An Interview with

MARGARET LOFTUS

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Conducted by Judy E. O'Neill

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1

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Abstract

After breifly describing her educational background, Loftus discusses her work software at Control Data Corporation in both their Palo Alto, California and Arden Hills, Minnesota facilities. She describes her move from applications software to operating systems and recalls the differences in the management style and climate for women in Palo Alto and Arden Hills. Loftus discusses her advancement at Control Data and her decision to join Cray Research after returning from a position in Australia. She describes the difficulty of developing software with the prevalent anti-software attitude and the challenges associate with assembling a software staff. Loftus concludes the interview with a description of Loftus Brown-Wescott and this firm's involvement with local start up high technology firms.

DATE: April 18, 1995   INTERVIEWER: Judy E. O'Neill

LOCATION: Minneapolis, MN

O'NEILL: I would like to start with a little bit of your family background. I know that you went to Oklahoma State University. Were you born and raised in Oklahoma?

LOFTUS: No, I was born in Connecticut and then I moved to San Francisco and my father was teaching at Yale and then he moved to teach at San Francisco and then my parents moved back to Oklahoma. They were originally from that area of the country. Family responsibilities required them to move back to that area and I grew up in Oklahoma and Colorado.

O'NEILL: Why did you decide to go to Oklahoma State?

LOFTUS: Well, I'm a high school dropout and I decided probably fairly late in my junior year of high school that I wasn't going to finish high school and Oklahoma State was a school that was a nice place. Oklahoma has two universities and they're about equal size. Oklahoma State is a little bigger than Oklahoma University by maybe a few hundred students usually on a yearly basis, and I certainly didn't have the financial resources to go to an non-state school in Oklahoma, so that was the best choice I thought I could find.

O'NEILL: Why were you dropping out of high school?

LOFTUS: Well, it was not a high school that I really enjoyed going to and my personal friends were either in the class ahead of me or the class behind me and not in my class. It wasn't a school that people really got excited graduating from.

O'NEILL: And there was no problem getting into Oklahoma State?

LOFTUS: No, there really isn't that problem. I think a lot of people are doing that today. You see that very commonly. It wasn't very common when I did it but it was not difficult at all. One of the problems was I hadn't taken ACT tests which are what they gave in Oklahoma and so I had to take those, but other than that there was no issue at all getting into school.

O'NEILL: Why did you major in math? Had you been interested in math for a long time?

LOFTUS: Well, I was good at math. Math was not a subject I had any problems with. As a matter of fact, I really decided to be a math major early on, I think while I was still in high school. But I have a problem. I'm interested in a lot of things so I always feel like, well, if I go down one path, maybe I'm missing something. I'll go down that path. And I found out, probably by the end of my junior year, or middle of my junior year in college, I really didn't like math theory very well, but I liked the application kind of math, engineering math, and did think that maybe I would like to be . . . all aptitude tests said I should be a mechanical engineer, but being a mechanical engineer for a woman in that period was a little more brutal than I planned to tackle at the time . . . a math major. At least there were some other women math majors.

O'NEILL: So you knew even as a junior in college that the mechanical engineering department was not the place you wanted to be?

LOFTUS: Yes.

O'NEILL: You didn't actually have any immediate experience with them, you just knew that?

LOFTUS: I had just observed a few things. When I was a freshman or sophomore [in high school], I had taken some classes at Oklahoma University and been exposed a little bit to the engineering possibility. They were math classes and they had special math classes that they were teaching for high school kids to come in and expose them to college earlier, and the classes I took at that time seemed pretty easy [laughs]. Math wasn't going to be a big challenge as far as being able to . . . at least I didn't think so . . . get through a math degree. At least at Oklahoma University I was getting the feeling that it wasn't really accepted by the engineering department to have women too prevalent in their midst, and certainly in mechanical engineering. And I never really tried at Oklahoma State to do anything in engineering.

O'NEILL: You mentioned that there were other women in the mathematics department. Can you give me some idea -- was it like 10%?

LOFTUS: Oh, no. As a matter of fact after maybe the middle of our sophomore year or something like that you get to know who are the math majors and you arrange your schedules. Of course they had a very sophisticated, in the early 1960s, enrollment process. It was very computerized and I observed the University of Minnesota over the years and I say, "How can it be so archaic even today?" So it was very easy to schedule classes with people that you wanted to take classes with and you had a very high probability of getting

what you asked for when you asked for it.

O'NEILL: Sounds wonderful [laughs]. Did you have an idea of what you were going to do with your math major after you got out of college?

LOFTUS: Originally I minored in statistics and I had been exposed to statistics through some of the things I had taken from the University and in high school, and I thought I wanted to be a statistician. At Oklahoma State minoring in statistics I was taking the same classes that people that were getting their masters in statistics were taking and getting graded on the same scale. When I got closer to really talking about companies that might hire statisticians, it was required that you have a masters degree, and I said, "Well, I've taken these same classes that apply to a masters." They said, "No, you have to have a masters degree." Financially I was kind of tired of being poor and wasn't in a financial position to really think about going and getting my masters. I think I was maybe emotionally a little burned out of school at that time, and so I began interviewing with computer-related companies.

O'NEILL: Had you had any exposure to computers other than your registration system?

LOFTUS: I had computer classes as part of the math program at that time. There was no computer science department.

O'NEILL: But the math department did offer computer programs?

LOFTUS: All of the computer classes except for one that I took through the business school were offered as part of the math curriculum and so I'd had some exposure.

O'NEILL: Were these primarily programming classes?

LOFTUS: Yes, primarily. For the math classes it was, "Here's a hairy calculus problem. Now figure out how to write a program that solves it," and the school had an IBM 1620 computer that you fed cards into. You fed the compiler and your program behind it and it was pretty archaic, and you got your output on punched cards and then you had to take them over and figure out what the answer was by either reading the punched cards or sending it through a printer if you had very many of them. So it was fairly crude and I didn't think I wanted to be a programmer, but the companies interviewing at that time were looking for programmers.

5

O'NEILL: Had you heard of Control Data as an undergrad?

LOFTUS: Barely. I really didn't know much about Control Data until I interviewed with them.

O'NEILL: And they were just doing their general college recruiting program, I'm assuming?

LOFTUS: Yes, and they came to the campus, and then invited me to go to Minneapolis for additional interviews, and I did do that. I interviewed with Boeing, IBM, a few of the oil companies. I have to say Control Data gave me my lowest offer. I ask myself many times why did I take that job and why did I move to Minnesota because it seemed like it was something I didn't want -- being very cold [laughs]. I guess it was just meant to be.

O'NEILL: So you can't come up with reasons why you did that?

LOFTUS: Well, it's not real logical. Control Data seemed like a fairly exciting place when I went and interviewed with them, and it was a small department that I was hired into. The department had six people in it. They made offers to six college grads and all accepted, and they didn't think all would accept. There were two of us that were hired from Oklahoma State -- another woman and me. We both came to work approximately the same time and they asked both of us after maybe a month of not giving us anything to do but read manuals -- it got to the point that I'd read her a paragraph and she would read me a paragraph because it was just so boring. They gave us no programs to write. They came in and asked us if we'd consider moving to California. So that's how I got to Palo Alto.

O'NEILL: When you decided to take the offer from CDC initially, were you married at the time?

LOFTUS: No.

O'NEILL: So you didn't have any other considerations? You just were pretty much free to go?

LOFTUS: Yes, I could go.

O'NEILL: So you were hired into a group at CDC. Was it a software group *per se*?

LOFTUS: Yes. It was an applications group and Control Data was just experimenting with fairly rudimentary applications. Then when I moved to California it was really the same department in two locations, so it was moving into this applications group in Stanford Industrial Park where Control Data had a facility at that time.

O'NEILL: Can you give me your impression of the work force?

LOFTUS: Well, I think people were working very hard. It was a very exciting time. The 6600 was just being introduced and there was a lot of excitement about that machine. Control Data seemed to be in some ways kind of a confused place at that time. The company was growing pretty rapidly, but, from a college grad's perspective, where it was going was unknown to me. I think what attracted me to Control Data was the scientific computing emphasis of the company versus stat business computing. I'd had a brief exposure to business computing and I thought it was absolutely boring. As I went on my career with Control Data I got more into real nuts and bolts kind of software and I liked that real well.

O'NEILL: Were there a lot of other women?

LOFTUS: Yes. There were a few. As a matter of fact, in this department, the 12 people in Minneapolis, four were women.

O'NEILL: You go out to Palo Alto, and were you told what you'd be working on? Did you have a clear idea of you'd be doing?

LOFTUS: Yes.

O'NEILL: It was still applications?

LOFTUS: I was working on a PERT time program -- the first time Control Data had done a PERT time program. They'd started it for the lone (?) 3000 and they wanted it to run on the 6000. This department out there also did APT programming -- applications -- and some other things for Livermore on applications.

O'NEILL: How large was the Palo Alto group?

LOFTUS: It was larger. I would say it was 17-18 people. The Palo Alto facility had three office buildings and a computer room. They were all separate buildings and this group took one floor of one of those buildings. They weren't big buildings. You ask about women. There were several women there. One was Phyllis O'Toole. I don't know if you've come across that name. Phyllis, I think, was the first woman programmer that Control Data ever had. Phyllis was in Minneapolis, and then she moved to California. Phyllis died very soon after I went to Palo Alto. She has been dead a number of years, but she was a strong influence on how things were done out there and looked up to by the more senior people in the buildings. I worked in this application group for probably around a year and then I began working on the operating system with the 6600. They were originally doing the operating system in Los Angeles and it was called Cypros -- the first Cypros, probably. They had designed it. It was kind of a start-from-scratch operating system, and it wasn't working. They were having a lot of difficulty with that operating system. As a matter of fact, I went to L.A. For a significant part of that year, I got on a plane on Monday morning and went to Los Angeles and came home Friday. I was trying to get this PERT time program to work under Cypros, and it was hell [laughs]. At that time everything was done on cards in FORTRAN and I had these mammoth trays of cards to transport every week back and forth, and it was not a fun place. The Control Data facility in L.A. was the Arborvida facility which Control Data acquired from Bendix. They got this dreadful place and it was just awful. The machine time I got was like five at night until eight in the morning or something like that. I had a boss who was most frugal and he insisted we not get a car and stay in this motel that was in walking distance. It was right by the airport so you're trying to sleep all day and these planes are flying about ten inches above your head, and it was not a real joyous time of my life trying to get that software to work.

O'NEILL: Were you the only one working on this program?

LOFTUS: No, there were two of us.

O'NEILL: So the two of you would be traveling down to L.A.?

LOFTUS: Usually both of us would go to L.A. at the same time. There was a fellow by the name of Dick Enda (?). Dick works for Lockheed now in California.

O'NEILL: In this L.A. facility there was another software group there working on the rest of the operating system? You were just trying to get this one application to work under this system and so you were given these operating shifts.

LOFTUS: Right. So you got a new operating system all the time. Because this operating system was having trouble getting stabilizing and there seemed to be a lot of politics associated with which operating system should be done and what structure it should have -- high level politics within Control Data -- although I would only hear all the rumors at that time. There were all the rumors that this group in L.A. was going to be closed down, and these rumors lasted for months and months. It finally did happen. They had a ceremony and they buried Cypros.

O'NEILL: So that was about 1966?

LOFTUS: Yes. Then I began working on the Chippewa operating system which was what Seymour had invented for the machine -- Chippewa 1.1 it was called -- and somebody, I guess, stole it. I had a set of documentation that Seymour had written on the original operating system and it was very focused on most of the functions of the operating system being handled by the peripheral processors. That was a very trying time also because we weren't real smart about developing tools for ourselves. It seemed like, here's the job, start the job and not do anything else. There were no processes about how software was done and it was kind of you just decide. Everything was done on keypunch. You wrote on coding pads and then either did your own or sent it to some keypunch group for them to punch it all up in cards. I always say that during that time the creativity was on the coding pad and really no documentation was required or nobody did much documentation. Instead of doing it before the fact the way you do it now, we did it all after the fact. That operating system was successful. It did work and Control Data was able to sell 6600s to people who didn't plan on doing their own operating systems like Livermore and Los Alamos were doing. That kind of gave the 6600 a little bit of a boost as far as being able to sell it. Then the next operating system I worked on was called Scope 2.0. That was a significant rewrite of the Chippewa operating system.

O'NEILL: Was it a redesign or did they just kind of take a piece and say, "Oh, let's do this better," and that sort of thing?

LOFTUS: Well, the main thing was that it had a fairly sophisticated loader [laughs]. You could load things a little bit easier in the machine. There were a lot of contractors. Control Data hired a lot of contractors to work on that operating system. One of those contractors was Norm Akin (?), and so I knew in the old early days he worked for a company that was called URS. Just three letters [laughs]. It had a name, but somebody else had the name, so they just went with key initials. It was a software contracting firm.

O'NEILL: Out in Palo Alto?

LOFTUS: In California. I don't think they were in Palo Alto. They were somewhere around there, but worked at Control Data every day.

O'NEILL: Were there certain tasks given to the contractors and the real CDC people would do other things or was everybody pretty much just working on the project?

LOFTUS: Everybody was pretty much working.

O'NEILL: And there was no real process yet still? It was just sort of, this needs to be done and so you just go and do it?

LOFTUS: Right.

O'NEILL: Was there a testing process or a quality assurance of any sort?

LOFTUS: Yes there was. That was in place but they didn't get involved until the end. In some ways, at that time, I don't think they could control whether software went out the door or not. I think that was just evolving during that year. There was a testing group that took a whole floor of one of these buildings in Palo Alto. A fellow by the name of Al Parrow -- I don't know if you've come across that name -- probably has the record for moves between Minneapolis and Palo Alto. At times he headed that group and at times other people did.

O'NEILL: Did you as a programmer have much interaction with other software groups within the company or was it all pretty much focused? Was there an identity as a software group and you were the Palo Alto branch of it?

LOFTUS: Well, it seemed like again there were a lot of politics between California and Minneapolis as to who was going to do what software, but it was I guess decided before I was ever involved with this operating system for the 6600 that it was going to be done in L.A., originally, and then in Palo Alto.

O'NEILL: You spent five years in Palo Alto. Did you just remain programming on the operating system?

LOFTUS: Most of that time I worked on the operating system. Well, I had to be no more than 22 if I was 22, then I was put in a

project leadership role and that was real interesting because most everybody had a lot more experience than I did -- as much as 20 years or something like -- so it was very much a learning process for me. The project leadership involved really managing those people and getting them to do all these various assignments.

O'NEILL: Now, this was within the first year of your being out of school?

LOFTUS: This was my second year being out of school.

O'NEILL: So this was when you were working on the Scope operating system?

LOFTUS: Yes.

O'NEILL: So you became a project leader. How many people were working in your group?

LOFTUS: Three.

O'NEILL: Were you also still doing technical work?

LOFTUS: Yes. We still had a significant part of it. It was interesting because when I went into the operating system group, the department manager was a man, but all the other managers in the group were women. A woman by the name of Susan Campbell was my boss for some period of time. Mary Steele -- you may have heard of that name -- she was also my boss for some period of time. Their boss, and I think she was my boss for some period of time, was a woman by the name of Chaka (?) Murray. So in the Palo Alto area most of the first line managers, not only in the operating system but in other areas, were women.

O'NEILL: Why do you think that was?

LOFTUS: Well, these women were good. It never was discussed. Nobody made a big deal out of the fact that there were women, and I really didn't make a big deal about it until, in my mind, until I moved back to Minneapolis. I worked on the Scope 2 operating system, and then I worked on the Scope 3.0 operating system. The Scope 3.0 operating system was almost all contractors. There were only four or five people who were actual Control Data employees that worked on that. And then I worked on an operating system that

11

you've never heard of called Scope 4.0 for about a year. That was revamping significant parts of the system. I did that work.   They decided to kill the project and cut the funding for that, but a lot of the technical work got folded into the 3.0 -- 3.0 kind of grew forever. We had 20 versions of it, or something like that. It was getting a little ridiculous. Then I went to work at Palo Alto in a special systems group. Control Data was real big in special systems at that time.

O'NEILL: Special systems meaning for military sites?

LOFTUS: No, for anybody.

TAPE 1/SIDE 2

LOFTUS: Special systems were very successful at Control Data primarily because of their accounting system for software development. The machine expenses were part of the software development expenses. For special systems they just kind of put these machines on the back burner somewhere and you could use these machines designated for a special customer to do a special operating system for them. So that's how Mace (?) and later Kronos evolved. What's it called now, Nos? But that is those systems were able to have it. They really took the basic Scope or Chippewa or whatever you want to call it, and the system evolved from there so all the software evolved from the same place. It's not a start-from-scratch effort.

O'NEILL: So the special systems would just take these operating systems and modify them to whatever requirements for the customer and they would have more hardware resource in order to do the testing than the regular development crew?

LOFTUS: Yes. At one point when I was doing operating system development you signed up for hands-on machine time -- remember they had to be hands-on now -- and you signed up for blocks of ten minutes so you had to be very organized. I used to script everything so I wouldn't have to think while I was doing my ten minutes of machine time. This was usually four o'clock in the morning or some nice time like that. You'd have to put your tape up. Everything was dead start from tape. You had to dead start your system, run your test, get your dumps, and go away in ten minutes.

O'NEILL: And this was in the late 1960s, or between 1965 and 1970?

LOFTUS: Yes, 1965 and then in 1969 is when I went to work on the special systems.

O'NEILL: So at that time you were still just getting ten minutes of time on the hardware.

LOFTUS: That was one time when things were really tight as far as machine time. That was a few months of that kind of time. Sometimes if you wanted to come to work at four in the morning you could maybe get an hour block.

O'NEILL: Was there also sort of a service bureau at Palo Alto as well that had machines?

LOFTUS: Yes there was, but that was a different facility. In the Palo Alto area Control Data had three separate buildings. One was this service bureau, one was a marketing building, and one was the development, and they were within walking distance but from the development to the service bureau was a nice walk. There were a lot of buildings in between.

O'NEILL: So the development group has been growing significantly in this time. Is that true?

LOFTUS: No, we only had these three buildings [laughs].

O'NEILL: Well, when you went there you said that there were 17-18 people?

LOFTUS: In that applications group. The other buildings were full of other different kinds of people. I'd say what the people did and maybe the people themselves changed, but the facility remained the same.

O'NEILL: I was talking about the number of people . . .

LOFTUS: We maybe got a little more dense in the office spaces. I think we had two-man offices generally and I had a period in my life there that I had a three-man office. I had two periods. It taught me a lesson that two is a nice number to put in an office. One is ideal. Two is acceptable. Three, always one person wants to talk [laughs]. Then I got on my kick about what kind of offices and remained on that even today [laughs].

O'NEILL: So you were the program leader for the Scope system and in 1969 you moved over into the special systems group. What were you doing with the special systems group?

13

LOFTUS: In the special systems group I was working on an operating system for ETH in Zurich. Let me back up. I had another little detour in there. I went from the operating system to working on a special system for Standard & Poor's. Standard & Poor's had acquired a 6400 and they were going to use that for stock transactions, and I was very popular with all the upper management at Palo Alto because I had data that represented the last 20 years for 500 companies on the Standard & Poor's database. We were making an interactive system for them to be able to interact with this data, so you could do all kinds of what-ifs or give me the companies that have done this and this. You could and/or all this.

O'NEILL: Kind of a query language for the database setup.

LOFTUS: Yes.

O'NEILL: Scope as I understand it was not an interactive system. Is that right? It was just a batch system.

LOFTUS: Yes, but this was using Scope to be interactive.

O'NEILL: Okay. Was there time-sharing on this system as such or was it just you could write an interactive application?

LOFTUS: It was an interactive application that really dominated the machine and let the multiple users log in. You know we're dealing with nothing but dumb terminals now, with teletype mentality, and it let users log in and interact with it.

O'NEILL: Was there a debate within the development group about time-sharing? Right around here is when time-sharing is really kind of exploding and being talked about.

LOFTUS: Right, and that's the reason Kronos was interactive. I think it's probably overstated -- the difference. It would have been very easy to add the same kind of capabilities to Scope. It was more political than anything else in my opinion.

O'NEILL: Kronos was done in Arden Hills. Is that right?

LOFTUS: By the same special systems group that I eventually went to.

O'NEILL: Okay. I'm getting ahead of the story.

LOFTUS: They had a group in Arden Hills and that was when Control Data was building the Sunnyvale facility and so we all had to move out of these nice offices in Palo Alto and move to this place in Sunnyvale. They built a new building. The Palo Alto building was on Stanford property and we had this 100-year lease and so they got all nervous because the kind of the lease. The building had been there for 15-20 years or whatever it had been at that time, and so they were moving to a new place and selling that facility. They built this building in Sunnyvale and I moved into that building as part of the special systems and that's where I did the systems work for ETH.

O'NEILL: So then you end up back in Arden Hills?

LOFTUS: Well, I was in Sunnyvale for awhile and then I was working on this system. I did the design.

O'NEILL: And you were still a program leader at this point?

LOFTUS: I was the leader of the technical operating system part of ETH. ETH gets their money in big chunks every ten years or so -- a long time between these big chunks -- and they had bought a 6500 and a 6400 I believe. The 6500 was a multi processor machine, and the 6400, and they wanted to use them shared extended core memories, yes. The one piece machine. So the system I was working on was a multi processor system using UCS as the way to communicate between the two. I did not finish that system. I did the design, and it was really interesting. I went over to present it to ETH, this was 1969, and I was in Control Data's office in Zurich. The person that was the country manager for Control Data at the time got up and I thought he was going to give a nice little introduction before I presented. It turned out to be a very interesting introduction because it really focused on the fact that here I was this young woman, I couldn't even vote in Switzerland, and I was going to tell them how to do this multi-processor, multimillion-dollar system for their computer. So the customer was really taken aback by that, too, and we kind of sat there with our mouths hanging open for a little while and then I kind of went up to the board and started describing how I saw the system work. I got married at the very end of 1969. My husband at that time also worked at Control Data and he got transferred to Minneapolis so that's why I came back to Minneapolis. He promised me it was a temporary move. We have been here 25 years. The timing was pretty good. A fellow that I had worked for in Palo Alto had just been put in charge of the operating system for the 7600. Ed Michael was his name. He's working for a company in Oakland. So I called Ed up and said, "I need a job," and so he said, "Well, I've got this one. I've got that one. I've got something

else so come back and interview." So I came back and took the job that essentially created the permit file system on the 7600. So I headed that effort.

O'NEILL: Was your husband a programmer?

LOFTUS: No. My husband was one of the first 100 employees of Control Data and he isn't quite that old because he started, I think, he was 19 when he went to work for Control Data, and he was the gofer. He was the guy who went after everything. He has a lot of very interesting stories about his car. It was a company car, a 1951 Ford. You know, a kid's car with hard top, two-door [laughs], and getting these admiral friends of Norris' in the back seat and one day one of them put their foot through the floorboard. It rusted out. Norris bought a station wagon.

O'NEILL: So he had been out in Palo Alto?

LOFTUS: At that time, Control Data had four regional suppliers for their parts, big warehouses, and he had the whole Western part of the United States. So he ran that facility -- when a machine went down and they didn't have the part and keeping the parts all lined up.

O'NEILL: So he gets transferred back to Minneapolis. You go back.

LOFTUS: I work on the 7600 operating system.

O'NEILL: In what capacity are you working on it?

LOFTUS: I started out permit files.

O'NEILL: In a management position?

LOFTUS: Project leader. My work on the 7600 evolved, so I did that. Then they came up with an operating system for the 7600 called Scope 2.0, same as the 6600 original Scope name. Scope 2.0 was probably, in my mind, the most sophisticated operating system Control Data -- at least that I'm knowledgeable of -- ever had, and it was also the first place that process really started with any significance. The processes for code control had happened very early in Control Data. I think Control Data did that as well as

16

anybody on the scene up to this point. So code control was something Control Data figured out how to do in the mid-late 1960s .

O'NEILL: And by code control you mean what code actually goes into all these . . .

LOFTUS: Yes. The tracking, how did it get there, and you get this bug control fixes or new features and how they really get in the system, so Control Data knew how to do that. The 7600 really put another layer of that, of really looking at tracking things even more thoroughly than we had done on the 6600. But it put the design process in place, and it put design reviews in place, and a lot more management of how software was done, and I think Ed Michael was probably one of the real pushers of that. I worked for Ed when I worked on this Scope 4.0 thing way back when. That was his first management job ever and so he had seen, maybe, how not to do it and was making some changes and we had one person that was kind of in charge technically of the whole thing. His name was Pierre Fisher. He also came from California to Minneapolis, and I think Pierre did an excellent job of moving the process forward. I didn't always like his decisions and would fight with him occasionally. I'm sure he would say more than occasionally. He moved the whole process of process forward, and that worked out real well. Then the next step for me, I did some other things in Scope 2, but then they were going to come out with the new version of Scope 2 called Scope 2.1 which was a significant improvement and a lot of changes. I ended up having that same kind of job that Pierre had for the Scope 2.1 process, and ended up managing 35 people across multiple departments and Control Data had their dual ladder at that time and I had the title of some kind of consultant. I can't remember exactly what. I was not a manager and it was obvious to me I was not going to be a manager in Arden Hills. When I came back to Minneapolis, the way managers were treated in Arden Hills was fairly brutal, and they didn't last too long in most cases. I also ended up having a baby in 1972, so I took my three months maternity leave and when I left, my boss at the time -- I think I hardly got out the door -- he made three more managers, of which all were men. My phone was ringing off the hook at home with these men who were irate about what he just did [laughs].

O'NEILL: So when you left you were sort of this manager without the title of the 2.1 Scope release?

LOFTUS: Yes.

O'NEILL: When you left they named three managers for the same project?

LOFTUS: Well, no. Nobody headed up that project. As a matter of fact I did work at home, and that was another issue at Control Data. They wanted me to work at home. Control Data had a policy that I had to go home so I couldn't stay there, and so I worked

from home, and so they said, "Well, you can go part time." Control Data personnel had these two books this thick of policies and procedures and so they called me up, "Well, you could work part time, but you have to quit first," and I had ten years there or something like that at the time. I said, "Well, am I going to come back and lose all my seniority?" -- "yes". And you come back and start all over again and so I just kept my records of how many hours I worked and when I came back I just said, "I'm going to work, but I'm going to take off until I get this time used up." And it worked out fine because we had a baby at home and it gave me more freedom.

O'NEILL: So you didn't actually go part time?

LOFTUS: No.

O'NEILL: You managed to get around the rule or get around the procedure.

LOFTUS: Yes, and that was very necessary because things were moving ahead, but that work was just started and then when I came back the work for this new operating system really got into full gear.

O'NEILL: And this was just three months later?

LOFTUS: Yes.

O'NEILL: What do you think accounts for the atmosphere at Arden Hills towards the women managers in particular, I'm assuming? Were the women programmers treated poorly or was it really just the women managers?

LOFTUS: I think women programmers were treated fairly. There were just no opportunities. It's kind of the same mentality, you know when I said I didn't want to become a mechanical engineer, because the environment just wasn't good for that. Well, I did want to be a manager at Control Data, and I was. I mean, I was managing as much as a director was managing, but it was just a very unfriendly environment and some of the managers had no problems with women working for them as programmers, but women as peers or women as bosses were not tolerated. A lot of negative comments were made about women that went into management and really got beat up by their subordinates, or their peers, or their boss. It just seemed like there was no environment that they could survive in. Ed Michael -- who was someone that I had high regard for and certainly in California he had had women managers working

18

for him -- went back to California. So there didn't seem to be anybody that could have the power to champion anything like that. Nobody thought it was important anyway. As a matter of fact, my boss at that time, I think he had four children. I didn't know he had four. I thought he just had three. I worked for the guy for two years before I knew he had a girl. So that was kind of the mentality that existed. I knew all about his sons. They were hockey players and I knew in detail about all their kids because he just talked about them. He talked about his girl in one setting because his mother or mother-in-law was at their house and had a heart attack and died, but the girl was the only one who had the presence to try to give her CPR. I said, "What girl?" [laughs]. Anyway, it just was not a friendly place and I don't know where that came from. If, because we were in California, the leadership influence was less, and it was more prevalent here. I guess I always felt it came from the top. I have no evidence other than that feeling.

O'NEILL: Let me just get a few more questions here before we leave CDC. Other than this change in the attitude towards women managers than we've already talked about, was there a tension between the two development groups -- the one in Palo Alto and the one in Arden Hills?

LOFTUS: Oh, it was terrible! It was the most unhealthy thing that I have ever been in. I was in the cafeteria having a Coke and this one guy sat down, and this was not unusual, and he went into this tirade about how everybody in California was stupid and everybody in Minneapolis was smart. I said, "Oh, well I just moved from Palo Alto to here and does that mean I suddenly got smart?" and he said, "Yes." I mean, it wasn't a joke [laughs]. He was irate, and quite frankly, from my experience of working both places, I worked harder, I was more a member of a team, I was more involved, and I was more committed when I worked at Palo Alto than when I worked in Minneapolis, or St. Paul, I guess it was. It was just a whole different kind of attitude, and even though I had more responsibility, I mean I was committed to getting the job done, but I wasn't working the kind of hours.

We did do really some smart things on the 7600. That's the first place we really used hardware simulators in the development process so getting hands-on machine time to do operating system development was not a necessity. You could do the bulk of the work by just batch jobs on the 6600 using the simulator. That was a real boom for productivity and a real boom for quality of software that was produced. That, combined with the formalization of process, just made how we did things in the 1960s versus the 1970s a couple of light years away.

O'NEILL: So it's in the time that you were at CDC from 1965 to say 1975, you saw all of this evolve into some fairly sophisticated simulation tools . . .

LOFTUS: . . . very sophisticated simulation tools.

O'NEILL: You also mentioned that the Scope 2.0 for the 7600 was the most sophisticated operating system that CDC had done. What made it sophisticated?

LOFTUS: The structure of the operating system. Seymour had, and later at Cray too, he always liked to say that these peripheral processors were where the operating system ought to be. Well, on the 7600 he made the peripheral. The communication wasn't as good, and so we used the peripheral processors as just drivers -- just drove this disk or a tape or whatever. The operating system resided in the CPU and debugging an operating system that runs in the CPU is again light years ahead of debugging an operating system that runs on peripheral processes.   I mean, you can't see anything. You always have to take your dump and then try to figure out where you even were in the peripheral processor. To do tools for a peripheral processor, they're too small. They don't have enough memory.

O'NEILL: Would the operating system be on more than one peripheral processor?

LOFTUS: Yes. It was on all of them [laughs]. Then you've got these few cells in the central memory that are the communication paths between all these peripheral processors. Peripheral processors could do anything they wanted with central memory, so you never knew who did it. Using the kinds of memory controls that Seymour puts on the central processor to help control your operating system, you're only doing things for this job, and you've only got a few pieces of the operating system that can read and write all memory.

O'NEILL: A lot more under control.

LOFTUS: Yes, a lot more under control. They had an overlay system of these little pieces of the operating system. Now, one of the problems with this operating system, with the 7600 itself, was the memory structure. You didn't have any real memory to speak of -- 60-65K of real memory was the max and then it had extended memory. It had small core memory and large core memory, and it had this huge ECS-type memory they called LCM, and Control Data did their compilers, the FORTRAN compilers and everything, so it took advantage of all this stuff and had all these special commands writing all this stuff out into logical memory so it made that totally non-transportable to anywhere else.

LOFTUS: There's a fellow by the name of Hans Voyness (?). Hans was at Livermore. I think Seymour Cray gives credit to Hans and even takes it -- Hans has since retired from Livermore -- about saying, "I don't need real memory. If I just had this big extended memory that would be wonderful, but I need a lot of that." So Seymour listened to Hans and made a machine that looked like that, and, really, that was its downfall in combination with Control Data's direction for the machine. This was a Seymour Cray-designed machine. It was a scientific computer, and Control Data's marketing decided this was going to be their entry into the world of business. They weren't going to compete with Burroughs. They were going to compete with IBM with this machine. It didn't do the kinds of things that you need to do for a business machine. It crunched numbers. It was real good at that. They spent all this money on the COBOL compiler for the thing. Tons of money and effort. I don't know if they ever sold a machine.

O'NEILL: Had there been a COBOL compiler on any of the other machines? There had been, right? On the 6600?

LOFTUS: Yes, 6600. That was also a COBOL compiler. If you wanted to find something that was the brunt of 70% of the jokes at Palo Alto it had to be the COBOL compiler and the management of that process.

O'NEILL: So that didn't actually break into the business world at all?

LOFTUS: No, it didn't break in [laughs]. It might have broken the bank. They spent tons of money on it. Just like they spent tons of money on this next machine. So the 7600 had to have a front end. It didn't have human peripherals attached to it so you had to have 6600 or some kind of front end. They had a stripped down 6000 that was called a 7611-11. It was a machine that Control Data made and it was just this whole crude little thing that you could put card readers on it, and you could put tapes on it, and you could do all kinds of things. The tapes were staged on this thing. Then in 1975 the 7600 was declared kind of dead and part of it was this memory problem that it had -- unreliability. It was the most unreliable machine I ever worked on. They had a lot of trouble getting it right.

O'NEILL: Why was that?

LOFTUS: I have no idea. It was a machine that was redesigned as many times as you could possibly imagine. Now, the early 6600s had troubles. I said I went to L.A. and worked on this. I worked on Serial II 6600. Serial II is an infamous machine. It's been rejected by more customers than any machine that Control Data ever made. That was the machine that was in the data center at L.A. So you

21

think about why they couldn't get Cypros to work. I mean, they had cables or wires running around the room to make a path long enough in the machine. We'd write these little Fortran programs "Set "I" to ten, print "I,"" and "I" wouldn't be ten. Okay, so you're dealing with some very, very flaky hardware on the very early 6600, particularly the Serial II. Then on the 7600, the flaky hardware was throughout the product until very, very late in the game. It just didn't work. On both the 6600 and the 7600 Seymour put no parity checking. So the 7600 was kind of declared a dead-end machine in 1975, but at the same time they wanted to install one in the data center down in Bloomington so I went down with a guy that worked for me to install that machine and get it up to speed as far as working in a data center, and we did. I worked on that a few months, six months maybe, but working in the data center was not appealing to me at all. They had won a tremendous lawsuit with IBM and they inherited the service bureau part as part of the lawsuit and so most of the management of the data center was ex-IBM and there was a little culture. I didn't quite fit [laughs]. So I decided I had to find something else to do and it was to a point that I couldn't think of a good reason to come into work in the morning. We got the 7600 going. Yes, I had other projects to do, but none of them were exciting or challenging. I had a couple friends that had gone to work for Cray Research, a couple of guys that used to work on the 7600, but Cray wasn't going to do any software. They were just doing this kind of "play around" stuff with software. It helped design the machine. So an opportunity came to go to work in Australia with Control Data. They had one 7600 in Australia and they wanted it to do all these real unusual things with it, like front end it with a 3600 or something like that. You've got different word (?) sizes, all these other little problems. They didn't have a 6000 front ended. So I went to Australia and worked on that for awhile, and what my goal was there was to teach them how to be self-sufficient. The reason I was sent there was to do this software for them. Well, there was just a whole lot of software to do. There was no way that I could have gotten it finished in six months or something.

O'NEILL: This was in 1975?

LOFTUS: This was in 1975-76.

O'NEILL: So you had gone from the data center and you didn't like it there and you decided to take this?

LOFTUS: Yes. So I interviewed for this job and it was real strange because then that was another women's issue. Australians in the mid 1970s still had their separate pubs and lounges for women. A women couldn't go in the pub. Women couldn't do this. Women couldn't do that. There were all these rules about what women could do, and I went to work in an all male group in Australia and was interviewed by a guy who made that quite clear that he didn't know about hiring a woman. He interviewed some men, but he decided I was the most qualified. I knew the people he was interviewing and he was right. I was the most qualified, and it worked out real well. I

taught them how to use the simulator. I taught them how to maybe not be so fearful about making changes to things, and I would challenge them. They'd say, "We ought to this-this-this," and I'd say, "Well, do it. Design it and do it." So part of it was hand holding and part of it was I did do some of the software, but it was more making them self-sufficient.

O'NEILL: So empowering them, in other words?

LOFTUS: Yes, and this fellow that had his real reservations about me coming, he has since retired, but he was giving talks not too many years ago about how many millions of dollars I saved them by taking that approach versus actually doing the software and then going away and letting them maintain my stuff. So I worked there for awhile and one morning about three o'clock in the morning while I was still in Australia I got a phone call asking if maybe I'd like to talk to Cray Research went I got back. They knew I was coming back soon. And I said, "Well, are you going to be doing software?" "Well, I think we should have a talk."

O'NEILL: Had you taken your son with you to Australia?

LOFTUS: No, we didn't. My husband came. We were going to, but he stayed with my mother. My husband went for a couple months and then he came back.

O'NEILL: So you were juggling all this as well.

LOFTUS: It worked out well that he didn't come. The situation we ended up living in would not have been a conducive spot for him. My mother is a retired first grade teacher so it was her heaven to have her only grandchild.

O'NEILL: And you knew this was only going to be six months.

LOFTUS: Well, I was there less than that.

O'NEILL: So you get this call asking if you want to come and talk to the people at Cray Research. You mentioned that you knew some people who had gone to work there. Can you tell me who they were?

LOFTUS: Dick Nelson. Dick and I had offices next door to each other at Control Data in Arden Hills, so we knew each other pretty

well. I managed in my pseudo-management role some of the things that Dick was doing. This giant project I told you about, the 2.1, he was doing some work on that. Another one was Dave Judd. Dave Judd is an excellent technical guy, and he had been at CDC working on the 7600. That's about it as far as people that would have been pulling me in that direction.

O'NEILL: Who had called you?

LOFTUS: Jim Harris. He was Frank Mullaney's administrative assistant, and he was Cray Research's administration person when I first went to work for Cray Research. He was my husband's high school principal which is the reason my husband went to work for Control Data. Then Jim left Control Data and formed a real estate company and my husband worked for Jim in the real estate company -- that sounds like we're a little closer than -- not that we aren't friends, but our paths don't cross a lot. Jim and his wife and my husband and I might play golf in the summer time once or twice, and they live in the same town we live in. We live out in the country. They live on the lake -- Prior Lake -- where my husband grew up.

O'NEILL: So Jim Harris calls you and you come back to the States and you go and talk to somebody at Cray.

LOFTUS: Yes. I go talk to Dick Nelson or they talk to Jim or I talk to all these people and Jim wasn't too sure, but if they sent a woman to Australia to do this stuff I must have some kinds of talents, at least technical talents, that they would ask me to go. Dick and I have an excellent rapport. Dick had gone to Cray to do automatic vectorizing FORTRAN compiler, but not as a product -- kind of as an experiment and kind of to help Seymour with the design of the machine. Dick is a FORTRAN compiler expert and, you know, how do you take full advantage of this hardware or FORTRAN compiler and its generated code? So that was Dick's role and he was doing it as an experiment because nobody had ever done an automatic vectorizing FORTRAN compiler before. Dave went to work on a loader. So no operating system work of any consequences had really happened. This thing was really crude. So I decided that Cray was possibly the only exciting thing that I could find to do. Control Data, I was convinced, was getting out of the computer business. They just were not doing anything. They weren't investing money in R&D on the computer side and they weren't doing anything I wanted to do. So going to work for Cray was pretty exciting. I was told I could figure out what kind of software Cray ought to have. Hey, you know, you got this nice charter. So I spent the first two days at Cray researching and thinking about what kind of language should we write the operating system. Of course, we had no language. We didn't even have an assembler down at Cray. I had no constraints to speak of. On the third day Seymour came in and said, AMaybe you'd like to read a copy of the NCAR contract I just signed," and this NCAR contract had all the software specifics and all these dates and Cray had nothing. They had absolutely nothing. You know, I thought, nobody had even mentioned it to me before that day. They were competing for Control Data for the contract

24

so I could see that maybe they wouldn't want to tell me all about it although I was so far out of that loop at Control Data I wouldn't have even known who to talk to about it if I wanted to. I probably wouldn't have. So I really thought that I'd really been had. I was so mad I was furious. I stormed around my office for awhile, and I thought, "Margaret, you are bored at Control Data. You're not going to be bored here [laughs]. Better get your act together and figure out how to do this." So I began hiring software people which made Seymour awfully nervous. His comment was -- he didn't say it to me directly but I heard it from enough places -- that Margaret is going to hire airplane hangars full of programmers. And I said, "I don't even see an airplane hangar around here. Maybe at Northwest." We were at Metro Office Park then and could look across and see it.

O'NEILL: Had you had any contact with Seymour Cray at CDC?

LOFTUS: Not really. No.

O'NEILL: So this was your first exposure to him?

LOFTUS: Yes. Certainly the legend was alive and well and I had certainly a lot of respect for his abilities. It probably came more from the 6000 and going through the operating system and the kind of work he did from both the hardware and software standpoint. The 6000 was just such a leap ahead of anything that anybody ever thought of. The Cray I was also. They already loaned this machine to Los Alamos by the time I started. They had just done that. Now, the machine had no IO channels. Los Alamos was doing this test on it to see if how fast the CPU really ran, and there was a lot of fallout over the Star machine -- Control Data. Livermore had paid 15 million dollars for two machines each and invested this huge amount of money in redoing the software to work with those machines because you have to put special calls into FORTRAN to take advantage of vector capabilities in the machine. So what Dick Nelson was doing was trying to come up with a way to do an automatic vectorizing compiler so you could take garden variety FORTRAN and just feed it through and get the vectorization automatically. So we quickly turned his experiment into more of a product kind of mentality, and then Dave Judd got the assignment to do an assembler. Now, we had a simulator that was working on a Data General Eclipse. So he simulated a Cray I on a Data General Eclipse. Cray at that time was seriously in the red. There was an article about every week in the Minneapolis paper that said how Cray Research was going to go out of business and .....?....... was going to have him for lunch any day now and it just was never going to get off the ground. It didn't have any people, so I had to start hiring people.

O'NEILL: Was it difficult to hire people?

LOFTUS: Yes, because Cray Research was not an attractive place to work for those people. It made all the press that says the company's going out of business every day. Looking at the focus of the company prior to that was hardware only so how are you going to elevate software to the point of being a necessary evil and that was the point I was trying to elevate it to.

O'NEILL: What was your strategy for hiring people? Were you staying in the Twin Cities? Were you looking for certain kinds of credentials?

LOFTUS: We were staying in the Twin Cities, and we really didn't have much money to run ads. So most of the people I hired came from unsolicited résumés, the few people that were willing to take the risk of doing something like that. Now, I don't think it was a grandiose team that we put together, but what I tried to do was to set up the processes such that we wrote all the design first. We wrote no line of code until we had the design. I had done the design for the interaction between the various pieces of the operating system, and as I hired somebody I passed on a piece to them, and it had the general structure of what it was supposed to do, but here's the table structure -- it was already set up so we only had to add a few fields if I had forgot something. We had a process I carried over from the 7600 table definitions so everything was macro defined so we could just reassemble everything if we changed the tables and that worked out great. The operating system was all CPU resident and so that worked out great. You could read and write the disk from the CPU. That helped a lot. So I hired six people and we wrote the operating system. The fellow that was in charge of this was George Grinander (?), who is apparently with Cray -- he left and then came back -- but he was really pretty angry with me. George and I are since very good friends but he was pretty angry because I wouldn't let anybody write any code. He came storming in my office one day and said, "Margaret, when are you going to write some code? It's kind of hard to run benchmarks on documentation." A few months later he came back and he said, "You did it right" [laughs], because as we started getting these pieces together and people could check them out on this crude simulator that we had that ran on the Data General, and I also had an effort going on to write a simulator on the Cray so we could run a batch job on the Cray and simulate the operating system as we got more of it put together. We were working fast and furious to get an assembler that ran on the Cray. Dave Judd was doing that. Dick Nelson -- he has lake cabin and his family went to the lake for the summer -- I don't know if he ever saw them. Day and night he worked on the FORTRAN compiler. I hired a couple of people to help him work on the compiler. So we had less than a dozen people to do all the software, and that included all the libraries and all the associated utilities that you have to have for an operating system. We had to come up with a batch operating system that had a permanent file system and could run these big FORTRAN codes.

O'NEILL: And all of these things were in the contract?

LOFTUS: Yes.

O'NEILL: From the time that you started or a couple days after you started to the first deliverable in the contract, what period of time was that?

LOFTUS: When we had to install the machine, the last deliverable, was 15 months. Hiring the people, getting an operating system defined and debugging, and we didn't have a machine. There was this machine at Los Alamos, but it was Serial I oriented. It was kind of crude. And they were making a Serial II and then Seymour got convinced -- I don't know if convinced is the right word -- persuaded that --Les Davis maybe got persuaded that they ought to add sect add to the machine. The chassis for Serial I and II were too short to include all the bits for sect add so they took all the modules out of Serial II and put them in Serial III and so they were building Serial III and IV at the same time -- 1977 they built Serial III and IV. They built two machines. So we're trying to run on Serial II for awhile, then they start taking that apart, so trying to run remotely over a 9600 baud line from Bloomington to Chippewa to do operating system and compiler development.

O'NEILL: Was there any thought of you moving? I mean, why were you in Minneapolis? Why not just go to Chippewa and have the software group right there in Chippewa?

LOFTUS: Well, Cray was not a software company and we were protected a little bit by being in Minneapolis. It was a hostile environment when we went to Chippewa. Now, we had come to the necessary evil. We couldn't sell these machines without software. Livermore was going to buy one and Los Alamos had this one they were still testing which really made Seymour mad. Nobody had ever taken one of his machines and tested it like that before so he was pretty angry about that. Then the space in Chippewa -- they were like sardines. There was no place to go. People when they fly in, potential customers, want to talk more to the software people usually, and people who were going to buy machines with software on it and run software on the machine -- they were more software oriented people although they like to take their little trip to Chippewa, too, but they usually came in. I had a process, as a matter of fact I helped set up the process, that NCAR came about every month and we had to review the status, the progress, and things like that, so that worked out I think well for both of us. Then the machine moved to Chippewa in July and so we all moved -- all the software people moved almost en masse -- to Boulder. There's only two motels that I've ever stayed at in my life that if somebody calls me and I'm in the lobby I'm sure to get the call. One was the place we stayed in Boulder and one is the Flame in Chippewa Falls [laughs]. I would never miss a phone call.

O'NEILL: How many people in this software group were transported down to Boulder at that period?

LOFTUS: Well, there was another little problem. Cray managed to sell another machine to ECMWF -- European Center for Medium Range Weather Forecasting in the U.K. -- so they took Serial I out of Los Alamos, gave them Serial IV, and sent Serial I to U.K. The first acceptance of the software for both machines was November of 1977 so I had two machines using software going through acceptance at the same time.

O'NEILL: These two machines are the one at Boulder and one at ECMWF, not Los Alamos?

LOFTUS: Yes. Los Alamos was doing their own thing with software. They were writing an operating system called Deemos (?). It never got off the ground. It had some basic underlying design issues that you could not be sure what you wrote to the disk, but other than that . . .

O'NEILL: Okay, so in November 1977 NCAR is supposed to be going through acceptance of the software, and the ECMWF contract included the same software?

LOFTUS: Yes.

O'NEILL: But each running on a Cray I without sect add?

LOFTUS: Right. Well, sect add doesn't come into play usually with the software although memory didn't work the same with both machines.

O'NEILL: I would think it would have some . . .

LOFTUS: Not really. Cray was under a lot of scrutiny, particularly in the U.S. Could we really pull this off? Could we really get this machine at NCAR accepted? The ECMWF one was a little more in the background. So I sent one person to ECMWF to get that machine going and the other ones, we all kind of all rotated through Boulder. We covered the machine during acceptance -- seven days a week, 24 hours a day --, with a software person just to babysit and make sure things were working fine. It ended up that the most serious problem with NCAR acceptance was one of the modules had a solder spray on it and it caused unusual things to happen at

unusual times that somebody hit heat sensitive and sometimes it was just some change in the temperature and you got all kinds of funny results out of the machine until we found that, which was after acceptance. Hardware and software acceptance was only required to be 90% in both places. In today's terms, that's pretty meager. One of the great things about the Cray I, of all the machines I've ever worked on that Seymour designed, it was leaps and bounds ahead of everything as far as your reliability. It was a dynamite machine. It was just great. It hardly ever went down. The only problems I had running remote from Chippewa Falls of the machine doing down was when I'd be running my software and somebody in the software group would be running their software and the engineers in Chippewa would be in the process of taking the machine apart. But other than that [laughs] -- of course that caused some very heated discussions over the phone lines [laughs]. "What are your doing? It's my time!" [laughs]. And everything had to come back . . . if we ran something and wanted to get output back, wanted to get a dump back, everything had to come back over this 9600 baud line. So it was hell getting the software done. The mechanics of actually accessing the machine in Chippewa and getting some results back reminded me very much of this time I told you when we got ten minutes of machine time. You had to be just on top of everything every minute.

TAPE 2/SIDE 2

LOFTUS: It was the most important element you wanted in hiring people. You asked about the kinds of people we hired. You hired people with a kind of determined personality, almost obsessive to some extent, and they're going to get it done regardless. As a matter of fact, one of the marketing guys hired this one person to go out and do a lot of early selling for him. He said that I gave people points for running over anybody that would possibly be running any benchmarks [laughs]. Elbow them out of the way. It wasn't quite fame, but close. But to me the thing that seemed so important was the company either surviving or not surviving.

There was a fellow by the name of Noel Stone whom you've probably tracked his career through ERA, Control Data, and Univac, and he was one of the founders of Cray. Noel has since died. He didn't really get to see Cray's big success, but he would come down to my office most every day and say, "Margaret, are you going to get that software done?" And I would look him right in the eye and say, "Yes, Noel, we're going to get it done," no matter what kind of bad day I was having or no matter how many things had gone wrong I was determined that I wasn't going to let Noel think I wasn't going to get it down or him go away and start telling people it wasn't going to happen. The NCAR contract had a penalty clause in it if the software wasn't done, and he would say, "Well, you know, I just went through my calculations and if we don't get it done the company can stay in business and pay these penalties," these different financial penalties, "x" days, and "x" was somewhere between 10 and 15. So he was kind of keeping the pressure on every day. You could write the script of him walking in the office.

O'NEILL: What was his position? What was he actually doing? Was he a financial person?

LOFTUS: No, he was an engineer. I'm not really sure. He was a founder. He had an office. He worried a lot [laughs]. He was real good at that [laughs]. He was probably the biggest worrier of any of the founders of the company. I can't recall what Noel's role was. I worked for George Hanson and George died about a year ago. George and I were very good friends even after he left Cray. He left Cray before we did the NCAR contract. He was vice president of operations and Les Davis and I both reported to George. George had a son-in-law. His son-in-law is a friend of mine also. His son-in-law's name is Bruce Zimler (?). George had a lake cabin and Bruce and his wife, George's daughter, and their family would be at the lake cabin quite a bit in the summer, particularly that summer, and so George would go up to the lake with Bruce and Bruce would parade this doom and gloom about how -- he was at Control Data -- we were never going to get the software done and how it just impossible with the task they started out. So George would come back and I would spend my Monday mornings kind of calming George down and saying, "It's possible, George. It's hard, but it's possible" [laughs].

O'NEILL: Had George come from CDC?

LOFTUS: Yes, he was the ERA.

O'NEILL: I knew he had been involved in ERA, but I wasn't sure exactly what he had done after that.

LOFTUS: He was Control Data's first marketing vice president. George was a super guy. George and my paths continued -- let me just tell a George story. When George left Cray Research, part of it was his idea that Cray ought to build more machines and do more things, and Seymour saying we're going to build four a year and that's it. That ought to satisfy all the computing needs of the world. Now, this is the same story I heard when I first got out of college and went to work for Control Data. They were going to build four 6600s and that might saturate all the computing needs in the world. So four is this nice number. So in George's going away speech at Cray when he was retiring he said -- he was very interested in woodworking so he defined woodworking as going in the bird house business -- and he thought he would build four a year and that would probably satisfy the world in need of bird houses [laughs]. George did go in the woodworking business and I have a house full of cabinets that George's cabinet company made, these very spectacular European designed cabinets.

O'NEILL: When George left, who took his position?

LOFTUS: Nobody, I think.

O'NEILL: So you and Les Davis were now . . .

LOFTUS: Well, Les reported to whoever he wanted to report to [laughs]. My comment was that I always worked better without a boss. Not that took up a real boss role. It was more a strong personal relationship that we developed. John Rollwagen was vice president of finance and marketing -- he was a CFO and a marketing guy -- and when George left I then reported to John. John had reported to George. George is John's connection of how John got involved with Cray. You've probably heard that story, about the barbershop, which was in the same building that we ended up having our office space in down in the basement. Anyway, so George was John's scout master when he was a boy scout or cub scout or something.

Anyway, the NCAR machine and the ECMWF machine were both accepted and I think the hardware/software up time was in excess of 95% in both places so far in excess of the contract requirements. We ended up, because of the big push from NCAR, particularly, with a good base even though it was not written in high level language. It was written in assembly language. We didn't even have an assembler when we started writing this assembler language. It wasn't the kind of operating system had I had my time and a little more resources to do things with, but we'd done a good job of defining it, writing documentation that was maintainable, and in really making it a system that we knew. It was very expandable.

O'NEILL: How much of this software effort came over from CDC? Not the software itself, but the approach to doing the operating system.

LOFTUS: Well, I would say because I already liked the 7600 operating system and was very familiar with it, if you had to say what was it closest to at Control Data. Certainly the way the design of the machine and how I thought operating systems ought to be wedded itself right together because the machine was not constrained by memory and so we could have fairly sizeable chunks of memory dedicated to pieces of the operating system and I think it was a good structure. Yes, if I'd had more time I'd have liked to have done things differently, but you do what you can in the time frame allowed. It worked, it was fast, and it showed off the machine.

O'NEILL: As far as the people who ended up in that division of software group, what percentage had come from CDC at that point?

LOFTUS: Certainly by 1978 the most predominant ex-employer was Univac. Because the visible people were ex-Control Data, in most cases, there's always this linking of the two companies. I'd say both companies in my era were about as different as day and night. There was no comparison. I had some certain ideas of about how I thought a company ought to be, how people ought to be treated in a company, and how a company ought to work. I'd say I learned a lot at Control Data along those lines about how not to because Control Data really managed to just make people angry with a lot of unexplained out-of-the-blue kinds of policies or whatever.

O'NEILL: Was this true even when you were at Palo Alto or are you talking more about Arden Hills?

LOFTUS: No, Control Data wasn't like that except Palo Alto didn't follow the rules. Maybe that's me. I don't follow rules very well. If I think the rules are stupid, I'm not going to follow them. As long as you're not doing something illegal or immoral, your job is to get the job done. What I saw with all these real thick policy books that Control Data had was that they were inhibiting. For example, when I wanted to take my part time employment, there was a rule against that. Well, break the rule. "You can't break the rule. Impossible." So I think that when companies have a lot of rules like that people get discouraged from thinking and they get discouraged from looking at how to do things and it stifles creativity. When I left Cray Research I think they had ten policies, and I think maybe now they have eleven. It was things that really were required.

Let me digress a little bit and tell another Seymour story. I hadn't worked for Cray Research very long and I had been out of town. I was on the road selling Cray machines to a lot of people. We're trying to drum up customers and starting to get a system that we can maybe run a benchmark or two on, so we'd have these little tours and George Grinander and I would be the primary people to go out. He would give a hardware presentation and I would give a software presentation. We gave them to every big customer probably in the United States. So I had a flight that got in the middle of the day. I came into the office and someone says, "Seymour was looking for you. He couldn't find you and so he wrote you a memo." So I thought, "Oh, aren't I important. Seymour's writing me these memos." Well, I've since learned that I've gotten very few letters and memos from Seymour and most of them I didn't want, and this was one I really didn't want. Even though the software had progressed, Cray Research couldn't afford anything except to do everything on punched cards. So everything was still done on punched cards at Cray Research. Seymour had written me this memo that said we had run out of punched cards and he suggested some ways that I maybe make sure that didn't happen in the future. We always made fun of Seymour's baby blue punched cards. He liked these solid blue ones. He did his own keypunching. Well, everybody had to do their own keypunching including Seymour, but he preferred these blue ones and wanted to make sure that we had some blue ones. So I was furious. I didn't even know I was supposed to worry about punched cards. Nobody ever said this was part of your job [laughs]. Here I had this fancy job at Control Data and now I'm in charge of punched cards. I mean, what's the deal here [laughs]. I'm supposed to be in charge

of software [laughs]. So I stormed around my office for a little while and then I decided I'd go down and see if Dick Nelson was in. I asked Dick, "Did you drive your truck today?" He said, "Yes." I said, "Well, let's go buy some cards." So we went and bought some cards, and I decided, well, if I was in charge of punched cards and I was in charge of software, there might be a whole lot of things in between that I might like to have some say in how they went. So I just kind of took over the piece between those two and anything I decided I wanted to do, I did. Cray was a place that let you get away with that, even encouraged it. So if something wasn't getting done either I did it or I had somebody do it or whatever and it didn't wait around for boxes to be built that you could work in, and that's what I always object to. I never liked job descriptions because I consider them limiting and that they might prohibit me from doing something I might want to do. So this gave me a pretty wide range of possibilities. Cray, from a people policy and a style of a company from when I started, I would equate it to 1965 Control Data. We had all the same forms. It looked like it. It felt like it. It operated like it. We had a lot of the same people that were at Control Data in 1965 and thought that was wonderful so they -- most of them were men that were older -- George Hanson, Noel Stone, Jim Harris, Seymour Cray, and Frank Mullaney. Now, these people, I consider them friends, but they didn't view the world the same way I viewed the world. For example, at NCAR during this acceptance period Cray owned a phone line in NCAR that could be used to send data back and forth, but I encouraged, versus paying to the hotel, people to use that phone to call home, and what ended up was a lot of people got called at home and they weren't there so you called somebody at home and asked them a question, talk to them about something that you were trying to do. After we finished NCAR acceptance Jim Harris called me into his office and he had this $2,000 phone bill. NCAR had paid cash for the machine, so you know they had bought the machine [laughs]. Cray was instantly profitable. I thought they could afford this $2,000 phone bill. So he was very upset about this, and I knew that I had used that phone, and he named all the people he was upset with. He had checked. Some of them weren't even there. Somebody had called them from that phone. I knew that I had used the phone plus I had been called a lot. If I came home for any reason I was on the phone, with that phone, talking to people in Boulder. So I said, "You didn't mention Mitch and me. My number is on there." He said, "Well, that's okay because you're away from home, and you've got this small child." So being a woman was a real advantage there [laughs]. He wasn't going to yell at me. He was just going to yell at these other people about using that phone. So I told him to forget it. Pay the bill.

O'NEILL: That's very interesting that he would sort of cut you slack -- of course it was okay for you to use it, but not for the other people. All the other people were male?

LOFTUS: No, they weren't, but his list was all male.

O'NEILL: There's a couple different directions we can go here. Let me just pick up something on the software at Cray. You said that

they were forced into taking it on as a necessary evil. Would you say that that attitude continued like that or when did you see a shift away from that? Was it the NCAR acceptance?

LOFTUS: Oh, no. NCAR acceptance was almost the end for software at Cray. I think John Rollwagen deserves the credit for salvaging that. I think Seymour thought software was done. Seymour's view of software was a crude little operating system and you do this stuff and you get things in and out of the machine and that's it. What more would anybody want? And the more software you put into the machine the more overhead it causes and the machine will store it. So it was my understanding, although he never said it to me at the time, that he really wanted us all to go away. Just get rid of all the software people. And that almost happened. John Rollwagen intervened. It was never blatantly said to me, but about as close as you could get without saying it.   Then there was, well, should this woman -- me -- be the one heading up software, or should we get somebody else. I have to say John, I believe, intervened in that. Software at that time was stable, but it was feature four. I got criticized. We were going through the acceptance at NCAR. We were sitting down with NCAR, eyeball to eyeball, going through the contract line by line trying to say we did this and this and this. Are they going to sign off on it and pay us this 12 million dollars to make the company instantly profitable? So we're going through it, all the software stuff, and we get all the way through it and one of the NCAR management people, all of a sudden, he turns kind of bright red. He really was angry and he looked at me and said, "You didn't do a thing that wasn't in the contract" [laughs]. I said, "right" [laughs]. Barely got that done [laughs]. So that's all it had. And we had ECMWF as a customer and they had a fellow by the name of Peter Gray who is English and can really be a nitpicker about stuff, but his nitpicking, in my opinion, was all the right stuff. So he pushed and we delivered. He knew what he wanted and what he wanted was what I thought we ought to be doing, so we just kept putting out software. We went to -- in hindsight it was a crazy thing -- a quarterly release cycle of all the software. So every three months we updated all the software and manuals and sent them out to all the customers that Cray had and we did that for seven quarters, and the publication people were probably -- Janet Robideaux was the most -- yelling "stop" [laughs]. And finally, we had customers say, "You know, we really can't upgrade." So that said to me that the things that we had put into the software at that point, because we had put a real heavy emphasis on features, we got enough features out there that we could go back to something more reasonable. From day one when we first started releasing software, we put in place all this process that could support the development for a long time. I remember being in Chippewa and not supposed to be overhearing a conversation like, "What the hell does she think this is going to be, a big company? She's got all this stuff." And so Chippewa ended up scrambling a little bit more than a software organization did as Cray really took off. That base of software -- we went from Cray Is to Cray ISs and IO subsystems, Cray XMPs and even some YMPs could run that software and we put on-line tapes. That software was the basis for all the on-line tape software. That was a big deal. Adding on-line tapes to the Cray was something that I tried not to do.

O'NEILL: Why was that?

LOFTUS: It's like opening a can of worms when you start doing on-line tapes. High performance on-line tapes you want it to be. It's Cray. It's going to be the best on-line tape system there is. What it means is with on-line tapes quickly generated out in the field -- in the backs of pickup trucks or wherever they make these tapes -- there are the God-awfulest error problems you've ever seen. The first place you go with on-line tapes is in the petroleum industry. It's just awful, and it was. It was terrible because the Cray could generate more errors [laughs] than any other machine they knew of. Texaco, for example, we had to rerun benchmarks because they thought we had them in fast forward and just were producing canned data so they came and changed the data and produced some different results because these tapes just screamed and we could scream a whole wall full of tapes. Now, I have been to a lot of oil companies -- IBM shops and CDC shops and Univac shops and I have never seen big time tape activity. They always say you should have been here yesterday or whatever, but I can't have missed it all that much, but they have these walls and walls of tapes and you see a few of them kind of cranking along, these IBM machines. Now, Crays, when I saw those running, I mean they had every tape drive full and every tape drive running all out. I do think that even though on-line tapes was a real problem that we did kind of stretch the envelope quite a bit there.

TAPE 3/SIDE 1

O'NEILL: It's April 25 and we are continuing the interview with Margaret Loftus. Last week you described the early environment at Cray Research in the software area and how you felt that software was viewed as a necessary evil at Cray, initially. I was wondering how long it stayed that way and was there a time or an event that signaled to you that software had become a valuable commodity there?

LOFTUS: Well, I guess I would say initially I don't even think it was at the necessary evil category. I think there was a lot of question of why Cray should even have software. If Cray Research had been better and smarter and all those other things, they could avoid this terrible ordeal of developing software.

O'NEILL: So it was even less than a necessary evil.

LOFTUS: Yes [laughs]. I think we graduated to a necessary evil with NCAR, but probably not at the beginning of the contract. I think it was well into the development stage that it became obvious maybe to a lot of the people there that software, at least whether you

35

like it or not, was going to have to be a part of Cray Research. The like it part -- I'm not sure that all aspects of Cray Research during my tenure there really even got to that point. I think from my perspective doing software at Cray was an annual battle for money and a battle for every Serial I. It was never the norm during my tenure there that we got a computer, so it was a fight. They always wanted to ship it off to Livermore or ship it to somewhere and not make it available for software development. As soon as I thought that we had reached that there was always some event that would occur that made me realize that it wasn't really true. I think I mentioned that a pinnacle event early on in Cray software development was deciding to put on-line tapes on the Cray and I remember an executive staff meeting at which I had decided to do that and I kind of announced it and it got this kind of ho-hum from the rest of the people in the meeting and so I said it again later in the meeting and the comment I got was, "Well, we heard you the first time." I felt like, "Shut up. Don't bother us with these details" [laughs], and so I wasn't able to make the rest of the senior management at Cray Research really understand that that was a big deal even though I was trying to make a big deal out of it. Probably the next really major occurrence, if I had to say what were some pinnacle events, was UNIX and trying to go to a UNIX operating system. Seymour's comment to me was that I "get out a blank sheet of paper every time I design a new computer. What's wrong with you? Why do you want to take somebody else's work and bring it to a Cray computer," and the continual comment during my last four years or so at Cray about "You can never get performance out of UNIX. You're sacrificing performance for UNIX. If you had any guts you'd be doing something creative and original." I have to say that I was explicitly told not to put UNIX on an XMT. I ignored that and so I just told the people to shut up about what they were doing [laughs] and keep going.

O'NEILL: The reason you were told not to put UNIX on XMT was because of the performance?

LOFTUS: I don't have the slightest idea what the motivation for that was. There were so many real negatives happening during that time frame.

O'NEILL: This was 1983?

LOFTUS: Probably 1983-84. The UNIX decision to me was so critical. Where I got the idea was I went to Amdahl. You know that Cray was an Amdahl customer and we bought an Amdahl machine and I took a nice little customer visit -- I was in California anyway -- to Amdahl. You get wined and dined in their executive cafeteria and they start telling you all these things their doing. At that time Amdahl had a -- I'm sure it's not any top secret project anymore -- but one which they were putting UNIX on one of their machines, an IBM compatible machine, and they were using it in-house. All their development work was being done with UNIX as the operating system, and the fellow -- I think it was Bill Hines -- was in charge of it. I was very impressed with how he described the work he was

doing . I had some personal friends that worked for Amdahl and one of them had just taken a significant leave of absence and had come back to work and she was just really giving me glowing comments about how she didn't have to re-learn anything. UNIX was so easy, and she didn't forget it all. She had been away, then came back, and how great it was for her, and I was getting some inside information about how they hoped that they could supplant some of IBM's maybe VM customers, probably not their NVS customers, with UNIX. Now, I don't think that ever happened, but that was Amdahl's plan. This was probably the very early 1980s -- 1981-82 -- something in that time frame. So I came back and we were in the throes of what to do at Cray because Cray had five independent hardware development activities going on at that time and only one software development effort. Somehow I had to figure out how to support all these hardware efforts and they were hardware incompatible. Now, it was pretty obvious all five of them weren't going to win, but I didn't feel that I should be the one picking who wins or that I was even smart enough to tell who should win. So that was driving me to say, "Well, what kind of operating system for the future should we have?" We had already started on the modular compiling system so from a compiler standpoint we had an effort in place to move down that path. From the operating standpoint we were really in sad shape because all we had was this similar language stuff and what we were going to do as far as replacing that.

O'NEILL: I was going to ask if we could just give a little detail here before we continue on of what the five projects were. Do you recall?

LOFTUS: Yes, let me think. St eve Chen had his effort, Seymour had his effort -- the Cray II -- well that was probably the Cray III and then the Cray II was going on, the XMP, and that probably was when Steve had started his MP (?) products or whatever it was called. The XMP and the YMP kind of go together. I can't remember all the details of it.

O'NEILL: So there were five separate projects including the existing product line?

LOFTUS: Well, the XMP wasn't quite there yet. Maybe it was the XMP, the YMP. Maybe it was before Steve started that MP whatever it was. I can't remember the acronym for that. But I do know that there were five [laughs].

O'NEILL: Okay. I was just trying to get a sense of what was happening.

LOFTUS: We had the Cray II which we had, initially, because of pressure, decided to go with CTSS as the operating system. That was an operating system that was developed by Livermore. It was written in FORTRAN, so it was somewhat transportable. Livermore at that time had a new operating systems -- NLTSS -- something like that. I can't remember all the acronyms for it. They had been

working on that operating system for in excess of all the time that Cray Research had been working on software, but they had not had to run it anywhere really yet so there was a lot of pressure to go with NLTSS. Los Alamos had picked up CTSS so the pressure was from one of the groups in Livermore and from Los Alamos to go with CTSS. Seymour said I should get out my blank sheet of paper and start from scratch. We looked at rewriting COS (?), the existing operating system on the Cray, rewriting that in higher level language so that was one of the options. UNIX wasn't an option. I set up a group to look at a new operating system. It was called the FOG -- the Future Operating System Group -- very appropriately named, and in the meantime was when I went out to Amdahl while this group was kind of starting down their path and it just seemed like we ought to bring UNIX into the possibilities to consider. Then independently some of the people on this FOG group kept wandering into my office one by one and saying this does this well, or this operating system does that well, but it ended up UNIX kind of being everybody's second choice. They said, "But UNIX does this or UNIX does that." So with that pressure and what I saw at Amdahl, I said, "Well, maybe we should seriously look at UNIX." We got kind of funny support from Bell Labs. Bell Labs was kind of for med in an unusual way, although when I started looking at UNIX and how it was used and the environments it was used in, I got a little concerned because particularly at Bell Labs it was like ten guys down the hall from each other and I remember asking Dennis Riche, "What if I had 40-50 people working on UNIX? How would it work? What kind of tools are there available for maintaining this software and controlling the source?" I think he thought I was crazy because that was beyond their domain.

O'NEILL: They weren't running production systems in a way that you were interested in that development?

LOFTUS: Right. UNIX was running on VAXs. It wasn't running on any significant machines of any consequence. It wasn't running in an environment that had IO as an important element, and scheduling multiple processes or jobs was not a serious concern of UNIX at that time. So we started looking at UNIX , there were a lot of shortfalls in UNIX, but there were things that I thought we had people at Cray who were very well equipped to fix, to change, and it really wouldn't impact the fact that it was UNIX. From a user perspective it still looked the same and that was probably the important point in the decision process -- that it would still look like UNIX. I don't know if it still does, but that was an important decision point. We could greatly enhance the IO, greatly enhance the scheduling, and there were a lot of other little performance things that we could do that could make it run very very fast and performance would not be an issue and it'd still be used. It seems to me that we were just beginning to buy Suns and Sun was moving towards UNIX. The other major workstation in there at the time was Apollo and they had their own homegrown version -- Domain something or other. I forgot what that operating system was called. I wasn't real fond of it. Apollo seemed to be so secretive and even though Sun maybe wasn't as open as they made themselves appear, they at least caught the open systems strategy, and it seemed like that was much more appealing to me than dealing with a very secretive organization as Apollo's from a Cray perspective at the

time because we had an Apollo station and they would not tell us any information about new software releases in advance so we were always scrambling after the release to make the station software work with whatever their latest and greatest operating system was. I can't remember all the details but it seemed like there were some fairly kind of old fashioned ways of doing things and it caused us lots of problems. So Cray Research was buying probably equal numbers of Apollo workstations and Suns at one point and because of the secretiveness and the openness of Sun we changed that. We bought Apollo workstations only where graphics were important, the driving force, and bought some workstations for IBMs. It seemed like you could have some workstations sitting at a desk accessing a Cray, and you didn't have to learn all this operating system gibberish that was different between the two machines. It would greatly enhance your productivity.

O'NEILL: So you saw this as both a tool within Cray Research and then as something that customers would also use?

LOFTUS: Yes. Although the decision was technical, I have been told since that it was Cray's greatest marketing decision, but it was not a decision that Cray Research accepted very easily. There was nothing fun about it. From the time we made the decision to go with UNIX until I left Cray, I would say my life was pretty miserable [laughs]. It was not fun because there were all these groups that were very threatened by that decision. I think the field analysts were threatened because they were taking away their security blanket and putting something in that they didn't know so there was an unknown there. From a sales standpoint we were making the salesman's job harder because he had to go sell UNIX and perhaps we weren't giving him enough ammunition to sell it at that time because we weren't smart enough in order to give that. From the executive management within Cray Research, the support was almost non-existent. So in some ways it's strange that somebody didn't take the money away. I did have pretty much, once a budget was established. Cray was not selling as many computers. I mean nobody came back and started talking about taking money away from their budget so that was kind of a style that Cray had established.

Moving towards an operating system change is something I had observed through Control Data and I didn't think they had done a very good job of moving their customers towards that so I was determined to try to do a better job. What I saw Control Data do was waffle. As soon as some customer of any magnitude threw a big temper tantrum and said, "This is awful," they'd say, "Oh, well, we'll support this one, too and we'll support this forever," and I thought that that lead to a lot of Control Data's problems with moving and that's why they ended up with three operating systems toward the end of their credible life. I thought that was just such a waste of money. I remember telling the software development people that were working on the operating system, I said, "Well, I've been involved with writing four operating systems in my career and that was a lot of fun. It's fun you guys don't get to have. We're kind of past that era. You don't get to do that anymore. You better find other ways to have some fun." I remember going to the first user meeting after we

had talked about going to UNIX. It was in Oxford. Los Alamos, particularly, spread -- because they're good at this -- their people throughout the whole audience and so I was bombarded from every logistical place within the audience and it was important to that I didn't back down from that decision. I just stated the reasons we were going, and they stated how stupid an idea that was, and then I just restated why we were going, and it was really interesting. After the meeting I had a number of the customers who didn't say a word during the meeting, in particular European customers that had been Control Data customers and they saw some of the ways that some of these large labs had really controlled Control Data. One, for example, had very small memory machines and so Control Data made commitments to support memory sizes that were just totally ridiculous. They had seen all this stuff. I'd seen it, too, and they said, "Margaret, we're so glad you didn't fold under the pressure of the Mafia" [laughs]. That became kind of the standard phrase, not that these people would probably have said it to any of the Lab's faces, but that's how they felt about the pressure that the Lab has put on some of them -- what they would say at Control Data and what they were saying at Cray. Not that they weren't an important part of your business, but sometimes I think you just got to have enough guts to say, "This is the best decision, and no matter what, this is what we have to do, and it may be painful, but the pain will be long term if you don't make it. The pain will be short term if you make it."

O'NEILL: Were they lobbying in particular for CTSS or the new version of CTSS?

LOFTUS: Well, see we had originally made the decision to go with CTSS on the Cray II. Dave Judd had made that decision and then essentially we reneged on it. I was never in favor of that decision. CTSS to me was a 1960s operating system and it served its purpose very well, but it seemed like we needed to take a step forward. UNIX maybe only moved us a decade forward, but it was written in C. I thought that that was a more credible language to write an operating system in and I realized that all the selling points that Livermore had for CTSS when it was written in FORTRAN. I really didn't think that was the right choice.

O'NEILL: Did you also get resistance from the development group, or from the programmers, or was it all external resistance?

LOFTUS: I got no resistance that I am aware of at all from the software development group. There were some schemes looked at of how to prolong the life of COS and the scheme that they came up with was a scheme that I had seen at Control Data. Memory was increasing fairly dramatically and we had I don't know how many bits memory addresses at that time -- I think 24 at Cray and 18 at Control Data or something like that. So when memory size at Control Data had exceeded their number of bits that they had to know that memory, they found this kludgey way of storing these extra bits somewhere else and it was just a disaster. So it just seemed like we had to talk about memory. Address a piece of memory. Why are you directing 64 bits to address it. That ought to be enough. Maybe

it won't some day, but that ought to be enough today.

O'NEILL: Did you ever consider going back and working with Amdahl who might have been having some more types of problems in terms of making a production version of UNIX?

LOFTUS: No. I didn't think we wanted to get bogged down in the IBM mentality. I think that we wanted to move forward, and not too far after that, Fujitsu acquired a significant piece of Amdahl and I didn't think we wanted to have anything to do with Fujitsu.

O'NEILL: Were the people that you knew at Amdahl from your past connection to CDC? That's just a curiosity on my point. Just kind of beside the point.

LOFTUS: The friends that were more the users of the system were.

O'NEILL: Not the management, but I meant the person who said how they liked UNIX?

LOFTUS: Yes, right.

O'NEILL: Because they are out in southern California, right?

LOFTUS: No, northern California, and I worked in northern California for five years for Control Data.

O'NEILL: Okay. UNIX was actually one of the big topics I wanted to talk about, but let me back up a little bit and talk about a couple other things. Last week we talked a little bit about the early struggle to get new employees for Cray when the company wasn't viewed as very viable. What kinds of problems did you have later, if any, of hiring people?

LOFTUS: Cray had no problems later hiring people. As a matter of fact, I avoided going to meetings except the ones I spoke at because I would just be bombarded by people asking if we had any openings for jobs. We had job fairs at the facility -- open houses -- and the first time we did it we kind of called around and talked to a few companies about how they had had these open houses and how many people came and it was 50 or less. We had well over 300. It was absolutely a zoo. Cray was such an attractive place to work in the Twin Cities that it was unbelievable. We had a software job in Germany -- one job -- and we had 2,000 résumés. So the problem

was dealing with the quantity of people that were applying for jobs, very much opposed to the early days of trying to find somebody who wanted to work there. But, also the kinds of people that were interested in Cray later on were not the people that would have even considered taking the risk to come to work for Cray in the early days. They were more risk-averse. Today with all the number of start-up companies, the same phenomena happens everywhere. As a company gets more viable, different kinds of people find it a possibility that they would consider working at these places.

TAPE 3/SIDE 2

O'NEILL: Well, that implies to me then that you didn't need to maintain or encourage a relationship with the University of Minnesota or other schools in the area, or did you?

LOFTUS: Yes. We had a fairly formal college recruiting program. I think you look at that as a tool for affirmative action. You look at it as a tool to really search out. We started an intern program which was really my attempt to try to reach out past the University of Minnesota and get more people as interns other than just Minnesota students. That program, I think, worked well. We had people from all over the United States and it gave us a chance to look at people and sometimes hire them later.

O'NEILL: Why did you want to get beyond the University of Minnesota?

LOFTUS: I've been involved with the computer science department at the University of Minnesota. I was very actively involved for quite a few of years. They had an associates group that was trying to move the computer science department forward. I think the University of Minnesota at that time -- I couldn't say today because I'm not involved with it -- teaching undergraduates was not high on their list at that time. I was very frustrated with the quality of students I was getting out of the University of Minnesota. They might know the technical part real well, but I was not pleased with their communications skills and their interpersonal skills. I think that some changes have been made in I.T., but that was something that was important to me because I put a heavy emphasis on peoples' ability particularly to write, to describe what they're going to do, to write design documents, to stand up at least in front of their peers and give a presentation about what they are trying to accomplish for feedback. If they are going to prosper in a software organization that I have some influence on, they are going to really reach a leadership role. Those are going to be important skills that they are going to have to acquire. You go through life in a technical field and the things you get rewarded for up to a point suddenly change and if you aren't prepared to move ahead or you haven't had some training or exposure, a lot of people just run up against brick walls. Although Cray hired a lot of University of Minnesota graduates, I wanted more diversity. I was very pleased at one

point at what I saw at the University of Texas. Michigan State at one point produced people that I had hired and they just hit the ground running. Training was a non-issue. I had some very good people from Michigan. I guess probably if I had to rank them during the early 1980s I would have put Michigan State number one, Texas number two, and maybe Michigan number three, as far as my experience and exposure. Not that we didn't hire people from a lot of other schools -- Iowa -- a lot of other places.

O'NEILL: And that was based primarily not just on the technical background, but also on their ability to communicate?

LOFTUS: Yes, the whole person.

O'NEILL: Another personnel issue had to do with where the development groups were located, the fact that Cray had development groups located internationally. Was that a set plan on your part to try to have development groups in different areas?

LOFTUS: No, I probably resisted that initially. It's certainly a lot easier if they're all in one place. John Rollwagen really wanted to have diverse locations and so we started doing a little bit of that at his insistence.

O'NEILL: What was his reason? Do you recall?

LOFTUS: Well, a lot of reasons Cray did things during that era was just to do it differently than anyone else, to be unique. I had lived through Control Data working both in Minneapolis and on the West Coast and the friction that that had, and I thought that if I was going to have to do this I certainly was going to try to do it in a way that wasn't destructive. Because of the station concept at Cray Research, it was easy to parcel out those kinds of pieces to all the different of locations. I was happy with the kind of work people did, but I was also happy with how each of those subsidiaries looked at themselves. Adding software development -- adding a development piece -- to their business made them have a lot more breadth in how they looked at themselves as an organization and a lot more ownership maybe for the whole company. Maybe that was John's ulterior motive. He never shared that with me, but I would say that was something I saw and it was kind of an activity and effort that I tried to support as best I could. When I would go to a lot of these subsidiaries, all of them that had software, I ended up having an employee meeting, and it wasn't just the software developers. It would be everybody. Sometimes the country manager would show up and sometimes they wouldn't. I certainly wasn't threatening to their marketing efforts but it gave me a chance and it gave them a chance to get them exposed to my perception of Cray Research and my perception of software and how software was going to fit together, and they asked lots and lots of questions and those are the kinds of meetings I like and it was a lot of fun.

O'NEILL: This was the U.K. and Germany and . . .

LOFTUS: France and Japan.

O'NEILL: They all had software development groups in their subsidiaries?

LOFTUS: Right.

O'NEILL: Other than not being with the rest of the developers, what kinds of problems did that . . .

LOFTUS: I think there's another benefit that I didn't mention. Cray was successful then so travel was not a significant issue and phone calls were never an issue at Cray during my [tenure], but it really causes a lot more communication, a lot more cross-fertilization of the company. From a negative standpoint for me, personally, it meant I rode a whole lot more airplanes than I would have liked. I used an airplane as a way I processed my "in" basket. I remember being on a plan once going to Tokyo and working the whole trip and the pilot going back and forth and commenting as we were approaching Tokyo that I was the only person he had ever seen that worked the whole trip from Minneapolis to Tokyo and I felt so good because I had gotten all this work done [laughs]. I was kind of tired, but I think that also it was a job I had to treat very seriously of keeping the communication alive and well. Some of the countries, particularly the U.K., always seemed to have a view that their work was superior to, particularly, the other subsidiary software people. Quite frankly I thought Germany probably did the best work. I would go there and they would be making negative comments and I would say, "Well, I was just in Germany. I didn't see any problems there." I would start challenging, what have you got about this or that. So then I would be trying to really get them to think a little more broadly. It's probably technical people. Sometimes just because, when you just don't see someone, you assume they're doing something bad instead of something good, so part of my job was to go around and tell everybody what good work everybody else was doing.

O'NEILL: One of the other issues of the corporate culture at Cray Research was the Cray style statement and that was something that you co-authored as I understand it. Can you tell me how that came about and what was the intent?

LOFTUS: John Rollwagen was the initiator of that. That came out of a strategic planning meeting and we were set up as a committee to write a philosophy statement. Bill Ochie (?) was coming and in his book there are a number of philosophy statements from

companies.

O'NEILL: This was the early 1980s?

LOFTUS: Yes, maybe 1981 or something like that. It was the early 1980s. The exact year I'm not quite sure of. So I had some things really clear in my mind and I'm sure John did too. He took the pen and he said he got to be the scribe, and I would leave the meetings real happy that John wrote down what I thought he should have written down, and John thought he had the pen and he got to write down what he pleased. If we both tell the story it comes out a little differently, but I very much believe in the kinds of things that are said in the Cray style statement. I have no idea what its impact is today in Cray Research, but I think its impact during my tenure there was tremendous, and I was always surprised at the impact. One of the things I did on a quarterly basis was, when Cray was growing very rapidly, I had an orientation meeting and it was for software, but every new employee that had joined the company in that quarter was invited to attend. We usually had it in a place that was big enough to accommodate anybody who wanted to show up, and I would encourage some of the people that had been at Cray for a number of years to go, kind of as a refresher. We'd go through the history of Cray Research and usually John Rollwagen would come and go through the style statement. I would go through expectations from an employee standpoint what the employees expected of the company, get audience participation and talk about me from both the employer standpoint and from me as an employee -- what did I expect from Cray Research -- and that combination with the style statement really was a fairly emotional thing for a lot of people and I think it really helped to get people involved with the culture of the company. That's how I'm involved with a lot of these little companies today. That's some of the things that I think are very important and helps define a place where everybody is considered important and everybody's opinions can contribute and their ideas and their work is going to contribute and that we create an environment where people really share in the rewards of success.

O'NEILL: So the impact was in the attitude of the employee and then thereby to Cray?

LOFTUS: Yes, and it was real interesting because maybe you'd show somebody the style statement -- I had a number of managers come and talk about new employees that they had and they'd show them the style statement and it was kind of even scoffed at during the interview process or whatever -- then after we had gone through this orientation and they'd had a little time and there were people talking about it, I guess they finally believed that it was more than just a lot of hot air. I think the fact that it was short, less than a page, everybody can read it, and I'd certainly had statements thrown back at me, and to me you can't take something like that very literally. It wasn't my intent when I was involved with creating it to make it something that's literal. It's really kind of how it feels like that, and yes, you can find a day that feels that way [laughs], but if you found that week after week it didn't feel that way then

something is wrong, or even day after day.

O'NEILL: As an employee I know it certainly did have an impact in terms of the attitude of the employees towards the company. Can you think of specific obstacles that you faced or advantages that you had as a female executive?

LOFTUS: Well, probably an advantage and a disadvantage is that you're always visible, because you're usually the only one, the only woman. That can be to your advantage a lot of times, and it certainly can be to your disadvantage because if you screw up anything it's remembered. It's kind of like a professor I had in college. I remember there was a class with like 60 or something -- huge class -- different equations, and there were five women in the class and he called on a woman every other time so the men could kind of sit there and be at ease because the chance of them being called on was pretty slim, but the women were all sitting there at the edge of their seat and paying attention because you knew you were going to get called on several times during the course of the hour. I think maybe that was good training because I don't think that has changed that severely. I think that -- maybe it's my personality -- I'm not un-opinionated and I'm not a person that doesn't say what they think even if it's not the most popular thing so I guess I thought I was always expected to state an opinion or ask a question or challenge an idea if I had a reason to do it, and that's certainly well at times and certainly not very well at times.

O'NEILL: Did you have any particular interest in who your managers were? Was there any attempt on your part to have more female managers or to encourage women into management roles or any of that sort of thing? Was it not a conscious issue?

LOFTUS: No, I don't think it was so much a conscious issue, although I did have a few software managers that were women and that was sometimes talked about negatively at Cray, but if you looked at where Cray should have been -- all the affirmative action numbers -- Cray was always, even in software, behind the curve as far as women, particularly and surprisingly in software. The comment I would make to a group we were talking about hiring and promoting was, I usually had my standard -- after we got the numbers all back and somebody had talked to me about where we stood -- I would say, "Contrary to popular opinion, software development does not have as many women managers as the U. S. Government would like us to have." I think maybe the fact I was a woman made the women in the organization feel more comfortable about trying to move ahead and advance than if it had been a man in the job.

O'NEILL: Why did you leave Cray Research? In 1987, right?

LOFTUS: It was officially 1988, but I left in 1987. Cray was moving in a direction that I was having difficulty supporting, from

probably more a leadership standpoint, and what was being rewarded was not something I supported. Cray changed a lot by leaps and bounds during my 12 years there and in general I think I was very involved with helping make changes or supportive of the changes, but the changes I saw beginning were not changes I could really support. I think one of the real magics of Cray Research was its decentralization. People that had never had autonomy before got it and they loved it and they did great things with it. Cray was moving towards centralized control and a lot more paper. Some of the technical credibility-type issues that were important to me seemed to be getting lost in the shuffle. I guess I had to look myself in the mirror. I'd always given people the advice that "if it wasn't any fun it wasn't worth doing," and for me it wasn't any fun. I would have looked anybody in the eye, and for 11 of those 12 years I could say I had the best software job in the world. I don't think I would have any problems supporting that, but the last year I was with Cray it just wasn't any fun. It seemed like I was fighting for the wrong things for the wrong reasons. The rules changed without me really understanding, and it seemed like we had invented pressure. I work real well under pressure. I do my best under really severe pressure, but it has to be real pressure. If it says Cray's going to make money because of it -- and that was one of the things I really appreciated about coming to work for Cray Research -- was that when Cray starting making money, and for 9-92 years, we never left a dime on the table. We got every dollar or every penny that was owed us. We got it timely ,and we got it when it was due. The whole executive management of the company was really focused on that, and we understood where problems were and strategized how to make sure that didn't happen, shether it be a customer that was having trouble paying, or the main problem, which was acceptances. We used to stack acceptances in the fourth quarter and a lot of them in January so the thing I would do is post in the cafeteria almost a minute by minute status of what was happening with each one of those machines and what the problem was, when something was down, and when it wasn't down and just try to keep everybody informed. I would have just a ton of people come into my office and say, "That machine at Exxon, I can go do this about that. I know how to do that, and this is what I think you ought to do, or this is what so-and-so ought to do," so you got everybody involved with the bottom line. I think it made things fun for people, and profit sharing was a real interesting phenomenon because when Cray was making money it could be very significant for everybody, and I think John Rollwagen deserves a lot of credit. He really pushed for profit sharing and that was not a real popular thing when he first started bringing it up, and Cray started profit sharing. We didn't sit around and count our money for a few years when it came in. They started profit sharing when we had profits. We started devising a plan for profit sharing, and that was real important, I think, not just for the money, but for the currents, the happening, the sharing, the involvement people felt.

TAPE 4/SIDE 1

O'NEILL: I'd like you to switch over and talk a little bit about the firms you're involved with now. In 1989 you formed Loftus Brown-Wescott, and she [Judy] was a former director of human resources at Cray Research. How did this company come about?

LOFTUS: Well, I left Cray quite a while before Judy left Cray and Judy and I never worked together on a day-to-day basis at Cray. I used Judy as a facilitator for meetings. Carolyn Harrington (?) was my HR person in software, and when Carolyn wanted to be a full participant in a meeting I would bring Judy in as a facilitator and that worked well. I was the hiring committee of one when Judy interviewed with Cray, and had picked her, and she was chosen for the job and worked for Kathy Gunderson who was the original director of human resources for Cray, and Kathy had this test. She was getting her final three applicants, and I thought it was really a rotten way to hire someone, but it was a personnel problem that I had and she described the problem to each one of these people independently and they had to tell how they'd solve it. She went through the first two and one of them did really awful and one did really great so it was obvious to me that that was the one to pick, and then Judy was the third person. Kathy and I had gone through several kind of dead ends of working on this problem and finally had come to a way that it worked. Judy stood up and told us how we should solve this problem and it was exactly the way that it worked. So it was pretty obvious [laughs] that if you're going to use this test of any merit that Judy was very perceptive about people issues and that was important for where Cray was in their stage of growth. So that was my first introduction to Judy, and, as I said, we didn't work together on a day-to-day basis but when we worked together it was on critical problems. Sometimes I got involved with critical problems in the field and was kind of in some cases a sounding board for ideas and we used each other that way as almost consultants to each other, although not real often, but when it worked it worked well and it was obvious that we had a common value system and that, if we had to, we could work very effectively together and move things through very quickly. So I left Cray and I took a year and a half off.

O'NEILL: Did you know when you left Cray that you wanted to take a year and a half off? Was that your plan? Did you know what direction you wanted to go in?

LOFTUS: No, I think my plan was to take forever off. I was really pretty frustrated and kind of emotionally burned out at that point in my life. I worked on my tennis and my golf. My husband would say, "The only thing you seem to get excited about is going to play tennis these days," or something. I'd be in bed, he'd get up, and he'd say, "What are you going to do today?" and I would say, "Nothing" [laughs]. He'd get real upset [laughs]. Like, "What's wrong with you! You're not the person I know" [laughs]. But I was kind of enjoying doing nothing, and Judy left Cray, and I don't know -- I think one of us called about going to lunch or something and she started talking about all of the things she was considering doing. I was kind of talking to her about having her work through some of the possibilities for jobs that she was looking at. I really don't know whose idea it was. It just kind of seemed like, well, maybe I should go back to work. Somehow I had this in my mind. It almost kind of appeared. It wasn't like I had this grandiose plan that I was going to take a year and a half off and then go back to work. But she had some ideas for a business. I had some ideas of what I'd like to do.

48

In some ways they were not overlapping. Because I had been involved with a lot of people going through management assessments and had been involved with coming up with development plans for people based upon a management assessment, I thought [and] Judy said maybe we could do outplacement. Well, that's a lot of it. We do something now called inplacement where we go inside companies and work with them as far as doing the assessment and coming up with a plan that makes them more effective with the long term vision for them inside the company where they are currently working. That's something that's fun to me and it's not that difficult for me to do that. It wasn't like I had to get this big learning curve or anything like that because I had been very involved with the coaching aspect of management leadership so really working in outplacement and doing any kind of assessment and evaluation of people and maybe having a psychologist involved like that was something I was very comfortable with. So it's something I like to do. I think I'm pretty good at it, but it is not near enough for me to just do that. I'd say I have a character flaw. I'm not happy doing the same thing for very long at all. I have to have a lot of variety. If I don't have a lot of variety I get pretty impatient and I'm not very effective at the one or two things I might be doing. So Judy and I wrote a business plan for this business before we started, and I said, "I want to work with start-up companies" because, when I looked at when I had the most fun in my career, probably number two was the early years at Control Data but number one by leaps and bounds was the early days at Cray Research. I thought that was something I really enjoyed where every day every new thing you do makes a difference. I said earlier I think I work well under pressure and taking risks to me is not something that's going to keep me awake at night or anything like that. I think I have a lot I can risk, whether it be personally or maybe even financially -- sometimes I don't know about that part -- but I'm not concerned with job stability. That's never been a thing that ever worried me. Maybe it should have. Maybe I should have been more concerned about that, but it's the last thing that enters my mind. The things that are real important to me are to have a lot of autonomy and to work in an environment that is entrepreneurial. Judy and I gave a test to our outplacement people and that's one of the things of what is your value system around the job, and do you want something that's service oriented, and do you want something that's real secure. Well, those are at the bottom of my list, and at the top are the entrepreneurial and autonomy. So we wrote a business plan and we said in this month we were going to work with a start-up company, and that month a young man, Andrew Hunkins (?), came and knocked on our door and said he wanted some help in his company. Now, he misread an ad we had in the paper and got confused about what we did although he was certainly in line with what we did. It was a software product and he was a company of just him. So we got involved with that company, and he had a list of things he wanted me to do and after delving into it I said, "Well, I'd be glad to help you but I think you should do something different," and so after some discussion he said "okay" and I began working with that company, Unimax (?), and that's a company that I sublet from today -- they used to sublet from me -- and we raised a little bit of money and hired a few people and now the company is 15 people and beginning to produce revenues and I think is a real solid company.

O'NEILL: Did your other company, Loftus Brown-Wescott, have any specific connection to computing or computer companies or

was it just an outplacement for any company that came to you?

LOFTUS: Well, when it came to working with people, I usually got the technical people to work with although Judy's perfectly capable of working with the technical people. But early on I did the technical people and she did everybody else -- financial types and so forth. Then we would kind of mix and match.

O'NEILL: So the company isn't set up for just technical people or it's not really computer-related necessarily at all?

LOFTUS: Loftus Brown-Wescott is a management consulting company basically, and we do management consulting in all kinds of shapes and forms. As one component of consulting we do would be the outplacement, but I think we evolved very much from my way of thinking of how we do it in a consulting role. So even though if you stood back it might seem like it's a little foreign to all the other things we get involved with, it really isn't, because there is so much involvement in the mentoring process or the coaching process and even when you're doing outplacement you're trying to fill that kind of role and you're trying to help people, in some cases, break out of a mold of how they were doing things in the past. They're certainly asked to break out of a company and change how they look at themselves. I've worked with people in changing their communications styles because sometimes that was a major roadblock to moving forward in their career and maybe in some cases cause them to lose their job. There are all kinds of other things. What you do in outplacement is try to get people to have a good mirror in front of them as to how they are seen so they are able to go out and communicate well about themselves be it through a résumé or an interview or whatever means. If they can do that well then most people will find the kind of jobs that they wanted to find.

O'NEILL: Okay. Let's talk a little bit about Unimax and how that got started. You are also connected with Netstar?

LOFTUS: I was a founder of Netstar. I'm not involved currently with Netstar at all. Netstar is a high performance networking company. I was involved with Doug Peale (?), who is the CEO of Netstar, in founding the company. I'm drawing a blank here. I can't think of his last name. Anyway, another person started a little bit later in the founding activities. We financed the setting up of the company, raised some money, set up an office, and started down the path of doing high performance networking. The product idea was mine based upon my experience at Cray and looking at what was rarely done to push the state of the art of performance in networking. From the time I had left Cray until the time we started Netstar, the thing that had emerged was a lot of standards. The Hippie (?) was a standard now, but it was Cray in Los Alamos who had invented it, but it is a standard that's being used in a wider spectrum. Fiberchannel (?) came out of IBM, but it is standardized; ATM from the phone companies, and even FDDI which is lower

50

performance, but even that standard didn't exist until after I left Cray. It was just starting to get finalized then. So high performance

networking and moving a lot of data seems to be of growing importance, and with all the talk about phone companies and how they

want use ATM it just seemed like to have a company that was only focused on that . . . Netstar has a product called a Gigarouter that is

capable of handling at least, to the best of my knowledge, up to 64 gigabytes it transfers, simultaneously. So with that kind of

capability I think that Netstar has a pretty bright future. I don't know of any other company that's doing anything like that, and they

have attracted quite a bit of attention from the supercomputer market but also from the phone companies. MCI has bought quite a bit

of stuff from NETstor lately.

O'NEILL: So the idea came from your background with Cray and high performance, but was there any connection between the people

who were starting the company and Cray itself?

LOFTUS: Of the three founders, two came from Lee Data, and myself. We hired some ex-Cray people. A fellow by the name of John

Renwick (?) invented Hippie with Los Alamos and I think he still works for Netstar. We hired Larry Schirmer (?) who at Cray was the

guy I looked for, as his career progressed, as the guy that could get the most performance out of anything. There are a few other ex-

Cray people at Netstar.

O'NEILL: Is that based here in the Twin Cities?

LOFTUS: Yes. It's in Eden Prairie.

O'NEILL: Do you get involved in any companies that are not based in Minnesota? Is there a necessary connection with start-ups in

Minnesota in your view?

LOFTUS: I'm currently not involved with any start-up that isn't in Minnesota. I've been on the fringes in the past. There's one in

Michigan I've talked with quite a bit. There's one in Munich I've talked with quite a bit. But it's been more from a helping standpoint

versus a direct involvement although if both of those could have figured out how for me to be directly involved, or I could figure out, I

think we would do it. I'm currently involved with a company that's Minnesota-based and I'm in the process of merging that with a

French company.

O'NEILL: Which company is that?

LOFTUS: It's Itasca. It's an object-oriented database company and the French company has an application that uses the Itasca database and so we're trying to give that company a hand. I was involved with foreign subsidiaries at Cray Research and that seemed a lot easier than this task that we're trying to make happen right at the moment. I do think it's mostly an organizational issue of just getting all the pieces put together and knowing all the tax laws that deal with all these different countries.

O'NEILL: How do you view the environment in Minnesota for computer-related companies?

LOFTUS: Well, I think that with all the big companies downsizing, it certainly creates a lot of start-ups. A lot of them are spinoffs of Unisys, Control Data, or Cray Research. Cray is surprisingly having a lot of start-ups spun off it, or people that are going to get involved with start-ups. I think that the environment is good from a technology standpoint, that there's a lot of good technology ideas that people have that could form a company. It's not so good from a financial standpoint. It's very difficult to get money here. I use the analogy that they think the only good deal is at least 500 miles away and preferably on either coast and investing money in Minnesota companies doesn't seem to be something that's high on the venture capitalists' in Minnesota list. So most of the financing I get involved with is through private placements where you end up with a lot of passive investors. Sometimes it makes money fairly expensive to get. You have to pay a brokerage firm, but it's the only way I've found success to deal with a start-up company. My experience with the venture firms is if you don't need it, money's available, but if you need it, the risk taking just isn't there. I see with individuals more a willingness to take a $25,000 risk or $50,000 risk and for the venturists to take a more sizeable risk. In just kind of looking at companies that have been financed through venture funding in the Twin Cities, I guess my feeling is I don't understand why they picked them plus I think they gave them too much money. I think there's a real danger of a company getting too much money.

O'NEILL: What's the danger?

LOFTUS: They don't make the best decisions about how they spend it. They don't really analyze their decision process as much as they should, and they make choices that are just not the best for the long term, and they don't see themselves as running out of money.

O'NEILL: Do you think that was ever a factor at Cray when things were so profitable?

LOFTUS: Well, Cray wasn't a start-up. I think Cray was an excellent model for a start-up. I remember the first piece of capital

equipment -- I'll use that term rather loosely -- that I ever bought. Maybe I mentioned this to you earlier, but we were getting benchmarks -- all the benchmark data and the written material was coming on microfiche which was a big deal during the 1970s. Everything was on microfiche and we didn't have a microfiche reader so I would go to the Hennepin County Library and use their microfiche reader. Unfortunately, I didn't live in Hennepin County so I got kicked off the microfiche reader whenever anybody from Hennepin County wanted to use it, which thoroughly irritated me, and so it took a lot of time -- you know, then you've got to get reestablished, and you know how microfiche was not the most eye-friendly exercise -- we had all the stuff on microfiche and so we agonized over whether we should buy a microfiche reader. We were in Metro Office Park and there was a place in Metro Office Park that sold them, so after all our agonizing over spending this $150 we finally decided that it was really money that we should spend, so I got a check for $150 and went over there and flopped it down and carried it back, and that was a big deal, spending $150. That was in 1976 so $150 was probably worth a whole lot more than today. Still, Cray Research was not based upon having any luxuries. I think I said earlier we couldn't afford a Cray. Even access to a Cray was pretty limited and we did everything on these awful Data General Eclipses that I had learned to despise. The tools that Cray provided -- was able to supply -- were meager. Now, I don't believe that's the right choice of how to spend your money at some point. I think that every company should have the best tools they can afford. I'd rather spend money on tools than people. That's the philosophy that I used throughout my career at Cray even though software grew as a fairly sizeable organization. I never wanted to hire anybody unless I had a real job for them. I never even wanted to bring an intern in unless I had a real job for them. You don't just bring them in for training. You bring them in to get something done. Some of the companies I'm involved with that are growing, we make sure that when anybody walks through the door that their assignment is written down, and maybe they go through a learning process for the first week, but I've always used the philosophy of bringing in new people and to scare the hell out of them the first week [laughs]. It really works. They feel so important [laughs].

O'NEILL: Well, that's the end of my questions unless you've got anything else you want to add in looking back on your career in Minnesota computing or as a woman in computing or any of those issues. I think we've covered a lot of ground.

LOFTUS: Well, good. I guess nothing really comes to mind right now. I'm sure something will come to mind later that I wish I had told you, but that's the breaks.

O'NEILL: Well, that's the nature of these things.

[END OF INTERVIEW]