

# Changing Lives Through Technology

David Nagel, CEO of PalmSource, talks about his work at NASA, Apple and AT&T, and gives examples of success and failure in human factors design.

**UBIQUITY:** You've had such an interesting career -- why don't we just work our way through it. Where did you grow up?

**NAGEL:** We lived in a small farming community about 20 miles outside Louisville, Kentucky, where my dad was a contractor and small businessman. I had an older brother who had all sorts of adolescent respiratory problems, so my mother, my brother and I ended up moving to Arizona, where I spent my formative years as an adolescent in the desert around Tucson. In Kentucky, the school I would have gone to was an eight-grade one room country schoolhouse, and my parents for reasons known best to themselves decided they wanted me to go to a regular public school in Louisville.

**UBIQUITY:** A good decision?

**NAGEL:** Actually, when I got older I sometimes questioned it, because I might have had a really interesting experience in that one-room schoolhouse. But at any rate my parents did what they did and so I attended a public school in Louisville until I was in about the sixth grade, and then I went to a school in Arizona.

**UBIQUITY:** What sort of life did you have there?

**NAGEL:** My major sport the whole time I was growing up was shooting. I was a target shooter, with a .22 and all kinds of other guns. At that time, kids both in Kentucky and in Arizona had their own guns. I used to go to the national rifle shooting matches, in a place called Port Clinton, Ohio, near the shores of Lake Erie. I went to the national matches every year and managed to be the national champion when I was 13.

**UBIQUITY:** How long did you continue as a marksman?

**NAGEL:** All through high school, and then when I got through high school and went to college, it was about the time that the Vietnamese War was beginning to crank up, and shooting things was not socially accepted any more. Also, I became, of course, much more aware of world events, and like many kids in my generation I was not real thrilled with the war. So I've never done much target-shooting since that time. At any rate, I had a really interesting childhood. I played the guitar and learned how to do a bunch of outdoors things. In Arizona, I used to ride a lot and do the Western thing.

**UBIQUITY:** The Western thing? Ride horses?

**NAGEL:** Yes, horses and also motorcycles. I developed a fondness for motorcycles because those are also popular in the desert, and I still enjoy motorcycle riding and a little racing from time to time. I grew up mostly in the country, and spent most of my time when I was in Tucson out in the desert roaming around with another friend of mine. I had a collection of snakes that we kept and really liked wildlife and did the target shooting thing and played the guitar and, you know, had really a great childhood. Everyone should be so lucky.

**UBIQUITY:** Where did you go to college?

**NAGEL:** UCLA -- as an engineer student.

**UBIQUITY:** Was that inevitable? Did you know from age seven that you wanted to be an engineer?

**NAGEL:** Well, I always liked to build things. As I said, my father was a contractor, and I worked for him every summer. I'd go back to Louisville, while my brother and mother would generally stay in Tucson -- at least my brother did because every time he went back east he would get sick again. But I would go back every summer when I was a teenager and work as a laborer for my dad's company. He was a roofing and sheet metal contractor and did heating and air conditioning and things like that. It was a small business with, at its peak, maybe 20, 25 mechanics. Of course, I had no

useful skills, so I did odd jobs -- and as you might imagine the guys who worked for my dad had great fun with the boss's kid, getting me to carry giant loads and that sort of thing. But that was probably a good experience too. I worked with my hands a lot and I actually like building things. And to answer your question: yes, for whatever reason, I always assumed I was going to be an engineer, I just assumed that being an engineer was what one went to college to do. At UCLA my focus was on mechanical engineering topics, even though they didn't offer a formal M.E. degree. I took a lot of thermodynamics and heat-transfer and the usual stuff mechanical engineers take as opposed to electrical.

**UBIQUITY:** And you stayed in engineering?

**NAGEL:** For a good while, although I eventually got much more interested in acoustics and started working part-time for a company that was then called Bolt, Beranek and Newman, working on noise control in the psychoacoustics department. As a function of that experience I got interested much more in human response to physical phenomena -- in this case noise. I had done an undergraduate honors thesis on people's ability or inability to localize noises or sounds underwater, and that was my first real attempt to try to do a measurement on human beings.

**UBIQUITY:** What's the general nature of that problem?

**NAGEL:** Here's the question: if you want to know how to measure someone's ability to localize sounds underwater, how would you do that experiment? As an engineer, I'd never really come to grips with how you measure things on people, so this was an entirely new problem to me. The physics had two main aspects: The first is that you localize sounds in air through the use of two cues -- inter-aural intensity differences and inter-aural time differences. Inter-aural intensity differences result because if the sound's on your right side it's louder in your right ear by just a little bit. Interaural time differences happen because the sounds reach your right ear just a little faster than they reach your left ear. And your brain turns out to be exquisitely well-tuned to exploit both cues. Underwater, the propagation velocity of sound is 4.6 times what it is in air, so the time differences are cut

down by a corresponding factor and the specific impedance of your head is about the same as, well, seawater at least. This means that there's very little intensity difference between the two ears, and in fact the sound goes right through your head. So both the major cues that use the localized sounds are correspondingly reduced if not effectively eliminated. There are lots of complications, but my point now is that the experience made me realize that I simply did not know how to do such an experiment.

**UBIQUITY:** So what did you do?

**NAGEL:** I began taking courses in the psychology department. I found out that there was a whole discipline having to do with psychological measurement and there were fields like perception and sensation and cognitive science, etc., that were entirely new to me.

**UBIQUITY:** What did you find different between your psychology classes and your engineering classes?

**NAGEL:** I'll start with the most salient one: There were actually *women* in the psychology classes! When I was at UCLA, I think there were only two women in the entire school of engineering, which had 4,000 students. Engineering just wasn't something that girls did at that time, and of course that state of affairs has now changed somewhat, though I'm sure there's still a bit of a bias gender-wise. But when I was at UCLA, the psychology department had more women than men, so for someone like me who had been stuck down in the south part of the campus with guys carrying slide rules, psychology was quite an eye opener, almost literally. And then the other shocker for me was that in the psychology classes students actually *talked*. In fact, maybe that was really the most salient difference, because in engineering at that time they didn't really have a lot of things called seminars: you basically just sat in a classroom and listened passively to lectures. You occasionally would ask a point of clarification, but then you would go off and do your thermo problems and come back and turn in your answers. There just wasn't a lot of discussion and a lot of engineers were very inarticulate, because they weren't pressed to explain themselves in engineering school.

**UBIQUITY:** Women and conversation. You were making important discoveries.

**NAGEL:** Yes indeed. And I guess another thing was that I found I had a very useful and unique set of skills. I started working part-time for one of the professors, Ed Carterette, one of the first psychologists to buy a minicomputer at UCLA and to use it to create a computer-controlled laboratory. He found that I could do things like design and build circuits that worked -- filters and audio circuits and so forth -- because of my engineering focus at UCLA, where I took all the circuit analysis courses and labs. Students learned how to do basic electrical engineering design, and so I could build a bunch of stuff, and even more weird, I could program the minicomputer and write assembly-level and machine-level code. So from his point of view, I was a great research assistant, despite strenuous objections from the chairman of the department, who didn't really want engineers in the psychology department.

**UBIQUITY:** Why not?

**NAGEL:** I guess he felt we weren't well-trained and didn't have good backgrounds (both criticisms were probably true). But Ed Carterette wanted me badly enough in the department that he got me and I spent the next three years getting a Ph.D. in psychology with a focus on perception and mathematical psychology.

**UBIQUITY:** How long did you stay at UCLA?

**NAGEL:** A total of nine years -- six in engineering school and three in psychology. My research in psychology was in an area called signal detectability theory, focusing on how people hear.

**UBIQUITY:** What did you think the future had in store for you at that point in your life?

**NAGEL:** I guess by then I had pretty much given up the idea of building things, and had become much more interested in using a scientific approach

to understanding things. In my old age now, I find both perspectives useful and I think it would be great if many people had such multi-perspective training, but at the time I came to feel that I wanted to be a scientist, and I decided that the best way to do that would be to get a job at a university and go down a traditional academic path.

**UBIQUITY:** Was it an easy decision for you to make?

**NAGEL:** Pretty much so, because I was by that time married and my wife and I had an infant daughter, and I couldn't continue living on \$25 a month or whatever. I received a post-doctoral fellowship at the NASA Ames Research Center, which had a quite active program at that time in psychoacoustics and also in fields like simulation technologies, where an understanding of how people see and hear could be very useful. Also, NASA was at that time doing a lot of work in aircraft noise control and it sponsored a lot of the work that for example, Bolt, Beranek and Newman was doing when I was working there as a graduate student. There were a whole bunch of reasons that it seemed like NASA Ames was good place to go. It was also in the Bay area, up north, which I always liked much better than the Los Angeles area, one reason being that it looks a little more like Kentucky, with real trees and things, and not everything is a palm tree. I liked it up here and I still enjoy the people and the culture up here a little better than the LA scene. For a whole variety of reasons I decided to take that post-doc with the idea that it would be a springboard to an eventual career as an academician or professor somewhere.

**UBIQUITY:** How did life begin for you at NASA Ames?

**NAGEL:** Ed, my thesis advisor, was a good friend of Dick Atkinson, who eventually became the President of the University of California but at the time was Chairman of the Stanford Psychology Department. I believe that Dick was at the time one of the youngest psychologists inducted into the National Academy of Sciences, and quite a well-known, aggressive, ambitious, young mathematical and cognitive scientist. I had developed and started teaching a course called mathematical models in perception (as

opposed to mathematical models in learning, for example) -- and I co-taught that course with Dick Atkinson.

**UBIQUITY:** Did you like co-teaching?

**NAGEL:** I can't say that I did. What co-teaching meant was that I would prepare the lectures and come and teach them and Dick would raise his hand about every 15 seconds and say he disagreed with me -- or he would press me on a point of fact or a point of interpretation. He generally made it a pretty miserable experience for me, although in retrospect it was probably a useful one. But it was horrifying at the time because he was a very well-known guy and I was sort of nothing. To make it even more embarrassing, it was an undergraduate course and an upper-division course for Stanford students -- yet the first day I showed up there were half a dozen graduate students and three or four faculty members sitting there in addition to two undergraduates. So after my having prepared somewhat simple-minded lectures that undergraduates might be able to follow, the faculty and the grad students who showed up were always wanting to take it off into a much more complicated and sophisticated direction.

**UBIQUITY:** Do you still have nightmares about the experience?

**NAGEL:** No, but I do still have vivid memories of wearing a blue shirt that had not a dry spot on it -- things of that kind. Another factor in my distress was that public speaking was not something that came naturally to me. The horror of it all helped me understand that my skills at that time were probably better-tuned to doing research than to teaching. Besides, once you experience universities at close hand, you see their weaknesses as well as their strengths as places of employment.

**UBIQUITY:** What did you do next?

**NAGEL:** NASA offered me a job in research, so I began a 17-year career as a NASA research scientist at the Ames Research Center. Before long, I started a vision group at NASA which is still there, and it's quite a distinguished one, if I do say so myself. I think a lot of the work done in the human factors

research division at Ames still has affected the way airline pilots, for example, are trained all over the world. Scientists in the division developed something called the Aviation Safety Reporting System, which was operated by NASA for the FAA. The ASRS was and, I believe, still is an incident reporting system that probably has led to more insights about pilot error and sources thereof -- and, more importantly, ways to fix it, than any other single source of information on an ongoing basis. It was a very clever program that gave pilots positive incentives to report their own errors, because they received limited immunity for having done so: they couldn't be prosecuted for making a flying mistake unless they had done something for which they were criminally liable.

**UBIQUITY:** How would you sum up your experience working for NASA?

**NAGEL:** That was the first time in which I worked with what I would call a world class group. People throw the term "world class" around pretty loosely, but these guys really were. I was sort of the least of them. I was more the functionary, if anything, of the department manager or division chief, but working with these guys and finding out first-hand by working with them, that a small group of six or eight people could change the world. This was for me a completely eye-opening experience that I've never forgotten. I've never forgotten any of scientists or the work that they did, and that we did as a group. It was a spectacular way to start life as a professional. I got very interested in the broader topic of human factors then, and that's when Don Norman and I became good friends.

**UBIQUITY:** After 17 years at NASA you moved to Apple. What made you decide to do that?

**NAGEL:** At NASA I began to get much more involved in the broader human factors community, and got to know some people at Apple. And the government's salary structure had gotten so skewed relative to industry that I was just starving my family, more or less. My decision to make a change was helped by the fact that my wife and I unfortunately had lost our home to a landslide in one of these enormously heavy California rainstorms that dumped 18 inches of rain in a 24-hour period.

**UBIQUITY:** Oh, goodness.

**NAGEL:** So anyway, there were a growing number of reasons that made me think that maybe it was time to get out of the government, as much as I'd enjoyed it, and I ended up taking a job at Apple.

**UBIQUITY:** And what did you find at Apple?

**NAGEL:** People were smart at Apple, but they weren't always well-trained (formally at least) or well-disciplined. As a result, the skills I'd developed at NASA turned out to be quite usable. When I first went there, I was scared to death because I thought that whatever limited success I'd had in my career was somehow idiosyncratically attached to NASA and that I could not really succeed anywhere else. There was a lot of folklore about government bureaucrats being worthless and so on (remember this was the Reagan era), and I probably started to believe some of it myself. But I soon found out that I had some useful skills, and so I advanced quite quickly at Apple and became head of the advanced technology group. Then at some point the company asked me to take over all of product development in a series of career moves.

**UBIQUITY:** Characterize your Apple years for us.

**NAGEL:** We did a lot of quite revolutionary things when I was there. One that I am most proud of was our efforts to get the FCC to put aside spectrum for wireless data networks. The so-called NII bands of stuff in the multi gigahertz range now form the basis of some of the new 802.11 technologies. So in a very small way I played a role in the evolution of wireless data networks such as Wi-Fi, though of course I had nothing to do with inventing the Wi-Fi protocols. At minimum we recognized the importance of wireless data networks before Wi-Fi became so popular and impactful on our industry. We were also one of the first groups to really exploit search technology in a personal computer. (I wish I could say that I had the idea for Mosaic and Netscape, but we were looking at search more as a way to find information in the system itself -- on your desktop or whatever.) Anyway, our

group did a lot of things that were quite revolutionary at the time. Once again, I found that the thing I loved most was getting to associate with world class people like Bill Atkinson and Larry Tesler and others who invented stuff that had great impact. It was an enormous privilege to work with people like that, get to know them, and find out how they think.

**UBIQUITY:** After Apple you went to AT&T. How did that happen?

**NAGEL:** AT&T had begun looking for a computer company to buy. As you probably remember, they ended up buying NCR, but one of the companies they also looked at was Apple, so I got to know the AT&T due diligence team, including the chairman, Bob Allen. At some point AT&T split up into different pieces, and I was asked to become president of the part of Bell Labs that stayed with AT&T. It was a dream job for me because Bell Labs was one of the premier places in the world that did acoustics, speech and auditory-related stuff. To be asked to go there and be the president of the Labs was quite a spectacular offer -- but not so spectacular was the prospect of moving to New Jersey. For various reasons, my wife was not enthusiastic about moving, so I told Bob that although I thought it was a great job offer I didn't want to move.

**UBIQUITY:** How was the problem resolved?

**NAGEL:** After six months or so, AT&T agreed to build a small lab on the West Coast where I could spend at least half of my time and occasionally I would go back to New Jersey and run the lab back there, which had a few thousand people by then. So I did that. Over time I ended up spending three-quarters of my time in New Jersey, not California.

**UBIQUITY:** Before too long you became AT&T's Chief Technology Officer, right?

**NAGEL:** Right. I think I'd been there a maybe a year and a half, when Bob Allen asked me to be CTO. AT&T had not too long before acquired what became the AT&T Wireless Company and they were looking at getting into cable, which they eventually did after Mike Armstrong replace Bob as the

Chairman and CEO of AT&T. Bob in effect said, "We're going to have all these networks that we're going to glom on to our own, and it's going to be an architectural nightmare. We'd like you to be the CTO for the company and make sure that the networks evolve in the right ways and do a lot more in the way of data and packet services."

**UBIQUITY:** What did you really know about all that stuff?

**NAGEL:** "Not much" is the brief answer. I made that pretty clear. I told them that the last thing I wanted to do was to characterize myself as an expert in the phone business. Oh, I knew more or less how circuit switch stuff works and all that, but I made it clear that I most likely wasn't going to be making contributions in that area. But I also told them: I do know a little about computing and networking and the Internet and things of that sort, so if that's what you want, I'm your guy, and I can develop whatever necessary skills there are to complement what I already know.

**UBIQUITY:** What did you find most interesting about your new job as CTO?

**NAGEL:** It was the gradual realization that, despite having been home to one of the premier industrial research labs in the world, AT&T was not very interested in technology. What I found is that service companies are just not particularly interested in developing technology, they're only interested in buying it. So getting world class technology out of the labs and into service was really, really hard and not a natural act for the company.

**UBIQUITY:** So presumably you found the job somewhat frustrating.

**NAGEL:** That's very true. But even so, the job of being President of the Labs was fabulous. When I arrived, there were six or seven members of the National Academy of Sciences and Engineering just in the research group alone. It was a spectacular group of people, and being around such people and being able to talk with them, argue with them, and struggle with them, was an incredible experience intellectually and emotionally. I loved that part of my job but didn't like the CTO part very much. In addition, the travel became very demanding, because I found myself commuting between the

West Coast and East Coast just about every week. I'd get in an airplane, fly back to California, get there at midnight and often leave on Sunday morning so I could be at work on Monday morning back in New Jersey. I found out the CTO job was such that you couldn't get much done unless you were physically sitting in front of people and hammering them or getting hammered or both.

**UBIQUITY:** Why is that the case?

**NAGEL:** It's the case because you're making recommendations or decisions that are enormously complicated and have huge financial and other consequences, and those are the kinds of decisions that people do not make unless there's a certain degree of trust. That kind of trust is developed through face-to-face, interpersonal struggle and interaction.

**UBIQUITY:** Video conferencing won't do the trick?

**NAGEL:** When I was back on the West Coast, I used video conferencing a lot. It certainly has its place, but at the end of the day it's not like showing up at a meeting in which people are heatedly trying to persuade one another to make risky decisions. And *all* these decisions are risky. So you have to be there. Interpersonal influence and trust and things like that are important because things are not black-and-white and not always provable. A lot has to be done by persuasion, talking, interpersonal relationships, going to lunch, going to dinner, developing alliances, et cetera.

**UBIQUITY:** After AT&T you moved to Palm. How did that come about?

**NAGEL:** I had been named to an advisory committee for President Clinton on information technology, which came eventually to be known as PITAC, the President's Information Technology Advisory Committee. Another member of the Committee was Eric Benhamou, who was the founder of 3Com, a company that had at one point bought a little company called Palm from U.S. Robotics. Eric asked me to join Palm's board, which I gratefully did and was really interested in, because like Apple Palm had invented an entirely

new kind of product that was in certain ways changing people's lives. I found it absolutely fascinating.

**UBIQUITY:** Was Palm like Apple in any other ways?

**NAGEL:** Absolutely. In fact, when I got on the board I became aware that the board had already -- months or even years before -- decided that learning from Apple would be a good idea, and that if you wanted to be successful as a platform, you had to separate the software from the hardware -- a step that Apple had refused to take, or had at any rate delayed the decision until it was past the point at which they could implement it. You can't win the platform battle if you have a closed system, so Palm had already decided to license technologies to others. Before too long it became clear that Palm was going to split into two companies, hardware and software, and I was asked by the board if I'd like to be the CEO of the new software company, which eventual came to be known as PalmSource.

**UBIQUITY:** And you accepted immediately?

**NAGEL:** Yes. I'd never been a CEO, so of course that part had a definite appeal; in addition, I had not only run software development at Apple, but the skills I developed at AT&T were excellent preparation for me, since the handheld industry has been moving more and more towards things like phones and network devices where I had a lot of experience and relevant skills from AT&T. At some point I came to realize that it was a perfect job for me.

**UBIQUITY:** Looking backwards now over your career, does it seem to have been a straight line from where you started to where you ended up?

**NAGEL:** That would be a stretch but there are some major themes that have remained pretty constant in my career. One theme has been my association with groups known for doing great human factors work, and another is my association with people who are trying to make a difference. It's just incredibly exciting to be with a group of people that want to remake a major

part of industry or change people's lives through technology. That's the most exciting thing that you can do as an engineer.

**UBIQUITY:** How has your own life been changed by Palm's technology?

**NAGEL:** Yes, in a number of ways. I've become quite addicted to the stuff. I carry a Treo 600, which is the current example of a so-called smart phone. When I was at AT&T I had a Nokia phone. I don't think I ever had more than a dozen phone numbers in it because it was hard to put the phone numbers in, and I could never remember how to do it. There's an anecdote that is attributed to various people, but I think the guy who actually said it was Bjarne Stroustrup, who as you know was the C++ inventor, who just happened to work at AT&T. He said, "I've always wanted a computer as easy to use as my cell phone, and now I have that. I can no longer use my cell phone."

**UBIQUITY:** That's funny.

**NAGEL:** I had also started using a Blackberry and that was a neat device that did mail really well, but I never used the address book and the rest of the little applications on it because they were just too hard to use and too awkward and didn't do the right things. Since it was a closed platform there weren't any third-party applications and so it never got better. But now on my Treo I have around 2,500 phone numbers, because I travel all over the world. I have every phone number that I'll ever need. I can send people short messages. I can e-mail them. I can call them. It's become completely indispensable to me.

**UBIQUITY:** No complaints?

**NAGEL:** Sure. It's still not quite easy enough to use. I think we have a lot of work yet to do on that, particularly as we try to reach down into the broader general population.

**UBIQUITY:** What do you think is the real problem with making devices more user-friendly?

**NAGEL:** Details! General theory is all very good, but at some point you have to get down to details. For example, yesterday I was trying get my new Treo ready to take to Europe with me. It's a CDMA phone that I use in the U.S. on the Sprint network and obviously there aren't any CDMA networks in Europe and I've got to have a GSM phone. But it turned out that my Cingular account never turned on GPRS, the data service. That's not a big deal except that it took me about 25 minutes to figure that out because it's not absolutely clear that that's the case from looking at one's account on the Cingular Website. I had to call customer service and go through the carrier's service activation process, and I began wondering if a hair stylist could do this or would put up with having to do it. The whole process is just too irritating. What's needed is stuff that works out of the box, so that you rip the box open and you turn it on and everything works. That's what you need if you want to develop a mass market for a complex device like a smart phone.

**UBIQUITY:** Who do you have working on that? Do you have a separate lab to address that kind of problem?

**NAGEL:** That's an interesting question: should you or shouldn't you put a big human factors group together and a UI group and so forth? We had that at Apple and we had some wonderful people there -- for example, Don Norman, who came after I left and ended up heading the advanced technology group. But my feeling now is that a better strategy is to inspire everyone in the company to understand that it's absolutely essential for the company's product designs to offer a great user experience. Somehow that idea needs to be adopted by literally everyone, from the guys writing the micro-kernel to the guys doing the actual UI design. As Don Norman would tell you, it's just crazy to design an exceedingly complicated system and then try to slap a state of the art UI on top of it. That's one of the reasons that Unix has never been really successful as a desktop system or as a handheld platform -- and I say that even though you can buy Linux-based handhels from people like Sharp and others. They are far from easy to use.

**UBIQUITY:** What's the fundamental problem?

**NAGEL:** The fundamental problem is that if the underlying system model incorporates abstractions that are difficult for normal human beings to understand, it's always, always going to behave in unpredictable and non-understandable ways to them. In general, it's harder to make such systems easy to use, and that's why good human factors must be reflected in every aspect of a design, from the fundamental architecture of the system through to the implementation of the exact way you draw the graphics on the screen and the exact way you support interaction with the screen via tapping and talking and anything else you might do. There are some spectacularly good examples of human factors design, and there are equally spectacular examples of failures.

**UBIQUITY:** Do you have a favorite example of good design?

**NAGEL:** Well, one of the systems that I've always loved is one called Wildfire, a speech recognition-based, call-forwarding, "find-me, follow-me" service. If you've used it you know that you can call it up and say, "Hi, is John there?" And it says something like, "Well, who are you?" And you tell it your name and from then on, it responds to you when you call and says, "Hi Dave." They managed to take speech-recognition technology, which is still limited, and through clever implementation and a couple of unique ideas make a system that is delightful to use, even though it occasionally makes mistakes. It has a sense of humor, and is programmed so that you can occasionally say things to it and it will say more or less appropriate and kind of funny things back to you.

**UBIQUITY:** Is there a Henny Youngman version of the software?

**NAGEL:** You know, there may be one back there in the lab somewhere. Wildfire can do something like this: Suppose it asks you, "How are you?" and you answer "I'm fine, how are you?" (a fairly normal involuntary response when you're asked how you are); the system will then answer something like: "Not bad for someone in a box." Because it can make such surprising and amusing responses to things, it's able to make the overall experience a lot of fun. But you just don't find designers who are willing to

take those kinds of chances -- or, frankly, organizations willing to let them get away with it. I think that's one of my favorite examples of good user-interaction.

**UBIQUITY:** What's your worst-case example?

**NAGEL:** This will sound vaguely competitive but I think some things Microsoft has done come to mind immediately as horrible examples. Windows has evolved to the point at which it's just not usable. It's become so complex and so enormously rich with features (if I can use a positive term like "features"), that managing the system becomes a whole career. Frankly, I don't want to manage computers anymore; I just want them to do things for me.

**UBIQUITY:** Surprise, you're not a huge fan of PocketPC!

**NAGEL:** I find the very concept of a pocket PC pretty odd. I don't want a PC in my pocket! I want a device that I can use, that's *not* like a PC, that doesn't have the disadvantages of a PC. Some of the new phones coming out are so misguided that when you turn them on they don't actually come up as a phone, they come up as a computer-like thing. Whether you buy a smart phone or a dumb phone, one thing clear is that, first and foremost, you want a phone. At least that's clear to me. If it doesn't do a good job as a phone, I'm not interested. So I think there are some fundamental breakdowns in some of the designs.

**UBIQUITY:** Not quite on the subject of design, what do you think of the sheer variety of devices and standards? Whether you think about cell phones or TV remotes or ATM machines, it seems you never find any two alike.

**NAGEL:** Well, devices can be different and still be usable. The real test is, "Do I know how to use the thing without reading a manual?" Since you got me on the topic, let's take TV remotes, which represent a terrible example of bad user interface design. I think that, by contrast, Microsoft software is enormously well-engineered and works great.

**UBIQUITY:** Have we touched a nerve here?

**NAGEL:** You certainly have. Think about it: I now have four remotes that operate my video system, which consists of a new flat panel TV, a DVD player, a box for our cable network, and then a high-definition extension set-up box thing which you have to get if you want to look at high-definition content on your high-definition TV. (Are there people who *don't*?) So each one of those has a separate remote, which I guess is not surprising, but the surprising thing is that it's critical that the devices be turned on in *exactly the right sequence* if you expect anything to happen. That was for me the astounding discovery.

**UBIQUITY:** And you don't know who to take out and shoot.

**NAGEL:** Well, you take everybody out: you take the whole industry out, categorically or metaphorically I guess, and shoot the entire industry. It's just a blatant disregard for the details.

**UBIQUITY:** Is there any hope for cases like this? Or should we all just give up?

**NAGEL:** Well, there are people who make things called universal remotes, though I've never successfully gotten one to work. I'm told that some of them are quite good and have a lot of intelligence, so they can figure out things like "Sequencing is important, etcetera, etcetera." Phillips makes some nice, beautiful-looking products that seem to work in that regard. But still, people essentially have to program them -- maybe not by writing code in the same way that software engineers write but they still have to program the devices, and I would say that, in general, people are not good at programming things.

**UBIQUITY:** So what's the solution?

**NAGEL:** Well, having a 13-year-old or 14-year-old son or daughter turns out to be a good thing to have in this new age, so I guess we should all have a couple of those around at all times, because they know how to figure this

stuff out and they're interested enough and patient enough to do it. Certainly, not everyone has that kind of time and energy. My wife Joan and I bought something the other day and Joan -- who by the way is very, very good with technology -- said to me, "You may think this is really cool, but what it means to me is that it's another four hours a month that I'm hanging on a support line, trying to figure out how to keep this thing working." I've always loved the title of Don Norman's wonderful book "Things That Make Us Smart," and I've always wanted to write a sequel called "Things That Make Us Stupid." We now have a whole variety of devices in our lives that make us feel stupid either because we can't figure out how to use them or because they humiliate us by wasting our time and making us less productive.

**UBIQUITY:** Earlier you mentioned having an infant daughter.

**NAGEL:** Yes. She's 34 now, no longer an infant I guess.

**UBIQUITY:** Did she become an engineer?

**NAGEL:** She did not. But she does use computers. She's a graphic designer and Web site creator and she is a wonderful artist. She's someone who intuitively understands how to make things easy to use and how to make them fun and delightful. She was trained as a fine artist in college and resisted doing the engineering thing -- and even resisted getting a computer. But at some point I bought her a Mac and she got the idea that, gee, this thing could actually be kind of fun, you can actually *do* stuff on it. I'm quite proud of her because she's much better at it now than I am, and she is a superb designer.

**UBIQUITY:** Does that suggest anything about engineering education?

**NAGEL:** It does. I'm quite a fan of young people getting a broad liberal education. Engineers and scientists need to be confronted, right from the very beginning of their training, with the ethical consequences and consequences of what they might end up doing to all of us if they, and we, aren't very careful, very sensitive, and very alert.

END

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