea doesn't make sense. I'm not going to do that again," but they've been trying it now for I don't know how many years, almost 20 years.

Dubinsky: I think this brings us to Zoomer so tell us about how you came up with the idea for that and what is the genesis of that product.

Hawkins: This is the genesis of the Zoomer. I was at GRiD. We were doing tablet computers for vertical markets. Customers who were using the GRiDPads and the follow-on to the GRiDPads were saying, "Hey, I like this thing. It's really easy to use and it's so easy to enter information on. You just touch it." And people were telling me, "If you just could make a really small one and really inexpensive, I'd like to use it personally. If you could get it under $500 and you could make it small …. And I heard this from a couple of customers unsolicited and I said, "Hey, if people tell me that they probably want that," and I started thinking about how you'd do a consumer version of the GRiDPad. I said you could do it. Sony at the time had done a series of products called the Palmtop and so we got those. They were only available in Japan. I had those products and they were building these smaller so the consumer tablet computers, very Japanese-like, very difficult to use, but clever, and I said, "Well, we could build something like that and then we could build a better interface on it and we can make a small consumer product." It became very obvious to me that people in the future would all have small computers and that Moore's Law would continue to make things smaller and smaller and smaller and we'd be able to put very powerful computers in smaller and smaller packages. So I got excited about working on that.

By the way, this was a little bit of a disappointment for me because my four years in my neuroscience career, these four years were up and I was scheduled to go back into neuroscience. I had accomplished what I wanted to accomplish. I had made some money. I had made a little bit of a name for myself. I had matured. I figured out how to do things and I said to myself, "Well, according to my schedule I should be going back to school now, right, or going back to neuroscience," but I got so intrigued with doing a consumer version of the GRiDPad that I said, "Well, I'll just go do one more thing. I'll do this consumer GRiDPad because it'll be fun." And that's when I started calling it; it was the Consumer GRiDPad and then we started talking to our parent company, Tandy, and they said, "What's the code name for this thing?" And I said, "There isn't one". Then I said, "Well, it's the Consumer GRiDPad" and then I said, "Consumer Zoomer." I said, "Well, let's call it the Zoomer," and it was the half of "Consumer." So I made up that name as a code name and I started talking to Tandy. They were very excited about this but then I realized that this was not a place to do this. I couldn't do it at GRiD. GRiD had problems and it was a company focusing on vertical computing markets and this was a consumer product. I really couldn't do it within Tandy because they didn't have the right sort of strengths and abilities. Even though they were a retail presence, they didn't have the right sort of genes for building [this business].

Dubinsky: We should mention they owned Radio Shack.

Dubinsky: They owned Radio Shack. That's right. And they were actually at that time one of the largest personal computer manufacturers in the world. I think they might have been number three. They were building huge factories. But I met John Roach and I met the other people there and I said, "This ain't going to happen" because my ideas about product design and how you build companies and how you build teams … it was just totally different than Tandy. This was an old-school company in Texas and the idea that I was somehow going to be working with their engineers in Texas building this consumer product—wouldn't work. I couldn't have attracted engineers. It was totally against the whole Silicon Valley sort of culture. It just wasn't going to work. They had technology and said "Well, you have to use our technology," and I said, "No. I can't use your technology." After I convinced them this was a great idea and after I had everyone at GRiD interested in this, I had to somehow tell them all that I can't do this here, this doesn't make sense to do here. If I could, I would have. But I knew I couldn't do it there and so I had to say, "I'm going to leave and do this elsewhere." They were very upset about this and they went through all kinds of machinations to keep me there and to make it difficult for me to leave. But I had to leave in the end. That was one of the most difficult parts of my career, trying to extricate myself from GRiD and Tandy in order to start a new company, yet I also needed the technology for the handwriting recognition. So I needed to take some technology which was now owned by GRiD and Tandy with me as I leave to make a product which they were all excited about.

Dubinsky: How did you pull that off?

Hawkins: I forget whose suggestion it was. It might have been Bruce Dunlevie's or somebody else's. Basically, the way I pulled it off was to make Tandy a partner in the consumer product. I said, "Look. I'm going to leave. I know you don't want me to leave but I'm going to leave and I'm going to start a company to do this but we'll strike a deal with you early on where you can be part of the process. You can have early access to the product, and you can be the first one to sell it, and you can invest in the company." That was I think Bruce's contribution. "You can invest in the company so it's like you have a part of it, too." And we did that and it all worked out. Again it was actually very, very difficult because at the 11th hour, 11th hour and 59th minute, almost the day I was going to leave, the guy who was running GRiD at the time had a staff meeting and he pulled us all in there. It was my last week there and he says, "I've decided that we're not going to give Jeff the technology and we're not going to participate in this and we're not going to help him at all," and I was "Oh, no," and so I had to scramble and I ran around and talked to everybody and it was hard.

Dubinsky: It sounds hard.

Dubinsky: Now you founded Palm, you've separated yourself from Tandy and GRiD, and you're starting down the path of creating the Zoomer. And it was hard to create the Zoomer. So first maybe we should start with one of the most fundamental decisions you made which was to use the GEOS [Graphic Environment Operating System] operating system. How did that come about?

Hawkins: The whole context of this is that I wanted to build consumer handheld computers, and I was trying to figure out how to do it. I was looking at it internally with Tandy, and then I was approached by some VCs [venture capitalists]. One of them was Bruce Dunlevie who was an investor in GeoWorks, and

GeoWorks had an operating system. So I was targeted as one of these kids, they look at the conferences and they say that's a smart person and maybe we should go talk to him. So Bruce came to me and he said, "What are you doing, what are you working on?" I said, "Well I'm trying to work on these consumer things." VC funding goes through these waves of what they think is hot, and at the time application software was the hot thing, and it was viewed that you shouldn't go hardware, because that's old school, no one does that anymore, no value there; and that operating systems were really too hard-- very, very difficult to build. And after the continuing failure of GO [Corporation], no one wants to invest in new operating systems. So he said, "Hey, you ought to start an applications company." And then, "I already have an investment in this operating system company called GeoWorks, why don't you check them out and see if it's suitable?" Then I met Brian Dougherty in Berkeley at GeoWorks, and I looked at their technology. And it looked okay. It's very impressive looking on the outside. It's actually when you scratch the surface later you realize it's really complex. But at the outside it looked pretty good-- very fast, very beautiful, very impressive looking. And so I said, "Okay, well that makes sense." I was, sure, whatever; if that's what you recommend. It wasn't like I was trying to start a company; remember I was being asked to start a company. So I said, "Okay, well I can do the applications company and then GeoWorks can provide the operating system, and we'll get Tandy to manufacture it, because we've been talking to them, we're trying to put this altogether." And that's how that came about. It was not very well planned. It more just fell into place. It wasn't like I had this grand plan that I knew what I was going to do.

Dubinsky: Well you wanted to build this consumer handheld.

Hawkins: Yes.

Dubinsky: Yet you didn't end up forming a company to do the hardware. So you were focused on the software.

Hawkins: But only because I was told that I'd be foolish to start a company doing the hardware. I was told that application software was where it was hot-- that's where it was at, you would be crazy to build the hardware. So I said, "Okay, you know best-- I don't know." I'd been building hardware but it was a struggle and maybe they know better. And anyway the VC's were not interested in funding a hardware company, they were only interested in funding an application software company. So again I was more focused on the product and other people were almost crafting how it is that you're going to get that product. And I said, "Yes, I know the product I want to build." And they said, "Okay, well we'll put these pieces together for you." And I said, "Okay." And I felt that I personally wasn't interested in building a big business. I wasn't interested in building a business as much as I'm interested in building a product. So somehow having other companies do more of the work sounded good to me-- less things for me to build. I just wanted to put it all together.

Dubinsky: So the Zoomer ended up being a consortium including Casio who actually built the hardware. Can you describe a little bit about designing the product by a consortium?

Hawkins: Yes. Tandy brought in Casio to build the hardware, and also Intuit and AOL were brought in. So we had this consortium, as you say. Even though I started the whole thing and it was my idea, very quickly it became clear that these other companies didn't view it as Palm's creation, that we were just providing some applications, not even all the applications, and we were providing the core technology for

handwriting recognition. But Casio viewed it as their product, and Tandy viewed it as their product, and GeoWorks viewed it as their product. AOL and Intuit, I don't think they viewed it as their product but they had their own input on the fact. So we ended up having these monstrous meetings where all these companies would get together, and I think we alternated between the United States and Japan, and we'd get in these rooms and we'd try to hash through all these product definitions and product issues, and it was just a mess, nothing could get done, it took forever. Decisions were made by committee. Things that we wanted to do they said you can't do and vice-versa. So it was a struggle to do that. And at this time I'd hired Donna Dubinsky as CEO because I couldn't deal with this, and she was managing the whole relationship between Palm and all these companies. I was trying to just focus on the product, which I could do. But in hindsight it was a disastrous way of building products. In hindsight, you lost control of everything and you trusted other people-- like if they say that's the right way to do it, well that's the right way to do it; and implicitly trusting that this consortium would put the right things together. It didn't happen.

Dubinsky: I do think this was a big lesson that later came to play in the Pilot story.

Hawkins: Yes.

Dubinsky: So that's why I'm harping on it. When you're building something that's substantially different than in the past, a singular vision driving it seems a lot more effective than this.

Hawkins: Yes, it was a big lesson that we learned, all of us learned.   It's so clear now that great products come about with teams of people, yes, but there has to be a person in charge who is basically setting the vision for what this product is and making difficult choices. And why they're difficult is not that they're technically hard or anything like that. But you have to make choices about product direction that not everyone agrees with. And you say, "I don't care. If we can't all agree it doesn't matter. I'm picking -- under my big vision or my grand theme, this is the right choice to make, and if it's the wrong choice it doesn't matter, we're making it and we're going to go down this path"-- as opposed to hashing things out and you end up with what happened with the Zoomer -- we just ended up with compromises, compromises, compromises. It's better to have a very clear vision, a very clear focus, make clear decisions and get some of those decisions wrong but in the end the product still hangs together pretty well. Yes, after going through this really bad experience with the Zoomer and Casio-- and we can talk more about it-- but when we got around to doing the Pilot, it was the exact opposite. We had no partners, we had no resources. We said it's just us, there's nobody else going to be involved, we're going to make all the choices and we don't even have the opportunity to spend time and money experimenting. We just have to go for it, we only have a little bit of money. And that singular focus and drive really made the product successful.

Dubinsky: Let's just finish off a little bit more on the Zoomer and then we'll move on. So the Zoomer failed.

Hawkins: Yes.

Dubinsky: Why did the Zoomer fail?

Hawkins: The Zoomer failed because it was a bad product. This is the Zoomer. It was very similar in size to the Newton. These two products were coming out around the same time. The Newton was creating huge amounts of interest, just tremendous amounts of PR and interest. And this was the poor step-child or cousin to the PDA [personal digital assistant] family. Both products were flawed pretty badly. The Zoomer's flaws, we can list them briefly: it was too big, it was too expensive; primarily it was too slow. The things it did might have been okay if it was really fast doing them, but it was incredibly painful to use this product. The screens would come up very slowly, it would take forever to switch applications. That was partly because the processor was under-powered, and the reason it was under-powered was because Casio insisted it had to have 80 hours of battery life on AAA batteries. It was slow, under-powered and too big and expensive, and we got some of the technology wrong. It had hits on every single dimension. And so when the Newton came out and it failed, and Casio was there, it wouldn't even matter if this product was even better than it was because the whole PDA thing just stunk, and all PDAs were failures. This product wouldn't have been successful in its own right. It might have been a little bit more successful without the Newton. But it doesn't matter. The products were big, they were expensive, They were hard to use, too slow.

Dubinsky: Along the way we did a couple of things that turned out to be interesting though-- one was Graffiti and one was PalmConnect. Maybe you can touch on those.

Hawkins: Sure. The first part of the business for Palm was [royalties per Zoomer unit, and] we weren't going to make enough money selling these things. So our value-added was going to be selling the connectivity software between the Zoomer and the desktop, to synchronize your data across.

Dubinsky: We should just back up and say what we did on it, because I don't think we ever said that.

Hawkins: Yes. So Palm's business, we did the internal software here, we did the PIM [personal information manager], calendar, address book, we did the calculator, we did little memo taking abilities, and we did the text input technology, both ink and character recognition. That was what was bundled with the product. And I don't remember what we got paid for each of these units but it wasn't much.

Dubinsky: Seven to eight dollars [in royalties per Zoomer unit].

Hawkins: Was it that much even?

Dubinsky: I think.

Hawkins: Well, okay. But we weren't going to make a big business selling the embedded software. So the real business was selling accessories and add-on software. And the first thing we focused on was PalmConnect, which was the connectivity software of the PC and this, which is actually an essential component of the product. It synchronized your PIM data between the PDA, the Zoomer, and your desktop PC. You had to have it. So we had a great business. We were selling something that everyone had to have. I remember Walt Mossberg was the first one that called us on it when he wrote a bad review of the product. He said, "That should be bundled with the product because if everyone needs it--

after I spend $700.00 on this thing I now have to go out and buy another $100.00 add-on software which is required-- that should be included. How are you ripping off the consumer here?" And when I heard him say that I said, "Oh my gosh, he's right." Our whole business model was built on selling these PalmConnects, yet it had to be bundled with the product-- he's absolutely correct.

The other thing we did at the time, we were trying to solve the text input problems. I was never a big fan of handwriting recognition, I knew how limited it was. So we had focused on ink capture. And everybody kept saying, "We've got to have better handwriting recognition, you've got to have better handwriting recognition." And I kept saying, "I don't think you can really do good handwriting recognition." So in the process of that, at that time, after the Zoomer had shipped, we came up with the idea for Graffiti, which is an alternate to handwriting recognition, it's a different way of entering text with a pen. And we first implemented it on the Zoomer. Then we implemented it on the Newton and General Magic. That turned out to be a great success, people really liked it. But obviously we were selling add-on software for failed products, and there was no business selling add-on software for failed products, because not enough were being sold.

Dubinsky: Explain quickly why Graffiti was different than other kinds of handwriting recognition.

Hawkins: Yes. What most people were trying to do with handwriting recognition was that they were trying to achieve what they called walk-up accuracy. So you take someone off the street and you say, "Here's a pen, here's a display, write on it, and I want it to recognize what you're writing." That was the Holy Grail, - everyone was measuring the walk-up recognition accuracy. And that was an impossible task to achieve, in my mind. What Graffiti said is there is no walk-up accuracy, it's a tool, you have to learn how to use it. And it's something you have to train yourself how to use. But if you learn how to use it, then it works. The analogy was physical keyboards. I said to myself, a physical keyboard, the QWERTY keyboard, is actually really hard to use, and it takes a long time to learn how to use it, to get good at it. It takes months to get decent at typing. Yet people do it all the time. I said, why wouldn't people be willing to learn how to enter text using the stylus if it took a little bit of learning? Everyone thought this was crazy. They all said, no, no, you can't; the user can't adopt it. The whole goal is that it will recognize your handwriting. Remember, the pen is the point. They were all thinking that it's all about handwriting recognition, it's all about making this paper-like interface. And so [the concept behind Graffiti] went against the grain. But I said, look, let's come up with a simple alphabet that if you write it the way we tell you to write it, it always works. Many of the problems with handwriting recognition had to do with spaces and carriage returns and word breaks and punctuation and all this kind of stuff, and capitalization. We didn't try to recognize any of that. We had little symbols for them-- a space was a line going from left to right. If you wanted to capitalize a letter, you'd do an upstroke before you write the letter and so on-- not like paper at all. And it wasn't that hard to learn. We figured it takes about 20 minutes to learn how to use Graffiti—maybe in an hour, you get okay at it. Most people thought it wouldn't work, but I felt that having worked in this field for so long, I felt pretty certain it would work and that people would be excited. It would work well. It turned out to work pretty well.

Dubinsky: Yes, I'd say PalmConnect and Graffiti were more the successes, than the Zoomer.

Hawkins: Yes, coming out of Zoomer-- exactly right. First of all with PalmConnect, we realized that people weren't doing a good job of connectivity software. Most of the times when people would connect--

like existing organizers, for example, they have connectivity software. It was a very laborious process. You'd say, okay, I want to transfer; you'd copy and drag things over; and when they found conflicts between two calendars-- which you almost always did because you could edit on both sides-- it would put them in front of you, and you'd have to choose which one to pick and so on. And I very quickly realized, no, the strength of doing connectivity software is to make it seamless or easy. So we set out a goal, or I set out a goal, saying when you tell the software to synchronize, it will never stop, it will never stop and ask you questions, it will just complete. My thing was you can tell it to synchronize, you go get a cup of coffee, when you come back it's done. And people said well but what we do about all the conflicts? I said "We'll figure out what to do with them, we'll do the right thing, we'll do the best we can." And so that took a long time to figure out how to do that. But, for example, we would then notice which one was changed, which one wasn't changed, and we would say if one is changed recently since the last synch, we would use that one. Then we would say if they both changed, we would keep both the records and we'd put them in your calendar and we'd just tell you later, hey, I got two versions of this appointment. But don't stop and ask them. Because at this point, I had already developed some rules about user interface design, and people are really annoyed when computers stop and take extra steps and so on. So I said the goal is just to complete. And we did that, and we were the first people to do that in a real clean way, in PalmConnect. And then Graffiti was good. So they became two of the core features of what became the Pilot.

Dubinsky: So now let's go on to the Pilot, which was code-named Touchdown. As a business, we were wandering around with no great business ideas, and then Touchdown comes on the scene. Tell us the story about how the idea for Touchdown started.

Hawkins: Yes, Palm was struggling. We had 27 employees, we had a couple of million dollars left in the bank. All of our partners had abandoned us on doing Zoomer 2. No one was interested in doing PDAs at all, and there was no real business selling PalmConnect and Graffiti. We were kind of bummed out, everyone was sort of miserable about it. But I still believed in the mobile computing space. So Donna Dubinsky and I went and visited one of our VCs one time, Bruce Dunlevie. We were sitting in his office and we were complaining about how our partners had abandoned us and how everything was hard, and Bruce said-- my recollection was in an annoying tone, "Well, I don't want to hear you complain about this. Do you know what you should be doing?" Something along those lines. And I said, "Yes, I know what we should be doing," although I had no idea what we should be doing. But I said, "I can think of it"-- immediately I said I can think of what we should do. If you ask me, I'll tell you what we should do, something different. It occurred to me right away. I said, "Well we should do a new computer and we're going to take everything we've learned and fix all the problems and do it again. That's what we should do." I didn't know what that would look like yet because we had never really considered doing the whole computer again ourselves. We were still trying to work with Casio and GeoWorks and other people. And Bruce said, "Well if you know what to do, why don't you go do it?" And our answer was, "We don't really have the money to do that, we don't really have the right type of people to do that-- we only have software people. But if you think we can, if you don't mind us trying, we'll go do it." And that was the beginning, the genesis of the Pilot. That night I went home and-- I'm not sure, I think it was that night, maybe it was the next night, I don't remember, I think it was that night.

Dubinsky: I think it was that night.

Hawkins: And I went home and I made this little model. This is a wood model. It's covered in paper. It's often written that it's balsa wood, but it's not balsa wood, it's a hardwood model. I made a stylus out of a chopstick, which I just chopped down. I wrapped it in tape and paper to give it a nice little effect. I cut a slot in the side so I could [put] my stylus in there like that. There was some thinking behind this. I laid out the basic thinking of the batteries and the display and how it would all fit in there. In order to make it fit, I had to provide an area for Graffiti input which wasn't under the display, because that made it thinner. So basically came back in with this model. I made a little cradle to sit it in, because I knew the cradle was important-- that was the key component of this thing, to have a cradle and a button. You push the one button and it synchronizes-- that was emphasizing the whole connectivity component of it. This became the model for it-- we just started working on the Pilot.

Dubinsky: Can you summarize, what were the differences between Pilot and the prior approaches? It was very different; what were those differences?

Hawkins: Some of the differences evolved over time working with people like Rob Haitani and so on. But we had a number of goals. One was the product had to be smaller-- this is substantially smaller than the Zoomer-- and therefore it would be lighter and so on. So it had to be substantially smaller. The goal was to fit in a shirt pocket-- not that I would carry it that way, that was the easy way of saying that it had to be that small. Another goal, it had to be inexpensive. So we shot for under $300.00. Again, [the previous PDAs] were $600 - $700.00 and this [Pilot] was under $300.00; so less than half the price. A third goal, and this is really, really important, was that it had to be really fast. We learned with the Zoomer that it didn't zoom, it was so slow, and that was one of its major problems. It struck me that instantaneous response was one of the most important things that you can do from a user interface perspective. So the goal of this product was instant on, instant application switch, no delays.

We started measuring the performance of the product against paper systems, as opposed to computer systems. This was an idea of Rob Haitani, I believe, where we were trying to replace paper systems, and therefore we should see how long and how many steps it takes to do activities with paper, and then compare the [Pilot] against [paper]. So we started doing these metrics, measuring performance against paper. And then the fourth thing was the connectivity. So the integrated, seamless connectivity, roll your apps from the desktop, you don't have to think about it. And there was the cradle, the button to press on the cradle, things like that. Those were the four items. And those were all substantially different than what we had on the PDAs before then. And, by the way, people think it was all about Graffiti. It wasn't all about Graffiti. Graffiti was the technology that was debated internally at Palm-- should we do Graffiti or should we do a keyboard? About half the company wanted to do a keyboard, and half the company and I wanted to do Graffiti. So that wasn't what it was all about, that wasn't one of the four criteria. But it turned out we ended up doing Graffiti and it was fine, it worked well.

Dubinsky: Tell us a little bit about the process of designing the Pilot-- what was that like?

Hawkins: The process for the design of the Pilot was interesting and fun. We had a really good team of people at that time. I worked most closely with Rob Haitani and Ed Colligan in working out the design features. The thing that struck me most is we spent a lot of time trying to figure out how to put the software on this small of a display. There were other products on the market, other Japanese organizers that had smaller displays, but they were really terrible. This was the first time anyone tried to put a

graphical user interface with a sophisticated operating system on a display of this size with a pointing device. And at the time it was really hard. It took us a large amount of time to get this figured out. Now I think it's big, we wasted so much space. But at the time it was hard. And what we did was Rob would print out these [screenshots]. This is printout that Rob made. He would be working in HyperCard and printing out screenshots. We would paste them down—we had a little can of spray glue, sticky glue-- and we'd paste them down, like I did right here, and we'd have a little flipchart so we could flip between the displays, trying to imagine what they'd look like. I said, "Okay, if I push this button this is going to happen." And we could walk around trying to pretend-- is this a big enough font, can I see it? It was a very integral part of actually playing with a physical product to do that. That helped a great deal.

We went through lots of iterations. The idea of putting the extra buttons on the bottom came later. Originally-- interesting with the iPhone coming out now-- originally we were going to have one button. My idea was I wanted one button-- that was the simplest interface I could think of. I was fighting for that very, very hard. That was the principle, and we were going to make this work with one button. Somewhere along the line I think Rob convinced me that it would be better to have multiple buttons. If we could have each button instantaneously take you to different apps, that instantaneous response overrode the simplicity of a single button. That was a great innovation, and I'm glad he pushed me on that. That stuck with all the Palm products after that. In fact I think that was the first product ever-- and Palm got a patent on this-- where you essentially can push a button, it turns the computer on, and it takes you to a particular application instantly.

Dubinsky: You called the calendar button the Today button, not the calendar button.

Hawkins: Yes, it was the Today button, and all our competitors didn't understand this. They thought it was like, oh, you press it and it takes you to the calendar app. But it did and it didn't. What it did, it would take you to Today and it would take you to the appointments that you have coming up, so that if you had a lot of appointments today and they didn't all fit on here, it would show you- it would slide the screen up automatically. The point is when you push that button you're trying to see what you're doing next. Our competitors, like Microsoft, for many years tried to copy this, but they made it a calendar button, and when it's a calendar button, it would take you back to the calendar app, and it would save the date, whatever the calendar app is. So whatever you were looking at last in the calendar, that's what you'd be looking at-- which is almost never what you want. I pick this thing up in the morning, and I want to push the button and I want to see what am I doing today-- not have to ask, is this today I'm looking at?; or no, that's next week because I was looking at next week [last time I used the device]. It took them years and years to figure this out, that it wasn't a calendar button. By the way, that came from the paper again. If you think about paper organizers, many of them have little corners you peel off every day. So there was a place you could put your thumb and you could open the book and it would be showing you today-- that was the equivalent of the Today button. The calendar itself was the calendar. That was the functionality we were trying to accomplish-- push this button, it's like taking you to that ripped off corner and then you'd be looking at what you're doing for today.

Dubinsky: Was there anything technically hard in creating the PalmPilot in terms of pushing the edge of the envelope, or was it really integration and user interface design?

Hawkins: There were a couple of things that were technically hard-- when I say technically hard, that's a matter of interpretation. One is that we wanted a very fast OS and a very small footprint. Now, that does not require extra code, that doesn't require amazingly complex code, it doesn't require new types of compilers or anything like that, but it does require some very careful engineering and setting some very careful goals. So is it technically hard? In some sense it's technically easier, if you only look at what was produced. But if you ask how hard was it to produce, get a bunch of engineers to produce that? It was actually pretty hard. I decided some criteria because the engineers were asking for faster processors. In my experience at GRiD, the original GRiD Compass had an 8 megahertz [Intel] 8088 [microprocessor] in it, which was an old processor; and they had great performance doing a true preemptive multitasking operating system. The GRiD Compass had a very advanced operating system. So I knew that you could build a high performance, preemptive multitasking operating system on something equivalent to an 8 megahertz 8088. So when the engineers were telling me they needed these faster and faster processors, I said no you don't; I said you just need to redesign the OS to make it fast on a small thing.

The first thing we had to do was abandon what they called two-tier memory. Most operating systems had a secondary storage, like a disk drive, and then a primary storage, like your RAM, and you'd be copying files back and forth. Well copying those things back and forth takes time-- and most computers still have that today. Almost all computers today have a hard drive and internal memory and so on. So we said, no, there's only one tier of memory and that's it, and so everything has to work out of that. We came up with clever ways to make the memory manager work. And you ended up with a simple operating system, not that much code in it, and really fast. But it was hard because it was against what people were trying to do at the time and the trend in the industry.

Dubinsky: As I recall there were other hard things like sourcing the display, for example.

Hawkins: Yes, that's right. There were some very difficult things. Sourcing the display and the digitizer were difficult things to do because we were asking people for a display, 160 by 160 pixels of a certain size, and there was no market for displays like this, at that time. There was a market for much smaller displays, like watches and phones. There was a market for much larger displays, like laptops. But this was sort of a no-man's land. And the first few bids we got back, the display bids were very expensive, depressingly expensive, like we can't possibly build this product. So that took a lot of negotiation and continued work.

We couldn't get the memory we needed. I knew we needed this thing called Pseudostatic RAM-- that was the right solution, and I knew this from my previous work at GRiD. All the vendors were saying we want to get out of the business of Pseudostatic RAM. But I said, " that's the memory we need; we need that to build this product." And so our sourcing team was saying we can't get it. And I said "We just have to get it; there's no choice, we have to get Pseudostatic RAM." And so they would go back, over and over again, and negotiate. And we got them to [agree to make] a limited production run for us, but there's no guarantee in the future. So most companies would say "we can't build a product where they're going to shut down the line on the key component." And I said, "We have to, there's no choice in the matter. We'll figure it out. We'll sell enough Pilots, they'll make more". So that was hard. And the digitizer was hard because people hadn't really started making these kind of digitizers in this size before. It was also difficult getting it in the package. I had some very stringent thickness goals that I wanted to accomplish and people were constantly wanting to make the product bigger and we had to come up with clever ways

of keeping the thinness and making thinner wall thicknesses on plastic-- things that people hadn't really done a lot back then, but now it's pretty old-hat.

Dubinsky: I remember you calling me when I was at a conference and saying, "They want to make it thicker and I can't prove that I can make it thinner but I have five ideas on how I could make it thinner."

Hawkins: Did I say that?

Dubinsky: "And I need you to authorize buying the plastics in spite of not having a solution-- is that okay?"

Hawkins: Well, I was a stickler about thickness. Everything creeps up on you. When you build products, consumer products, or you try to hit a low cost price point, everything conspires against you. Every individual function in the organization, from legal down, conspires against you, because they want to do the least risky thing. So the least risky thing is to [not] make the plastics thinner; the least risky thing is to buy the part we can get from the most vendors; the least risky thing is to not go forward with this pre-production build, not certain if it's going to work; and so on. And very, very few people are willing to say "I don't care, we're going to do it, we're going to do it, we're going to do it, we just have to do this." So that was the job I played.

Dubinsky: The Pilot was as much about what we didn't do as what we did. You managed to preach this simplicity doctrine. You've touched on it a bit. But the whole industry was always going the other way-- more stuff, more stuff, fancier, fancier. How did you keep such a clear head on that?

Hawkins: Yes. What you're referring to here is that the entire industry was trying to push you into more complexity. When the Newton failed, the biggest things they said they had to do, make the handwriting recognition better, put in more communications options, we needed an infrared port, we needed expansion slots, blah-blah-blah-- we needed a spreadsheet, that was another one; you can't have a computer if you [don't] have a spreadsheet. So there's this long laundry list of things you have to do to make the product, add these things. And the team developed at that time a philosophy of no, simplicity is better. Again, we were focusing on that paper experience, and we were focusing on the failures of the Zoomer, which was too complex and didn't do a few things well. And I don't know how this idea gelled in us but if you just can do a few things …. well, talking to Zoomer owners and Newton owners, we asked them, "What do you want the product to do?" And they said, "All I wanted it to do was organize my life. I wanted to be able to keep my calendar and keep my address books and communicate with my secretary." We heard that over and over again, and we said, "Well okay, then that's what we're going to do, nothing else; nothing else, that's it, just do the one thing they ask for, forget everything else." And it was hard keeping that focus, it was really, really hard, because even our own employees would come back and say, "Well I think this extra feature would be really great". And I would say, "You're right, it would be great, but we don't have time to do that and we don't have the ability to do that, and if I say that for ten features then you have ten new great features and the product's bigger and expensive and complex and so on." And it affected everything from the microprocessor choice, to the way the software is written, to the memory manager, just this endless list. We had the benefit of not having the luxury to take more time, because Palm was really small, we were running out of money, we had almost no money. We had no time because we're going to run out of money. We didn't have money to spend and

we didn't have money to spend on time. Therefore we had no choice to explore these things. It made it easier for me to say, "Too bad, we're not going to do that; too bad, we're not going to do that; no time to decide; no time to experiment; no time to test this idea; forget it, we're just going forward with Plan A or Plan B or whatever." People complained about it a lot but I think in the end-- obviously it worked out well in the end. And I think also people somehow were happy that there were people making decisions.

Dubinsky: Now the process of designing the Pilot, as we touched on before when we talked about the Zoomer, was really different than the Zoomer. We actually didn't even have any hardware engineers when we designed the Pilot.

Hawkins: Yes.

Dubinsky: And we did this desktop software, our whole OS [operating system], the application software and the device, so on and so forth. Why don't you just touch on the difference in the process about how we designed it?

Hawkins: Yes. We had 27 software engineers. The only person who had any hardware experience was me, and at this time I wasn't doing any engineering.   I wasn't writing code or anything like that. We had to build an operating system, we had to build the PIM apps, and we had done the PIM apps so we knew how to do that, because we'd done that for the Zoomer. We had to do the connectivity. Well we had a done a version of connectivity before. We had Graffiti. But we had to do a new operating system, new hardware, and create all these new apps, improve the connectivity and so on.

Dubinsky: And the desktop software.

Hawkins: Oh, and the desktop software, that's right, I forgot, we had a whole desktop component we had to have. We couldn't hire anyone. Donna knew that we didn't have time to hire. We could spend money on people on the outside but we didn't have time to hire and train people ourselves, because we would run out of money-- we didn't have time for that. So I think I called an old friend, Karl Townsend is the hardware guy-- I think he was in the beginning of this. But anyway I'd worked with him at GRiD and brought him in as a consultant-- I'm trying to remember, was it Karl or Dave Paulsen, I think it was Karl-- do you remember?

Dubinsky: I think it was the two, they were working together.

Hawkins: Oh, all right, Dave Paulsen and Karl Townsend, and we said, look, can you design the hardware for this? Then we contracted out much of the desktop software to a third party firm. And so our project, it really became doing some of the internal work ourselves and then just managing all the outside vendors. We had some project managers who were doing that and Donna did that and Ed did that. We were trying to coordinate these other people building the desktop software and we had to buy part of the OS because it was quicker to buy part of the OS, and we contracted with these two guys to do the electrical design. Then we needed someone to build the physical hardware, which became this guy right here.

And I remember-- this is a funny story. We needed an industrial designer; and up until to this point in my career I had worked with IDEO and the predecessors to IDEO, Matrix and so on, when I was at GRiD. And they're real expensive and we couldn't afford them at the time, we didn't have the money to afford a good industrial design firm-- or I shouldn't say-- one of the top brands. So I said, "Ed, we need to get something right away." So Ed pulls the yellow pages off the table and he looks up Industrial Design and said "Here's one, Palo Alto Design Group" and he called them up on the phone-- I was with him-- and he goes, "Can you guys design a small consumer product?" And it was Malcolm Smith at Palo Alto Design Group. And these guys, it was two guys and they were doing some other work and they weren't really the perfect fit, but anyway they did the product-- and it was pretty funny.

Dubinsky: Okay, so we were unsuccessful in raising venture capital to fund the Pilot. You mentioned that we were running out of money. Why do you think that was the case? Why couldn't anybody see this vision?

Hawkins: First of all Donna had spent a tremendous amount of time trying to raise money and had some success. I recall that we had gotten a million dollar commitment out of Ericsson-- you don't agree with me?-- and we were working on a deal with Compaq, but the terms of these deals were just terrible on us. We tried to get regular funding from VCs, and why was it so hard? I think there's a simple answer to this question, and I learned this prior to this time. The venture capital industry, they really follow one another, and a large part of their investment decisions is to match or participate or counter what their competitor venture capital firms are doing. I remember what is now Benchmark, which at the time was Merrill Pickard Anderson & Eyre, which was an initial investor in Palm. They put some money into some of the pen-only software companies at the same time they were putting money into Palm. I remember telling Bruce, "Bruce, those companies are going to go out of business, they're all going to go out of business. Why are you putting money into them? " And he says, "Well we bet because we like to place bets with our partners, the other VC firms, and we like to place bets all around the table, and this is what everyone's investing in, so we want to have other investments in it as well." It didn't matter whether you believed in it or not, they were just spreading their risk. So at the time we were trying to raise money for the Pilot, everybody had decided that the PDA, pen-computing space was dead, and no one would want to go out on a limb. It would almost be an embarrassment to anybody investing money in this space-- and they don't care, they've got other things to invest in. They weren't even looking at the product carefully, they weren't trying to evaluate it. They were evaluating it [like this]: the entire venture capital industry made a lot of mistakes here and I'm not going to make another mistake. I don't want to look bad. No one else is investing, so we're off to something else. And on one really looked at it freshly.

Dubinsky: This was after the really spectacular failure of the Newton.

Hawkins: Yes.

Dubinsky: And a billion dollars of losses, we might add.

Hawkins: That's right, yes. And so a spectacular failure of the Newton, but we had our own failure too-- right? We're coming in saying, hey, our first product was a failure, the Zoomer, but trust us, we got the next one. I can understand why they might not trust us. They're not product people. They don't look at a

product upfront, early on, and say "oh I can see that's going to be great". They just say, "No I've already invested in this space", or "I've decided not to invest in this space."

Dubinsky: Palm subsequently sold itself to U.S. Robotics mainly as a way to fund the Pilot. I'm not going to go on about the business history but let's just state that for the record. Once it was clear that the Pilot was a success, how did you establish priorities for the next generation product? I remember admiring that we seemed to always have an incremental product in the works and a revolutionary product. How did you figure out what to do next?

Hawkins: Once a new product category is established, then the decision making process changes. In the beginning, before the Pilot, we basically had a very strong vision. You could say the vision dictates everything - the four criteria, the small size, paper-like performance. Once you start selling a lot of product, then the market dominates things more as you start listening to people and hearing what they say and what problems they're dealing with. It becomes much more market driven and market research focused. With the Pilot, we went from the Pilot to the PalmPilot Professional or something, and then we went to the Palm III. Those were market driven incremental changes, like we needed to make the product more robust because the original one was too flimsy. So the Palm III was about being robust. But we kept with the same plastics, the same basic industrial design, we just added changes to the software, people were complaining about how the different software worked and different parts. It was all incremental changes.

But at the same time there's still room for a bigger visionary thing. To me the big one was when we designed the Palm V. It was probably the most successful design exercise I've ever been through. It was a very successful product and it met all of its criteria. The vision came about for that one actually as a reaction to Microsoft. You have to understand that as soon as we started having success with the Pilot that Microsoft announced that they were going to do products that were similar and they started having all these people build - I don't know what it was called at the time but the Windows PDAs - and they were out to kill us. They were telling people, "We're going to kill Palm". They didn't want us establishing a new platform. So I started getting condolence emails, people saying "Sorry, Microsoft's going to kill you, what are you going to do next?" I'm serious, I got emails like this. So I said "Well we have to compete against Microsoft". The Palm V was the reaction to that. What I decided was you can't go head to head with a big competitor like Microsoft. They had all these software engineers and they were going to put so many features in their products and we could never put newer features in the product. But at the time we were building hardware and they weren't building hardware. They were just building-- and they still don't [build hardware] - the software, and the hardware was being built by these companies that weren't doing a very good job. So I said "Our competitive advantage is we can build beautiful hardware, they can't." So the Palm V came about as an exercise building the most beautiful PDA we could imagine. We worked with IDEO on this one, the high class design firm.

Dubinsky: We could afford IDEO now.

Hawkins: We could afford IDEO at this time, and a lot of the credit goes to them. But I remember in the cell phone space there was the [Motorola] StarTAC, which was a big, huge success, and the StarTAC was small and it was thin, and it was sexy. I said "We need to build the StarTAC of PDA's." I didn't know what that was at the moment but it had to be really thin. I decided the only way to get thin was to get rid

of the AAA batteries. You had to go to rechargeable batteries. No one at that time had put lithium ion rechargeable batteries inside of a product before. There was a huge concern about that but that was the right technology.   I knew it. Then IDEO came up with the idea of doing these metal cases, and so we ended up building a very thin, very beautiful product. The interesting thing about the design process was I had a huge battle with the Director of Product Marketing at the time, at Palm, because he wanted to put a whole bunch of new software features in the Palm V, and I said "I want no new software features in the Palm V." The reason I didn't want any new software features in the Palm V was because Microsoft was introducing new versions of their product with all these new software features, and we were going to come out with Palm V which was a beautiful, sexy, thin product. I said "If we put any new features in the Palm V, then people will write about those features, and they'll compare our new features to Microsoft's new features, and that won't look good. If we put no new software features in our product, but just make a beautiful product, the only thing they can write about is the beautiful product, and Microsoft doesn't have a beautiful product." I had a huge battle on it. I, of course, prevailed, not just because I had seniority. Anyway, that was the strategy. Who knows why, but in the end it was a very successful strategy. The product came out - it was one of the first few technology fashion icons ever. People loved it and it was beautiful and it sold tremendous quantities.

Dubinsky: Yes. At some point you came to the conclusion that communications would be important. When was that, and how did you explore the role of communications in these devices?

Hawkins: Yes. I remember at the beginning I actually pooh poohed the idea of adding communications. I remember Brian Dougherty of GeoWorks one day when we were working on the first Zoomer and Brian said to me "Look, I've got a TCP/IP stack in our operating system." I said, "What are we going to do with our TCP/IP stack?   We can't get this damn thing to keep track of today right". So I was actually resisting [communications] early on. Then just to complete the whole picture, the first piece of communication we put in the product was infrared. We were actually not the first company to implement infrared, but we were the first company to implement infrared in a successful, truly successful, application. I remember the guy who ran the IRDA which was the Infrared Association at the time, and he was so thrilled because we put infrared in the Pilots and they talk to Pilots and so they always worked. It was simple and you could send information back and forth and no one had done the end-to-end solution before. We were the first people to do that - it was magical at that time.

The next piece of communications we did was actually when we were part of U.S. Robotics. They owned another company called Megahertz. We were being asked to put a radio into the PalmPilot, into the Palm III essentially, and I really didn't want to do that at the time. I was pushing back very heavily and the senior managers at U.S. Robotics said "Well if you don't do it, we're going to let the Megahertz guys do it. We're going to take the product away from you." I didn't want that so I said "All right. If he really wants to do something, we'll do it." That was the genesis of the Palm VII, not a very successful product. The Palm VII had an integrated paging network, a two way paging network in it. I can't remember the name of it now. We gave it a little antenna because it needed an antenna and we built a miniature web browsing experience with sort of a half a browser and a little data applet. It all worked and we put a lot of money and time into it but it really wasn't the right thing. It was managing the technology at the time, trying to do web browsing, and it really wasn't the right thing. RIM got it right. They actually got the right application, which is email. We missed that opportunity - that was a mistake on our part. We focused on web access. That was the first time we did a wide-area wireless network. Then when we started Handspring, at that time it became clear to me that cell phones were going to be the dominant computing platform in the world. That the thing that people carried - their cell phone - would morph into being a personal

computer as opposed to the personal computer dominating.   The PDA [business] was a small business. The cell phone business was a huge business. Everyone's going to have a cell phone. We had to put cell phone technology into the PDA.

Dubinsky: This is extraordinary. You saw this trend years before everybody else saw it. How is it that you can see these trends?

Hawkins: I don't know if I did see it for years before everyone else. When did we start Handspring? It was about 1996, right?

Dubinsky: Yes.

Hawkins: So it was probably the beginning of 1996 that I started thinking along these lines. It seemed really obvious to me, it just seemed obvious. Look at the growth of the cell phone industry and how many people are carrying cell phones. Even back in 1996 it wasn't as it is today, but you could see the growth and you could just follow Moore's Law and say "Why wouldn't everyone have a cell phone?" Once it gets cheap enough, who wouldn't want one? At that time it was still pretty expensive, it was a high end executive thing, but you could just imagine it didn't have to be. I had done this analysis about wireless networks - perhaps you remember it - where I follow this logical deduction where I concluded that wireless data would be essentially free in the future, even though it was very expensive, because the infrastructure costs get amortized. There's no wires being brought to your house, it's very low cost infrastructure and once it's amortized, you can provide the services for free pretty much. I concluded that wireless data was going to be free, wireless voice was going to be free. "Free" like you won't even be thinking about it, you'll be paying something for it but you won't be thinking about it. Therefore everyone in the world will own a cell phone because, why wouldn't they? If everyone owns a cell phone, and the growth of the cell phone business was going to be faster than the growth in the PDA business, therefore this was a huge setback for the PDA business, because we had to now somehow merge into the cell phone business because that was going to be the driving factor for consumer things in their pocket. I don't know it was just a logical deduction.

Dubinsky: Again I'm not going to get into the details of the business story but U.S. Robotics was acquired by 3Com, we left there and we created a new company, Handspring. You very quickly came up with a new product concept at Handspring. How did this come about? What was your thinking about our original product strategy at Handspring?

Hawkins: Yes. I'm not sure if this is a good product strategy or not, in hindsight. When we started Handspring, we needed to get into the business very rapidly and so we needed to produce a product that we were certain could sell in high volume. It wasn't a company to build some radically new thing. We had just -- we as in the team Donna, me and Ed and whoever else had joined Handspring - we had just finished designing the Palm V. I don't think it had even come out yet, it was about to come out just when we started Handspring. It didn't seem it would make sense to try to do a high end, beautiful product like that. We said let's go for the high volume segment of the market, which would be the lower end of the PDA space, so replace the Palm III. We didn't want to take a risk. We wanted to be able to get going very quickly. It wasn't like we were building some new platform. We had to get right back in the game and so we said, "Let's do a low end product". We picked a low price point and we picked consumer colors. I

was looking for something that really differentiated the product from the original Palm III's and so what would really make it unique. I was looking for something yet not really jeopardize the product. So make it unique, but don't make it so unique that you might get it wrong and people don't want it.

At the same time, I was trying to think about how we were going to put radios into those PDA's and I was struggling with that because maybe we should do a phone product. I said "Well that would be really risky. That would be a risky product for a company to do who was trying to get up to volume quickly." Then I had the idea - why don't we make a PDA that's expandable? That's its core new feature. At the same time we could expand it by putting in radios. That was the idea, and we came up with what was called the Springboard slot. Then I said "Well let's stick to our simplicity theme, let's make it so when you plug in the expansion [cartridge], the radio - or whatever - into this Handspring Visor, that it just automatically configures itself, there's no software, you don't have to do anything, you just plug it in and it goes. No one had really done that before, no one had done plug-and-play expansion properly before, where the software was embedded in the expansion module. You plug it in, the software, hardware, everything works. That was the goal and it technically all worked. It really did work. Also from a business point of view it worked, too, because the Visor was very successful, and the Springboard slot got a lot of attention. People bought it because they thought they'd want to put expansion cards in it. It wasn't successful because none of the expansion cards or any of the expansion options really sold enough to justify it. Then it got usurped by SD and other things. So as a platform it didn't work, but from the business objective, and technically, it did work.

Dubinsky: Handspring was a very successful company for a while.

Hawkins: Yes, we got off to a great start. Other than the few hiccups in the beginning, we were off and selling millions of units in just a couple of years.

Dubinsky: I think there was a time when Handspring was the fastest growth company in American business history for a little while there before the bubble burst.

Hawkins: That was quick.

Dubinsky: What were the greatest technical achievements at Handspring?

Hawkins: At Handspring, I don't think there were many technical achievements. The Springboard Expansion Slot was a great idea, it worked, but I can't really call it a success if it didn't work in the market place. So technically it was good but I don't think technically is good enough, that doesn't qualify as a success for me. What we did at Handspring is we did build cell phone radios. We first did a module with Options International. It was a little plug-in thing and it was very hard - it didn't work very well. The whole combination was kind of clumsy but we got our feet wet in the cell phone space. Then we designed the first Treos like this, again not a high volume product, but we were improving the user experience. We were figuring out how to make all the stuff work better. If this had been really high volume, we could have probably kept Handspring independent but it wasn't. It just struggled - but it got good reviews. So it became clear to me that our next generation would probably be the right one. So we did the first as a plug-in module that was the Visor phone. Then we did this first Treo, two versions of this, one with a

keyboard and one with Graffiti [handwriting recognition software].   Following on beyond this, we designed the Treo 600 which turned out to be our real first success in the smartphone space. But that was actually after Handspring and Palm were recombined.

Dubinsky: Let's just touch on this theme of keyboard versus pen input. You started out lobbying during the PalmPilot days for the stylus input, and then by the time we now get to Treo, we shifted focus towards the keyboard. Why?

Hawkins: That's pretty simple. Again, my focus on stylus input, it was not about input - it was always about user interface. Graffiti was the best way I could come up with entering text on a small computer with a stylus. No doubt about it - RIM [Research in Motion] showed that you can make small keyboards that worked. They surprised everyone, and they get credit for that. I remember the first time people started using RIM pagers. I would ask people about it and I heard the same reaction every time. People would say "When I first saw this little keyboard, I thought there was no way I could type on it. Then I started using it and I find it's really good." I heard that a few times and I said "That's it, the game is over." That's the right way of going forward because the little keyboard is faster and more accurate and more familiar, but mostly it's faster and more accurate than the stylus input that we were doing with Graffiti. It didn't matter as much when you were doing PIM [personal information management] applications like calendar and address book, but when you started doing email and other text intensive applications, it starts making a big difference. By the time we designed this product, I was 100% convinced that the keyboard was the way to go.

But now the momentum at Handspring was not that way. We were having success with Graffiti, and there were a number of people that said "We can't abandon Graffiti. It's so important and it works so well - how can we abandon it for keyboard? I can't type on that keyboard." I said "That's the future." It was funny. At the very last minute, we were about to ship this project, we're getting very close and there was so much angst about this, that we decided we could do a quick version that didn't have a keyboard. That was the Treo 180G, G for Graffiti. This was because the people were so nervous that we were going to shoot ourselves and kill our baby because we didn't have Graffiti on it. So I said "Okay, we'll do it." I kind of knew the outcome but you just have to say "fine, we're going to test it". So we sold two of these versions, one with a keyboard and one without the keyboard. It was partly your decision Donna to say "We'll test it" because that was the right thing to do, test it. We'll see what our sales rates are, and that will answer the question right there. We did, and it was overwhelming in favor of the keyboard and that was it, that was the end of Graffiti.

Dubinsky: Irony.

Hawkins: I don't mind. People ask me, "How do you feel about that?" I feel fine. I'm not Mr. Graffiti, you know. It's whatever works.

Dubinsky: I'm going to move to some general questions and move towards wrapping up but before we do, do you want to tell us quickly about the Foleo in terms of touching on the last product?

Hawkins: Sure. I didn't think we were going to do that, but if you want me to, I will. This is about the Foleo, which at the time we're taping this, we haven't even shipped it yet. I remember there was a time where we were at Handspring, and it was a Monday because over the weekend I was thinking about the futures of smartphones. Let me take out my Treo here. We were designing these products and thinking about the Treo 600. But I was imagining a time in the future. I was just following logical deduction what was going to happen. I'm saying "Oh my gosh - in the future I'm going to have so much memory on here and I'm going to have beautiful displays and I'm going to have fast wireless data connections". I said "There's everything and a fast CPU. It's everything that a computer has", and I said "This is like a personal computer, it's going to have everything, it's going to have music and video and everything except there were two things." I said "There's only two things the most powerful personal computer can have that this thing can't have. One was, this can't have a big display because I need to fit it in my pocket, and the pressure is to make the display smaller and smaller. The second is it can't have a big keyboard. It can have a small keyboard, and again the pressure is to make it smaller and smaller."

So I was bummed out initially and I said "Well I'm building the future personal computer but I have these two limitations and they're severe limitations." You just can't get away with a teeny display all the time. Then I said to myself, "Well, if billions of people on the planet are going to own a computer that looks like this, that's going to be the dominant personal computer. They may at times need a large screen and a full sized keyboard. Then there's an opportunity to create an accessory to the phone which is a big screen and a full sized keyboard." This is the genesis of what is now called Foleo. At first I wanted it to be just that, a display and keyboard, and have the applications running on [the Treo]. I just had this simple, big display and a keyboard, that is being driven by this [Treo]. Technically, that wasn't doable at this time. So we ended up doing it synching with BlueTooth. That was the genesis of Foleo.

I started getting exciting about it because then I realized that it's the first time somebody could have a personal computer that was instant on and instant apps switch. It had all the attributes of a PDA. As Joe Sipher once said "It's a laptop designed like a PDA" and that's an important thing. So I got really excited about it, and I saw it as a way of kick starting the PC industry, getting into semi-conductor, instant on, instant performing laptops. We could do it because we weren't going to go after the PC, we're going to do it as an accessory to the cell phone. That was the strategy because you can't go after the big guys, you have to come from the side. Start as an accessory to the smartphone, our strength, and then it ultimately becomes like a PC. We'll see how it turns out.

Dubinsky: We'll check back with you on that in a few years. You used to say at Palm that the future of personal computing is handheld computing. Do you still feel this is true?

Hawkins: Yes, absolutely. I'm not sure if I said that exactly. Did I say it was that, or did I say that the future of personal computing is mobile computing, which implies handheld but a little bit different?

Yes, absolutely. There's no question about it. I think it's almost surprising how rapidly it has occurred. I remember when I first started saying that - it would have been probably like 1992 or something like that. I don't know if I said it would take 20 years or 30 years but I said some period of time this would take to occur. I guess I said 20 years. It was 1992, that would be 2012. Of course, I didn't really know how it was going to happen. I couldn't predict it. I didn't know about the cell phones and how they were going to be dominant at the time. But it was just an extension of Moore's Law. It was purely an extension of

Moore's Law plus the knowledge that people would rather have something in their pocket and small than something that's big. They want something that's less expensive and easy to use over something that's expensive and hard to use. So combined with Moore's Law, that was just an inevitable outcome.

What surprised me along the way is the whole cell phone thing, and now there are several billion people who own a cell phone. That's incredible and it doesn't seem like it's going to stop. It's still going. Those cell phones are going to become powerful personal computers. So if you count the things like the Treo in the future of personal computing, absolutely. I still believe it. It's going to happen. What we think of as desktop computers now will become workstations. Even the laptops role will be changing because their role will not be the primary computer for people. This is going to be the primary computer for people or the generations that like this and you'll only go back to that other thing, the bigger thing, whether it's a Foleo or a laptop, when you need to. But this is going to be the place you go on the web, and watch the videos and do whatever else you're going to do in the future - listen to music and do your email and all that kind of stuff.

Dubinsky: Can you summarize the greatest lessons you've learned? You've had many successful products. You've also had failed products. Can you characterize for people who are thinking about designing products in the future, what are the key lessons?

Hawkins: Yes, a couple of things. One I already touched on earlier, but I'll do it again. If you're trying to do something new, something that hasn't been done before, it takes a great team, and it takes a leader, and you have to have a real vision. When someone comes to me and says "I want to build some great new thing." I don't even listen to what the thing is. I look at the person and I say "Are they a leader? Are they able to make decisions. Are they able to think clearly about what's important, what's not important?" It requires that. You still need the team and you have to have a great team, but it's not one or the other. You also have to have a great leader. I think that's true for business but it's definitely true for product design. That's one of the clearer lessons. I certainly didn't know that starting my career. I just discovered as we go along, and I've been able to play that role sometimes.

The other thing, from a purely technical consumer interface point of view, is the importance of simplicity, if you want to use a single word for it. I call it accessibility, which is a little bit broader than simplicity. Engineers just aren't good at this, and product designers aren't good at this, and marketers aren't good at this, and consumers aren't even able to tell you this is what they want. But so often if you build something that is simple - that is you press the button and how long does it take to respond when I touch - do I have to wait, are there multiple steps, can I reduce it from two steps to one step? These things although no one really understands them, they don't look at them. They say "Oh, I see how you made this simple." When they get a product that works like this - Ed [Colligan] would say "It's delightful, I like it, it's easy." Just the "instant on" alone is such an important feature that it's amazing that we are in the year 2007 and most computers are not instant on, even laptops that have good sleep modes aren't generally instant on. They still have to wake up and go through some gyrations and so on. It's just incredible. There's a few things like that in consumer products. I like to talk about my television, which has gotten slower. It used to be when I was a young kid it would be pretty quick to turn on and it would be pretty quick to change stations. Now it's slower and it's more annoying. So another lesson is from a consumer designer's point of view, not from a pure technology point of view, the overwhelming importance of simplicity, and how hard it is to design that into products. Everybody conspires against it. Every single

function in the organization conspires against making products simple and it's a challenge. Therefore that's a skill that I suggest people develop.

Dubinsky: I think that was one of the key reasons for the success of the PalmPilot. So how would you characterize yourself? Do you view yourself as an inventor, an entrepreneur, a marketer, a technologist? You're hard to put in a box.

Hawkins: I don't think of myself as an engineer, although that's what I was trained in and I have a lot of engineering skills. I mentioned earlier in the interview that I went to engineering school and very quickly decided I should have been a physicist because I like big ideas. One of the reasons I like physics is it's a field where there are a frontier of big ideas and there's interesting things to think about. I fell by accident into engineering and even the whole Palm thing, it was an accident that I didn't continue at Berkley and so on. What I've always been interested in is pursuing big ideas. If I have a choice between the more sound business decision and the more radical, riskier product idea, I always go to the one that has the bigger idea behind it. Foleo as an example - it's a big idea. It may be a failure, I don't know, but it was a big idea. It's more exciting to me than other things. I'm a person who gets excited about concepts and about big ideas and future things and I try to make them happen. So wherever the biggest ideas are, that's where I tend to go. That's why I'm interested in brains because to me that was one of the best frontiers of all humanity - to understand human nature and who we are and how our brains work. Then the whole computing side is a pretty important part of humanity, too - how we use technology and what part can I focus on. Which is the biggest idea that I can have an impact on? Well, that's mobility and simplicity and making products more accessible to more people and see how far you can go with that.

Dubinsky: Let's talk a little bit about Numenta and what you hope will become of it.

Hawkins: Do I need to tell people what Numenta is?

Dubinsky: Yes.

Hawkins: After Palm and Handspring and Palm again, I actually did go back at least part time, half time, working on brains. I formed a neuroscience institute and ran that with the help of people like Donna Dubinsky and Harry Saal. We made a lot of progress through this effort of understanding how the neocortex works, a tremendous amount of progress. I wrote a book about this which is a lot of work but it was the best thing for me to promote the idea. The concepts I'm very, very certain are the correct concepts for how the neocortex works and basically how a lot of complex systems work. I think I figured out something very important from a science point of view, and it'll take a number of years for that to filter out and be vetted among other people.

I started Numenta as a process of proselytizing the scientific ideas that I developed at the Redwood Neuroscience Institute. I didn't want to start a business. In fact I didn't ant to start a business - that's a lot of work. Thankfully Donna Dubinsky has been helping me tremendously on this, I'm much appreciative. I didn't really need to have another business success, that wasn't a thing I wanted to do at this point in my life. However I felt that if we could take the science behind neocortex, and the science behind neural systems, and turn it into a very successful technology, that would get many, many people

working on it. One of the things I've learned in life is that the academic science world works at a fairly slow pace. Ideas are slowly introduced, slowly tested, slowly challenged, slowly … everything is slow. In the business world, it's a hyper frenetic fast, technology world, Silicon Valley. You throw an idea out there and very quickly people try it and they abandon it or they go with it. If it works, they work at it really fast and they go hard. So the idea is can we take this science and turn it into a technology that gets many, many people thinking and successful with it where now you can have 10,000 or 100,000 people working on it. Otherwise I might get 50 scientists to work on it, but I can get 10,000 engineers working on it and drive the science and the adoption of this knowledge through the tools we have here in Silicon Valley. That's the goal behind Numenta.

Dubinsky: Do you have any hopes of what your legacy will be?

Hawkins: I don't think about my legacy much but I think I remember telling you, Donna, early on, when we were having success with all the Pilot stuff, I kept dismissing it and saying "Well this is pretty neat, but this is not what I want to be remembered by. I want to be remembered by my neuroscience work". This is before I'd even figured all of it out. But I knew I was going to.

I guess the legacy I would like to have is a pretty broad one. It would be more along the neuroscience world. It would be that I introduced into the public discourse rational discussion about the nature of human thought and human failure due to our nervous systems. We are creatures that have a very logical brain, and old parts of the brain which are not very logical, and if we understand how the human brain works, which we're getting pretty close to, that knowledge will lead to a better discourse about why we disagree about things, about who we really are, how we got here, what our future is, how do we make our lives better, what's the meaning of life and all that kind of stuff. I would hope that during my lifetime, or during the period that we're living now, that people say this is the time when we actually figured this out, what the human brain is all about, what our condition is all about and now that became part of the public discourse going forward and part of the rational politics and everything else in the world. This sounds a little fuzzy but it's the best I could do.

Dubinsky: I think it's good. Do you have any advice for young people starting out today as they're embarking on their own adventures?

Hawkins: I need to be careful not to repeat things I've heard from you.

Dubinsky: That's okay.

Hawkins: Yes I do. I have given a couple of talks like this and I apologize if it's stuff you say as well, I don't know. I've learned so much from you. First of all, I tell people there's no right career. Some people say "Well, what do you recommend?" I say "I can't recommend what's right for you. I can only say what worked for me, and if you like what I did and you want to pick up some pieces of what I did. well I'll tell you what worked for me." And what worked for me is I found things I was passionate about. I was not impatient about them, I didn't look for them. I didn't start out my career saying "I need to get something to work on, I need to start a company." No I just went with whatever job came my way. Okay, I'll study this, but then I found something I was passionate about and then I pursued it. You have to be loyal to the

thing you're passionate about so if in terms of mobile computing, I wanted to build the future of personal computing, which is mobile computing. Well, that's not the same as building companies, it's not the same as making a lot of money, it's not the same as all these other metrics that people might have. That means if the best thing to do is to sell the company, then the best thing to do is sell the company. If it's the best thing to do something else you don't like or move or whatever it is, you follow your passion where it takes you. Even though when we sold Palm, it looked like that might have been the end of it, not if you continue following your passion, it's not the end of it, it just keeps coming, new opportunities come to you. So my advice is: find something you're passionate about, stick with it and be patient. You don't have to find it. It will come and find you. If it's in your nature, you'll find it.

Dubinsky: Last question: do you have any mentors who you want to point to - people who really influenced you?

Hawkins: We were at dinner last night and someone asked me what books I read as a child. I'm going to answer that question first because I never really had people I looked up to. I didn't have a role model in some industrial tycoon or something like that or famous technologist. When I was a child I was fairly influenced by a couple of things. One is I was a huge fan of Martin Gardner. Martin Gardner was the editor of the Mathematical Games column at the end of Scientific American, and he had a whole series of books about science and about math and about pseudoscience. I collected every one of his books and I read them over and over again. I enjoyed not just the mathy ones but there was one called the ambidextrous universe which opened my eyes first time to how physics can be amazingly elegant and surprising, not just a bunch of equations and so on. I learned about relativity theory through him. One of my favorite books of all time was "Fads and Fallacies in the Name of Science." He chronicled all these crazy people who had crazy ideas and they believed in them. I don't want to be like that, but it was interesting what people actually believe in, amazing things that inform all these cults. It taught me that the human mind is very pliable and you have to be very careful not to fool yourself about what you're doing especially if you're trying to do things like figuring out how the brain works, you have to be really careful not to be foolish about that. So his writings had a lot of influence on me when I was a child, probably more than anyone else I can think of.

END OF INTERVIEW