An Interview with

BARRY W. JOHNSON
1997 IEEE Computer Society President

Conducted by David Walden

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WALDEN: Today is September 23, 2016 and I'm with Barry Johnson at the University of Virginia in Charlottesville. Barry was the 1997 IEEE Computer Society president and I am interviewing him as part of the society's history committee project to college oral histories of past society presidents.

Barry, thank you for agreeing to do this interview. For the record, the interview is being recorded and after we are finished it will be transcribed by a professional transcriber. Then I'll do a pass over the written transcript to fill in things the transcriber didn't understand and removing unnecessary words like "um" and "unh." Then I'll pass the interview back to you to review. Once you're satisfied, the corrected transcript will be posted on the website of the Computer Society History Committee in a special category on the website of the IEEE History Committee's Global History Network. Therefore, before I leave I'd like to collect the permissions form that you said you signed and would give to me. Help me remember, please, to take that away.

JOHNSON: Absolutely.

WALDEN: So, let me start. This is an oral history, so we're going to start at the beginning and go as far as you've gone. Naturally, we'll emphasize the Computer Society in the middle, but let me begin with the beginning.

Please tell me a little bit about where you're from, your youth, your hobbies; anything you think is interesting about your parents, siblings, home town, and so forth.

JOHNSON: I'm originally from Gretna, Virginia, which is a very small town in central Virginia; which used to be the heart of tobacco country. Within the Commonwealth of Virginia, it's a town of approximately 800 people, so it's a very, very small town but my roots in that town go back to the early 1700s, so my family has been there for many, many generations. I grew up there, went to high school there, graduated from high

school, and attended the University of Virginia for all of my degrees; bachelor's, master's, and Ph.D. in electrical engineering. You mentioned hobbies; I'm a sports fan and I'm very much into . . .

WALDEN: Back then already?

JOHNSON: . . . back then, very much enjoyed playing sports.

WALDEN: So you did high school sports?

JOHNSON: I did; I played formally on the football team and the baseball team in high school; and played for fun basketball and other types of sports as I was growing up. So I was very much interested in sports activities and also worked for my father. My father had a small business; he was an electrical contractor and that's where I became interested in electrical engineering and ultimately ended up majoring in that. But my dad had a very small company that he ran from the time he returned at the end of World War II, from France at the end of World War II 'til he retired when he was 85. So he ran that business for many, many decades.

WALDEN: When you say he was an electrical contractor, he was an electrician plus he had a business.

JOHNSON: Yes.

WALDEN: He was putting in wall plugs, and lights, and all that type of stuff.

JOHNSON: He did. When he first started out, and this was in the late 1940s when he first started out, he did plumbing and electricity. He eventually gave up the plumbing

portion of it and expanded to do heating and cooling systems. He installed air conditioning systems or HVAC systems; he did both commercial and residential wiring, heating, cooling. [It was a] small business; he typically had five or six employees so it was mostly himself and a few others, and his sons. All of us worked for him Saturdays [pause]

WALDEN: You had a lot of siblings?

JOHNSON: There were four of us; three boys and a girl. The boys all worked in some capacity with my father.

WALDEN: So in addition to doing — I'm not quite sure what you call it — power electricity, were you at that time also interested in electronics, or did that come later?

JOHNSON: I was interested in electronics. I was always interested in how things worked, you know, even mechanical things. I would take things apart and put them back together, and did all of my maintenance for the automobiles that I owned early on, before it became too complicated to do that. But I also helped my father with those types of things as well. But very, very interested in mechanical things and how they worked, and electrical things and how they worked. I was not exposed to computers, though, until I came to college, to university. It was the first experience I had with computer.

WALDEN: So you said that you came here and got all your degrees. What kind of electrical engineering were you studying here?

JOHNSON: Today I would call myself a computer engineer because I was in the electrical engineering department, and they did not have at the time a computer engineering department. But I was always interested in the computer technology, so I

worked with microprocessors, and small computers; what would be called embedded systems design today, where you have computer-based control systems. So I worked on many control applications. I did my research, starting at the undergraduate level, on devices to aid physically disabled individuals, so we did some of the early work in computer-based control systems for electric wheelchairs. We also did automated feeders, robotic feeders.

WALDEN: Jim [Aylor] was describing similar things [in my interview of him] this morning. Was that a coincidence?

JOHNSON: Well Jim was my advisor.

WALDEN: Oh I see.

JOHNSON: So there's a reason for that. I was Jim's first Ph.D. student and I started working with Jim when I was an undergraduate student and have worked with him very, very closely for the last 40 years, basically.

WALDEN: So the kind of courses you would take would be logic design, and [pause]

JOHNSON: I did take a course in logic design; I had a course, one of the very first courses offered at the university, in microprocessors; I had a computer design course; computer architecture courses; programming courses; graphics, computer graphics; so anything that had either an understanding of how computers worked or how they are used and fit into various types of applications was of interest to me.

WALDEN: And did you continue any of your extracurricular activities from high school here?

JOHNSON: I've always continued to love sports. I played softball for many, many years after graduating from high school. I did not play organized sports in college; I did not play football or baseball. I played basketball and softball on recreational teams as I was coming along.

WALDEN: Interesting. And so by the time you got a back…; well let me step back. The university by that time had a fairly explicit computer engineering and computer science department or not?

JOHNSON: We had a computer science department, that was explicitly a department; and we had an electrical engineering department. But we did not have a computer engineering department.

WALDEN: Okay, so you were studying computer engineering implicitly.

JOHNSON: Exactly, and I was studying it within both of those departments; both electrical engineering and computer science. I took courses that were computer science courses; I took courses that were offered by electrical engineering.

WALDEN: So computer science was not in the engineering school?

JOHNSON: It was in the engineering school; in fact, the computer science department here grew out of what at that time was called applied math. And there were a number of folks within applied math that were very interested in computing and [it] grew out of that, developed [into] a department of computer science.

WALDEN: And the applied math people were in engineering or were they in math?

JOHNSON: They were in engineering.

WALDEN: So these were the people that would give you the math to do engineering.

JOHNSON: Exactly.

WALDEN: Interesting. You said you got your master's degree here?

JOHNSON: Yes.

WALDEN: What was your thesis topic or project?

JOHNSON: I did a project for my master's degree. At the time, you could do a master of science, which was a thesis-oriented degree; or you could do a master's of engineering, which was non-thesis but required project work. My project work was done within the Center for Rehabilitation Engineering, where we worked on, as I mentioned earlier, electronically controlled wheelchairs and robotic feeders; we did work on motion analysis for helping train individuals how to use wheelchairs properly if they were using a manually-controlled wheelchair. Any of a number of things; this was a major center here at the university; it was funded for many, many years and I was a graduate student funded by that center for work on all those types of activities.

WALDEN: What led you to continue your academic career after your bachelor's degree rather than going out into industry at that time?

JOHNSON: I went into industry after my Ph.D. I think there were several things. I knew that the odds of someone being able to come back after getting out were pretty rare. I was

a unique graduate student in the sense that I was married and had a child at that time. So my wife and I were married in 1977; our daughter was born in 1979, the day I started graduate school. So I was in a position where I knew that my responsibilities to my family would not allow me to come back once I got out. So I was very motivated to finish; I was very motivated to get my degrees.

WALDEN: And already you were interested in going through to a Ph.D.?

JOHNSON: I had not made that decision. When I was a master's student I was actually toying with the idea of going and getting a master's in business, which was something I had an interest in. In fact, I think my mentors at the time — Jim Aylor being one of those — are the ones that really convinced me that the right path for me to take was to get a Ph.D. But I did look at business schools; I did look at going into industry. I actually did interview in industry after my bachelor's and master's both, and had job offers after both and decided the best route was for me to continue in the university and get a Ph.D.

WALDEN: And did you already have an idea of going into academia after that, or you could've gone into industry, or [pause]

JOHNSON: I did not. Actually, to be honest, I had the opposite. I was convinced I was going to go into industry and make my career in industry, because that was very appealing to me. I had a brother who was a professor at the University of Georgia, so I had been exposed to the academic world a fair amount through him. But I was convinced I was going to go into industry and make my career in industry because I really loved the industry environment. That was my plan. I went to work for Harris Corporation in Melbourne, Florida and just happened to be sitting in my office one day when I received a call from Jerry Cook, who was department chair at Vanderbilt University. Jerry had been at the University of Virginia — he was on my committee for my Ph.D. — and he

called me up out of the blue and said hey, I have an opening, would you consider becoming a faculty member? And I decided that I would look into that because I knew Jerry, had a lot of respect for Jerry, and really would have welcomed the opportunity to become one of his department faculty. So I figured at that point, if I was going to look at one place I really needed to look at more than one. We were living in Florida at the time, so I applied to the University of Florida, who also had openings; and I called back to the University of Virginia, not thinking that it was even an option. I actually called back to get references. One of my references was Ed Parrish, who was department chair here at UVA in electrical engineering and Ed said, I'll be happy to be a reference but I have an opening; would you have interest in considering something here at UVA? And so I had… I was very, very fortunate to have an offer from all three places; the University of Florida, Vanderbilt, and the University of Virginia. There were two things that really brought me back to the University of Virginia; three things, I would say. One was the experience that I had here as a student was just absolutely phenomenal. I was very, very fortunate; I worked very closely with a number of faculty and just benefitted tremendously from that experience and so that experience made me a believer in what UVA does. So I was very interested in being a part of that. The second, which is somewhat related to that, is the people that I knew here. I knew Ed Parrish really well; I knew Jim Aylor really well; they were both mentors to me as I was coming along; especially Jim because he was my advisor. Bob Ramey was another mentor of mine here at the university. I probably would credit Bob as much as anybody for convincing me to stay in grad school, at least until the master's, and eventually into the Ph.D. So the people were a big part of it for me, and I wanted to be working with great people [interrupted]

WALDEN: Presumably you also had family in this area.

JOHNSON: I did. My wife and I are both native Virginians. We grew up in small towns 10 miles from each other and her parents were still alive at that time. My parents were

still alive at that time. So we had family here, we had a young child at that point; at that time she was five and we wanted her to be able to be around her grandparents. At that point, she was seeing them maybe two or three times a year and we just wanted them to be a bigger part of her life than that. So those were the three factors that lead me back here and I've never regretted it; it was a great decision.

WALDEN: Back to your Ph.D.: what was your thesis topic then?

JOHNSON: My dissertation was focused on adaptive control algorithms, and specifically digital adaptive control. At that time, you have to remember, microprocessors were very minimal in terms of the computational ability that they had. So what we were looking at was how do you take complex digital adaptive control algorithms and implement them in a way that you could execute them on small 8-bit microprocessors with very, very limited memory. So we developed some new algorithms for doing that; for designing computational efficient complex digital adaptive control algorithms, and we applied it to the wheelchair system. Wheelchairs are kind of interesting things because if you think about it, the vast majority of the weight of a wheelchair when it has a person in it is the person, but that can vary tremendously from an adult that might weigh a couple hundred pounds to a child that might weigh 40 or 50 pounds. And the dynamics of the chair change drastically depending on who you had in the chair. So the responsiveness will be different, the handling characteristics will be different, so what we developed was a microprocessor system that could adapt automatically to the dynamics of the chair, including the occupant of the chair and adjust the algorithm to be able to effectively and efficiently control that chair under some pretty significant changes that would exist in the parameters. And so we did a lot of experimental work on that; we developed some fairly complicated models of the wheelchair; developed some control algorithms that were based on pattern recognition, so we actually used some technologies from pattern

recognition to be able to recognize changes in parameters and then adapt and adjust the algorithms based on those. And we actually built it.

What I became interested in as part of that was given that you are implementing these algorithms in the hardware/software systems, how do you make them safe? How do you ensure the reliability? How do you predict how safe they're gonna be and design the system so that bugs in the software or faults in the hardware cannot cause catastrophic events in the system. And so that was an interest that I developed at that point, based on some of the work that we were doing. Actually it was a chapter in my dissertation that focused on fault-tolerant architectures for microprocessor-based systems. It turns out that that chapter was probably, out of the seven or eight chapters I had, was the most important because it really determined the remainder of my career.

WALDEN: Back to Harris. What did you do at Harris?

JOHNSON: I was in a system architecture and controls group. It was part of the government aerospace systems division at Harris, and we designed flight control systems for mostly military, but some non-military helicopters, airplanes; so I was part of a team that actually designed and analyzed microprocessor-based systems for flight control systems. So we did one of the first fly-by-wire flight control systems for a helicopter; both the tail rotor and the main rotor. I was part of a team that did some of the early architectural work on what is now the Osprey, a tilt engine aircraft that's flying in the military today. So Harris and Bell Boeing actually worked collaboratively during some early days of that program to develop some of the architectures for the flight control systems and other avionics on the aircraft, and I was part of a team that did that. I did a little bit of space-based technology, but fundamentally what I was focused on was how do you design a computer-based system to be safe? And then was part of a team that was fortunate to do that.

WALDEN: You then returned to UVA and you've explained how that came about. What did you teach when you got back here?

JOHNSON: We came back into the computer portion of the electrical engineering department, so digital systems. I taught advanced switching theory, which was a graduate course on advanced technologies for designing computers and computer-based systems. I developed a course on fault-tolerant computing, reliability issues, and then developed and taught that course for many years. I taught undergraduate courses on digital logic design. I taught an undergraduate course on microprocessor system design. Computer interfacing — I taught an undergraduate course on that. So it was really any of the courses that were related to — either both undergraduate and graduate — that were related to how you design computers, how you design systems based on computers. I ultimately taught computer architecture courses and developed a course later in my career on biometrics, looking at security issues associated with computer-based systems. But it was all in the computer technology, computer science areas [interrupted]

WALDEN: And was this at all close to what was going on in the computer science side of things?

JOHNSON: It was very close. In fact, we jointly taught the computer architecture course with computer science so generally, it was one person from computer science, and one person from electrical engineering and we would collaborate on teaching that course. We did the same thing for the digital logic design course; same thing. In fact, a lot of the courses were cross-listed, meaning that there was a CS number and an EE number for the same course. So I had computer science majors taking my classes, in addition to electrical engineering majors, and eventually computer engineering majors as we developed that program.

WALDEN: This is a digression, but I know people for instance, at Cisco, who do ASIC designs. And they move back and forth between the hardware design and the software to do the testing. The distinction between hardware and software, at least at the level of developing hardware, is not very big.

JOHNSON: Yes, and it's actually important to, in my opinion, to consider that linkage between the two. In fact, if you look at the research that I've done over the years, that really was the unique focus of it. We were really looking at the integrated hardware/software system, how the two pieces actually interacted with one another as you were executing software on a hardware platform.

WALDEN: Where it makes sense to put one piece of the function or the other piece of the function.

JOHNSON: And the interplay between them.

WALDEN: [We've discussed] teaching. [Let's talk about] research. You hinted that you stayed in the same research area for a long time and that was going on once you got back.

JOHNSON: Yes. Started doing research here at the university in 1984, which is when I came to the university as a faculty member and continued to do externally funded research until 2012, 2014, somewhere along in there. [In] 2006 I went into an administrative position in the dean's office as associate dean for research, and senior associate dean, but all the way from 1984 until 2012, when I passed over some of my grants to other people, I continued to do research; and it was all focused on how you design reliable and safe computer-based systems. We became interested in security issues because of the relationship between reliability and safety and security. And so the

research was funded by NASA; it was funded by the Department of Defense; it was funded by the National Science Foundation; it was funded very, very heavily by industry; funded by the Nuclear Regulatory Commission. One of the things that I really took a lot of pride in was that I had sponsors that stayed with me for a long, long time. I had an industry sponsor Ansaldo, which is an Italian company that funded me continuously from 1989 to approximately 2012. And then the Nuclear Regulatory Commission funded me continuously from 1997 to roughly 2012, somewhere along in there. So I had a number of very large — fortunately — and also very long-term sponsors. The Nuclear Regulatory Commission was very interested in how you predict the safety of a digital control system in a power plant, both the reactor protection system, as well as digital feed water control systems, and as well as human/machine interface in that environment, and how you predict the safety of the hardware/software/human system that you're dealing with there. So we worked for many years on that. Ansaldo is a maker of train control systems, as well as other technologies around high speed rail. They make people mover systems; they make Metro systems, like in the Washington Metro; they make a lot of control systems for those; and they were interested in a very similar problem for trains. The move at that point was to become autonomous and to have driverless systems for trains. So the question was how do you design and how do you predict how safe a system is going to be if it's totally dependent upon computer-based control? So we worked for years with them on how you model these systems; how you develop architectures that are reliable and safe; how you predict the safety; experimental work that you could do that will demonstrate some of these concepts. So we were very, very focused on using real systems to show that this worked. So, for example, in the train control application we did two major systems. One was the Los Angeles Green Line that was created and built during that time that we were working with Ansaldo. So we took that system and actually applied our technologies to that system to show that it would work. And the other was the Copenhagen system. The Copenhagen Metro system was again, being designed at that time and refurbished at that time; and so we took that system and actually applied our

work to it. On the nuclear side we used the digital feed water control system from the Calvert Cliffs Nuclear Power Plant and then we used the reactor protection system that is found in many plants in the U.S. So we did both of those that were real systems, real hardware, real software; and we analyzed those systems and did experimental work on them; and learned quite a bit. It was fascinating. So I was very, very proud that they were with us for quite some time.

WALDEN: You said you became the school dean for research. What does a dean for research do?

JOHNSON: In 2006 I became senior associate dean and associate dean for research; and served in that capacity for five years until we expanded the role of the senior associate dean, and I became senior associate dean alone; and served in that capacity until 2015. So to answer your question, the associate dean for research is really focused on two main things; one is all of the administrative support to help faculty develop their proposals and administer their research grants, and find opportunities for funding. So that was part of it. We had an office of pre-award research and an office of post-award research; and we worked very closely with those — I did — to make sure that we were properly supporting the faculty in the research mission of the university.

WALDEN: Does post-research include licensing and things like that?

WALDEN: It does. I was involved in that for the engineering school, so I would represent the engineering school on university-wide initiatives that had to do with licensing and tech transfer; also served on the conflict of interest committee for the university, to handle any research conflicts of interest, you know, that would come along. Would also work on… probably the biggest part of the job that ultimately became a major part, if not almost exclusively the role of the senior associate dean, was corporate

relationships because we were working very, very hard to grow the research program within the school. Our goal was to double the externally funded research; to increase the number of faculty that were engaged in research; so a big part of the job was to get faculty engaged in research and in some cases that meant awarding internally-funded grants to stimulate research activity within the engineering school and in other cases it meant helping to link faculty with research opportunities both within industry and government. So that was a big part of the job. The senior associate dean portion at the beginning was representing the dean when the dean was unable to be there personally. Jim Aylor was the dean, so I worked for Jim in that capacity, so I really viewed myself as his right-hand person to work with him on initiatives for the school, to actually represent the school when he was unable to represent the school, and really to help him carry the load of being dean.

WALDEN: How do you learn to be this research and industry liaison?

JOHNSON: [Laughing.] Well I think the thing that helped me was that I had worked so closely with industry so I knew a lot of people in industry, I knew how industry operated, and I think that helped me tremendously.

WALDEN: Did you look at how other universities did it?

JOHNSON: I did; I spent a lot of time looking at other universities. We actually had a dozen or so universities that we benchmarked to try to see a number of things; you know, what percentage of their research funding came from industry versus NSF, versus DoD, versus the other common sources for engineering schools. What percentage of their faculty was actually engaged in research. What other universities did to try to stimulate research activity. What percentage was funded by industry and how did they interact with industry; what were their intellectual property agreements; what were the issues that they

had to address. We spent a lot of time looking at that and developing our own ideas. And at the time that we started, you know the percentage of funding from industry into the engineering school was very, very low. It was well under 10 percent and our goal was to get it into the 20-30 percent. When we benchmarked those other schools, it appeared that the leaders in engineering were in that 20-30 percent industry funding, and that's where we wanted to get; and we ended up getting there.

WALDEN: That's 20-30 percent industry independent, for instance, of government funding?

JOHNSON: Absolutely. If you look at the total volume of research measured in dollars, supported, then we wanted to get to 20-30 percent that would be funded by industry. And we got there. To be honest, I've been working on assignment at the National Science Foundation for the last couple of years and so I haven't looked recently at what the percentages are but we were able to get it into that 25-30 percent range.

WALDEN: Before I go on to the professional society side of things, talk about industry makes me wonder, did all those connections with industry help in either internships or ultimate placements of students?

JOHNSON: Absolutely. In fact, a lot of students — and certainly the students that I advised — I was able to help them with connections to industry for jobs. In fact most of my Ph.D. students have gone to work in industry; a few into the academic world; a lot into industry and so it certainly helped there. We also worked very… in fact when I was in the dean's office and responsible for strategic corporate partnerships for the school, we actually developed some very, very strong partnerships at that time. Probably the largest one was with Rolls Royce. We had a strategic relationship with Rolls Royce that ended up helping us create a couple of research centers; one that was the Commonwealth Center

for Aerospace Propulsion Systems; the second one was the Commonwealth Center for Advanced Manufacturing. Rolls Royce working with UVA and Virginia Tech as a threesome created both of those centers and were able to grow research funding from companies as a result of that. The Center for Advanced Manufacturing is the center that now has approximately 25 corporate members. Rolls Royce is one of those, but they now have Alcoa, Airbus, Aerojet, Chromalloy, Siemens, Newport News Shipbuilding; a fairly long list of companies that are funding research through that center; some of it done at the center itself, some of it done at the universities that are involved. We now have five universities involved in that center; and now also have NASA as a government member. I mention that in answer to your question because we've done several things as a result of that. We have an international internship; that's a Rolls Royce international internship program available to undergraduate students so we have five or six undergraduate students that each year get supported by the monies from that program to go work at an international location of Rolls Royce. Usually, in the early years, it was in the United Kingdom but they're interested in expanding it to other places in the world that they have facilities. We also have a Rolls Royce doctoral program that funds Ph.D. students to come here and work in research at the university. We also were able to generate resources for funding labs and things of that sort out of that program. And then with the Advanced Manufacturing Center, they hire somewhere in the neighborhood of 20-30 interns every year to bring them into the research facility and get them exposed to the companies. So those corporate relationships are incredibly important because students — even Ph.D.s — 85 percent of our Ph.D.s go to work in industry, they don't go to universities and so it's really important that the relationships with industry exist so that they can benefit from them.

WALDEN: When and how and why did you first get involved with professional society activities?

JOHNSON: I first became involved in 1985.

WALDEN: And not just the Computer Society but any other societies first.

JOHNSON: That was specifically the Computer Society. It was. I had reviewed for professional journals and things of that sort prior to that but Jim Aylor, my mentor, actually brought me into some activities that he was involved in within the Computer Society and that started in January of 1985.

WALDEN: I guess the university was supportive of this because Jim took you there.

JOHNSON: Very much so. Jim was an associate professor at that time, so he wasn't in a leadership position.

WALDEN: I see.

JOHNSON: That's a department chair, dean, or any one of that sort.

WALDEN: He told me this morning that Ed Parrish encouraged him to join [inaudible] IEEE activities.

JOHNSON: Ed Parrish encouraged him and absolutely, universities expect faculties to do research and service. The service is both inside the university on various committees and other things, but it's also service to the profession, and that typically is in the form of professional societies, so it is very much encouraged.

WALDEN: And when you were at Harris, you weren't involved with professional societies?

JOHNSON: I did reviews. I reviewed papers and I published papers while I was at Harris, and participated in conferences, things of that sort. I was not involved the way I became involved [later].

WALDEN: Would you please talk to me about your progression of activities within the Computer Society?

JOHNSON: Well, I will [pause]

WALDEN: I have the list.

JOHNSON: [Laughing.] I think I can remember most of it. When I first became involved I was involved in conference activities for the most part, so I was helping with some conference activities, some as a volunteer to help support those — I may get these in a little bit different order, but as I remember them — then became very heavily involved in membership activities. We were very interested in determining ways that we could recruit new members to the society, and actually make the society more appealing to student members because they were the future; but also to industry members. We were very heavily concentrated with academic members because it was really considered a part of the job, to some extent, for an academic, but we wanted to make the society much more appealing to industry as well.

WALDEN: Is there a student chapter of the Computer Society here?

JOHNSON: Absolutely there is a student chapter of the Computer Society here. And so I became involved in membership activities; I then became involved in the financial activities of the society; and I ended up holding positions as vice president for

conferences and tutorials; vice president for publications; vice president for membership activities; I was also the treasurer of the Computer Society, so I had a mix of experiences.

WALDEN: I also have VP for press activities.

JOHNSON: I was vice president for press activities. So the Computer Society press was separate from the publications. Publications were the journals, and [the] press was books, for the most part. So I held all of those VP roles; and eventually became President Elect, President, and Past President of the Society.

WALDEN: Let me go back to the activities board; oh that's the IEEE Technical Activities Board, not the Computer Society.

JOHNSON: Right. I actually served on the Technical Activities Board in several capacities. The early involvement directly with IEEE was on the IEEE Technical Activities Board Finance Committee. I was the Computer Society's representative, essentially, to that committee and served on that for a number of years. And during that time, very quickly actually in that time, I was asked to be the IEEE Technical Activities Board Treasurer. And so that meant that I actually chaired the so-called TAB Finance Committee, and served on the Technical Activities Board for the IEEE. I later became a member of that Technical Activities Board because I was president of the Computer Society so I served on the Technical Activities Board as president; and I ultimately became division director and represented the Computer Society at the IEEE. So I was on the IEEE board of directors, but also as the Computer Society's division director — one of the two that we had — I served on the Technical Activities Board as well.

WALDEN: You mentioned that part of the role of a faculty member here is service and your Computer Society activities qualified. Did professional society activities help you in other ways, less explicit ways?

JOHNSON: [Laughs.] I think it helped. I think there were at least two ways that it helped tremendously. It helped me develop my leadership skills because it put me in a position of leading committees, leading groups of people, having work with others collaboratively. And so I think it… you know I was, I think, in some respects I look back on it sometimes and think maybe I should have become president of the Computer Society much later in my career because in 1997 is when I turned 40; so I was elected to president when I was 39 and so I was pretty early in my professional career. So I was very, very fortunate to have leadership roles very early in my career; and the Computer Society gave me those roles that I don't think I could've gotten anywhere else at that relatively early stage of my career. So I think that was part of it. I think the other part of it was the relationships that were developed. I met some remarkable people from throughout the world, and had a chance to work with them on a number of activities that you just don't necessarily imagine when you're growing up in Gretna, Virginia, that you're gonna have some of those opportunities made available to you over the years. So I think it was the relationships; those relationships have continued to this day. So I think relationships, the experiences, and I hope I had an impact; I mean I think I had an impact and I hope I did; and I think it was an opportunity to give back and contribute to an organization that gave me certainly tremendous opportunities.

WALDEN: What were your considerations when you were thinking about running for president?

JOHNSON: One of the things that struck me about that time in the life of the Computer Society is that it was very, very early in the electronic publishing and digital library phase

of the IEEE, as well as the Computer Society. My predecessors as president, Jim being one of them, Duncan Lawrie being one, Ron Hoeltzeman, any of the folks that were presidents of the society prior to me, Mario Barbacci; they really created the roadmap for moving the society into the digital library of the world and I believe that the Computer Society was — I know — that the Computer Society led IEEE as a whole into that world, and really plowed ground that had never been plowed before. I really felt that when I came in in 1997, one of my jobs was to continue that momentum and hopefully enhance that momentum and get us even further into that electronic publishing and digital library world. I think we made some good progress on that.

WALDEN: In preparing for this interview, I looked around to see what I could learn and I couldn't find that you wrote letters in *Computer*, as many of the presidents did. Was that intentional?

JOHNSON: That was intentional. Michael Elliott, who was the executive director at that time, when I was president elect; we sat down and had a conversation about that. There were several things that we noticed. Those letters from the presidents were not the top-rated portions of the magazine, to be blunt about it. They were not that widely read and we [pause]

WALDEN: Except by future researchers in history.

JOHNSON: [Laughing.] That's true. But we intentionally decided to not do them. We ended up trying to communicate with the membership in other ways. We did that through some of the membership documents that we worked on, and so forth, but we intentionally chose not to consume the pages in *Computer* magazine. It was an experiment, and I think probably everybody before me and everybody after me probably did those letters, but it was intentional on our part to try to communicate in other ways with the membership.

WALDEN: I'll report that back to Anne Marie. She should remember.

JOHNSON: I've already told her that.
[Laughing.]
WALDEN: She should remember, but it's funny.

JOHNSON: Yes it is. But it was intentional why I did that.

WALDEN: So your vision as you; well, presumably it was a contested election, they all are.

JOHNSON: Yes, absolutely.

WALDEN: Was it back in the time; did they already have the system of the president elect, the president, and past president?

JOHNSON: Yes they did. I was president elect for one year, president for one year, and then past president for one year. That was actually a phenomenal experience as well, because that threesome worked very, very closely together for three years and so you really were in that team for three years. And Michael was an instrumental part of that as the executive director of the Society, as well. But that group of four worked just very, very closely together and you know when the president was unable to do something, they pulled the past president or president elect in, and so we worked together and that was very, very rewarding to me. Mario Barbacci was the past president when I was president; I'm sorry, he was president when I was president elect; and if I'm not mistaken, Ron Hoeltzeman might've been the past president when I was president elect. But that was a

good team; and then Doris Carver became president elect when I was president; and she and I served as division directors together for the IEEE.

WALDEN: She's another person that we've interviewed; I didn't, it was Jeff Yost, I believe, who interviewed her. [At the time of this editing, I was mistaken about this interview having already taken place. –Dave Walden]

JOHNSON: Good.

WALDEN: My understanding today, and my understanding is vague, is that a big chunk of the role of the president elect is planning. Was that true at that time as well?

JOHNSON: That's true, yes.

WALDEN: The president has the job of operating the organization for that year.

JOHNSON: And that was one of the reasons that the structure of president elect, president, past president was created is that you actually planned during your president elect year, and then you had really two years to be a part of a team when some of those things were executed. And so I think, you know, the focus as I mentioned; we were very focused on electronic publishing and digital library concepts. We were also very heavily focused on international activities and that's something that I really felt good about being part of that team. You know, Bruce Shriver was someone that was very instrumental in the international programs that we have within the Society. I've benefitted from that and I've gotten to travel to some of the countries to present some of the Computer Pioneer Awards. The focus at that time was we had a Computer Pioneer Award and one of the requirements of that award was that it was not presented posthumorously. It was for contributions that were made more than 15 years ago but the recipient needed to be living

to receive it. And when the wall fell down and some of the former Soviet Union countries were opened up and were made visible to us, we realized that a lot of substantial contributions had been made that the rest of the world really didn't know about and so we eliminated for a total of I think 20 awards; we eliminated the requirement that the recipient be living. We did multiple awards in each of a number of countries. I got to present the awards in Russia, Poland, Ukraine, and Romania; and travel to those countries and in some cases — in most cases — the recipients were no longer living because these happened a while ago but I got to meet the families of the recipients, I got to present the awards. In some cases the individuals were still alive. But this was to recognize the contributions to computing made in those countries that were just not visible to the rest of the world at that time so it was a remarkable experience.

WALDEN: You mentioned travel; did the university give you some relief from teaching or something to help with this?

JOHNSON: The university was very supportive. I was not relieved of teaching but I was given an opportunity; for example, I had a post-doc that was able to help with the teaching, so that she and I both would be there teaching when I was there. Then if I had to be gone, she would actually teach the class. And so the school and the university [inaudible] were very, very supportive but I continued to teach during that time and continued to keep my research program going so it was a very, very busy time. But the thing that made the job doable as a volunteer, because presidents are volunteers, but the thing that made it doable is the Computer Society staff. You mentioned Anne Marie, I mean Anne Marie was supporting at that time the conferences program, with Michael Elliott who was the executive director, later title Chief Executive Officer. They made it happen; they supported us, helped get things done, let the volunteers focus on what to do, and let the staff focus on how to do it and the implementation aspects of it. It never would have been feasible without that type of support structure in place.

WALDEN: And as the past president, what was your function then?

JOHNSON: Well you were still a part of that threesome and in fact, some of these presentations that I mentioned that I did, I actually did when I was past president because Doris Carver asked me to make some of them on her behalf. So I made a trip or two of those that I mentioned, while I was past president. So you continued to do that; you were still a part of the executive committee; so at that time — I was president in 1997, and I was past president in 1998 — and during 1998 was when I was elected to the IEEE Board of Directors, so I served from 1999-2000 on the IEEE board. One of the other things that I did and I think I have the year correct, is that I actually chaired the Computer Society Fellows Committee at some point in that process, as well.

WALDEN: 2000-2002.

JOHNSON: Okay, 2000-2002; so that overlapped one year, I guess, the board of directors process. But the key takeaway for me was I always viewed the president elect/president/past president as a team and they shared the job of running the Society as a team.

WALDEN: As president, were there, in retrospect, key decisions that you had to make?

JOHNSON: I think that that's a good question. I think that generally most of the key decisions ended up being decisions of who to put into certain positions, because one of the jobs of the president is to appoint the other vice presidents. There were actually two vice presidents elected, first vice president and second vice president, so the president actually determined, working with them, the portfolio that they would have. But then the other remaining vice presidents and the treasurer were appointed by the president. I think

that selecting that team, making the choices of that team, was really one of the keys to the success of the program.

WALDEN: After you were president…I believe ***while*** you were president, you were on the History Committee . . .

JOHNSON: I was on the History Committee, yes.

WALDEN: . . . it says in my records, for four years; 1996-1999, and the chairs were Helen Wood, Jan Lee, and Mike Williams during that period.

JOHNSON: Yes.

WALDEN: Because I'm here on the behalf of the History Committee, I'm curious. What was the History Committee doing back then?

JOHNSON: There were… one of the things that that group was working on back then — and I apologize, I don't remember exactly when it was completed — but they were working on a history of computing. So what they ended up creating was a timeline . . .

WALDEN: I know the timeline well.

JOHNSON: . . . that showed key contributions or developments . . .

WALDEN: The Sixtieth Anniversary Timeline.

JOHNSON: . . . exactly; so key developments in the life of computing, and making sure that credit was given to appropriate people who actually made those contributions. And

so that was a significant undertaking to keep it up to date, to develop it in the first place but then to keep it up to date, and evolve it and add to it over time. So they were working very heavily on that. You know it's interesting, I can remember even back then there being a desire to collect the input and commentary from the presidents, former presidents, because the Computer Society had been around for quite a while even at that time, with a number of presidents. That was a discussion point; I don't recall that much progress was made on that but it was definitely a discussion point.

WALDEN: If I may comment on that; in late 2010, Angela Burgess, the current executive director of the Society, who participated apparently in the original timeline, asked that the history committee update it. It hadn't been updated, so we did another 10 or 12 years in 2001, augmented the chart. (let me tell you that matching the fonts and the colors and all retroactively was difficult.) And then during the next several years, while Jeff Yost has been the chair of the history committee, each time he's thought it's not time to update it again, let's let a little more history pass.

JOHNSON: That makes sense. No, that's good.

WALDEN: But I personally was there, working on fonts. [Laughs.]

JOHNSON: That's good, I'm glad to hear that because I think it's really, really important.

WALDEN: Well we get questions about it and people write in occasionally to the history committee saying I should be on it. [Laughs.]
What was PRAVARIS?

JOHNSON: PRIVARIS. Yes.

WALDEN: Maybe I'm spelling it wrong; is it P-R-I?

JOHNSON: It's P–R-I-V-A-R-I-S. That's a company that I was one of the cofounders of; and actually that company formation overlaps some of my time with the Computer Society. That company that three of us that were the cofounders of the company, we started in 1998. And 1998, 1999, 2000 was nights and weekends; just typical startup; nights weekends, our own money, trying to get things off the ground. In 2001 we raised some money from an angel investor to actually start the company. The company was a biometrics security company and we developed a keychain sized device that would only work for you, so it encapsulated all of your fingerprint information inside it, and your fingerprint was used then to unlock the device. And once you proved that you were the owner of the device by authenticating to it, then it would unlock and allow you to do things like log on to your computer, log on to a web account, enter a building — if you've ever used a contactless card to enter a building, we worked with that same infrastructure, the only difference was that we only worked when you proved that you were the owner of the device — so you could actually store digital credentials in there, you could store certificates in the device, you could store a drivers' license, a passport, any of a number of things and we had a whole sequence of applications that we had envisioned. We developed with a strategic partner a single integrated circuit that was a secure processor, so that we could actually guarantee the integrity of the process so that your fingerprint never existed outside of this secure boundary that we were able to create. And so we started that company for real, with money, in 2001. And in 2002, from 2002 on to 2006 I took a partial leave of absence from the university and served as CEO of the company for four years, and served on the board of directors from its inception. When we first got our money in January of 2001, we created the board and I was on that board and chaired that board through the wrap-up of the company, which was in 2014, when we sold the assets of the company. So you know, we built…when I was CEO we raised more

money to support it. We eventually became a venture capital funded company in 2005. We closed a round of venture capital funding and continued to grow the company. It ended up we created a product, we launched that product, we sold that product world wide — we had customers all over the world for that product — what ultimately ended up being the valuable thing that we created was the intellectual property portfolio, and that's what we ended up selling was the IP portfolio. And that was done in 2014. So I; you know, I was on 50 percent leave when I was CEO, so I continued to teach class and continued to do a number of things here at the university from 2002-2006. The university really doesn't like to have you off on leave more than four years, so in 2006, Jim Aylor called me up and said hey, I'd really love to have you come back to the university full time and be senior associate dean for me, within the dean's office. So at that time, we hired a new CEO for PRIVARIS, because I knew I had to come back eventually anyway unless I wanted to quit UVA, which I did not want to do. And so we hired a new CEO for PRIVARIS; I remained chairman of the board and came back full time to UVA. So that was another great experience, which again, I think the leadership experience that I had from the Computer Society really put me in a position that really prepared me to take a role like that within a private company. I was responsible for the company when we hired our first employee, I built it up to about 25 full time employees and was CEO when we developed some strategic partnerships that enabled us to develop the secure integrated circuit, and it's public knowledge who these partners are. Broadcom was the partner that we had to develop the integrated circuit; we also had a partnership with Assa Abloy, which is a large Swedish company, to implement their protocols in our device so that we could actually interface with their contactless structure; we also had a partnership with RSA so we could do biometrically authenticated one-time passwords, using the RSA infrastructure. During that time that I was CEO we raised the money to support the company, we developed those partnership, and then launched the company's first products. As I said, we built the worldwide distribution and had customers worldwide.

WALDEN: What's the Center for Safety Critical Systems?

JOHNSON: That was the research center that I helped create here at the university.

WALDEN: You mentioned that earlier.

JOHNSON: Yes, the Center for Safety Critical Systems which housed certainly all of the research that I was doing, and we had collaborations with other faculty members as well.

WALDEN: Let me go back to your time as president for a moment. In one of the reports from Michael Elliott, he reports on the progress of the manuscript management system. Was that largely done by then, or done during your time, or was it still [pause]

JOHNSON: It was still ongoing; it was part of that electronic publishing initiative. One of our goals was to eliminate paper so we wanted to go from electronic submission by the author to electronic dissemination for review, an electronic system to manage the process, and then once something was accepted for publication, be able to go directly to a desktop publishing system so that the article could be laid out and ultimately directly to printers to print, and then obviously to digital library. So that whole process of submission to digital library or printed copy was part of; the manuscript management system was the front end of that, that would interface with the author, and the review committee, and the editors of the various journals, but also interface with the desktop publishing infrastructure that the society had developed. That was all ongoing and being developed, and I think it really was — and I don't remember the exact timing of all of that — but it was certainly, I think, instrumental in moving us into the digital age.

WALDEN: That was done within the Computer Society, or was that IEEE-wide?

JOHNSON: It was done within the Computer Society. What you found, typically, and this is not always the case, but what you found typically was that the Computer Society was on the leading edge. We would develop something and then IEEE as a whole would adopt it. And actually I think that's the way it should've been because you know, the Computer Society you would expect to be leading edge in terms of those types of activities.

WALDEN: How were relations between the Computer Society and the IEEE when you were president?

JOHNSON: They were strained I think to put it mildly. The computer Society was very large. Computer Society had developed a history of operating very autonomously; and there was friction there. That was actually something that I had to deal with quite a bit. When I was president I had to deal with it; when I was past president; I had to deal with it when I was division director for IEEE; and it was a challenge but I have to admit I was first and foremost an electrical engineer, that's what I was by training. When I first joined as a member, I joined IEEE and then subsequently joined the Computer Society, and so I really considered myself an IEEE member first and foremost, and then a Computer Society member as part of that, not separate in any way. In fact, I've always really preferred that we refer to ourselves as the IEEE Computer Society, because that's what we are.

WALDEN: I think so too.

JOHNSON: I think that's the appropriate way to think of ourselves. We were the largest and like I said, the leading edge, and we did a lot of things. That did lead to some friction but I think for the most part we were able to work through that and manage.

WALDEN: The question came to mind because you know that the manuscript system began in the Computer Society and now it's IEEE-wide. Of course the Computer Society is forced to sometimes deal with system-wide, IEEE-wide issues that they wish they had some independence about. [Laughs.]

JOHNSON: That's absolutely the case, and there were a lot of examples of that where we oftentimes felt that we would've been more efficient, perhaps, if we had our own things. But again, if [you] look across IEEE [pause]

WALDEN: For efficiency, it makes sense to have the scale and especially across all the journals and things for something like the manuscript system.

JOHNSON: Right. That was always problematic and it did create friction, and we did work hard to manage that friction, there's no doubt about that.

WALDEN: Another thing that is mentioned in one of Michael Elliott's letters is a membership database. And again, my question is was that within the Computer Society, because I think it's IEEE-wide today.

JOHNSON: It is. And we were working very, very hard to develop our own database and to be honest with you I don't recall whether we ever got to the point that we actually had a fully functional database of our own, because we were interested in getting information about our members that we couldn't get, or could not easily get out of the IEEE system, and that was a point of frustration.

WALDEN: It's all very interesting. Last year, you took a position with NSF, or a couple of years ago. Tell me about that, please.

JOHNSON: March of 2015, I became Director of the Division of Industrial Innovation and Partnerships at the National Science Foundation. I'm still a UVA faculty member, which is why I'm in this office today. The way this program works is that the National Science Foundation provides UVA a grant that covers 100 percent of my salary and benefits, and as part of that grant agreement UVA agrees to allow me to dedicate 100 percent of my time to the National Science Foundation. So I started in March of 2015. This program is called the Intergovernmental Personnel Act, or IPA Assignment Program. It's managed in such a way that it has a limit of four years, so I could do this for up to four years. I'm in my second year and I've been temporarily asked to step up a level and right now I have a role as Deputy Assistant Director for the Engineering Directorate. So I'm actually acting in the position of the person that I reported to when I was Division Director, so I have responsibilities that span all of the divisions in the engineering directorate right now. That's a temporary thing until we get a hire concluded, and then I'll go back to the division that I went there to be part of.

WALDEN: How did NSF find you, or how did you find them for this position?

JOHNSON: In 2015, Jim was reaching the end of his term as dean; I was reaching the end of my term as senior associate dean; I wanted to do something a little different. I always had reviewed for NSF, I had funding from NSF, I knew a lot about the organization and really admired it, and felt it would be a great experience at this point in my career to go and do something there. So initially, I was very interested in being a program director for the industry university cooperative research center. That was something that I was passionate about so that was my initial interest but they asked me if I would consider being a candidate for the division director. And so I applied, was interviewed, and then fortunately they selected me for that position. So the Division of Industrial Innovation and Partnerships is where the Industry University Cooperative Research Centers Program resides; but it also is where small business innovation research

and small business technology transfer programs reside, so we actually fund startup companies out of this division, through SBIR and STTR. We also have a program called I-Corps, which is an entrepreneurial education program. We have a program called GOALI, which is Grant Opportunities for Academic Liaisons with Industry. We have a program called Partnerships for Innovation, which are industry/university interactions, and partnerships. So the division is the largest division within the engineering directorate; and it is where all of the industry/university partnerships, and entrepreneurial activities, innovation, tech transfer-type activities occur. So it's a good fit for my background.

WALDEN: Have you been involved with the National Academy at all?

JOHNSON: I have. In fact the National Academy of Engineering routinely does studies for NSF and they routinely do studies of the SBIR and STTR programs. And so since I've been at NSF I have given presentations to working groups multiple times — three, four, five times, something in there — at the national academies to describe to them the programs that we do with our small businesses and to answer questions. I've also had an opportunity to testify before Congressional committees so it's been a great experience as well from lots of different perspectives.

WALDEN: You've written a lot — couple of books, book chapters, papers — did they all tend to be a relatively narrow area or were they in many different areas?

JOHNSON: It's interesting because when I first went to work at Harris, day one what Harris told me is that they wanted me to become their resident expert on fault-tolerant computing and design of reliable and safe computer systems. So they wanted me to not only be part of the team that did it, but they wanted me to become the resident expert. So they supported a part of my time to go off and really study that field in depth, and supported my participation in conferences; and so what I developed over a couple of

years at Harris doing that lead to the book called *Fault-Tolerant Digital Systems* that I published in 1989. So that all formed a basis for that book and so really, it catapulted my career as far as writing a book because it's somewhat rare, I think, for someone that's an assistant professor to develop a book and have it published right there at the end of the time that I was an assistant professor. But I was able to do that because of the support I had at Harris where they wanted me to go off and do it. So most of my publications are in that area, the books are in that area; even the *Hardware/Software Co-Design* book that we did was really focused on how do hardware and software interact and my role in that was really looking at it from a reliability and safety and a fault-tolerant perspective.

WALDEN: Please tell me a little bit more, if you're willing, a little bit more about the rest of your life; your family, the activities you do outside of your many jobs [pause]

JOHNSON: I'm happy to do that. My wife and I just celebrated our 39th wedding anniversary July 30; our daughter just turned 37 August 29.

WALDEN: This is the five-year-old? [Laughs.]

JOHNSON: This is the five-year-old I was talking about earlier, but she turned 37 at the end of August; she has a son, she and her husband have a son and he actually turns six tomorrow, so his birthday is right upon us. Very fortunate that we all live in Charlottesville, even though I spend my weekdays up in Arlington at the National Science Foundation. I'm fortunate that that's close enough that I get back here on the weekends, so I get to spend a lot of time with my daughter and my grandson, which is something that I really, really enjoy doing. So that family is the focal point of my life outside of work, but we all share in a number of common interests. We love sports so we all go to the football games together and the basketball games together.

WALDEN: These are on campus?

JOHNSON: These are the games on campus. We go to the ACC Tournament together as a family, we try to do as much of that as we can. We generally have dinner together once a week, so a lot of my activity is focused on those family events and getting together as a family. I don't have a lot of hobbies. I enjoy my work and to some extent, work is a hobby for me because I do get a lot of pleasure out of it. But any time that I have available that's not devoted to my professional life is really devoted to my family.

WALDEN: Is there anything else you think I should've asked?

JOHNSON: [Laughing] You've asked a lot of questions and I hope I've given some reasonable answers. Really appreciate the opportunity to be a part of this interview; I appreciate the experience the Computer Society gave me; and that IEEE gave me. It made a huge impact on me professionally and personally, and like I said at one point in this conversation, when you grow up as a first generation college kid — neither of my parents went to college, none of their siblings went to college — my brothers and sister and I were the first in our generation; the first to go to college and when you come from an environment like that, you don't imagine necessarily that you'll get to do the things that I've been able to do. So I've been very fortunate and I think that the IEEE Computer Society was a major part of that good fortune.

WALDEN: Thank you very, very much for taking the time to do this interview. I really enjoyed it, thank you.

JOHNSON: I really appreciate it.