



## **Oral History of Demetrios Lignos**

Interviewed by:  
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**Saviers:** Good morning! I'm Grant Saviers. And I'm here with Demetrios Lignos, also known as Demetri! Who just returned from a trip to Greece, so it's wonderful that he was able to join us today for his oral history. So, Demetri, I understand you were born in Greece.

**Lignos:** Yes, I was born in Greece, April 1<sup>st</sup>, 1941. And incidentally, I was born April 1<sup>st</sup>, and as you recall, 1941 the World War II had begun. The Nazi's were right outside Greece, and on April 9<sup>th</sup>, they walked in, they invaded Greece after a very long battles, first against the Italians, where my father participated, and he was wounded, as a matter of fact in Albania. But then it got to be too much for the Greeks, and the Nazis invaded the country and I went through WW-II as a very young baby, I wasn't able to understand much until I was four, three/four-years-old. So pretty much the Second World War, but I do remember stories that my parents were telling me about how tough it was for them to find stuff to eat and we managed to survive. There were three boys and a girl in the family. I'm the oldest. And my sister is the youngest by six years. As a matter of fact, when I visit Greece now, and I've been doing it so far every year, I stay with her and my brother-in-law. She has a wonderful family, and grandchildren, you know, so I just was there for just five days. I went through the Orthodox Easter.

**Saviers:** Ah, yes.

**Lignos:** Which happened to be Sunday, this past Sunday, so the traditional lamb on a skewer, and some other Greek delicacies and so I had a wonderful time. Yes, short, but it was a wonderful time.

**Saviers:** I know it's a very big holiday in Greece, the Orthodox Easter.

**Lignos:** For Orthodoxy, Easter is the biggest holiday.

**Saviers:** Yes.

**Lignos:** Based on the belief of a resurrection.

**Saviers:** Right, so did the whole family get together for that?

**Lignos:** Yes, I was able to see everyone in my immediate family. My brother and his family. And unfortunately, my younger brother, the third one, passed away about four or five years ago. But he has a great family. He has three children with grandchildren. And so yes, I was able to see all of them, and that was the plan. That was the purpose.

**Saviers:** Did Raynette join you in this?

**Lignos:** No. Unfortunately, Raynette hasn't been to Greece for ten years. She has a number of physical ailments that prevent her for taking long trips.

**Saviers:** Sorry to hear that. So the War ends, and did you go to school in Greece?

**Lignos:** Yes. I went to a public school up until sixth grade, fourth grade, I'm sorry. And then my grandfather, who had some connections because he was working at a barber shop at Great Britain Hotel, which is Downtown Athens, he had a lot of connections, and one of them was the President, Dr. Homer Davis, who was President of Athens College. Athens College was a high school basically, that was established as a result of the Marshal Plan. That's one of the good things that happened to Greece as building them up after the war. So anyway, the high school was primarily for Greek students that showed some aptitude for learning. And my grandfather was able to submit an application. I got in fourth grade, and I graduated from Athens College with a high school degree basically. However the advantage was that half the subjects of the school were in English taught by American-born graduates from various universities who came to Greece for a couple years. So I heard the language the way I should hear it. There were some British people, so I got the accents mixed up. But in any case, I got a good education, very good education. Now that connection from Athens College was the impetus for me to consider coming to the United States to further educate myself. And with the help of Dr. Davis himself and a couple of other people within the faculty of Athens College, I was able to submit some bunch of applications, and Muskingum College, at the time, now it's Muskingum University, Muskingum College gave me an opportunity, financial opportunity to come. And I received financial aid for most of my education. I finished in three years. Because Athens College had given me enough background, believe it or not for me to cover some of the basic courses that everyone has to take. You know? And a liberal arts school. That's what it was. I majored in Physics and Math. My objective was to become an Engineer. In Greece while I was growing up, I learned about computers.

**Saviers:** Oh, wonderful!

**Lignos:** I had no idea what a Computer Engineer is, but I wanted to be one. <laughter> But as I studied more and more in Athens College, I became more and more familiar with it. That's what I wanted to do. However, because of the financial aid I said to myself, "Hey, let's finish Step 1, and then we'll see what happens Step 2." So following my graduation, Cum Laude, I should say from Muskingum College, then I went to University of Toledo.

**Saviers:** So let's slow down for a second. So you said you knew that you wanted to be in computers when you were at Athens College, so how did you know that, and what sparked that interest?

**Lignos:** Well, being in Athens College, there were some magazines that those days they were coming in from either people that travel back to the U.S., they were bringing them back with them, or subscriptions. And they were talking about the IBM room-size computers, and some of the breakthroughs that were happening and some, especially, they had some people that were visionaries and they could tell what could happen someday. You know, from where we were now.

**Saviers:** But this is 1960/'61, right?

**Lignos:** Yes, that's right.

**Saviers:** So very early relative to the computer industry.

**Lignos:** That's right. This was at the time where computers were at the infancy, right? Nevertheless, there were a lot of things written up, and people-- we had Jack Tracy-- I mean, Dick Tracy with the-- I knew about Dick Tracy and his watch. And what the watch could do. And that, to me, was, that I mean was fantasy at the time, but it was also vision. And this now at the time 1960, 1959, you know, hard to visualize.

**Saviers:** Sure.

**Lignos:** That someday we'll be able to do something like that. But there were people that were thinking along those lines. I wanted to be part of it!

**Saviers:** So when did you first touch a computer?

**Lignos:** Well, it wasn't until I came to this country. And it wasn't until I went to the University of Toledo. They had an IBM 360. Muskingum College, at the time, it was a small liberal arts school, as I said before, and they didn't have computers. Everything was, you know, typing machines and Selectrics and you know, but the IBM 360 because one of my first year graduate courses was programming. So punch cards. So I remember I had trouble between "O" and zero. So my first program, I learned the hard way the difference between punching an O or a zero on a punch card, because it didn't work with-- and that zero had to be zero! <laughter> So the concept of accuracy when you're working with computers. Obviously, now we know it's how important it is.

**Saviers:** Sure. So do you remember what model 360 that was?

**Lignos:** No, no. It was the size of a-- a little bit taller than, as thick as the couch, but a little bit taller than that.

**Saviers:** All right, so one of their smaller machines. At Muskingum, you got the Physics degree and the Mathematics degree.

**Lignos:** And Math, that's right.

**Saviers:** And then at the University of Toledo, it became an Engineering degree?

**Lignos:** In Engineering Science. You know, when I spoke with the Dean at the University of Toledo, and he said, "If you want-- I want an EE." Right? But EE, he told me, we cannot give you a EE degree until you go back to undergraduate school and take all kinds of circuits courses and all the courses that-- the basic courses that are required for someone to take in order--," but he said, "Since you have the Physics and Math background, we can give you an Engineering Science Master's degree, okay? And if you like," and he said, "If you want to, it's up to you, you can audit." Which I did! You know, so while I was taking the Engineering Science (courses) which was Theoretical Physics, and Calculus, Advanced Calculus. that I had some of the background in order for me to take those courses. I did sit in some of the circuits courses, so finally this is where I learned, those days were components, you know.

**Saviers:** Sure.

**Lignos:** And how do you put them together, what you do with them and so forth.

**Saviers:** Right, right. So this is about 1966 that you got the master's degree?

**Lignos:** Yes, 1966, I graduated from University of Toledo, yes.

**Saviers:** And that set you up for finding a job.

**Lignos:** Yes, in 1966, those days, we had recruiters come to schools, right? And among the recruiters were people from other universities looking for post-graduate students. And I did receive, oh, boy, there's a couple of invitations because my grades were pretty good. So I did receive invitations to go for a doctorate. And, I thought about it, I was married in 1964, so my wife Raynette and I were living in Toledo nearby in a small apartment. And I was anxious to go to industry. So once I finished my graduate work, I said, "Well, I'm not done with learning, obviously, but I'm anxious to make some money," because coming from Greece I had very little money, and my wife is not exactly a Rockefeller family's daughter. So but we had a good life, you know, even as graduate student. She taught English. She has an English and Psychology degree. So she taught Literature in the local high school in Toledo. So we did well, we did okay. So but I was anxious to start practicing what I'd learned. And I said, you know, "Maybe the companies I work for will give me an opportunity to continue. Maybe someday, maybe someday I'll get a PhD, but not now." So anyway, my first job, I said, "No," to the people coming from the universities. But NCR, which happened to be-- you know, I was in Toledo, they happened to be in Dayton, Ohio, and they were beginning to develop a computer system which they called-- they didn't call it a computer, they called it an accounting machine, accounting machine. Now the reason they did that, I learned subsequently, that they were working very closely with some company in California who was developing a computer, so there was some corporate competition, and they changed the name to protect the innocent. Nevertheless, it was something I was very interested. I accepted the job. I worked for NCR for two years, and the first thing they put me on, and that's how I got to learn something about storage, they had me responsible-- now just coming out of school, right-- to design a controller for a disc drive, you know, to interface to the main bus, you know, the computer bus, which was proprietary. Those days they were doing a lot of proprietary stuff. There was nothing--

**Saviers:** There were no standards.

**Lignos:** There's no standards, right. Every company was jockeying for position, right?

**Saviers:** Yes.

**Lignos:** NCR's intent was to make this the machine of the point of sale machine of the future.

**Saviers:** Point of sale now.

**Lignos:** Right. So anyway, I worked for them for two years. And I worked on that controller and I began to learn how a disc drive would work. The concept of how I can transfer data through the controller taking commands, simple commands at the time, read/write, position and move data into the main computer.

**Saviers:** Was this a disc drive that NCR had designed or was it somebody else's?

**Lignos:** No, it was somebody else's. Somebody else's. We were working with another company. And they had a paper tape. It was another peripheral <laughs>, the computer had peripherals, right? A paper tape, a disc drive, and a printer. It was very basic stuff. Those days, of course, state of the art stuff, you know? But we're talking about 1966, '66/'68. About the time I was responsible for debug, part of the work on third shift for the first time those days trying to get the machine up and running, and there were no integrated circuits, right? Everything was flip-flops were making with tubes and we didn't even have transistors those days, you know? The company had not decided to use transistors, you know? We were working with hard components, you know?

**Saviers:** And tubes?

**Lignos:** And tubes.

**Saviers:** Oh, interesting.

**Lignos:** But halfway through the project, the Vice President of Engineering, I forget his name, very sharp guy, he said, "Stop! The transistor is here. Let's use transistors now to start doing gates. You know, to start building gates and flops," you know? So we switched, we had a very sharp Project Engineer. You know, I was looking up-- Ernie Shayfeild, and I was looking very--, to me, I respected the fellow. I learned a lot from him. And anyway, he led the transition, you know? So we changed the designs. The other thing that it didn't matter those days is how long it took to develop anything. You know? I learned that the hard way when I went to work for Maxtor, you know, doing disc drives in six months, right? Anyway, that's another story. But it took time to change all our designs, but anyway.

**Saviers:** So you got a whole team making the transition from tubes to transistors. Any interesting things happen there in terms of somebody says, "I'm not going to do this! Tubes are the way!"

**Lignos:** Well, there was skepticism. There was skepticism, right? Because not everyone was familiar. I mean, our design - our development team did not know enough about how to-- and it was the same transition impact, if you will, engineering team, that I experienced later on, many years later when at Digital we went to a microprocessor. Because we didn't have microprocessors when I joined DEC. Right? And so some years later, Kirby, that was the fellow from TI, right?

**Saviers:** Right, Jack Kirby.

**Lignos:** And then finally we-- and it was under your leadership back at the time, when I was working on another controller those days, and we said, "We're going to switch to a microprocessor."

**Saviers:** So at NCR, does the product get done and shipping?

**Lignos:** Not when I left. Not when I left. We were debugging it. We had a working prototype, quote/unquote, a "working prototype." Ah, you know, sometimes it would read the paper tape, sometimes read from the disc, sometimes it wouldn't. And you know how that is. It needed some more work. It was when Honeywell came to town. Big group! They rented a big hotel, and put the word out they're looking for people. Now we wanted-- Raynette and I wanted to go to Massachusetts. I wanted to be close to the sea. You know? I was born very close to the water, and I was raised there, and we had been there on vacation with my in-laws at the time. So we wanted an opportunity to go to Massachusetts. Honeywell came and they were interviewing for people in Waltham. I remember the night I went for interview was the night that Martin Luther King was assassinated. So I was a little nervous, because where the hotel was, I had to cross an area that there was a potential for riots, nevertheless, I went. They made me an offer. I accepted it. And then Raynette and I found ourselves transitioning from Ohio to New England.

**Saviers:** And where was this in New England?

**Lignos:** Waltham. I began working in Waltham. I was with Honeywell for four years in Waltham, and then Billerica, they built a brand new facility. Those days Honeywell was growing leaps and bounds. Another computer startup company, you know? This is where I actually worked on my first disc drive. Not directly. What was the name of this IBM drive - it had two big 20-pack discs?

**Saviers:** It was the 2314.

**Lignos:** 2314 , it had nine drives. Eight active and one spare.

**Saviers:** Yes, right, right. One huge box with, right, nine drives.

**Lignos:** So they asked me--

**Saviers:** Now that was a Honeywell design, though, wasn't it? Or they were using IBM drives?

**Lignos:** No, no, it was a Honeywell design, but they were copying. We were reverse engineering the drive. So my job was part of the team, but I did not really have any disc drive design expertise. So what they did is they had me design what they call a diagnostic routine machine. The hardware of that machine was housed inside that facility, <IBM term for the subsystem> okay? And was working concurrently with the monitoring all the data transition from the hard drive-- from the disc drive back through the bus, interface bus to the computer. And it was predicting if it saw an anomaly, it was predicting a failure. In fact, I wrote an article, those days *The Computer Design Magazine*, and I did write an article on that. And it actually worked. That thing worked and I learned how from a system's standpoint not the hardware, from the systems standpoint how the disc drive is supposed to work. You know?

**Saviers:** So was this diagnostic device have a small computer in it?

**Lignos:** Yes!

**Saviers:** Okay.

**Lignos:** But I built it. I didn't have a microprocessor, because they didn't exist. So I built it from scratch, right?

**Saviers:** Could you tell us any of the details of that little computer that you remember?

**Lignos:** I mean, it was several large boards. I'd say there were three or four large boards, and I went through design reviews, you know, with the Honeywell Senior Level Engineers, I mean, very senior. I forget what they used to call the people but they were people with ten, twenty years' experience, you know? And I was relatively new, but I went through design reviews and I learned the techniques for logic. It's basically logic design. But you had to know how the system works in order to make this work right. And--

**Saviers:** When you said, "I need a computer," how did you decide word length, instruction set?

**Lignos:** Well, I knew the format. You know, they gave me the format. And I was monitoring the transition. I knew the commands, so I could tap in and look at the commands. And so I was able to picture what was happening, inside with the help of-- I mean, I wasn't in a vacuum. I had a lot of help, and that's how I learned. You know, because every step of the way we'd sit down with the disc drive design people. And I'd say, "Well, okay, this is what I'm planning to do, is that going to work?" So I would walk them through. I would walk them through the log-- the sequence, logic design, right? The sequential steps. And I would explain to them with the flow charts and block diagrams. I mean, it was a lengthy process, right?

**Saviers:** Sure.

**Lignos:** And yes, it was a computer, however, it was real tuned (special purpose) computer that worked for a specific purpose, right, no other application. You know, but it worked! It worked. And I was very happy about that. And then after that project--

**Saviers:** So that became part of a shipping system by Honeywell?

**Lignos:** Honeywell, yes, yes, they shipped that facility with-- Honeywell worked on their own computers. They were developing their own computers. And the computer, those days the controllers were the size of washing machines, right? So that was the last project I had at Honeywell, when I was invited to go to Digital, by Elmer Simmons. I was working on a controller, and I was a Project Section Head. PROJECT SECTION HEAD. Right? I mean, they liked the work that I did before, I had occasionally a technician a couple of technicians working with me, a Junior Engineer at Honeywell. So they thought that I would be able to manage a very small group of people. So there were about four or five of us. And we were working on it. Is it too much detail?



**Saviers:** No, no! It's fine! So tell me a little bit the circumstance of how was like working at Honeywell?

**Lignos:** It was Waltham, it was relaxed. But at the same time it was tension. You know, there were different groups, and people were jockeying for position I remember, especially the more senior people. I didn't know enough those days to get involved in any corporate battles. I mean, I was too low on the totem pole. I was trying to worry about, you know, getting my own stuff and taking a paycheck at the time. I remember some of the characters that we had. And there were some good people, and there were some politicians. I tell ya. And like every company, you know? Later on, when I was able to be-- to tell really what was happening, you know. But most people were interested to get the job done.

**Saviers:** Right.

**Lignos:** Okay, so, and I'm very detail-oriented, and goal-oriented. You told me once that I was too focused. I was focused to a fault! You know? Because yeah, I sometimes I got too close to the forest to see the trees, and that was in retrospect, but this is my nature on the other hand. You know, and you can't change some things.

**Saviers:** Well, if you're going to do logic design, it's pretty important.

**Lignos:** Yeah, that is. But then when you have management responsibility, you got to have a little more leeway.

**Saviers:** So if I understood the situation correctly at that time, Honeywell makes some decisions about the future of the disc business.

**Lignos:** Yes.

**Saviers:** And so were you kind of caught up in that at all?

**Lignos:** Well, I left-- I was focused on finishing that project, okay? And I finished that project and then they asked me to go Billerica to work on a control unit for a new computer system, right? And manage-- as a Section Head, and manage a group of people. Now, I was not involved in strategic decisions. Okay? They said this is the project, and it was a brand new group. I did not know those people, and, no, this-- I left-- no, this, we have to backtrack a little bit.

**Saviers:** Okay.

**Lignos:** This project that I'm just telling you about with the controller was actually at Digital.

**Saviers:** Oh, okay. But you mentioned Elmer Simmons, who had come to DEC already.

**Lignos:** Elmer, yes.

**Saviers:** They said, "Your next job's in Oklahoma City," or something like that.

**Lignos:** Yes, Oklahoma City

**Saviers:** Well, with NCR. NCR merged with-- who was it?

**Lignos:** Oh, no, Digital was-- not Digital-- Honeywell merged with a company in Minnesota.

**Saviers:** Mmm, Control Data?

**Lignos:** Control Data, right. And Control Data had their operations in Oklahoma City. And so they put us all in a bus, in the airplane, rather, and took us over to Oklahoma City to look for places to-- just to look at the place. I decided not to go.

**Saviers:** Okay.

**Lignos:** And that's-- my memory's a little fuzzy during those days. They were very intense. There were a lot of things going on. So that was the time when I was looking for a different kind of job, a lot of people that I knew had already gone to Digital. Digital was growing leaps and bounds. This was 1972, when I came in. And I came to interview at DEC. I spoke with you. This was the first time I saw Fred Hertrich in the hallway. I didn't know who he was, of course. But then subsequently I remembered him. But he was visiting at the time. But I came to talk to you.

**Saviers:** So we get this crazy idea that we should go buy a big disc drive, right?

**Lignos:** Yes! And then that was my first, the RP04. It was my first project. The RP04.

**Saviers:** So the RP04 was a copy of 2314?

**Lignos:** 2314, that's right. Designed by ISS, who were ex-IBM people, right?

**Saviers:** Right, yes.

**Lignos:** I mean, the basic group, and they started this company in San Jose. And that was-- I remember when you said casually, "Oh, next week we're going to California." I had never been anywhere. I mean, to me, getting on an airplane and going to California was a big, big new horizon, you know? But that started it all, because after that, I traveled extensively for a number of different companies. But I remember that day, when you said, "Well, we're going next week to California," I said, "What?!" "Go out to California." That was Pete McClean, myself, Peter Svenson and a couple of other people, you know, that we went to talk to ISS about the RP-04.

**Saviers:** We were deciding, I think, who to buy something from.

**Lignos:** Yes, we went to Memorex, we went ISS, Control Data. There were a number of possibilities. It was an OEM deal, right? But in those days, DEC was the king. VAX systems were proprietary architecture, way ahead of their time. And everybody was bending over backwards. So I remember the receptions that we received, that's another eye-opener for me, how things were done. So now, we talked to them, we wanted our own skin colors and buttons and make it, personalize it, right? It's a Digital machine. But we need to have an interface, because we were very almost paranoid about people plugging us. We did not want anybody to copy us, so you asked me to do an interface. Minimum device level interface. And right. So I built that interface, and worked with ISS, working together, down to the drive level, which they also working together with DEC, they changed their interface in order to be able to match our interface at the lower level. You know? So we did that interface, and actually it worked. You know?

**Saviers:** And this is the first Massbus controller.

**Lignos:** Yes, the first Massbus controller. That's right. We're building the Massbus at the time, and I got a patent on that, along with John Levy and a bunch of other people, you know? Because those days a lot of people were getting into patents.

**Saviers:** Right. Say a little bit about what the Massbus was.

**Lignos:** The, Massbus was a new idea whereby it was a serial bus daisy chain. And everyone was, as I recall, and it was designed not for any particular peripheral, but it was designed to have multiple peripherals that can be attached to it, as long as you follow certain protocol. So it was a higher level bus, rather than, you know, so and that's why we needed those interim interfaces because the interfaces made the product-- the peripheral unique. Okay? And brought it from the uniqueness, brought it back to a point where the computer would then recognize the standard data transition commands and so forth. So it was a great invention, I thought, you know? Digital was always ahead of its time. You know, every step of the way. I mean, networking. The stuff that we used to do! Talking to each other, different facilities around the world, right?

**Saviers:** Email, yes.

**Lignos:** Yes, email, way before anybody else. So, I mean, sometimes I think about the company--

**Saviers:** What happened?

**Lignos:** What happened? What happened?

**Saviers:** So we go back to the origins of Massbus, I think there was another fixed head disc drive, and there was a tape drive, and then the RP04.

**Lignos:** Yes, they-- was it-- RS-- something 20.

**Saviers:** Well, there was an RS03 and an RS04.

**Lignos:** RS03. That was McClean's project.

**Saviers:** Right, yeah, right.

**Lignos:** Right? So it was a head per track disc.

**Saviers:** Yeah, the last one. <laughs>

**Lignos:** Yes, 20 megabytes?

**Saviers:** No, no! It was like one or two.

**Lignos:** Gigabyte.

**Saviers:** No megabytes, megabytes!

**Lignos:** One or two megabytes. <laughter> Yeah, but those days memories were expensive, remember?

**Saviers:** Oh, yeah.

**Lignos:** And so it was like a memory extension, because it was much faster.

**Saviers:** Swapping memory, right?

**Lignos:** That's right. That's right. So ahead of its time.

**Saviers:** Right, so I think the-- there was a customer who wanted the big storage, right?

**Lignos:** Yes, now who was that customer?

**Saviers:** It was a guy in Holland, I think, or--

**Lignos:** Yes!

**Saviers:** Oh, you remember the name of the company!

**Lignos:** Yes, Infonet.

**Saviers:** Yeah, okay.

**Lignos:** Yes, we called it "Outfonet.." And it was Dick Clayton that was the contact with that company, right? So he put us all in an airplane. And we visited. And they really wanted that product, and we did basically for them, but there was a lot of other people that bought it. Okay, but we started and developed the RP04 for them, and I went with a great big specification, remember that big thick book? I wish I had a copy of that, you know? Not that it matters anymore, but we gave them-- and just the size of it they were impressed. And had a couple of meetings, and--

**Saviers:** And drank--

**Lignos:** Drank a lot of beer.

**Saviers:** A lot of their super dense, intense coffee.

**Lignos:** Yes, coffee. And steaks. They had steaks for us, you know? And so, yes, that was in Holland and then we visited a few more times, but the first time it was interesting.

**Saviers:** And a chateau in--

**Lignos:** The chateau! Oh! How can I forget the chateau? That was quite a place!

**Saviers:** Yes, it was.

**Lignos:** That was quite a place. So those are perks. That's the other thing I remember fondly, fondly from Digital, you know? All this travel to the sales meetings, and customers and suppliers and all those people. You know, like the people that provided until we developed our own product. And I was really fortunate. Very fortunate. And this is the first time in all my career until then that I got close to a disc drive was the R80. The R80.

**Saviers:** Well, let's back up a little bit. The RP-04, that leads to a whole succession of RP discs.

**Lignos:** RP04, RP05, RP06, RP07, RPR02! Remember, all of a sudden, you had to go back. I mean, it's like going back to history. I was working on the R-07, which was, at the time, the state of the art, right? 200 megabyte, something like that.

**Saviers:** Or more, 300 or 400, yeah. It was the 3380 copy by ISS.

**Lignos:** 3380.

**Saviers:** Which was Unisys at that time.

**Lignos:** Right. 3380.

**Saviers:** Because Unisys bought ISS.

**Lignos:** Yes, that's right.

**Saviers:** The disc drive from hell, if I remember. <laughter>

**Lignos:** But then Memorex had-- actually they were taking back those 2314 20 megabyte drives.

**Saviers:** So the RPR02.

**Lignos:** The RPR-02 refurbished. The R stood for RPR refurbished02. And it was 2314, right?

**Saviers:** Right.

**Lignos:** It was return drives, which they refurbished them, and we brought them in. Actually we got some-- we sold a bunch of those.

**Saviers:** Oh, yeah. It was a filler product for Irwin Jacobs in the Small Business Product Line. He needed a smaller capacity, cheaper disc drive, which we didn't have, and Memorex was in dire straits.

**Lignos:** In dire straits. I mean, Arnold Cooley? Remember Arnold Cooley? Our buddy. And Tom-- his sidekick was Tom-somebody, I forget his last name. But Arnold, I will never forget. He was something. So yes, now, before the RM80, another actually big learning experience for me was the RL01. You know? That we had Fred Hertrich develop. And way ahead of its time. As a matter of fact, we got an award for that, right? The I--

**Saviers:** IR-100.

**Lignos:** IR-100 award. And we all went to Chicago with our formal attire. Right. And I used to have a picture of that. Maybe I still do.

**Saviers:** I do. So let's backup and talk about what-- why the RL01, and why Hertrich, and what happened there?

**Lignos:** Well, Hertrich, we're talking earlier about people with vision, not to mention excellent technical expertise, right? And with this guy, who you found, I guess, because he was there before I arrived, had all those credentials, you know? Hard to work with sometimes, and if he didn't like you, you were nowhere. If he didn't like you-- so I recognized that.

**Saviers:** Right, and Fred was German PhD, right?

**Lignos:** Yeah, German PhD, right. But it wasn't even - he didn't even have like an Electrical Engineering background. I think he was at the different scientific subject, but it was a different subject then. And nevertheless, nevertheless, this-- he had a group like Shaw-- I forget his first name-- you know, he had a group of very good technical small group. Very good technical people. He wanted to, and he deserved to

be the lead on that development, and the reason we went with Fred is because he had already proven before I arrived, his expertise, good thoughts, direction, and he was a logical guy. He, I think-- I think he proposed this to you, didn't he? How did that-- I remember, I wasn't part of the original proposal for an RL01.

**Saviers:** We did the RK05 which used the IBM 2315 front-loading cartridge, and there were so many problems with that cartridge, and IBM, in fact, frankly ditched it after one product, then went to the 5440, which was the top-loading sealed cartridge.

**Lignos:** Yes.

**Saviers:** And we wanted to have a successor product to the RK05, so...

**Lignos:** Yes, RK05, that's right.

**Saviers:** Right.

**Lignos:** That was Phil Arnold that did that, right?

**Saviers:** Yeah. No, it was before Phil, actually. But anyway, it was Elmer and-- Elmer Simmons and Dale Jensen and Mac Sloan and--

**Lignos:** Okay. I remember some of those guys.

**Saviers:** One more. I can't remember the name. Anyway, so the objective was an embedded track following to eliminate all the interchange problems too, so that was what Fred had actually tried in a startup company, is where I first met him, and that company failed.

**Lignos:** See, I wasn't aware of that.

**Saviers:** You weren't aware of all that.

**Lignos:** Because that was before my time.

**Saviers:** Right. So you start to work with Fred.

**Lignos:** I start-- yes. I started to work with Fred, and Fred made a proposal to you and he started-- you gave him the okay to start working, and he asked for a baseplate - he wanted a unibody construction baseplate, and the agreement was that I'm going to work offline on positioners and electronics and this and that. We had someone in Maynard who was good with woodwork, right, and we commissioned him.

**Saviers:** Mike O'Buck.

**Lignos:** I now forget his name.

**Saviers:** A pattern maker.

**Lignos:** Yes. Yes. But he was an expert, and Fred asked for two baseplates, two wooden baseplates, and I do remember one night <laughs> when you and I were-- and I was going to pick you up and we'll go to the airport. You didn't know that I had a small car. So I had a Karmann-Ghia those days, which was the poor-man Porsche, which I wanted, and I got three of them after that, you know, but I had the Karmann-Ghia and we got in the Karmann-Ghia. It was very, very limited space and you were holding-- we took one baseplate then. I took one. The other one went later, but we took one baseplate. Fred had finished with the offline design of mechanical positioner and the electronics, and we got to Logan and to the airport and we went to Boulder. We got to Boulder to Fred's-- Fred was waiting for us nine thirty at night. Fred was waiting for us, so, <laughs> I remember his... <laughs> He saw the baseplate. I'll be damned if he didn't put those components and turned it on and the thing worked. I don't know that it was transferring data but it worked basically I mean, all remote, and a wooden baseplate were, was subject to vibrations in all the drive, so while there're interferences, you know, nevertheless, he was an exceptional engineer, and that was the beginning of the RL01, you know, and that became , as we know, a tremendously successful product.

**Saviers:** I think that wooden baseplate is in the computer museum.

**Lignos:** Is it?

**Saviers:** It is. <laughs>

**Lignos:** I tell you, it brings a lot of memories, you know, just to see some of those things. Also later on, the TK50, you know.

**Saviers:** Well, let's talk more about the RL01, because this starts a relationship between you and Fred.

**Lignos:** Yes. Now, one thing that I learned early enough, you know, working with Fred, you did not contradict him. You, I mean, he accepted criticism, but you have to be very careful how to approach that, and if he ever caught, catch you not be sincere, that will be the end of the relationship. I was very careful about that, and I gave him, which he deserved. I never told him. I never even gave him the impression that I knew more about the disk drive than he did, like some people. Some people do <snaps> and they screw themselves up, because, you know, this man was very proud.

**Saviers:** Well, I think he-- deservedly so, because I think he was, at IBM, he was director of all magnetic recording technology, which was a very big job.

**Lignos:** Yes. Even if you didn't know that. Just by talking to him and letting him tell you what he's doing and why. You didn't have to know that what he did before-- I mean, you could tell that this guy was really



good at what he did, so I was-- he and I worked as partners. I mean, I adopted, I mean, I was essentially-- we were paying his salary, we're-- but he and I were partners.

**Saviers:** Yeah. So Fred was quite a smoker and drinker and skier, right?

**Lignos:** Oh. He was-- yes. All those things. I mean, he had-- he was a two-martini-- always martinis. You know, before lunch and before dinner. Especially the dinners. That's how he would begin, and yes, a drinker and a smoker, and smoking was, essentially, one cigarette after the next.

**Saviers:** <laughs>

**Lignos:** And I really liked him and we became very good friends, even after he stopped working. When I was working for Maxtor, I took sometimes, I went-- he had retired. He and his wife developed some personal problems, and he was living by himself for a number of years. Greg Hertrich, his son, was always very close to his father, and then a couple of the other children. I used to go to his house and pick him up and bring him over to my house in Boulder and had dinner, you know, occasionally. So it-- I got to understand him, you know, and he and I had an excellent relationship, and it was that relationship that also led us to the next very, very successful family of products, the DLT products.

**Saviers:** So now you're-- the RL01 is a big success. There's the RL02 comes out. It's double the capacity, and Digital starts to get serious about operations in Colorado.

**Lignos:** Yes. Ah, yes. Yes. Digital began to look for expansion, and it had to be a place, of course, where you can attract talent, the costs are right, you know, plenty of space for a new building in Colorado Springs. Turn out to be-- I forget the name of the fellow that actually found the place for us in Colorado Springs.

**Saviers:** Dave Brown.

**Lignos:** Dave Brown was--

**Saviers:** He might've been number two. Right.

**Lignos:** He was number two. I remember the guy's name, but anyway, we built a beautiful facility in Colorado Springs, and you asked me to go to the Springs.

At first, I wasn't happy with that. I wasn't happy with that, and now I look back and it was the best decision I ever made, because it was great not only for my education but for my career. I mean, that helped me quite a bit understand, especially later on when you were promoted to vice president and then selected me, you know, which it's totally unexpected, to take over the responsibility of running Colorado operations, because I'm basically not politician and I told that to other people that I worked for. "I'm not much for standing up on a soapbox and telling you how great I am," you know, but some people-- and

happened not only at Digital but elsewhere recognized that and gave me some responsibilities, you know. So yes. So I went to Colorado Springs. Once I bought into it with your help...

<laughter>

**Lignos:** I was able to attract a lot of people from the relationships that I had established with Memorex, with ISS, with all these suppliers from California, enabled us. I mean, I was able to call people, pull some talent, like George Frenchman, Bill Montaro and some other people, a very bright guy. I forget his name, you know.

**Saviers:** Oh, Bob Noguchi?

**Lignos:** Noguchi, and another guy. You know, tall, thin fellow. But anyway, I forget his name. So we got a good, strong, strong development team. Now, the RM80 would not have happened without Riggle. You know, because Mike Riggle, I saw him a few days before he died. Nelson Diaz and I, we were then-- working for InPhase. We went to his home in Black Forest.

**Saviers:** Yes. towards Castle Rock.

**Lignos:** right..

**Lignos:** So anyway, to see him, just to say goodbye. He was gone. Just a about a month later or less. Anyway, Mike, was responsible for advanced development, was developing that tricky interface, <laughs> and I remember the problems we had. He would format the disks in Massachusetts, and by the time they came to Colorado, format was-- it just, it would-- the disk would not hold the format.

**Saviers:** Wow. <laughs>

**Lignos:** You know, and then you'll come and say, "Progress." "Grant--" you know, "We can't--" the problem was solved and I forget now how Mike Riggle and Rottmayer

**Saviers:** Bob Rottmayer.

**Lignos:** Bob Rottmayer.

**Lignos:** How they solved the problem, but the disk was coming in formatted and I remember there was something, some magnetic source of magnetism from somewhere around the drive that was-- either we're generating it or because we could not pin it down - this almost, almost caused us not to be able to produce the RM80. I mean, that was going to be a huge disappointment, not to mention the amount of money that had been spent at the time, you know. But we managed to get it through. Once-- that was the worst problem, one of the worst problems that I remember in my entire career.

**Saviers:** Right. We called the RM80 a practice product, right, because it was a Massbus interface.

**Lignos:** that's right.

**Saviers:** Had the old interface technology.

**Lignos:** Yes, yes.

**Saviers:** And the next generation was going to be the big leap.

**Lignos:** Yes. Yeah, and then that was the-- what was the name of that architect - was that Barry Rubinson?

**Saviers:** Yes. Well, there was the UDA50 for the UNIBUS.

**Lignos:** UDA, yes.

**Saviers:** And the HSC50.

**Lignos:** HSC50..

**Saviers:** Right.

**Lignos:** That's the one that we were developing, that it was just like a general-purpose controller.

**Saviers:** Right, right.

**Lignos:** So but we did the RM80, and I remember Dave Brown was the plant manager and I developed a very good relationship with Dave, which those days was he the plant manager, I was the engineering manager, so we got to know each other quite a bit.

**Saviers:** So that product ships and starts DEC into the large disk business, right?

**Lignos:** Yes. After the RM80-- now, this was the Clamshell, of course, right?

**Saviers:** Yes

**Lignos:** Did we do a second generation of that? I don't remember.

**Saviers:** Yes, we did the 81 and the 82.

**Lignos:** RA81-- that's right, 81 and 82. Now It wasn't-- not long after the RM80 shipped, because that took about four years.

**Saviers:** Yes, a big jump.

**Lignos:** You know, I asked if I could be transferred back. Raynette was not-- she was, again, once again, looking to go back to Massachusetts because that's where she felt much more comfortable. You know that sometimes it was a little difficult, you know, for us. You came to Colorado and you lived there, I think, two years, right?

**Saviers:** Uh-huh.

**Lignos:** But Raynette always, my wife always wanted to go back. So after we finished the RM80 and the HSC50 was still in development, I had an opportunity with your help, go interview Bill Demmer, and Bill Demmer gave me the opportunity also to go and work on the MicroVAX. This was the multi chip MicroVAX. It was the one that we're developing from scratch, okay. The MicroVAX chip was in development at time or the early stages of development. I forget now, and then the Digital strategy was, "We'll introduce the MicroVAX system and then followed by the real microprocessor-based. It wasn't the good experience you want from the relationship standpoint. I was never accepted. Never accepted by the well-established Steve Teicher and Mike Teitelbaum and all these guys. I realized that they were a clique, and I was unwanted. In fact, I was told by Teicher several times, "You should go back to where you came from. Yeah, you can't do this," and, "You don't have the background," Very insulting, actually.

**Saviers:** And that was a new bus, a BI bus or something was--

**Lignos:** The BI. Yes.

**Saviers:** You were involved in the middle of this.

**Lignos:** That's right. The BI bus was being developed, and then we were attaching that system to the BI.

**Saviers:** Right.

**Lignos:** So I lasted I think two years, and then I came back and asked you, you heard-- you had heard that there was some issues, okay, and Bill Demmer invited me to his office and he told me it wasn't working, you know. So fortunately, I went back home after that, you know, and--

**Saviers:** <laughs> Back to the storage business.

**Lignos:** Back to the storage business, and I was delighted when Dave Brown-- he didn't even have to take me to dinner at the Rustic Scupper to tell me that there was this opportunity to work with Fred again on TK50. I said, "Yes."

<laughter>

**Lignos:** And then he was starting to sell me. "Yes. You're overselling. You're overselling." You know, it was, to me, that was a way out. I mean, this, I mean, I don't mind just saying it. It was-- it did not-- now, I

did learn, again, because the rationale to go to that, from that standpoint, was I wanted to know from a systems point of view, get some experience. See how a system looks at the peripheral, and it would've been much better opportunity, learning opportunity, if I didn't have this constant resentment. Real resentment from these guys.

**Saviers:** Interesting.

**Lignos:** Yeah. So anyway, I was delighted to go back and the TK50, you know. Then as soon as I went back we went to Boulder and sat down with Fred, and the rest is history. I mean, the TK50 was another monumentally successful product.

**Saviers:** Right. So what was the objective with the TK50?

**Lignos:** Yes. Up until the TK50 came along, software updates were being done for VMS with floppies, 80-some-odd floppies, you know, to send a software update. So the TK50 with 200 megabytes [in a 5.25" package], which was at least double what industry was doing at the time, we were going to send a tape, you know. So that turned out to be it was an essential product for the introduction of the MicroVAX, you know, so...

**Saviers:** Because there's a five-and-a-quarter-inch disk drive there of pretty good capacity.

**Lignos:** That's right. That's right. So we deliver that on time, I think. We delivered that on time. On whatever schedule--

**Saviers:** So tell us little bit more about Fred and the TK50 and what-- how the TK50 worked.

**Lignos:** Yes. Well, the TK50 had Fred's ideas. All the inventions, were Fred Hertrich's. The loading-- the cartridge design, and the buckling.

<laughter>

**Lignos:** The buckling mechanism I had one. I had a cartridge and Greg Hertrich [Fred's son] gave me a drive. But in the moves, Grant, I tell you, in all those moves, because I moved so many times, you know, and then down-sized. From a big house to apartment that we live now. It's gone. I don't know what happened to it, but it's gone. Anyway, the buckling mechanism, ingenious. Right. There's-- it's a plastic - piece of plastic with a hole and then you have a receptor on the other side, on-- touched to the link mechanism, you know, and the damn thing always, you-- and there's no way that-- once it was perfected, you could make a mistake. This thing, flimsy. Now, some people said, "What the hell is this?" You know, "This is flimsy." I mean... But it worked. Every single time it worked. So he designed the head, he designed the electronics. We worked with 3M, I believe.

**Saviers:** Yes.

**Lignos:** With the tape.

**Saviers:** Right, the cartridge.

**Lignos:** The cartridge and the tape itself, and a five-and-a-quarter form factor?

**Saviers:** Yes.

**Lignos:** You know, which was incredible for the kind of performance that this product, this little product had, and so that was the main purpose.

**Saviers:** And it was serpentine?

**Lignos:** Serpentine recording.

**Saviers:** Track following.

**Lignos:** Track following.

**Saviers:** Right.

**Lignos:** Serpentine recording. Right. I mean, all innovations, you know, and ahead of their time at the time, and let's see, We deliver that, we deliver the product on time and all of a sudden from the previous job that I had with a systems group, all of a sudden I was the savior, you know.

**Saviers:** <laughs>

**Lignos:** I used to go and update. They were asking me to come and update, and they were-- they, in big meetings, big meetings, they're trying to put us on the spot, because in the past, I mean, those, these products, people didn't understand. They were tremendous technology, every one we did internally. There were lot of innovations, inventions, right, and so occasionally we may have missed the schedule, so we're always-- they would not even give us the benefit of the doubt. "You're going to be late. You're going to be late." "We know." You've done it before, so... There was-- I remember the announcement when the TK50 was announced with the MicroVAX. I mean, it was a big announcement at the time in storage. Finally, I mean, not finally, because they had done it before, but once again, I should say, came up to the high level of execution, you know. Now, when the industry-- saw what we had done, remember they came, people came and asked if we could make it a standard? Industry standard.

**Saviers:** OEM product.

**Lignos:** OEM product. So the initial reaction from Ken Olsen at the time was, "No. That's a proprietary." Eventually, we worked with a company in California. Fred—(Fred Richardson) who was the CEO of a little company? (Cipher Corp) Another Fred, his name. But anyway, this was when Digital was beginning

to have problems, financial problems, and finally relented into considering to have us release the product as an OEM product.

**Saviers:** Yes. I remember. I could tell you the story, but it's your story. But, you know, you go back to the early days of the TK50, you learned a little bit about human interfaces, right?

**Lignos:** Yes, yes. That's right, because disks, you know, we had to unload them, but that was more of a mechanical. The TK50, it was a little bit different because it did require little more understanding from a human standpoint how to-- especially when, you know, you have to explain to people. The disk cartridge and pack, everybody knew. But they had a lot of apprehension about how that little tape drive would work in and out, again, get the cartridge in and out reliably and be able to read, so you had to go through and explain, you know, and I remember going on the board sometimes and with potential customers and explaining the basic, the fundamentals of how that thing would work, and then when we had some hardware, still, you look at that, how it seemed so simple and flimsy and it was difficult for people to understand that they can have the reliability.

**Saviers:** But there's another model that you put new lights on it and new interface for the operator, right, of the TK50? I don't know whether it's TK50A or something like that?

**Lignos:** You're talking about the one that we did in Tokyo?

**Saviers:** No.

**Lignos:** Or the half-height ?

**Saviers:** Yes there was a half height . You did the human factors study and then there was a new set of lights and stuff.

**Lignos:** Oh, yes. Yes. Because people wanted to have feedback. That's right. People wanted to have some feedback that this is actually-- the coupling worked, okay, so we had-- we put some different lights. We didn't want to put too many lights. I think we had color changes, okay, and combination on it to tell people that if-- but it was-- we gave them a little instruction sheet, you know, and this colors means that there's this, this, and this and that, yeah. But yes. That's a different type of interface than the disk.

**Saviers:** Right, right.

**Lignos:** So...

**Saviers:** Oh, yeah. So I forgot about the one in Japan, so...

**Lignos:** Well, in Japan, that was part of the plan for Digital to start an engineering operation in Japan. We had Jim Lacey, remember, go to become the manager. no, no. First manager was--

**Saviers:** Vince Bastiani.

**Lignos:** And Vince Bastiani started it and I was responsible for the project, and that took me to Japan several times, you know, with Fred. Many times I had Fred experiences <laughs> was another, you know. It was funny-- fun traveling with Fred, you know, but when he sat down with his people and very quickly the Japanese engineers understood how knowledgeable Fred is and he became the go-to person for them as well, you know, so yeah. So we did the half-height and then Vince Bastiani left and then Jim Lacey accepted to go for a couple years, I think, to live there.

**Saviers:** Oh, yes, right, mm-hm. Right. So that product actually shipped?

**Lignos:** Yeah, that shipped as well. I remember one time now. That brought back a lot of memories, I tell you. I remember one time the Japanese got in trouble. I forget. There was a serious problem, a serious problem. It wasn't mechanical. It was electromechanical. It was a combination. They couldn't solve it. Dave Brown was responsible for the tapes. So Dave Brown said that, "Hey, you need to form a posse and go to Tokyo and help them." So I called Fred and he and I and a couple of other people. Coincidentally with that, you had asked me to help you move your sail boat, along with a couple of other people, from South somewhere, over--

**Saviers:** Norfolk maybe?

**Lignos:** Norfolk or--

**Lignos:** Yes.

**Saviers:** Somewhere. Fine.

**Lignos:** Yes. Up until then I have done, since I retired, I tell you, I have sailed a lot. I know a lot of people, sailors here, I've sailed to the Bahamas. to Key West routinely, overnight sails and stuff. So I got it out of my system. I'm still doing it, but up until then I had never had an opportunity-- and now so I was looking forward to it, right? It was that time I had to go to Japan.

**Saviers:** <laughs>

**Lignos:** So I had to call you. The last minute, you know, because you needed a crew, and I was a member of the crew and I said, "Grant, I can't come." You know, "I have to go to..." So <laughs> duty called.

**Saviers:** <laughs> Right.

**Lignos:** So anyway, we went for three weeks in Japan, solved the problem, and came back. But that brought back the loss of that sailing opportunity.



**Saviers:** Right.

**Lignos:** It was the Oyster I think it was--

**Saviers:** Yes, an Oyster ketch, right.

**Lignos:** Yes.

**Saviers:** Yes. So the TK50 is successful and that leads into some new additional projects?

**Lignos:** Yes. The TK-- while the TK50 was the tail-end of it, it was in production and it was ramping up in production, so Fred began working on a second-generation product, TK70. Double. Four hundred megabytes. On this one, we decided we, from Maynard, we decided that rather than having Fred again do all engineering, we should have an engineering development also, complementing Fred. Fred still was the lead, but complementing it, and transition the engineering to an engineering group which we didn't do a TK50, we went straight to production, right. So I appointed Brian Hannon as the engineering manager. Because Brian Hannon didn't have that kind of background and engineering understanding, but he was diligent, hard worker, good with people, and I thought since Fred is leading the design anyway, you know, maybe it would be a good balance, and Fred and Brian worked well together. Brian was a good-- had good interpersonal skills, but we still, we needed more. We needed more. We needed to-- an engineering group, we needed, and I felt, that we needed to decouple ourselves with so much dependency on Fred, even though we had no reason. I mean, but still, still we're getting to be a multi-- hundreds of millions of dollars now potential revenue, right. So we had-- we should have-- so I found a wonderful-- another Fred. Different Fred, but an equivalent Fred. George Saliba. I got him. I asked-- I started looking for people, and I got him from Storage Tech, and he took the TK70 from Fred. He and Fred had little contact, because they were both extremely good engineers, extremely good, you know, and George, of course, he did not want to depend on Fred. Far from it. So anyway, he-- I believe that was George Saliba. He did a tolerance budget and he did a lot of the stuff that we didn't-- we hadn't done it, any of that, before. Because with tighter specifications, right, the tolerances that we had were not, relatively speaking, were not as forgiving as the TK50. Now we're working a different animal here.

**Saviers:** Yes.

**Lignos:** So George did a lot of that design and he was able to show and demo, so I considered TK70, I considered George to be the engineer, the engineering manager for that. So then TK70 came and shipped on time, you know. George surprised us. He gave us-- coming from Storage Tech, they had different schedules there.

**Saviers:** <laughs>

**Lignos:** Lot more pressure. So he gave us a schedule. Well, ah, this guy, there's no way. You know, something like a year, a year-- which at the time we expected twice that time, right?

**Saviers:** Yeah.

**Lignos:** Nevertheless, made it. He worked, we worked back in production. We're still in Colorado Springs. So I forget some of the guys that were production managers, but anyway, we got it through production, but George had already begun working on the 80. You know, which was a gigabyte. Right? Gigabyte or something. I mean...

**Saviers:** I don't remember.

**Lignos:** Yeah. It was a parallel--

**Saviers:** Or I had left DEC already, yeah.

**Lignos:** A head with parallel tracks.

**Saviers:** Oh, yes. Right.

**Lignos:** Okay. Parallel tracks, and different media that-- we're working with 3M again at different media, and cartridge the same. But recording and reading and writing in parallel, and it was much faster, because now we're doing lot of parallel--

**Saviers:** Parallel data.

**Lignos:** Yeah. So I'm trying to think now, when was the time where DEC decided divest the--

**Saviers:** Yeah, I left in '92, and I think the 80 had not shipped yet.

**Lignos:** No, it hadn't shipped yet.

**Saviers:** Right.

**Lignos:** Yes. After you left, unfortunately for me, we got the wrong guy, you know, to run storage, okay, and--

**Saviers:** A big mistake.

**Lignos:** Big mistake.

**Saviers:** My big mistake. <laughs>

**Lignos:** Well, wasn't your fault, right. You left.

**Saviers:** Right.

**Lignos:** Okay. So now this guy was politician, but that's what it was. I mean, and he focused on disks because that's really all he knew, and he just paid no attention. He threatened so many times. I had about hundred and-- plus or minus hundred people, and we were working to come up with a product that we had already demonstrated, that it was such a worthwhile product, you know. He didn't think that tapes were going anywhere. I mean, he-- as far as he was concerned, tapes were gone, and it was a matter of time and he was threatening to kill the whole project to save money and anyway, we were sold to Quantum, and I remember, and I said in my bio, was that writing this thing reminded me, the biggest disappointment is that I didn't know enough about starting a company at the time, because he told me 10 million dollars <to buy it>, 10 million dollars. Course, he thought was nothing. You know, it was not worth anything, right, and later on I thought maybe he was leading me on, but I don't believe so. I think if I could find 10 million dollars I would've been-- because I had the team, you know. I had the team. I had everything. I had all the process equipment for manufacturing. I had everything. I mean, the whole thing would-- I had to take it somewhere, you know, but no. So he gave it. He gave it to Quantum, because Quantum knew nothing about tape drives either. Okay. So Bill Miller (Quantum CEO at the time) appointed his girlfriend to run it, who was totally clueless, but she show me as big competition, you know, so I went through another analogous situation that I did with Steve Teicher, and they just didn't want me, you know. She just...

**Saviers:** So the back story here I think is-- when I left in '92 I remember you and several of the other storage people came to my going-away party and I said--

**Lignos:** Yes.

**Saviers:** --"DEC is in such dire need of cash that the storage business will be sold soon."

**Lignos:** Yes, and you were right.

**Saviers:** And it was.

**Lignos:** You're right.

**Saviers:** It was sold to Quantum.

**Lignos:** Well, I thought at the time that you already had inside information.

**Saviers:** <laughs> No way.

**Lignos:** No. Well, but I didn't know.

**Saviers:** Because Ken hadn't left yet. <laughs>

**Lignos:** Yes, Ken hadn't left yet, but I thought, yes, we would see that the end was, I mean, Digital would have to do something, because their proprietary architectures were out the window.

**Saviers:** Yeah

**Lignos:** Okay, and that was taking down the company. Fast. That was amazing how fast the company went down the tubes.

**Saviers:** Yes

**Lignos:** You know, and yes. Storage being one of the most profitable business, right?

**Saviers:** Right, mm-hm.

**Lignos:** Would have to be one of the first to go, so...

**Saviers:** That's where the cash was.

**Lignos:** Yeah. That was not a good time for me, because I was watching all the stuff that we had worked very hard to build, I mean, go away. But I survived. You know, I got a job after I saw the situation with Quantum. I lasted about six months, but I quickly started looking for someplace to go, and that was Maxtor.

**Saviers:** So we were talking about DEC had sold the storage business to Quantum, and you were there briefly and then we'll talk about where you went from there, but it would be interesting to hear your perspective of how that quantum DLT business went, even though you weren't directly responsible for it or involved and then how it transitioned to whatever IBM was doing in the cartridge tape business.

**Lignos:** Well, two things. I think that Quantum, first of all, not understanding or realizing the importance of the tapes because they never had any experience with tape products. Bill Miller, who was the CEO of Quantum, made a big mistake by not hiring. If he didn't want me as to run the business from a business standpoint, he made a big mistake by not hiring a business person from the California industry, which he had several knowledgeable people to run this and exploit it to its fullest. Instead, again, not realizing its value, he turned it over to someone close to him but with no experience whatsoever. So Quantum lost a lot of time, in my opinion, exploiting the importance or the perspective importance. The first-- the emphases of the, this person that took over the responsibility, her name was Gina Bornino. Gina Bornino, was-- raised the volume, you know. That's her first goal at all costs, raise the volume. Now, coming in from Digital, we were not used to 50,000, 30,000, 40,000. It turned out that this product had that potential, but I personally was not used to this kind of volumes, right. We're talking about an order of magnitude less, right, to satisfy our requirements. So that was good. But the emphasis was not looking at the tapes as a business in terms of not only engineering and manufacturing, but also position them in industry as a product of the future. I wasn't privy to any of the internal discussions, you know, but the actions lead me to believe that they didn't really give it much thought until later, which ironically when their disk business was going down the tubes and ended up selling their disk business to Maxtor, and I was on the receiving end then working for Maxtor. With DLT, they finally began to see the moneymaking <opportunity> , because had tremendous margin on the cartridges and the drives and everything and

service, you know. Began to see the importance and tapes business sustained them, because Quantum also then transitioned to software.

**Saviers:** Okay.

**Lignos:** Storage system software -- as far as I know. Now, IBM saw an opportunity. Because DLT was gaining ground so quickly and the products were so far ahead of their time, you know, they were all tied up with patents, which Quantum now owned. They're cheap. They didn't pay anything for that. As I said, they were given that, a tremendous amount of opportunity, and IBM then teamed up with Storage Tech and HP and a couple of other companies and they developed another format, and they knew. These people did know the tape business and they didn't think that was ready to go to pasture, right. So because of their name recognition and 'cause Quantum was little Quantum. Big companies and big customers did not want to depend on little Quantum with a supply of state-of-the-art products. So that's what I believe gave IBM a leg up on introducing their format and making it succeed.

**Saviers:** Yeah, right, interesting. Interesting perspective. So you make the decision it's time to end the brief assignment at Quantum, and where do you go from there?

**Lignos:** Because it became very uncomfortable for me for the reason as I stated earlier, <clears throat> I had some friends start working for Maxtor, and Maxtor was growing at the time. One of them was Nelson Diaz, who I knew him from Digital for a number of years.

**Saviers:** Right.

**Lignos:** And Nelson was vice president of quality for Maxtor. So he called me one day, and I was traveling in California for Quantum, and I made a point to stop in Boulder in Colorado and had an interview at Maxtor, and what they wanted me to do is be vice president of quality. Now, Nelson was senior VP and my focus was more on specific disk drive products. So I spoke to Rich Balanson, I believe-- he was a senior vice president of engineering at Maxtor-- and a few of his lieutenants, and they made me an offer, and it was actually a pretty good offer. I already liked Boulder, so it was a good opportunity for me for a number of reasons to go back to Boulder, and this where we lived. The job was in Longmont of course; this is where Maxtor headquarters were. So that's what I did: I went back and worked in quality, reporting to Nelson Diaz, and that's another type of experience. Up until then, I did not have that kind of experience where-- and I remember then it was so many new lessons for me, like six-month schedules for a new disk drive, and if you missed it, in this business if you missed it by two weeks, you're behind the eighth [sic] ball, because other people, they would satisfy customer requirements. The disk drives at the time are beginning to become commodities also. So we had to get to the next-- it was rather tricky to get to the next capacity point. There was a lot of discussion internally, because of course a company of size of Maxtor with a nine percent margin <laughs>-- I was used to thirty percent, forty percent, double, triple. I remember once that someone said at Digital back in its heyday "If it's not five-to-one margin, we're not going to make-- it's not worth it."

**Saviers:** Price-to-cost.

**Lignos:** Yes, price-to-cost, not worth it. <laughs> So now we went back to the eight, nine percent, and we had a lot of pressure, the engineering group, a lot of pressure to get the product out, and sometimes we had some issues. So as VP of quality for some of those products, many times I went to-- boy, those Koreans are really something as customers. Hyundai, Daewoo and some of those companies, they really demanded quick satisfaction. So my mission those days was to stall the customer by trying to sell him on what Maxtor was trying to do and what we're doing, and I was being pretty honest, not to a fault, trying to explain what the problem was and what Maxtor was going to do. So I did that for a couple years. I worked for Maxtor a total of five years.

**Saviers:** Okay.

**Lignos:** Then in 1999, Mike Cannon, the CEO, through my boss asked if I could take on the responsibility for Y2K, and the reason is because there was a big concern that everything was going to stop, going to have huge interruptions in manufacturing. And <clears throat> very big customers for Maxtor's like IBM were threatening that "If you don't prove to us that you're serious about this Y2K business, we're going to go to someone else." So I worked on that from mid-1999, I would say about July, August timeframe until of course January.

**Saviers:** Right, the big day.

**Lignos:** The big day, right. And me and my team visited suppliers all over the world. I couldn't do all of it myself, so we had two or three groups that we were dispatching them, and then we had to coordinate of course everything with manufacturing. We had satellite phones. We had command centers. I remember it's a command center room. We had portable generators outside so that we don't never miss power. It was really quite a production. But we pulled it off, and the important thing is, as we know, nothing much happened.

**Saviers:** Nothing happened, right.

**Lignos:** However, but it's mindset; it's mindset. The important thing is that, while we're leading up to January 1, people began to turn around. So we have people from various customers call and tell Mike and others, VP of marketing and sales, and saying that, hey, Maxtor is really serious about this. So as a, if you will, reward-- I mean what I did before I got to Y2K from quality, I went to work for new products introduction, okay? New products introduction, which reported to Vic Jipson, who was a senior vice president, executive VP of engineering. And the reason it was under engineering, the way Maxtor worked things out, is because you wanted to have your development teams, the vice presidents of different categories, working with new products introduction, because there's so much it had to be, too much common interface. That's another lesson that I learned, a lot of experience, 'cause we're developing the new process for the drives. So that's another perspective now of the disk drive business. And it was not always roses. Now I was manufacturing, right? And we know from years working with manufacturing how engineering blames manufacturing and vice versa if something bad happens. <laughs> So--

**Saviers:** Do you have any interesting anecdotes about that?

**Lignos:** Well, they're not pleasant. They're not pleasant, because again, under pressure, engineering would say "What are you talking about? The product's ready. We've had alpha and beta sites working for X amount of time." But the process, when you put it together, I said there's no process for doing the assembly, let's say, of head-to-media interface, which is always the trickiest part, right? It doesn't work. We have failures. We have, god forbid, intermittent failures. They wouldn't agree. So the only time it got pleasant is when the factory started shipping it; factory now is in Singapore. So after we developed the process in Longmont working with engineering, now I had another group of people that I had sometimes confrontations with. I had to release a process to Singapore, so they would send a team over, and I had about a 150 people that time. Many of them are assembly technicians and all of that stuff, not just manufacturing engineers. But we had to train the people, package and ship the process and then follow through while the process-- and of course we strived, always strived, and that's where some of the-- I don't want to call it confrontations-- disagreements took place, because we had to strive, and that was part of my job: to make sure that we don't revolutionize a process, 'cause then that's money, okay? I learned the value of 50 cents, 10 cents or 5 cents. When you make 50,000 a month now, 5 cents can be the matter of making money or not in this kind of volumes. So that was another-- and I did that until '99 when I transferred to do the Y2K, and then Y2K, I would like to think as a reward-- because after that I said "What the hell am I going to do when I go back?" Those jobs all are lost. All the other jobs were filled up, and Maxtor was not IBM or DEC in the heyday or so to have other opportunities. Coincidentally, Maxtor saw the opportunity to also going into the storage systems business, not be just a drive manufacturer, right? Storage systems. So they bought a company in I think it was San Jose or maybe Milpitas. It was a company in Milpitas. It was a startup company, had about 50, 60 people, and they were developing hardware and software, and they had a little server. And they were using disk drives, which Maxtor saw opportunity to use Maxtor disk drives now, and then built one board of interface and electronics and software. So these guys, they were buying the disk drives of course, but they had built their own computer and interface electronics that was running under their software.

**Saviers:** What was the name of the company? Do you remember?

**Lignos:** I don't remember. I don't remember. It was a small company. So what I was asked to do-- Vic Jipson left his job in Colorado, and he asked me to run the new products introduction, but actually it was not the same as we were doing for the disk drives, right? It was new products introduction, because what Maxtor wanted to do is use the software and hardware design and create a Maxtor server, okay? So I did that a couple of years.

**Saviers:** So Maxtor started to ship that product then?

**Lignos:** Yes, it started to ship that product, and it was a big disappointment. Dell showed a lot of interest for that product, and I felt so sorry for Vic Jipson. Somehow he got the impression someone was playing him, got the impression that Dell was going to buy it, okay? And we're looking at thousands selling them. It was a nice little product. In fact, they gave me one when I left, which, again, I don't have. But it was nice product, and somehow within Dell there was an internal conflict between people. Someone else took the job <of the executive> that Vic was working with, the interface, and that fell through, and that was a big disappointment. And then Maxtor tried to work with other people, but nothing like the kind of volumes

that we would've realized, which would really set Maxtor up, 'cause those days Dell was doing extremely well. They're still doing well, but they have a lot more competition now. So anyway, about 2001, early 2001-- I remember it was April 2001, because of course September 11 was 2001. So in April 2001, Steve Kitrosser-- did you know Steve Kitrosser?

**Saviers:** Sure, oh, yes.

**Lignos:** Yeah, he was a member of the board of InPhase. They had set up this startup company in Colorado comprised of ex-Bell Labs people working with holographic technology. They had developed a media, and that was the big problem with holography. Holographic technology's been around for a long time, but what was missing in terms of exploiting it is to develop the kind of media that retains the information, because they would write on the media, and then typically within an hour it'd be gone or less. So they did make tremendous breakthroughs at Bell Labs, so Bell Labs gave 50 patents, I remember, to a group of scientists, and they were able to get enough money to start a company in Boulder. So Steve Kitrosser got involved as one of the board of directors. Steve recommended Nelson, and Nelson came after me. There was nothing at the time; there was about a dozen people, and they asked me to build an engineering group i to productize it. So that's what I did, and I started in April of 2001, and I worked for the next five years for InPhase until I retired.

**Saviers:** So why was this going to be an interesting product? It was optical storage.

**Lignos:** Well, it was interesting for a number of reasons. One, I thought the technology was extremely interesting, even though, again, holographic-- we've known Ford has been doing holograms of new cars for 20 years, but no one had ever attempted to use holography, and the concept of holographic recording, instead of longitudinal recording, volumetric recording. The same spot, which is the size of a laser beam diameter, right? Then that was green-- eventually we went to blue, but green-- you can put all kinds of layers. By changing the intensity of a laser spatial light modulator with the data, changing the intensity, theoretically you can write several layers. And one of our PhDs that we hired subsequently to impress the customers said you can put 200 terabytes on a five-and-a-quarter size disk. That was theoretical. He was assuming so many layers and using violet beam sizes. That's easier said than done. The big difficulty. We started out with a premise that this was going to be a five-and-a-quarter disk drive. <clears throat> that's why it's interesting-- number one was the technology, and number two was the opportunity to hire a team. I felt energized; just put together a team.

**Saviers:** The ultimate idea was more capacity, more performance?

**Lignos:** Both.

**Saviers:** Both, okay.

**Lignos:** Both, because once you position, the way you record volumetrically, you don't move, plus you did not have to have a rotating disc. You can actually take the stationary disk and then move the beam. So you could do so many different things with this kind of-- and you came in and saw it once. So the



premise was that it will be a five-and-a-quarter-- in fact, we had a mock-up, and we used to take it to shows at Las Vegas and show it to people, these little blinking lights. But in reality, going from the washing machine, which was the prototype, really crude, early prototype that Bell Labs-- that's how they demonstrated that they can record on that medium, just one spot. So the original specifications, we're going to put 200 gigabytes. And that was the original specification, and so much transfer rate. The transfer rate was, I don't know, 15 megabytes per second or something like that.

**Saviers:** Very fast.

**Lignos:** Very fast. And as we started developing the actual hardware, the OMA-- OMA <opto-mechanical assembly> was the acronym for the positioning mechanism, okay?-- we discovered that the most important aspect of product testing this technology is to have a reliable positioning mechanism, because you had to move two beams-- one is the data, and one is the positioning beam-- and then you had to-- especially interchange, we were able to write, but interchanging is where it became much, much more challenging, okay? Then it was clear that five-and-a-quarter was out of--

**Saviers:** Out of reach.

**Lignos:** Out of reach, not for our first product. We could see ways of getting there someday, and even smaller. Once we got the technology to work reliably, productizing it at different kind of form factors with different positioning techniques-- like I was saying before, a technique where you have very tiny, square media that doesn't move, and then you have to position-- so the best we could do is a half rack, and we did build some beta machines for half rack. Our original partner was StorageTek. We knew that this was going to be a library product, and we went to StorageTek, and we were working with them putting the units in their new-- they're doing a new library. You remember the libraries that StorageTek was doing with the big robots and-- so that was going to be a petabytes capacity. And they were working with us. We had beta units running, although not to spec. We never got to 200 gigabytes.

**Saviers:** How far did you get?

**Lignos:** Fifty. We had a long way to go, okay? But we could see getting to that capacity, but interchange, because positioning the beam-- the beam itself was fine. We're using blue lasers. We got to the blue lasers, and the companies in Japan-- I was there most of the time-- they were able to make the blue lasers. We had Sony blue lasers. They had already introduced the Blu-rays, and they were interested in the media, 'cause as long as they could see us getting somewhere, then they-- Taiwan, where for manufacturing we used a company called Lite-On. They're still in business, very high volume manufacturer of consumer products; they do CDs, DVDs and stuff like that. But the interchange became an issue.

**Saviers:** Yeah, does that mean interchange between drives, or take it out and put it back?

**Lignos:** Well, taking out and putting back, yes, that's how we started, but between drives was the big problem, being able to reproduce accurately the position. So by that time, I had been commuting a year

and a half between Denver, and in April of 2006 I turned over 65, and I told Nelson that I-- there was another problem at the time. I was the original engineering manager. The board of directors was not pleased with the progress, because they wanted return on investment. They had already put in more money. All told, 120 million went into that company, and it still needed a lot more money. Then the economic situation was getting constrained, although not bad at the time, so there was every hope that we will get there. We could see a path, not with a five-and-a-quarter but a half rack. They were beginning to advertise it. Liz Murphy, the VP of sales and marketing, and I went a bunch of-- we were trying to sell it, and we had pretty good success, to the movie industry. They were going to get rid of all the magnetic tape and shrink the amount of warehouses, and we told them they can keep the holographic storage medium for 50 years, 'cause they were interested in longevity. So we had pretty good success, but then they wanted results. "When can we see it?" The other thing is that the board of directors felt-- and I was an officer. Although I was not a founder, so I had pretty good investment in the company. I had every hope that it will succeed. In addition to me getting older and commuting, because I was going every week, Nelson and I agreed that I was over 65; let's get somebody else. All the stars are lining up and the planets. It's time to--

**Saviers:** To move on.

**Lignos:** Move on. So it was a joint decision. The board agreed, so on June 1, it was my last day in 2006. So I left the company, it was still going, and two years later they closed.

**Saviers:** They couldn't raise the money.

**Lignos:** 2008. They couldn't raise any more money.

**Saviers:** Interesting. So it really had some high horsepower technology behind it.

**Lignos:** Oh, yes.

**Saviers:** But getting it into a product turned out to be a real difficult challenge.

**Lignos:** Yes, it was a challenge, and again, positioning-- the other thing is not only-- another problem, believe it or not, is we started thinking about servicing those units in the field, because lasers and other parts of that actuator mechanism, that position mechanism, sometimes fail. So how you design a field-replaceable with this type of accuracy on an interchange product, removable disk product, how do you design a mechanism that a field service engineer with minimum training can replace?

**Saviers:** Could do that, mm-hmm.

**Lignos:** It turned out that we were going to have to spare essentially the whole drive minus the electronics in order to make it easy for someone to replace it in the field. We talked about sending the drives back, but as you know, that's not good for business.

**Saviers:** Right, right, right, yep.

**Lignos:** You can't really send the drive back to have it fixed or upgrade in the field, so there's a number of issues. Also Lite-On, as a manufacturing partner, was complaining that we were pushing them, and yet we could see that we're not really ready to start building, because we're pushing them to buy parts, but all because of the pressure. From the investors' standpoint, we were late. We were late, because they were promised that within five years from day one, from 2001, within five years, we will be shipping product. And the marketing people, couple of guys we had marketing, they had made all kinds of beautiful presentations, how they've charged the-- you know how that works-- but it wasn't happening.

**Saviers:** So out of that experience, would you give any advice to other people trying to start up a storage company?

**Lignos:** Depends what technology you're using. I consider two types of technologies: one is evolutionary, and two's revolutionary. What we're trying to do at InPhase was definitely revolutionary. All the other magnetic technologies, yes, they all have challenges, but it was evolutionary. You build on something that you already have some knowledge and experience with, but there was no knowledge and experience at all on building a holographic storage product. Now, do I believe that the technology could be made to work? Yes, I do, but not by a small company.

**Saviers:** Yep, takes a lot of resources and patience.

**Lignos:** And a lot of money.

**Saviers:** Yeah, yeah.

**Lignos:** Yeah, and patience, absolutely.

**Saviers:** Do you think that whatever amount of money it would've taken would've been worthwhile?

**Lignos:** I think if we had been bought out-- and I'm not sure if there were some rumors. I was not part of the discussions that companies had approached Japanese companies, had approach InPhase to sell, and they declined. If a big company like IBM at the time, or a big Japanese media company <3M is not a Japanese company>, if they had put their might behind that and really bring a lot of people, focus on the different parts-- you couldn't find enough holographic engineer experts, but a large company with a lot of resources could've attracted people, would've done a lot of things to converge towards building a group of people dedicated to making it. The other thing that was happening is Nintendo-- those days was of course very secret-- came in and asked InPhase while we're struggling to develop the base product-- now they wanted a three-and-a-half-inch form factor holographic storage device for their future game, 'cause of course games, they need a lot of storage for the graphics. So they wanted to be first in industry, that it will have a little three-and-a-half-inch form factor drive that can have terabytes.

**Saviers:** And proprietary media.

**Lignos:** And proprietary media.

**Saviers:** Nobody could copy it.

**Lignos:** Right, that's right. So they started pulling us in different directions, and all that of course because the business people did not want to lose any business potential. And InPhase was not set up to be spread.

**Saviers:** Yeah, yeah. Focus is everything. So you kind of retired at that point. The company went on for two more years.

**Lignos:** Two more years.

**Saviers:** And then what happened?

**Lignos:** The company went on for two more years, and I was watching on the InPhase website what they were doing. They were publishing articles. They were going to a number of different shows, right? And they began to focus on-- they had beautiful renderings of the half rack unit, right? And they were demonstrating the interchange part of it. As far as I know, they never got to the 200 gigabytes, but if you were to come and look at the product, you could see that there was definitely a path to getting there, and then if you said "When?" if you were a customer, the next month. If you were someone with a company, we'd be maybe couple years. So it was converging; it was converging, but the big infusion that was needed about the time where the company shut down is another-- well, after I left, the relationship with Lite-On from Taiwan was beginning to sour, and there was a concern that what the Taiwanese were doing, they're trying to milk our engineers and especially the Bell Labs people for technical information. And we were giving them everything, so someone said "Hey, not anymore." So the other problem was the distance, okay? So Nelson and company said, after I left, "We're going to start manufacturing here," okay? So what InPhase did is they acquired the other half of the building that some other company had, so they left, and the intent was to set up manufacturing and then start with 10 a month, 20 a month, 50 a month, but to do that, which most of it had to be handmade, you need a lot of money and a lot of people, and this is where it stopped.

**Saviers:** And at that point, the magnetic disk drive industry's catching up--

**Lignos:** We were thinking about the super paramagnetic effect. Remember that? This was going to stop-- because then the bits, <laughs> the magnetic transitions were going to get so close that they were canceling each other out. And some of the experts were saying "You guys, dream on. That ain't going to happen," and we were saying that when the bit density was a tenth of what it is today. The super paramagnetic effect, that's going to kill the disk. We need another technology.

**Saviers:** Marched straight through it.

**Lignos:** That's right, went <laughs> right through it, and the magnetic storage technology, the traditional-- it was how many terabytes now?

**Saviers:** Well, you get at least four if not eight in a single three-and-a-half-inch form factor.

**Lignos:** Maybe 500 gigabytes we thought was going to be the end.

**Saviers:** Yeah, right.

**Lignos:** And for the holographic storage, that's the beginning.

**Saviers:** Yeah, right.

**Lignos:** So we were convinced that this was going to be a transition.

**Saviers:** Well, that's been a historical issue with how the promise of optical kind of gets caught up in the onward march of magnetic, and so far, the CD-ROM and the Blu-ray and so on have been hugely successful, but not as a computer storage medium.

**Lignos:** Yes, I was going to say as commercial products for gaming and stuff like that, but, yeah, not as storage. I mean the disks are still-- just like the people were trying to kill tape for so many decades, right? If it was up to them, that thinking, tape would've been dead 50 years ago, 30 years ago, and every time, they find a way to sustain it.

**Saviers:** Yep. You can't be cheaper than sitting on a shelf.

**Lignos:** Right. That's right.

**Saviers:** Yep. So you have retired and enjoying the retirement here in Sarasota, Florida?

**Lignos:** Yes, yes. Ever since we came to Florida - I could've retired in Colorado, but for health reasons we found out that Florida is better for us. And we live near the water, and I have diversified myself by working for a number of volunteer organizations. I volunteer for a number of different local organizations, and I feel good about that, because they need the help. Plus, I find some different and interesting things to do that I'd never done before, I never thought about doing before. There's plenty of sailing here, which is my hobby. I wanted to sail, never got the opportunity to go long-distance sailing, so I have done that. And for the boating organization I belong to, I teach all the electronics courses. They call them marine electronics systems, marine communications systems and marine navigation systems, okay? Not how to use them, how they work, 'cause-- USPS-- that's United States Power Squadrons-- USPS, that's the kind of focus they have on education, and the three electronics courses that I have are electives. I have taken all the courses, because it's like the university, so I'm a senior navigator. I've taken all the courses, and now I'm-- oh, occasionally I can do piloting, and the basic safety course, I help teaching that one. And that's how we generate membership, because we have anywhere from a dozen to 25 people every month

or every other month that we offer it, so we get new members that way. So, yes, between that and we have plenty of cultural events here--

**Saviers:** Are you still involved with the sheriff's department?

**Lignos:** Hm?

**Saviers:** You're involved with the sheriff's department?

**Lignos:** No, Sarasota Police Department.

**Saviers:** Sarasota Police Department.

**Lignos:** Yes, as a patrol officer. We have our cruiser. I have a cruiser with a partner. Volunteers don't go out by themselves. No weapons other than the radio, but we have a uniform. We write citations, parking citations. Another <laughs> opportunity to deal with the public, but no one is happy getting a ticket. <laughs>

**Saviers:** A real slice of life, huh?

**Lignos:** <laughs> Yeah. So, yes, and then I volunteer for the hospital, Sarasota Memorial Hospital. It's one of the best in the country. It's I think within among the top five; recently they evaluated it. And I'm a transporter. That means I transport people on stretchers from their rooms to the operating rooms and back, and then transport blood and cultures, stuff like that. So every day I got something to do. Makes life go. The only disadvantage with being too busy is time flies. I don't know since I retired where the-- and I was worried about that, that I wouldn't have enough to do. But actually, sometimes I maybe-- oh, I'm also president of our condo association, and this is my fourth year <laughs>. So I'm busy. I am busy.

**Saviers:** Certainly sounds like it. That's great.

**Lignos:** Yeah, and I like it, but time flies.

**Saviers:** Well, terrific. A wonderful career and a great retirement. What could be better?

**Lignos:** Yes. Well, we have a nice life. We have a nice life, my wife and I. Yeah, and so all said and done, we're healthy. Yeah, could've been worse of course. We have a lot of friends here that are not so lucky. But all in all, we have a nice life.

**Saviers:** Terrific. Well, thanks very much. It was wonderful chatting with you and refreshing some old memories that we shared together.

**Lignos:** Yes, I know.

**Saviers:** And many that were your stories, so thanks very much.

**Lignos:** We worked together for decades.

**Saviers:** Yes, right. Okay.

**Lignos:** Thank you, too.

END OF THE INTERVIEW