Computer History Museum

Oral History of Bert Sutherland

Interviewed by:
David Brock
Robert Sproull

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Sproull: Okay. So this is May 25th, 2017. I'm Bob Sproull interviewing Bert Sutherland, William Robert Sutherland but we all know him as Bert, and I have David Brock with me here as co-interviewer and we're at the Computer Museum in Mountain View. So Bert, we'll get into lots of details but since you were for most of your career a research manager I thought we'd start by doing a performance review, which is something that you honed to within a gnat's eyebrow over the years and there were three parts. The first part is what are you most proud of in the most recent review period? Now in this case your review period is your whole career so what are you most proud of?

Sutherland: Well, my first marriage I got three wonderful kids and they were fun to be with growing up. Technically, I think I was quite helpful in working with eliciting the chip revolution with Lynn Conway. The book that she and Carver wrote is dedicated to me in the front. It was an enormous amount of fun and excitement and I'm very proud of all the other-- all the people who thrived in the lab. I mean it was a wonderful experience at Sun Labs, at Xerox PARC, at the little consulting company that Bob Sproull and Ivan and I had. We did a lot of interesting work in different places and had a good time doing it.

Sproull: Okay, and the second question is what were some of the disappointments or things you think you could have done better?

Sutherland: Well, I could have done better by delegating more to the people. I mean I tried to push down the decisions as low as I could and that didn't always work. People are people, they do what they want no matter what they're supposed to do, and I could have been more patient with some of the frailties that I had to put up with. <laughs>

Sproull: Okay. The last question is what set some expectations for the future but I would like to in this case amend that by maybe a slightly better topic might be to describe a few of the principal lessons learned that you think were most important.

Sutherland: Well, I-- one of the things that I was always interested in was the finances of research. The companies that I worked for sometimes understood the need for research. You got to think of new things and do things differently and the function of a research lab is to change the company, otherwise why spend the money, so a research lab is a change agent and I think that's an important lesson for the management of the company and for the researchers. They are using up company money for something that's not directly apparent and it- it's something that need-- needs to be thought about. And the researchers need to respect the company often more than they do because the company is what they're supporting and is supporting them. I mean I always thought-- <laughs> in fact at Sun Labs I had a program where I wanted to send my researchers out to visit customers. If they wanted to go to a conference in Atlanta, that's fine; well, I'd call up the Atlanta Sun sales office and say, "Hey, we got some researchers coming. Wouldn't you like to take them out to see some customers?" And part of that is an

education of the research people about the customers' problems so I mean that's to me a very important lesson about how you make research effective. I mean it's easy to spend money doing your own private project but if that doesn't help the company why have you been doing it; why have they been paying you to do it?

Sproull: So that's good. We'll get a chance to talk more about this later. This was to be the teaser so that's--

Sutherland: Yes, that was the teaser.

Sproull: Okay. So let's now go to the more chronological thing and try to avoid the Tristram Shandy problem where recounting it takes longer than the doing it.

Sutherland: Right. <laughs>

Sproull: So I know you very much wanted to talk about your parents and of course growing up with Ivan, so over to you.

Sutherland: Okay. <laughs> Well, I had-- I was fortunate to be born to a couple of-- they were actually emigrant parents. My dad was from New Zealand, he was born and raised in New Zealand, and my mother was from Scotland and they were both well educated. She had a master's degree from Edinburgh University in liberal arts of some kind and he was a Ph.D. civil engineer from Imperial College in London. They met in Grenoble after World War I when they were both going to graduate school in Grenoble, France. They got married in Sydney, Australia, when my dad went back there after the war-- after World War I and anyway they married in Sydney and lived down in the Pacific area for a while. At one time just before World War II, he was the chief engineer on the phosphate mine on Christmas Island in the middle of the Indian Ocean and the boat came from Singapore every month to bring the supplies, etcetera, and the story is my mother when she went ashore the three other white English ladies on the island rushed up to her and said, "Do you play bridge?" so I guess she had to. Anyway, they came to the United States in the middle of the 1930s. I was actually born in Hastings, Nebraska, where my dad was the engineer on the-- a dam-- earthen dam project which they made by building two coffers along the river there and they flooded it with mud and let it dry and then they put rocks on the-- rocks to protect it on the sides. So he did that and then he moved to-- I was born in Nebraska and so I'm a Nebraska native son I guess. I got a thing from the computer department at Lincoln when they were looking around for <laughs> native Nebraskans that they could give this award to, but anyway-- I mean I had-- never really had anything to do with the university there but that's nothing. He got his job changed during the war in-- and we moved to Wilmette, Illinois, and he worked for Harza Engineering in downtown Chicago and we had-- during that time there was a housing problem of course with all the flood of people coming so we were near the navy base in Great Lakes which had lots of sailors from all over the world. So as part of the entertainment

around there my parents would always invite out the local sailors from New Zealand or from the British Empire I should say is the way to think of it 'cause they were sent over to the U.S. for training, and I was-- this is a funny aside to put in here: There was even a paddlewheel steamer on Lake Michigan the navy had made into an aircraft carrier by putting a wooden deck on top of it and they used it for training pilots who were learning-- just learning how to land on it. Later on I became a navy carrier pilot and so I did it on the big ships but I mean I remember these British navy guys were teaching me how to throw a baseball and do all that kind of stuff, we had them all over at the house, so that was interesting. Later on after the war I-- my dad moved in '46 or something to Manhattan; he worked for Ebasco Services designing-- he's a dam designer; he designed hydraulic dams and we lived in Scarsdale. I graduated from Scarsdale High School. I went on to Rensselaer Polytechnic Institute; it was the closest school that I could use my navy ROTC scholarship and I could take the train, go up to Harmon where they changed-- where New York Central changed the diesel engine to electric to go into Manhattan.

Sproull: So what induced you to go for a naval ROTC scholarship?

Sutherland: <laughs> Well, I don't really remember but it was something that could be done; it was available. I went down and I took the tests; I did fine. I eventually ended up going to an interview with-- I had to go somewhere down in maybe lower Manhattan and I actually went down-- I don't think I had a sport jacket or a jacket and a tie so I didn't even wear one, which was sort of frowned on a little, but I still made it and was accepted to Rensselaer. It was a good scholarship; I mean it was-- I got $50 a month.

Sproull: So let's back up a little bit. So in high school you were a ham radio operator?

Sutherland: <laughs> Yeah. I had a friend come in and say, "Bert, I went down and got my novice license" so I said, "Well, if he can do it then I can do it" so I went down and I- I'm currently an amateur extra class radio guy, inactive but W6AU is my call sign.

Sproull: Right. And so Ivan was not a ham guy.

Sutherland: Well, he tagged along afterwards. I mean—

Sproull: Did he ever get a license?

Sutherland: Yes, he has a license. He was K2BSW; I was K2BKV in the-- in those days. And my dad working in Manhattan used to go on to the surplus places that sprung up in Manhattan right after World War II and there was a Canal Street thing where they put all the-- most of the mechanical kinds of things. We got a pair of nice servomotors that when-- you'd turn this one and there were five wires and it would turn this one so you could just track things; that was fun. And there was also a Radio Row down on

Cortlandt Street where they had all kinds of vacuum tubes and capacitors and I mean the bits and pieces to make all kinds of things. So we-- I-- we actually made a ham radio transmitter that we used; it was a Viking; it was a kit. Heathkit in those days made the most wonderful kits; they were terrific. Skipping out of the thing, actually my son and his friend late-- many years later made a Heathkit pinball machine, <laughs> which I had gotten to solder together; it was a lot of fun. Let's see what else. I was a Boy Scout; I mean we joined the Boy Scouts. That for me was very important because the troop that I was in was run by the seniors-- high-school seniors who were still in it, which was-- and the scoutmaster was terrific but he didn't really have to do anything 'cause the seniors ran the troop. I had skipped a year of school so I was a year younger than everyone so normally you joined the Boy Scouts when you're in seventh grade. I couldn't do it until I was eighth grade, you had to turn 12 to join the Boy Scouts, so-- but I mean it was very interesting. We did all kinds of things. I learned how to make fire with a bow and drill and with flint and steel, catch a spark in the burnt cloth and so forth. This town I was in, Scarsdale, had a Memorial Day drill competition for marching and the troops competed about marching and they had-- a marine drill sergeant, probably a retired guy, <laughs> was the judge. And my troop sort of consistently won these various contests and it was a good experience. We had to-- there was a patrol of eight of us-- I was in tenth grade when I was the patrol leader-- and the troop had-- we had six patrols and every other week during the winter we had to cook outdoors for the whole 60 people-- 60 men of the troop and cook a meal with an appetizer, meat, vegetables, everything and a dessert, and we had to do it on an open fire out in the field down by the high school so it was-- we learned a lot and so forth. Go ahead.

Brock: Two kind of follow-up questions with the story of your mother and father inviting the naval officers over--

Sutherland: It was mostly enlisted people but it was fine.

Brock: Pardon me. I wondered if there was naval service or military service in your father's background.

Sutherland: Yes. He was a army New Zealand ANZAC Army infantry enlisted man. He went and fought in the trenches in World War I and survived. My mother's brother, Scott, was in World War I and he was gassed and sort of lived barely into the '30s as an invalid with-- from the gas exposure in World War I so that was--. My mother also went as-- had-- we had friends in Germany so after World War I she went to Germany to stay with her friends and she lived there during that horrible inflation that they had and she was always terrified of the currency inflation. I mean she was a very, very conservative-- she was a real Scot. <laughs>

Brock: And with your involvement and your brother's involvement in amateur radio and electronics and these projects was your father participating in those with you as he bought the supplies or was he simply sort of a source of parts?

Sutherland: No, no, no. Well, he actually got a ham radio license too but I don't think he ever-- you have to learn five words a minute Morse Code and all that but I don't think he ever-- I mean he did a couple of contacts but never-- he was just very proud of it but he never did it in any serious way, but as a kid he was there with us always. He always got us to help him with the household projects. I mean he-- Mother would say, "Please fix these doors" so he'd say, "Boys, come on and we've got our job to do" and it always took him about twice the time to have us help him but we learned a lot. He had gotten a Atlas metal lathe, six-inch little Atlas-- Craftsman in those days-- metal lathe and he'd set it up and he liked to-- he made some various parts and I was ten years old and I wanted to use it and do it and he says, "No." He says, "You have to wait until you're twelve and big enough to handle it" so-- and I still have that lathe in my barn here in Mountain View. It's been a useful tool to have for various purposes, when you need to make a funny nut and threads-- do the inside threads, which I have done, <laughs> to hold the kitchen faucet on, I mean you screw it up and I made my own nut, but it's-- tools and stuff were terrific. His Christmas presents were always the tool that the boys needed.

Sproull: So let's now switch to your mother because she squired you boys around to visit Ed Berkeley and Claude Shannon and tell a little bit. We've heard Ivan's view of this but we should hear yours.

Sutherland: <laughs> My mother hated to drive so she had to take us-- Ivan and I down to Bell Labs to meet with Claude Shannon and I should go-- step back and say she was-- she taught learning-- kids with learning disabilities and she was astounding. I mean these kids-- she had one little girl in fifth grade I think who was-- it was-- she was-- had-- she had epilepsy and the medicines knocked her way, way down and-- but she was the best kid in math in the fifth grade or whatever it was, I mean-- and my mother was really odd. She had a lot of kids who wanted to-- I mean people learned that if you wanted your kid to do well in school you sent her to see Anne Sutherland but they never could figure out how much she charged because she had an attitude that says, "Now parents who are-- can't afford it much and they're really working with their parents I won't charge them very much" but the rich kids whose parents just say, "Well, we- we're not going to help them; we'll send them to Anne Sutherland" she charges an arm and a leg for them <laughs> and it was-- I mean it was her own way of sort of-- "If you're working at it, I'll help you; if you're not working at it, you're going to pay through the nose" and-- but anyway it was-- we had all-- these kids used to come to the house; they'd be dropped off and they'd go away.

Sproull: So Anne and Berkeley might be a place to start.

Sutherland: Oh, yeah, all right. So she went to-- we went to a math conference in Exeter, New Hampshire, which is where you went to school, Bob, and a person we met there was Ed Berkeley who was a-- was actually an actuary. He was one of the founders of the ACM- Association for Computing Machinery; he helped found that. He had built a little robot in those days. "Giant Brains or Machines that Think" was his book and he had built a bunch of stuff and we went and met him and as a result of that Ivan and I worked for him. We lived in Scarsdale; he lived on West 11th Street in New York City. It's the first block of West 11th Street so I could take the train down to Grand Central, the subway down to 14th

Street, walk three blocks along and turn right and go across Fifth Avenue I think and then you're in-- at Ed's house. But what he wanted was a maze like Claude Shannon had built and so he hired Ivan and I to build him one. And it was a wonderful mechanical project and we worked at it, he paid us a little money and that was fine, but as a result he said, "Well, you ought to go down to visit Shannon and see his maze." So he called Claude down in Bell Labs and my mother had to drive us down there, go down across the Tappan Zee Bridge and then down the Garden State Parkway and then you get to Bell Labs. And we went to visit Shannon and we saw his maze and that was very nice. It was a good introduction because later both Ivan and I are half of Claude Shannon's thesis students.

Sproull: Okay. Let's now go back and pick up RPI up the Hudson--

Sutherland: Up the Hudson. <laughs>

Sproull: --and you majored in electrical engineering.

Sutherland: Yeah. It was the nearest school where I could use my navy ROTC scholarship and I could take the train up to-- up the Hudson to New York Central to-- it was the Montreal train that went on to Montreal that didn't cross the hundred and it just went up through Troy, New York.

Sproull: Did you bring your laundry home on weekends?

Sutherland: Sometimes or maybe I didn't do very much laundry, but I-- no, I actually didn't come home very much; I was pretty much just up there. RPI was-- it was a good school; it was kind of a rushed life. I lived in one of the dorms and found a roommate that I stayed then for the next three years, sophomore through senior, with, Malcolm G. Mugglin who was from Walton, New York, in the Catskills and he and I were very, very close friends. He was also in the navy ROTC and-- but I lost touch; I haven't seen him for—

Sproull: So you were engaged in a flying experiment.

Sutherland: <laughs> Yeah. One of the professors at-- in the electrical engineering department had a research contract that had something to do with sound transmission and the atmospheric conditions. I don't remember the details but what his grant got-- he was a pilot and his grant got him to rent a Cessna 182 and he put a bunch of big loudspeakers out on the wing strut and things to drive them with, different tones and stuff inside. And he would launch a bunch of hydrogen-- helium balloons I should say, not hydrogen-- helium balloons with a microphone on them and record and it would radio the data back to the airplane. And he would record it for-- I don't know what the point was, but anyway I got to build the equipment that went in the airplane, put it in the airplane and then operate it while he buzzed these

balloons. And we took off in the 182 from the Troy Municipal grass field and flew around doing that and I sort of discovered that I liked flying. It was kind of fun; looking down at the world was appreciated.

Sproull: Well, not only that; you had a Cessna full of electronics.

Sutherland: Yeah, right. <laughs>

Sproull: It could have been an ASW plane.

Sutherland: <laughs> Yes, almost, <laughs> but-- so that's sort of when I discovered that I actually liked to fly so when I got time to go in the navy I said, "Okay, I'll sign up to go to Pensacola and learn how to fly."

Sproull: So that's great. So you were commissioned in June '57--

Sutherland: June '57—

Sproull: --and your commitment was for two years after wings. Was that right?

Sutherland: Yes. We had to go learn to fly and after we got our wings we had to serve two years of obligated service and so I said, "Oh, that's fine." I mean my navy scholarship had three years of committed service after commissioned and it would take me a year to learn to fly and then another two year-- well, that was the same three years, not a problem--except I'd been through ground school and stuff and had barely started to fly when the navy said, "That's not cost effective. We should keep these guys-- new pilots for three and a half years instead of two." So they said, "Well, you have a pretty-- we'll give you a choice. You can drop out of the flight-training program and we'll send you to sea," probably a destroyer out of Reykjavik or something-- well, that's the sort of scuttlebutt that goes around-- and-- but I said, "Okay. Well, I want to learn to fly" so I signed up for three and a half years after that, which would take me then to July of '62 I think if I can still add properly.

Sproull: Yeah, but you're not going to get out of the navy that quickly.

Sutherland: No, I'm not. <laughs>

Sproull: So flight school was in Pensacola.

Sutherland: Pensacola, yeah. It was this ground school; it was terrific. I went through ground school with a perfect grade, didn't miss a single question on any of the tests, and they were all-- "Well, how did you do that?" It was actually easy. I mean come on. I'm a scientist. You want to figure out motion, the wind draws you that way and you're going this fast and there's a little triangle and that's hard. The Morse Code was easy being-- I'd been an amateur extra operator at 20 words a minute and the-- you had to-- all pilots had to learn Morse code and probably still do because the radio beacons are identified by Morse code so you have to understand it if you want to know what you're listening to. And actually in those days they still had the old radio ranges, which were the A and N signals that were overlapped 'cause the A and the N when they go together form a solid tone and you flew by navigating--if you turned right you heard N, if you turned left you heard A, and so you knew that when you had a solid tone you were just going fine.

Brock: So you did a broadcast of the Morse A and a broadcast of the Morse N. Is that correct?

Sutherland: That's right.

Brock: Okay, I got it.

Sutherland: Right, and the junction where the strength was equal was a solid tone and that would take you to where you were going.

Brock: Got it.

Sutherland: And we actually learned that in flight training. It was kind of not-- pretty hard to do but what-- so I got a nice solid tone; now am I going toward or away from the air-- from the point. You actually had to do that. There was a thing-- you had to go and find out where-- fly off the course so you could tell whether it was weaker or not, but anyway then there was TACAN, which is the modern--

Sproull: So you eventually wound up with a fleet in Norfolk.

Sutherland: Yes. I got my wings. They sent me to an electronics school. Since I'd been an electrical engineer graduate, I had discovered that you can affect your assignment by talking to the guy who is in the bureau of personnel who has the problem of making new assignments for officers needing new assignments, and he's got a stack of blank jobs and he's got a stack of names and if you talk to the guy he can actually make someone happy for the day by matching your thing into an empty slot that you would like. So those electronics-- So they were going to send me to a experimental-- sort of a test squadron in Norfolk but they sent me to electronics school first, which again was-- <laughs> it was pretty easy because the amateur extra radio exam covers a fair amount of technology and being an extra the school was-- I wound up teaching a number of the classes <laughs> to the other-- I mean there was-- it

was a marine major, a real small guy who had been a dive-bomber pilot, anyway a bunch of us, and the marine major says, "You got to teach what we're going to be examined on. Don't teach us the principles behind it." But I mean it was interesting, but the other strange thing was the flight time. As an aviator, I needed to fly four hours a month to get my flight pay, which was an extra $200 a month, which was quite a boost over my regular base pay, but the planes we had to fly was a old twin Beech World War II-- I airplane, SNB, S-- I don't-- anyway-- but it was-- it's a tail-- it was a tailwheel plane and why-- I had flown tailwheel planes in flight training. I learned in a Beech Bonanza version of-- with a tricycle gear but then I moved into the old SNJ, which was-- some of the airplanes there that I learned to fly them were actually older than I was. <laughs> I mean you could look at when was this airplane manufactured and it would be 1934 and I was born in 1936 so a good, solid airplane, but anyway this-- and in a Beech you had to make wheels landings. Normally, the navy teaches you to land by stalling out and dropping onto the ground. Well, on the-- this Beech as a commercial plane did not have enough strength to do that so you actually made a wheels landing and then set down the tail, which was really hard to do sometimes. Anyway, that was--

Sproull: Anyway, back to electronics school--

Sutherland: Back to the electronics school.

Sproull: --and then eventually Norfolk.

Sutherland: Eventually, I went to this test sort of-- S-- ASW, antisubmarine warfare test squadron in Norfolk, Virginia, VS-27. Our carrier was the USS Valley Forge, which was one of the old straight decks and so I learned the first-- my first carrier landings were on an angled deck outside of Corpus Christi, Texas, where I flew this-- the S2F, which is my airplane, S2-- S, submarine second version, F, F as in Grumman. <laughs> No. I mean it-- well, it was-- the F9F was the fighter; the last F says it was a Grumman fighter-- anyway-- <laughs> but-- So I had done my first six carrier landings ever on-- six is the magic number to qualify and if you do six and live through it you're good enough to go so I did those on the USS Lexington actually, which was the training carrier. Actually, the navy is allotted a certain number of carriers by the Congress and this is a training ship. I mean it lands airplanes and takes them off and—

Sproull: It's not a carrier.

Sutherland: It's not a carrier; it's a training ship and-- yeah. Remind me when we get back to-- I need to talk about the skipper of that ship. So anyway, and old straight-deck carrier and we-- it took a while to learn. You had to do field carrier landings and everything. What's different about them from the angle-deck carriers, and this'll come up in a minute, is when you're flying into the-- one of these straight-deck ships you're basically flying flat 'cause what you want to do is come in and cut the power and just plunk down on the deck so you're flying on the back side of the power curve, which-- the power curve says

there's some most efficient point which you use for long-distance flying and then the drag goes up because the plane is backwards, the wing-- I mean you're flying like this and this lift has a backwards point and if you want to go slower you have to put on power and-- because the plane's going to tilt up. So your instincts are all "How do I fly this sort of-- almost stalling the airplane but then plunk-- have a controlled stall when you want to land?" So we did that and we'd go out and we'd-- I-- in total over my career I did 108 carrier landings and as Ivan once said, "How many successful?" I said, "108." <laughs>

Sproull: But most of those were on angled decks. Right?

Sutherland: No. About half—

Sproull: Oh, okay.

Sutherland: Half on an angled deck, half on-- an angled deck's much easier 'cause you're actually gliding down to the landing and you have the old paddles-- the straight-deck carriers had the old paddle guy, with a set of paddles you're low, put on power, go a little slower, <laughs> put on power, go a little slower, and then he cut-- they cut and you're down for the night. You had a choice. You either caught a-- you caught a wire, one of the four arresting wires in the back or they had a barrier, tennis net, that came up in front and you put it into the barrier. Well, you stopped; it's all right. It didn't do any good to the plane, they could repair it probably, but-- and then if you waved off you put it on full bore and you flew around, but the difference of the angled deck is you can actually do a touch-and-go.

Sproull: Okay. So let's return to electronics because--

Sutherland: Yes, Sir.

Sproull: --your real duties here were the electronic officer for the--

Sutherland: Yeah, I was the electronics officer in this squadron. I'd been the electrical officer for a while 'cause the-- but that was the power, the generators and the searchlight on the wing and all that stuff and the batteries, but I got to be the electronics officer and each-- there were 20 airplanes in the squadron. They had 40 black boxes in them. We had radar electronic countermeasures, radio, sonobuoys; we dropped sonobuoys with a microphone into-- and listened to the-- trying to hear the submarines. We had magnetic airborne detection, which had a long stinger that would come out of the back-- it was retractable and it would come out the back and had a magnetometer, and so what you try and do is detect the fact that the submarine had distorted the earth's magnetic field and as you flew along through it -- and it had a range of a few hundred feet so you had to be low. So when you were trying to find a submarine with a MAD, M-A-D, magnetic anomaly detector, you had to fly low so it was always interesting to go down and

fly over the ocean at night at a hundred feet. And the ocean at night-- I'd say to people, "You want to know what the ocean at night is like when on a cloudy day? Go in a closet; turn out all the lights; shut the door. That's what the ocean-- what you see out the airplane." And tooling along at a hundred feet there was-- we did have a radar altimeter.

Sproull: With your 40 black boxes.

Sutherland: Forty black boxes and twelve hundred and fifty vacuum tubes in these--distributed by these 40 black boxes.

Brock: No need for a heater then in the airplane.

Sutherland: Oh, no, you did. It gets very cold—

Brock: Even with all those tubes?

Sutherland: Well, you had to cool them and I mean it was a problem to cool them. We had a very nice radar that would-- that was under the belly and it had a dome that would come down about three feet and then had a-- we had a full-search radar and-- but if 20 airplanes, 20-- 1250 vacuum tubes, 25,000 vacuum tubes I had to maintain.

Sproull: Yeah.

Sutherland: And you come down on a carrier landing, boom, repair again. However, it was very interesting because there was a lot of repair when you go out from the beach and you start on the carrier for going for a two week cruise that take you somewhere. And the first two or three days you had vacuum tubes giving up the ghost. But after a while they got pretty good. You didn't have to fix it. They were good enough. And I have one interesting story. We had gone into Quonset Point, the Naval Air Station at Quonset Point, Rhode Island. And we were there for two days or something. And so I decided that I would take out the 40 sonobuoy receivers. There were two of them in each airplane and take of 20, better take all 40 of them out. And we took 'em into the shop and lined up the IF strips for those-- this is one of the things, there wasn't one of them didn't need aligning. The sonobuoys were an FM system, so you had to have a discriminator to get the sound back. And a lot of the discriminators were not set in the middle of the IF strip where the all the signal came. We had a half a dipole antenna. It was a J. It was a-- you see these blades on their airplanes. They're often actually a half of a dipole antenna grounded at the-- at one end and the other is a co-ax to the receiver. So we went into the 40 and measured the resistance from the center of the co-ax cable to the hull of the airplane. Six of them were open.

Sproull: Oh geez.

Brock: Oops.

Sutherland: So I mean they had no antenna essentially. And at the time Hazeltine had the contract to build the sonobuoys. And they were beating the hell-- the Navy was beating the hell out of Hazeltine because the sonobuoys were totally unreliable. You couldn't count on them to do anything. And after we did this fixed we had 98 percent reliability on the sonobuoys you dropped.

Sproull: So I think you-- didn't you once have Ivan as a maintainer of some of this gear?

Sutherland: Yeah. Ivan was at MIT then. And he was a commissioned second lieutenant in the Army not yet on active duty, 'cause they wanted him to go--. They said we'd rather have a PhD second lieutenant than just a raw one and so we'll let you go to school. So he came down to Rhode Island and I got permission to let him come out on the carrier with me because he's a commissioned officer of a rival service, not a rival service as, but an associated service. So, but it was legal and the skipper and the air group commander finally said, "Yeah, sure, bring them along." So I put him in the backseat and he told that story, but--

Sproull: Yeah.

Sutherland: -- I put him in the backseat as a radar operator and he turned it on and was able to look and see the- the radar gave you a circular-- the usual thing using radar. And so I think that was his first carrier landing, which was, it was fine.

Sproull: But you made him fix some things too, didn't you?

Sutherland: What?

Sproull: Didn't you make him fix some gear?

Sutherland: Yes. He helped line these discriminators up--

Sproull: Yeah. <laughs>

Sutherland: <laughs> -- on the sonobuoy receivers.

Sproull: So let's keep with electronics. So, one of the things that you did during this tour of duty was the Juliet simulator. Talk a little bit about that.

Sutherland: Right. One of the Navy's ways to try and find sub-- submarines are hard to find. They're down there; you don't know where they are. The sea is not a friendly environment for searching. So they-- someone had had the idea, why don't we do some echo ranging. And so one of the things we carried was a little practice depth charge. It was a marker. We had a thing that could eject smoke things because you want to mark-- how do you mark something in the sea? You have to drop in a smoke buoy, a buoy that smokes and you can tell. And so we had a little thing that shot it out backwards. And you set the air pressure on it so it shot out backwards the same speed you're going forward. So in theory it would fall straight down. But you could also--we had a rack, I think, of little one-pound depth charges. They were just; it's like a firecracker going off, bang, under the water. And with the sonobuoys someone realized oh, we could drop one of those depth charges, make it go bang and then the sonobuoy can hear both the bang and the echo from the submarine. And they'll be coming at different times because the different distances you travel. And by doing this you can-- by flying a pattern and dropping it in the right place you can actually triangulate on where the submarine is. That was called Julie. It was developed in the Naval Air Development Center in Johnstown, Pennsylvania. And it was called Julie because this was a-- she was a stripper in Philadelphia who made the active boys-- passive boys active. So this is the Julie technique. And so one time I coughed into the-- my microphone. It was a carbon mic on my helmet and I coughed into it and the sound was just like the bang of the depth charge going off.

Sproull: Right.

Sutherland: So I said to myself, okay, this-- we could put a little timer on this and make the bang and then put a timer on it and put it in a very little short <makes sound> little short section of the bang. So it was-- it's trivial. I made-- I taped two microphones up against one of the air vents for the noise source and I made a little box that you plugged-- plugged into the airplane power. It actually had some of the Raytheon CK722--

Sproull: Oh my.

Sutherland: -- First Dollar transistors for an RC timer circuit. And so you could push the button and it would go bang and you'd hear that and then you could set the delay and do when you hear a little <makes sound> at the end. And you did-- I did two of those, two in one box with two knobs. So you could--lots of times you'd have two buoys. You had to put two buoys at the right place then you drop on one so the bang would go and then you'd hear the echo here and then there. And you could make a simulation in the pilots. You could sit and train-- try and train the pilots as to how to fly the pattern at 100 feet and figure out where to go, where to drop things, etcetera. And the problem with this technique is you needed a submarine to practice on. And if you want to stop on how much an hour does the submarine cost the Navy? A 200 million boat, <laughs> a crew of a 100 on the submarine, etcetera, etcetera. There's no way

to train on this thing. So I made this. I got--the skipper liked it, so we made a bunch of them in the overhaul and repair shop in Norfolk and they were issued out to fleet for that.

Sproull: So the airplane would carry the simulator, but it would also carry a guy whose job it was to listen to the sonobuoy returns and figure out what's going on.

Sutherland: Yeah. Well, that was the guy in the left-hand backseat--

Sproull: Right.

Sutherland: -- who had this strip chart recorder.

Sproull: Right.

Sutherland: It was-- and it was like you get an EKG.

Sproull: Right.

Sutherland: You get a little whip, you hear the bang and then you get a <makes sound>.

Sproull: So there was one guy in the plane who was sort of running the script--

Sutherland: Yes.

Sproull: -- simulating the submarine, if you will, via this--

Sutherland: Correct.

Sproull: -- thing you described.

Sutherland: Correct.

Sproull: And the rest of the plane was trying to fly to train.

Sutherland: Was doing its thing. Yeah.

Sproull: Right.

Sutherland: Right.

Sproull: Right.

Sutherland: And he-- this was a guy who was banished in the radar seat--

Sproull: Right. <laughs>

Sutherland: -- on the other one on the back. He had to be the orchestrator of the simulation exercise. And the Navy built, I don't know, 50 or 100 of them and in this O and R thing.

Sproull: And you got an award for it.

Sutherland: And the skipper thought this was terrific so he recommended me for a Legion of Merit, which I got six or eight months later, had to go through the chain of command. So I was the most junior officer in the Navy with the Legion of Merit at the time.

Sproull: So I think we want to return to this later.

Sutherland: Move forward.

Sproull: But one of the things that you always talk about your Navy experience is leadership. And what-- how the Navy brings people forward into leadership positions and how you learn about--

Sutherland: Well, the--

Sproull: -- getting people to do things collectively.

Sutherland: Yeah. I mean <laughs> a lot of it's done-- I mean I learned most of it by trial and error and on-the-job training. But I had 80 sailors in my electronics shop, most of whom could tell me the months,

weeks, hours, minutes, and seconds left on their hitch. <laughs> Not motivating-- and we had to maintain 25,000 vacuum tubes <laughs> so you learn very rapidly. In the Navy the chiefs--you get to be a chief petty officer, you've been in 16 odd years, you're a career guy, and the chiefs are pretty good and you have to really count on them. So as a junior officer I learned I have to delegate the responsibility to the chief. And he, in fact, my first chief, Eric-- this is so he said, "I want to tell you how this works." He said, "Do you know about these seven electrical guys who are your sailors?" He says, "You want to get something done, you come and tell me and I'll get it done for you." And I said, "Yes, chief, I got it."

<laughter>

Sproull: So you had a few chiefs then. You must've had--

Sutherland: Yeah, yeah, I had--

Sproull: -- a handful.

Sutherland: Oh, yeah, a handful of chiefs for these 80 guys.

Sproull: Yeah.

Sutherland: And then there's--their grades, first class petty officer--

Sproull: Right.

Sutherland: -- second class petty officer, third class petty officer, etcetera and their various skills and various things. But I mean it's a well-organized system with accountability built in. I mean as I said, I learned about accountability. I'm alive because I did several things right over the sea at night. And I mean that was a very important lesson and it caused me lots of trouble later on.

Sproull: Okay. So, but I think maybe it's about time to leave the Navy. You--

Sutherland: Yes.

Sproull: You-- let's see, when did you--

Sutherland: My time was up-- oh, no, before that before I got out the Navy.

Sproull: Fall-- yeah.

Sutherland: I managed-- I got a new skipper who'd never been a carrier pilot. He's given-- I mean it was hard to give enough command exposure to develop the guys who were going to become captains and admirals. I mean you need to have command at sea.

Sproull: Right.

Sutherland: And so in order to do that you have-- there's got to be squadrons that need a new commander. We got one and it turns out, I don't quite know how they selected him, but he had never flown a carrier airplane. So I got to help make his-- I mean so we had to help him. I mean he's a good flyer, but not flying backwards, <laughs> you know, on the backside of the power curve in a controlled stall. Actually, he came, he was a-- it was on the angle decks.

Sproull: Yeah. <laughs>

Sutherland: But anyway, so it was always kind of scary to fly with him. But I got to be the right seat safety pilot for his first set of six carrier landings to qualify. And it was, yeah, I had to wave him off several times and he, etcetera. It just wasn't a happy experience. And then the S2, a twin engine little plane, whose wings would fold over the top, was really cool. But he'd say, "Well, we got to fly formation around the carrier. We got to look good for the admiral." That bugged the heck out of me. I thought what we had to do was to find submarines and practice and do all that kind of stuff. Looking good around the ship didn't mean anything to me. So I finally got so fed up with the Navy and then we had a bad night experience flying around. We lost the executive officer of the squadron and an airplane they spun in. We found his helmet later--helmet floating in the ocean. I said, "I don't need to do this. I'm going to be-- this is not my career." So I turned in my wings and I said to them, "I'm not going to fly anymore. I'm done." It was a little shock because frankly, I was in the year I graduated from high school I had the highest flight turning grade in the flight program. And so I said, "I'm not going to fly anymore." They said, "Fine." The ship was on its way to a Mediterranean cruise. No, it was a North Atlantic cruise, Berlin wall went up and the ship was sent as a response to show the flag in Northern Europe. But too many people would drop out because they didn't want to go on the cruise. So the Navy said, "Fine, you don't have to fly. But--stay in your squadron and you're going on this cruise." I said, "Yes, sir."

Sutherland: But I got to be the training officer for the flight troop since I had done that stuff. But it was a good cruise. We went to Rotterdam and Southampton and we went to Hamburg, which happens to be 90 miles up the Elbe River.

Sproull: Right.

Sutherland: And you imagine taking a 45,000 ton carrier 90 miles up this river to anchor in Hamburg. And I'm sure the captain had much grayer hair <laughs> when he finally got back into the sea. But it was an interesting time because the admiral had decreed no-- we were showing the flag. This was to build the morale of the German people. And he said, "No invitation for offshore visits will be refused." So four old ladies in the suburb of Hamburg decide let's have some sailors for tea. You know, three sailors went to the suburbs of Hamburg for tea with these ladies <laughs>. I mean I went. We had an officer's box in the Hamburg Opera and I went once to listen to the opera in German. And the joke, of course, is well, you have to stay till the end and hear the verb.

Sproull: <laughs> Right.

Sutherland: But and we went to see the mod-- they had a model basin there for ships and we went to see that.

Sproull: Towing basin. Yeah.

Sutherland: Anyway, so that ended and I got out of the Navy in July of '62.

Sproull: Right. And then you spent the summer as an intern at Raytheon and--

Sutherland: Yeah, I got a summer job at Raytheon because due to the electronics and the airplane stuff, I had known some of the guys. And my job there was to do a microwave kluge. The-- Raytheon made the Hawk missile. It was a beam rider kind of missile with a continuous wave radar. It would just shoot this-- it had 10 kilowatt transmitter, which is a lot of power, X-band. So the X-band waveguides are about half an inch thick and two inches-- two inches wide. And what he wanted to do was to make a space where he had this 10 kilowatt RF-- radiofrequency energy come this way and this way. So think of one-- four different things crossing in the middle of a space and there were circular waveguides here. And the output of the illuminator-- the Hawk illuminator magnetron was an X-band rectangular waveguide.

Sproull: Mm-hm.

Sutherland: So my job was to fish through this-- it was a big box of all the microwave parts that they could find in the Raytheon microwave laboratory <laughs>. And my job was to make the thing that would take this X-band radar and make these four circularly polarized things that would cross in the middle of a piece of space and then this-- so the energy started here and will cross the space and then went into a dummy load to heat. And I had to put together these things. And it took-- it was my summer job basically to try-- it's like building Tinker toys as a kid. And it was a lot of fun and we finally did it. And we had to build-- also have to build a cage around it like the shield in your microwave oven--

Sproull: Right.

Sutherland: -- to let you look in but not let the microwave out. And so we finally fired it up and to make standing waves to get the-- you had to adjust the phase of these two big crossing beams so that the standing wave was right in the hole in the space. So I mean that's part of -- beyond these various reflector phasing things that would make it. So we got it tuned up and everything.

Sproull: So--

Sutherland: And we stuck-- finally go and the little blue flame just of ionized air would appear in the space. And he, my guy, stuck in a tungsten wire, which probably melted so I mean he was satisfied <laughs>.

Sproull: So this summer job was on your way to a PhD program at MIT--

Sutherland: Right.

Sproull: -- which you had presumably applied for some time earlier.

Sutherland: Yes.

Sproull: And so say a little bit about that and what you were looking for. So it was going to be a PhD in electrical engineering.

Sutherland: Yes.

Sproull: Were computers yet in your vocabulary?

Sutherland: Not really.

Sproull: So talk--

Sutherland: Well, yes. Not quite because Ed Berkeley had made Simple Simon, which was a little relay, two bit relay computer that Ivan and I had added a divide--it was actually a table look up divide instruction <laughs>. So we had to modify this two bit, literally a two bit computer <laughs>, pun intended.

Sproull: Well, and plus Ivan was already in the PhD program.

Sutherland: Yeah, and Ivan was--

Sproull: So he must have been cluing you in about certain things.

Sutherland: Yes. I mean I'd been down to see TX-0, I think. But I played the Space War thing on it but I never programmed it. So I went down to PhD and that was fine.

Sproull: So the first bit was really a master's program on campus.

Sutherland: Yeah, I did a master's program and I-- Dave Huffman turned out to be my thesis-- faculty advisor. A new student gets a faculty advisor. I got Dave Huffman who happened to be my next door neighbor in Lexington, Mass. And he said, "Well, you're going to do a master's thesis. Who's going to supervise it?" I said Claude Shannon. He said, "Really?" I said yes <laughs>. I said the family knows him <laughs>. Due to my mother's willingness to drive down across the George-- it was the George Washington Bridge, that's what it was. We drove across the George Washington down to the Bell Labs.

Sproull: So talk a little bit about your master's project and how it came to be. I mean it's-- what gave you the idea or was this something dreamed up with Shannon? Or--

Sutherland: Yeah, I don't actually remember how it came to be. What I wanted to do was to make a binocular rangefinder for something. The military used them all the time with you have this big thing and two mirrors, and if you focus-- you can focus on the thing out there and figure out--

Sproull: Line them up. You align, right? You twist the mirrors--

Sutherland: Yeah, twist the mirrors and line up the--

Sproull: -- and towards the line.

Sutherland: Line up, you could detect the fact that the-- so I thought, well, we can do that with a computer so let's do it. I don't remember why. So I-- Claude got me the ability to use the shop next door. And this was in the-- I forget the building. I was in kind of the main building where the EE-- were, E-E-people were, where his-- Building 25 comes to mind. But anyway, next door was the old radio-- was the lab shop for the RLE was it? I don't remember.

Sproull: Yeah. Yeah, it was--

Sutherland: Anyway it was the shop. So I made a head that could rotate and it had two little telescopes that I got at surplus somewhere, with a photomultiplier behind them so I could detect-- rotate and detect the light things. The hardest part was to make the slip rings. Just often think I had to have power up to the photomultipliers and two signals back, so I had to have four slip rings, and it was too hard to go find how to buy them and I didn't have any money either. So this was all kind of junk stuff and I wound up making some concentric rings on the lathe. I screwed the plate onto the lathe in the right places and then carved out the spaces between these rings. And I had a bunch of ball bearings that ran on them for the brushes. Anyway you could do that and I could finally do it. I mean it was an interesting project and I got it done, so I got a master's degree from Claude Shannon.

Sproull: And what was the class work like for a master's program at MIT in those-- at that time.

Sutherland: Oh, there was semiconductor stuff and density states and where's the Fermi level and all that.

Sproull: So but get--

Sutherland: My problem-- well, oh, the other thing was there was electromagnetic theory class.

Sproull: So MIT later got quite a reputation for being much more analytic and much less practical and applied.

Sutherland: Yes.

Sproull: But probably at the time, right after World War II, there was a considerable amount of still applied stuff.

Sutherland: Absolutely, yes.

Sproull: So can you get-- can you gauge that in some way? I mean if you're talking about electromagnetic theory that's obviously not-- that's--

Sutherland: I mean that's Maxwell's equation.

Sproull: That's Maxwell's equation and differential equation solving and boundary value problems and all that good stuff. But what-- there were probably were antennas and power--

Sutherland: Yeah, you learn some-- well, right. But ham radio guy cares about antennas <laughs>. And but I mean I never really got into--

Sproull: Never made too big an impression.

Sutherland: -- antenna theory. But no, the hardest part for me was the differential equations about diffusion in semiconductors and stuff like that. Now, it turns out that at Rensselaer, one of the-- we had to substitute some the Navy's elective classes for their elective classes. And the Navy said, "Oh, you're going to sea. You'll have to take our naval boilers class" <laughs>. So what was I going to lose out of the RPI curriculum? What I lost was thermodynamics which was a dreadful loss. I mean I should have had all <laughs> the stuff that goes with thermodynamics, so I'm still a fairly ignorant thermodynamicist. I know entropy was.

Sproull: Yeah. Okay, so-- go ahead.

M1: Just a question about the computer that you were using for the rangefinder project.

Sutherland: TX-0.

Brock: Could describe what it was like using it? How did you get access to it? What was it like using TX-0?

Sutherland: It was-- yeah, well, I loved it. I mean it was a really nice eight bit machine. And I think it was eight bits. Yeah, if not 16, I don't think it was 16. And it had a paper tape input and paper tape output. And a bunch-- I don't remember how the IO, how I was able to hook up the IO. But I guess it had an A-to-D

converter on to it 'cause I would've had to detect the pulses, the pulses that come back. And it was run in the same way the TX-2 was, which was a sole user, I was the user.

Brock: Got it.

Sutherland: There was no time sharing. You signed up for it and you got an hour when you needed. And there were rules about signing. Ivan has actually written a paper on how you do bidding to manage this kind of stuff. But it was in one of the rooms in a building on MIT campus and it was-- it's a great thing. I mean there were-- there was a bunch of the-- the guy, Alan Kotok and bunch of others who were sort of the MIT computer guys who were just-- they'd help me with the things that I needed and so forth. But they were-- it was really a great bunch of that-day equivalent of the hackers.

Sproull: So do you have any idea-- roughly how many TX-0 users do you think there were, order of magnitude?

Sutherland: Order of magnitude, probably less than a hundred but more than 10. How's that?

Sproull: Okay, that's good.

Sutherland: <laughs> Just to be sort of order of magnitude.

Sproull: Oh, that's fine. That's fine.

Brock: And you'd bring your experiment to the computer.

Sutherland: I cart my stuff on a cart and bring it in, hung it up, turn it on. This thing rotated. It had a couple of big headlights on the side 'cause you needed light for the photomultiplier to detect the edges <laughs>. And it was kind of a beast. I think I still have it actually somewhere. I could donate it to you guys if you wanted it <laughs>.

Sproull: Okay, so let's move on to Lincoln. So you-- after your master's you started a PhD program.

Sutherland: Right. And the reason, Lincoln had a fellowship program that the Air Force funded. I think it was actually a recruiting mechanism for them, where you could go to be a-- basically let's call it an intern at Lincoln lab. And they would pay your tuition and some small stipend. It was kind of like my Navy ROTC thing. And Ivan was up there doing the TX-2, so I said, well-- besides that I lived in Lexington, Mass., so I

could actually-- used to ride my bike down the hill along and then back up the hill to Lincoln. And, at the same time, I was in a flying club at Hanscom Field so I was flying out of Hanscom. So I applied for this program and I don't-- for this fellowship and they gave it to me. And I-- so I went out to Lincoln and said can I use the TX-2. And Wes Clark was there--he's terrific. He said, "Yes, sure." So what I decided to work on, I mean I had some more courses that I don't remember but I took them. And then I decided, well, what I'd like to do is draw a picture. Having seen what Ivan was doing with drawing pictures, I said why don't I draw pictures that we can then execute as programs? So that's what I decided to do for my thesis. And it was a wonderful bunch. That was a terrific machine. The maintenance guy lived just across Route 128 in Lexington, so when you are working at 2 A.M., if it--the machine bombed out you could actually call Omar and he'd get up and drive in, and try and fix it for you. Anyway it was marvelous. It was a-- it's a fascinating machine. It was shutdown on Wednesday to be rewired.

Sproull: So were you as a PhD, were you allowed to repair the machine or to try to diagnose problems with it, if it failed?

Sutherland: Well, yeah. I mean the thing they most liked is if you could set up-- there was a bank of toggle switches. And if you could set up a toggle switch program that you could start that would fail, that was a huge help for debugging it. So with that we could do and--

Sproull: So what was the most common type of failure, do you remember? Or was there any?

Sutherland: Oh, cold solder joints.

Sproull: But they could be anywhere in the whole machine <laughs>.

Sutherland: Absolutely. But--and transistor failures, not a lot but transistor failures.

Sproull: Was the memory a problem?

Sutherland: The memory was pretty good. It was-- this machine had for the time had a huge memory. It was 64K bytes of core memory. It was a big thing driven by vacuum tubes and, of course, those could fail, too. So your memory problems were generally a drive or vacuum tube problem. Had the marvelous tape drive which was the big version of the little DEC, the little DECtape drives with no moving parts except the tape and a fixed head and sort of smooth tape--

Sproull: Yeah-- route or--

Sutherland: Yeah, grooves in the thing that the tape rid in. It just take it up and it was variable speed, so it was started. But the tape drives are about this big, a whoosh, whoosh, whoosh, whoosh, whoosh, whoosh, whoosh.

Sproull: So let's go a little bit back to your thesis. So the style of programming or programs that you were drawing on the screen and then getting to simulate essentially were dataflow.

Sutherland: Is dataflow kind of. Was the idea was draw boxes of functions, hook them together with dataflow, and then there had to be some rules. And then I wrote the interpreter to do the executions. But there had to be some rules about could you keep data once on an input lead once you put it there. Or did you-- or did you want to say this is just one time use data only and it's gone afterwards? And you could put a little zero on the thing to--

Sproull: So there were rules about the flow.

Sutherland: The rules about the flow, right, about how you could realize what was happening and you could do feedback. Yeah, you could feed the thing back if you wanted to have a feedback. And but the graphics was just draw some boxes. Again, this was sort of a derivative of Sketchpad and stuff.

Sproull: But I want to go back to the dataflow again because later, or maybe at about that time, the campus CS people were getting into dataflow machines and--

Sutherland: Right, Jack Dennis and all.

Sproull: -- actually building some. I'm sorry.

Sutherland: Wasn't that Jack Dennis?

Sproull: Yeah, and Saltzer, I think as well.

Sutherland: We had very little contact with--

Sproull: But so but did you learn about dataflow from-- I mean was there something-- were the flow rules things you invented? Or was it--

Sutherland: The flow rules were something I had to dream up to make it work.

Sproull: Okay. Because it's extremely similar, I think, to what they were doing as well. And maybe it's natural, comes-- you got to solve that problem if you're--

Sutherland: Yeah, you got to solve the problem. So I said, well--

Sproull: It's either a combinatorial circuit or it has to have some rules about flow.

Sutherland: Yes.

Sproull: Yeah.

Sutherland: Yes. And your choice was-- what the simulator did is it looked at all these things and decided which one has enough input to do and then it would do it. And it [would] propagate the output to wherever it was going. And then it would go back and say, "Now which one can I do next?" And that was-- when you're doing sort of early stuff, you could do very simple stuff and its new <laughs>.

Sproull: That's true <laughs>. So I just want to pursue this a bit 'cause it's kind of a thread we probably won't come back to. But this, of course, was the beginning of lots of people in various settings using drawings to represent programs, not always dataflow programs.

Sutherland: Right, absolutely.

Sproull: And, in fact, even today, for example, some of the programming languages or programming schemes for kids are essentially diagrammatic. Things like Scratch, for example--

Sutherland: Yeah.

Brock: Yes.

Sproull: -- that Mitch Resnick did at the Media Lab, is you essentially move little tiles around, and--

Sutherland: Right.

Sproull: -- the pictorial representation of your program that then gets interpreted and executed.

Sutherland: Right.

Sproull: But the one thing that your thesis-- your thesis was early and I guess first.

Sutherland: I don't know.

Sproull: But this was actually tested later in a patent suit because National Instruments sued MathWorks when MathWorks, they're the MATLAB people--

Sutherland: Right. Right.

Sproull: -- tried to use a pictorial representation of a MATLAB program. Whereas National Instruments had an instrumentation scheme that--

Sutherland: That drew pictures and--

Sproull: They used pictures to set it, to configure, and essentially program it.

Sutherland: Right.

Sproull: And so, Bert, tell a little bit about your role in that suit.

Sutherland: Okay. I guess an aside, earlier all along, when I was at Lincoln, and other things like that, software was not patentable in those days. And all of a sudden I think, at least I felt it, so why is it patentable now? What's changed? You know, what's different? And I don't know, I mean the history of how that change actually happened is probably pretty interesting to understand. But anyway, so the lawyers for MathWorks were searching various places for relevant background that they could use for the suit, so they called me.

Sproull: Prior art.

Sutherland: What?

Sproull: Prior art.

Sutherland: Prior art, yeah, prior art. So they found my thesis and called me up and said, "How would you like to be a witness for us?" And I said, "Yeah," I said I didn't think that the patentable software was a very good idea at the time and I still don't but my feelings are irrelevant about the issue. But I said, "Sure, I'd be glad to work with you." So we did depositions. The law firm had a branch in Mountain View and so I did depositions out there.

Sproull: This was 2005 by the way just so we're recalibrated.

Sutherland: Okay. Yeah, that's after all, I moved out West in 1990 I think.

Sproull: We'll come back to that.

Sutherland: So I said, "Sure I'll do it." And they said, "What are your fees?" I said, "Well I'm against this software patenting stuff, so I'll do it pro bono for you." So I said, "Okay, but," I said, "You have to pay my expenses because I'm not going to fly." So we did some depositions and then I went down to the Marshall, Texas patent mill <laughs> and I mean the whole town was sort of dependent on the judge down there for the food for the things and the-- I mean, the economics of Marshall, Texas was based on patent suits. I went down there for two weeks and I testified at the trial and what I found interesting was the jury that we were dealing with was just sort of I guess what you'd expect. The most educated-- we got a little bit of background of the jurors, the most educated, the person with the most education on that jury was a second grade teacher and most of them were farmers from Texas. They were here doing this patent suit on the trickiness of prior art on graphical programming of software. I mean-- anyway, we made it through, we lost the suit. Well, I mean what do you expect from a jury like that. But the nice thing that came out for MathWorks was I think there was some limit, the judge put a limit of something like two million dollars on the damages and I think each side probably spent ten on the suit. So I mean it was sort of a poetic justice after all.

Sproull: Okay, so let's return to Lincoln, I just wanted to get that in there. So you submitted your thesis in December, 1965, I think you remarked to me that this was your Christmas present to yourself.

Sutherland: That's right, December 23rd.

<laughter>

Sutherland: It was my Christmas present to myself, to finish it and turn it in. My committee was Shannon and Tom Stockham and Steve Coons I think, I have to remember, but anyway they looked at it and said, "Fine, you're done."

Sproull: Three signatures.

Sutherland: Three <inaudible>. The thing that finishes a thesis is three signatures, you know.

Sproull: But you stayed on at Lincoln.

Sutherland: I was then hired to stay on at Lincoln. And it have various-- I mean TX-2 was doing all kinds of things. We got to watch Amar Bose do his acoustic research with "Joe took father's shoe bench out, he was waiting at the door," that came out of the TX-2 all the time, all the time, all the time. Tom Stockham had done a lot of his audio stuff.

Sproull: He was in noise and pictures and picture coding and things like that.

Sutherland: Right. Larry Roberts was there, Larry had written the macro assembler for TX-2 which was really beautiful and then Larry finally got dragooned into going down the run to ARPA.

Sproull: But all this funding, this was still all Air Force funding?

Sutherland: Yeah, when I was hired, I believe it was Air Force funding but then part of that shifted to become interested in integrated circuits. And I can remember going down to Philadelphia to whatever the IC player that the Air Force was using. Philco.

Sproull: Philco.

Sutherland: Philco. And they'd had, I mean it was kind of interesting, they had a big shutdown of their fab system because the floor cleaners had used the wrong sodium wax on the floors. So the semiconductor fab was done until they scrubbed it off and got new wax. So, I'd learned that. But then, so we had this TX-2 graphical thing so why not try and draw some masks, so we did that. One of the things we'd added onto TX-2 was a tablet, Sylvania made a tablet, commercial tablet that you could buy from Sylvania, is their lab down in Waltham or something and they had made this tablet, we hooked it on the TX-2. It was actually an interesting way--it was a conducting sheet that they had driven very judiciously with two frequencies, one for this and one for that, and what the pen actually did was a sensor for the electric field and what they had managed to do was a hyperbolic sine electric field that could sense X and Y and then when you touched there was a switch in the pan and you could actually tell that you'd touched but you could do the tracking without being terribly close, so that made it nice, you could definite action, it was easy to have definite action. Now of course Rand had done their tablet and all that stuff, so tablets are not new.

Sproull: No, but there weren't very many around.

Sutherland: There weren't very many around, that's right. And Jim Curry then made sort of a prototype [shape] recognizer, make a tic-tac-toe box and then if you make-- the order in which you go through these boxes, you can decide what shape it is.

Sproull: I see.

Sutherland: So in fact I either have a movie or you have the movie already of it, it's, you could draw a transistor of a particular kind. Now what I was doing at the time because that was sort of, the technology was emitter-coupled logic transistors, so you could draw a transistor, boom, you got the transistor. You could draw a wire, you could draw a wire…

Sproull: So this would probably today be called a gestural input.

Sutherland: Yes, that's a good word.

Sproull: So you use gestures of the pen that then got converted into drawings of components <inaudible>.

Sutherland: Or commands, I mean you wanted to erase something, you'd just scribble it out and it would go away.

Sproull: Right.

Sutherland: So it was simple, but that was a subroutine for TX-2, so you could do that sort of stuff. And I did a poles and zeroes kind of thing where you could draw this and put in your poles and zeroes and see the transfer function that you get. We took my thesis basis stuff and the signal processing guys could draw--you have a filter, you have a thing, you could draw the box, put it together and put clippers on it and you get square -- and then run it. So there's kind of lots of stuff like that that we're doing.

Sproull: And one of the people who was working on the mask stuff with you was Fontaine Richardson, is that right?

Sutherland: Fontaine Richardson was doing that. We hired him from Illinois I believe. And Jerry Feldman was my first office mate hired into Lincoln, he and I shared the same office.

Sproull: Oh and then Fontaine went off and actually started a company to do this.

Sutherland: Fontaine and Dick Spann and some others started Applicon.

Sproull: Right. Very soon after that or right about that time, right?

Sutherland: Yeah, I think I had left when they got going with that. I mean that was when the mini computers started and PDP-11 was out.

Brock: Were you drawing a circuit diagram that then would resolve into various masks for the layers or were you…

Sutherland: Yes.

Brock: Okay.

Sutherland: No, you draw the transistor, the ECL transistor and then you could choose various views of the layers that were built in to that transistor, so you could say, "Okay, let me look at the diffusion," and you did that by circling or writing it-- there was a place you could write a number like one or two or three and display would change.

Sproull: But maybe to in a way what's David's question is, you were positioning things as they were going to be laid out on the masks.

Sutherland: Correct.

Sproull: And so for example, wiring had to be done in such a way that you could actually wire it up with for example not causing shorts.

Sutherland: Yes, yes.

Sproull: Okay.

Brock: That's interesting.

Sproull: So it was more like layout than circuit diagram.

Brock: Right.

Sutherland: Right, yes.

Brock: But there's also some automatic generation of the different layers.

Sutherland: Well, you could filter out the layers. What you saw was sort of a composite view of all the layers.

Sproull: Right.

Brock: But were you drawing…

Sutherland: And then you could select which ones you wanted to see.

Sproull: Because I don't think anything was being automatically generated.

Brock: Okay. You were drawing each layer.

Sproull: Right, well no, a gesture would bring up a transistor which was a macro if you will for several layers, for some diffusion, some ohmic contact, some metal and so on.

Sutherland: Exactly.

Sproull: But it was multiple piece components but all positioned as one thing on the screen.

Brock: I see, you're drawing it on all those layers of the-- you're drawing it on all the masks at once.

Sproull: In effect, yes.

Sutherland: Yes.

Brock: Got it, thank you. Sorry.

Sproull: Good question.

Sutherland: I mean, again, this was simple stuff, we were doing the obvious thing.

Sproull: And by the way, at that time, to build an ECL transistor, you did it exactly one way, it wasn't like the Mead Conway stuff where you could choose geometry for your gates and diffusion regions. There was essentially one approved ECL transistor and you used it.

Brock: Right, understood.

Sproull: Or a few, there were a handful, but.

Sutherland: The other thing that we did that was fun there was so now we started to make these masks so I mean the Air Force, we were doing this, it was kind of interesting, the Air Force, so we said, "Well, we're going to do that, how are masks made?" So we went and found the D.W. Mann Company in Burlington who made masks. So they had a mask maker and it was really fascinating technology, I mean it was an X, Y table with a camera above and you could focus it and the making of the X, Y tables is fascinating, it was scraped, so they'd get the big cast iron table, put them together, find the high spots with soot, in between, then guys come with a scraper and they'd scrape off the high spots on both the top and the bottom. And then they put it together again and this repetitive process and it could easily probably take a week to make one machine of the things. But it was run by a punched paper tape. So I thought, well let's make some masks. So you had Larry's macro thing you could define, you didn't design it but you could define a mask set for memory cells of--the memory cell looks like this and with the macros you could then say…

Sproull: A layout.

Sutherland: …"Oh, here's my basic cell, let's step it along here, let's step it along here." And then since it was an executable program, you could then execute the program which would record the dimensions, the settings for the mask making machine at that location. And then I thought, all right, let's do a little more, let's sort it so that you can-- when you did it manually you said, "Well, I want do here then we'll move over here and we'll do it here and we'll do it here." But I said, "Let's sort it by looking at all these blocks that we have to draw and let's sort them by which one is closest next to do. I mean it was a stupid…

Sproull: Well this is what you did with pen plotters too at the time.

Sutherland: Yeah, okay, but I mean it was a simple sort but you just, for each one figure what's the next least time move to make. So I did that for one of their masks and the machine went bam, bam, bam, bam. They had never seen it move that fast at D.W. Mann, I mean we punched the tape and took it over and they said, "Run this and see what it does." They were amazed. But anyway they were very cooperative and very nice so I don't know what's happened to them, they're…

Brock: They were acquired I think by…

Sproull: So this might be a good place to stop for a break.

Sutherland: Sure.

Sproull: Unless there's anything about Lincoln you want to follow up on.

Brock: Well I would be interested to know about how it was in your PhD work with Claude Shannon, what sort of interaction did you have, what did he think of your project, what your experience of him was like in those years.

Sutherland: I mean he was very supportive, very helpful. He sort of looked-- I don't remember any particular advice that he gave me, if it was sort of key in finishing it or something. He'd come down and look and say, "Yeah, that's doing well, do a little more." I mean one interesting thing came when I decided I could draw these programs and interpret them and one of the things that I added was some functions. I mean I had to write the interpreter, the actual action for the blocks but I could make some things that would move the block. There was a block you could include in the program that said, "Move this block two units right." So I once made actually a program that looked like a big giant walking robot that could walk, if they executed it, it would walk itself across the street.

Sproull: Oh, that's cute.

Sutherland: I mean it was fun. And of course the signal processing the guys had a lot of fun with filtering and clipping and so forth. Claude, Claude would come-- I would go down to his house, he lived down on the lake in Arlington, Virginia, not Arlington, Virginia, Arlington, Mass for discussions, most of my meetings were at his house, not in the MIT office. And it was-- he was a very, very wonderful and his wife was terrific, so it was not quite the same family thing that Ivan had with, so forth but he was a very

splendid supervisor for my thesis and I made it. I got three signatures, so that's what matters. What else can I tell you?

Brock: Just, the last question would be again about him, why do you think that it was the case that you and your brother constituted half of his PhD students, why didn't he have more?

Sproull: Who were the other two?

Sutherland: The other two, for a long time I said there were three, I thought I was the last one. There was Henry Ernst who was an Austrian doing a hand thing of some kind on TX-0 and then Ivan and then me and then I found out not so long ago that Danny Hillis was the fourth. I didn't realize that, I didn't know. But I think the reason is, number one, he didn't go down to the university very much, I mean, yes he was a full tenured professor and all of that but anyone who really wanted him could be brought up to his house, which is hard to recruit students that way.

Sproull: But he was perfectly welcoming once you got there, was that it?

Sutherland: Oh, yeah.

Sproull: It's just that most people perhaps might not have recognized that would be the case.

Sutherland: Yeah, I mean, you're scared, "Oh, I have to go to Shannon's house, ooh," I'd be terrified. But he and Betty were just people, they were nice. And he had this cable car down to the lake from his house. So, no, it was-- but I mean he had done sort of the major things that he was well known for and he was a fixture. So he probably appeared to a lot of people to be fairly unapproachable but in fact he wasn't.

Brock: That's fascinating.

Sproull: I think that's right.

Brock: That's fascinating.

Sutherland: I got from Wiley, John Wiley, the publisher, a compendium that thick of his papers. I don't know if you-- you guys should have it.

Brock: I know of it, yeah.

Sutherland: I should bequeath the museum my copy.

Brock: That would be wonderful.

Sutherland: I mean it's a historical document, I mean it's got all kinds of stuff, just amazing. I could remember, when he did go down to campus, I can remember him on his gas powered pogo stick.

Brock: <laughs>

Sutherland: It was a one cylinder thing. I mean he was a balance nut. In fact one time we had him over and invited Huffman who was also a balance nut over from next door for dinner and the two of them sort of had their own challenge on the…

Sproull: Bongo boards.

Sutherland: …bongo boards with this and on the-- Shannon's real challenge was the round plate with a bowling ball underneath…

Brock: Oh my gosh.

Sutherland: …bowling ball underneath it.

Sproull: So I think our next step is over to BBN, Bolt, Beranek and Newman in Cambridge right near Fresh Pond.

Sutherland: Yes.

Sproull: So what took you there?

Sutherland: Well it was time to leave Lincoln and I can't remember a lot of the events that happened but…

Sproull: So BBN at the time had ARPA contracts…

Sutherland: Yes.

Sproull: …two divisions, there was a computer division and then there was Frank Heart's division, I don't know what it was called.

Sutherland: Computer Systems I think, something like that. One of the reasons is that I knew Danny Bobrow down there. Danny and I had met through Ed Berkeley and I mean one thing leads to another.

Sproull: So Danny was a Bronx High School of Science guy, wasn't he?

Sutherland: Yes, right. But Ed had known him somehow and he actually wanted to go down with us to Bell Labs but my mother didn't want to drive someone she didn't know through New York City, traffic, et cetera, et cetera, so Danny showed up at Shannon's as I recall but he had to take the train down to…

Sproull: I see.

Sutherland: …to I think-- but I'd known him when he-- so I think that was part of the connection. And through the ARPA, Lincoln was an ARPA contractor at that time and so we'd met at the various ARPA meetings.

Sproull: So you joined Jerry Elkind's division which was the Computer Science division.

Sutherland: That's right. And one of the things that I needed to do, I mean I had to do something down there and so I thought, well air traffic control would be an interesting thing since I'd been a Navy pilot and they had just started a new transportation research center for the Department of Transportation in Cambridge. So I think one of my first jobs down there was to go get a contract to do some work. So I went over to DOT and managed to enter a competition, we were competing with Raytheon because they needed to show pictures of airplane stuff in their research lab. So I competed to do that and I built a PDP-10 system with the E&S display on it that allowed you to define the routes around a terminal, around an airplane terminal, the approach routes, how do you time the planes to get to the runway at their scheduled landing time, et cetera, and I made a PDP-10 assembler macro system with macros for different things to do like fly to this place and then take up this heading and go until your time left to fly to your approach time is what it is then turn and go directly to that place. And you could build something out fairly complicated route structure around the New York airports or the Boston airports or whatever and you could launch-- I mean these were basically-- it was a simulation, you put in the structure and then you

simulated it by putting individual airplanes on each of these routes and all the airplane was a state of speed, altitude, heading, et cetera, et cetera and the interpreter went around over and over and over and just moved them another step forward. So you could make a very nice looking traffic display with-- things shooting off in different ways and it worked fine and I actually beat Raytheon in winning the contract. But again, I don't think it ever got very much use by the guys, I think they used it for demos mainly. So then I was also working with Larry, Larry by then had moved down, Larry Roberts had moved down to the ARPA and the TENEX system was being supported by ARPA now.

Sproull: And TENEX was being done by a small band in your division at BBN.

Sutherland: Yeah, I mean the division had some speech work in it, Bill Woods and some other people.

Sproull: John Makhoul.

Sutherland: John Makhoul, right and there was a human factors interest. It's hard to go back and remember all this but at that time Larry, we were thinking about TENEX had no billing basically built into it and Larry said the ARPANET should have some kind of charging system. And I think that's one of the biggest mistakes that was made in bringing it although I can-- the idea that the whole development of this new infrastructure was no charge--didn't cost you to do it--was very important but it has also come back to bite us because you can't charge for it in any natural way. And Larry once said to me, "Bert," he said, "You've got to try and figure some of that out," but I never got anywhere with it.

Sproull: But you also mentioned to me that this was your first I guess introduction to government grant finance accounting and you learned a lot about how that was done.

Sutherland: Yes. The ARPA contract for BBN leased the computers from that because the government plus fixed fee contract, depreciation was not allowed, you couldn't buy your computer and charge the depreciation against the contract but you could lease your computer and not own it and the government would pay the lease payments.

Sproull: This is called a no-brainer I think in today's lingo. <laughs>

Sutherland: It is, but it was pretty weird. But the government, I mean the government contracts are a different kind of a beast in many ways because you trace it way back to Congress, Congress wants to have control and it's very reluctant to do anything that releases control of the appropriations and that's sensible, that's what they're charged to do, but it causes troubles. So I learned a lot, the accountant that I had, Billy Diskin in that division was really a tremendous help in understanding the government contracts.

So my air traffic stuff control went on for a while and then basically there was the migration from Cambridge to Palo Alto when PARC opened and Danny Bobrow left, Warren Teitelman left.

Sproull: Jerry Elkind.

Sutherland: Jerry Elkind went and so forth. So the other guy who was in charge at BBN was John Swets, he was basically an acoustician tied with Beranek, Leo Beranek. So he was my boss and I went to him and said, "Oh, this is terrible, Jerry's leaving, the ARPA contracts will be a mess," et cetera, et cetera, "You need to do this and this and this and this" "Look, Bert," he says, "That's fine, you're deputized to do it, go do that, you know what to do, go do it." So I became the vice president in charge of that division and then I had to go negotiate with Steve Crocker and Larry and, I mean I knew the ARPA people but still it was an annual negotiation for a couple of million dollars a year and the whole operation was depending on it and I felt pretty tense about that, it was a lot of responsibility for other people.

Sproull: But it must have also been-- you must have had a great deal more contact with the ARPA community as a whole, partly because everybody was salivating over TENEX.

Sutherland: Oh yes. And we had-- the various ARPA principal investigator meetings that we called the ARPA Games <laughs> where we went and talked about things. That was the one where Wes Clark about the network suggested the IMP as a way of taking the networking out of the various IBM, Burroughs--all the different machines that would be on the net and make the network a self contained entity that had peripheral devices over the main machines that were going to be used.

Sproull: But just to be clear, that was fairly early on, that was what, '66?

Sutherland: Yeah, I'd have to look at the charts but yes, it was a fairly early meeting.

Sproull: Because by '68 I think BBN was shipping IMPs.

Sutherland: Yes. The contract went to Frank Heart's division.

Sproull: Right.

Sutherland: And some of the people that were there, Jerry Burchfield, Ray Tomlinson was, I call it the wizard, systems wizard in my part, I many time said, "If Ray Tomlinson can't do it, we can't do it."

Sproull: Well, and Dan Murphy was the other mover behind TENEX.

Sutherland: And Dan Murphy was the other nucleus and he got annoyed at me one time and quit and left for DEC and essentially took TENEX and modified it into whatever it became, the DEC commercial operating system.

Sproull: Yeah TOPS-20.

Sutherland: The PDP-10. And DEC then built their own paging system into it. BBN had built its own paging box and that whole business started I think because Teitelman and Bobrow wanted to be able to take their LISP code and use it with larger virtual memory…

Sproull: Exactly.

Sutherland: …without having to rewrite the LISP, so they just wanted a PDP-10 with big virtual memory and that's what TENEX gave them.

Sproull: That's right, exactly.

Sutherland: It was interesting and we had an E&S display that Ivan, that…

Sproull: LDS-1 that worked on TENEX.

Sutherland: Yeah, LDS-1, right.

Sproull: Worked on TENEX with the paging.

Sutherland: Right, right, with the paging. So I was able to show the air traffic routes and airplanes.

Sproull: I think you also mentioned that Bob Thomas did an experiment with TENEXs coupled through the net trying to see if you could hand off airplanes or something.

Sutherland: Oh yeah, Bob Thomas took this simulation system which once there were a bunch of TENEXs out on the ARPA network could all run it. So we thought, well look at this air traffic business in the way of-- so let's put a center of this simulation in each, four different TENEXs around different places

and let's experiment with how do you pick up one set of things and move it over the ARPANET to another TENEX and reinstall it and not lost the state. Now the ARPANET in those days started on 50 kilobit lines and it could be forever to move a big program and data and everything somewhere else, so that wasn't very effective but I think we learned something about how you freeze-dry something in one machine and move it to another one. So it was interesting but I can't say that it was enormously practical about anything.

Sproull: So let's keep moving here.

Sutherland: All right.

Sproull: So in 1975 you were recruited to go to PARC yourself.

Sutherland: Yes, and I think a lot of that had to do with-- well the people who knew me that had already moved from BBN—Danny and--I was never very close to Warren Teitelman but-- and I had met Alan Kay earlier at one of the-- in fact it may have been the very ARPA PI meeting where the IMP got created if you like. I had-- we were up in Alta, the resort in Alta outside Salt Lake City and this snow storm came and a bunch of the graduate students were trapped up there. So the empty bunk that Alan Kay moved into was in my room, so Alan Kay and I were roommates before we knew what was going to happen in years later. He was always a very interesting character. But I think Alan had a big part in recruiting me to PARC and suggesting that, "Oh, we should get Bert to come." The System Science Lab where I came in had been run in an interim manner, I think by Howard Hall first and then he moved to help Pake do whatever things they did, he was certainly many years ahead of me in age. So I came to PARC to fill the vacancy in the System Science Lab.

Sproull: Let's go through some of the projects in SSL at the time. Probably the top one was Smalltalk.

Sutherland: Yes, with Alan and Adele Goldberg and Dan Ingalls and…

Sproull: Diana, Diana Merry.

Sutherland: And what?

Sproull: Diana Merry?

Sutherland: Diana Merry, yeah. And I think actually Bob Flagal was kind of attached to that…

Sproull: Kind of.

Sutherland: …as he escaped from CSL.

Sproull: There were fluid arrangements.

Sutherland: Right. They were doing-- this is the Learning Research Group and they were experimenting with how kids could learn to do software. I didn't understand, I mean I liked Alan and he's certainly a very creative guy but I didn't really understand quite how he thought he thought he was going to impact a child's education.

Sproull: Well but there were some experiments deploying Smalltalk into schools both in Palo Alto and LA.

Sutherland: Yeah, and they took it down to Jordan Junior High in Palo Alto, but again I didn't really understand how that was going to help the Xerox Corporation make money on printers, what else it could do.

Sproull: Okay.

Sutherland: There was speech work with…

Sproull: You and I have discussed this and I want to go down sort of in order of…

Sutherland: Okay.

Sproull: So the second one on your list was Gypsy.

Sutherland: Gypsy was one of the editors, advertised as a modeless editor as opposed to Bravo which was the editor from-- the Bravo thing, and I remember was if you typed "edit" into Bravo, it said, everything, delete, I, insert a T. So that was not the thing to do for that. Gypsy was the kind of thing we do now where you select something and then operate on it and I much prefer that as a style of working. They were working with a Xerox educational subsidiary in Lexington, that was in Lexington, Mass.

Sproull: Ginn, Ginn Book Company.

Sutherland: Ginn Publisher and so that-- but that was kind of a spur program, not very much.

Sproull: Yeah, this was Larry Tesler and Tim Mott…

Sutherland: Yes.

Sproull: …and they used the Bravo infrastructure but not the Bravo user interface.

Sutherland: Right.

Sproull: And this was the first time--Larry had been on a kick trying to reduce modes for years…

Sutherland: Yes.

Sproull: …but this was the first time he was able to actually make it modeless.

Sutherland: Actually do it, right.

Sproull: And so machines were sent to Ginn…

Sutherland: Absolutely.

Sproull: …and they used them.

Sutherland: They used them for their publishing work. So that was a good one.

Sproull: And then the third one…

Sutherland: POLOS.

Sproull: Well we'll come to that in a moment.

Sutherland: All right.

Sproull: The third one, again, you mentioned was the human interaction performance stuff: Card, Moran and Newell.

Sutherland: Right. And Allen Newell was a very expensive consultant that I had to fit in my budget. But that was good work. They did a lot of good things. There were various studies of how people would interact, what were efficient ways of doing it, and so forth. So, that was, again, to me was kind of-- well that's-- I inherited a bunch of these projects. And that's fine. They're going to just keep going. I don't have to do much on it.

Sproull: Right, those were the three that you encouraged and kept around.

Sutherland: Yes.

Sproull: Now, there were some that you reorganized.

Sutherland: Yes. We-- every manager's entitled to at least one or two new reorganizations. And I had the-- I inherited the POLOS project. Again, it's hard to describe exactly the point given that the Altos were becoming so prevalent in Xerox. It was based on a cluster of Data General Nova's. It had a memory interface so they could all share memory space or communicate through their memories. And it had a-- the same display [CRT] was used for the Alto, but this display was driven by the Data General with a character generator on it. So, it was a text-based basically display.

Sproull: Text only.

Sutherland: Text only, yes, display. And I basically looked at it, and they had-- the idea I think was to split the functionality of the work among the different Data General machines specializing one for the editing and one for the file storage etc., etc. And it all worked. And it was going well. But again, it was time to change and do something different. Bill English had been the prime guy working on that I think. And so, I basically dissolved the project and surplused the Data General machines, which were unique in my world there because they had an Ethernet interface and you could connect them to a Bell telephone line. So, there were eight or ten Novas. And when I had surplused them, as the Alto grew pervasive in Xerox, [they were used] for the pseudo IMPs for the Xerox internal network at the Los Angeles office, the Stamford headquarters, Rochester etc. And the feature of that which I really remember was basically that the only thing-- expense that one of these recipients had to deal with was the expense, not capital. You didn't have to put in a capital request to get a computer to hook you up to the Xerox internal network. You just had to have a monthly bill from the phone company for the connection to the long lines. And it made spreading the Xerox internal network possible because, at that time, Xerox was capital short. It turns out that Xerox Corporation at that time found that T-Bills were more profitable than the company. So, they were very reluctant to spend capital money inside the company if you had to. So, it was like pulling teeth

to get capital requests-- capital requests approved. But I could just surplus these machines, and they'd fold it into their expense budget for the year. And that was-- it was a funny case example where the accounting behind research turned out to be surprisingly important. And at that time, Xerox PARC was being treated very nicely by George Pake, the director. He said, "Well, these researchers who've got to do all their hard thinking and new work," he says, "I won't bother them with capital budgets. I'll keep that in the center." And so, we had to write-- when we wanted to buy a new Alto, we had to write the requests, etc. But the budget that I got never had a depreciation in it. And that came along later after I'd long gone when Xerox really had to deal with the depreciation costs. PARC had built up a very big backlog of depreciation costs. It was an overhang that caused them much pain after I left.

Sproull: So, I can just add, so the other thing about using these Nova's as routers is imagine spreading Altos to the nether reaches of the company with no way to get updates or communicate with the mother ship. It would have been impossible. So, as a practical matter, making these machines actually useful in Dallas, or Webster, or Stamford, or whatever, it was essential that there be networking with them.

Sutherland: That's right.

Sproull: And so--

Sutherland: And the networking had to be maintained, and modified, and updated. And in the Sigma 7s that they got hooked to and other things, there was no real way to do that. You couldn't manage your network when part of it-- and that was one of the reasons to do the IMP in the first place. If you hooked up IBM 360, and a Xerox this, and a Honeywell, and a-- stuff, you had to manage the network.

Sproull: And the other thing, actually, again to intersect-- interject, this was one of the reasons Xerox actually had internetworking experience before the ARPA world did.

Sutherland: Yes, you're right. You're right.

Sproull: We had a need for it.

Sutherland: We had a need for it. And John Shoch and others had been involved in how do you do-- and the ARPA guys at BBN sometimes would call up and say, "How did you solve this problem?" And that was all very, very-- Bob Kahn-- Bob Kahn-- when I was at BBN, had moved over into my division from-- he and Frank Heart had had some fight about something. So, he didn't leave, but he came over in to work in mine. And I was sort of-- I was the parking place for Bob before he went off to do his independent stuff with the Corporation for National Research Initiatives.

Sproull: So, to get back to your reorganization, the other project was an OCR project.

Sutherland: It was a-- Xerox, at that time, made the commercial fax machine. And so, a research project at PARC had to do with making a more efficient less line charge cost fax by doing an optical character recognition and sending the character stream, rather than the bitmap of what you are wanting to send. And when you had to, you'd drop back and send the bitmap when you couldn't do the OCR effectively. And that was a project that had Mike Wilmer, who's-- came-- one of the few people who actually came to PARC from Rochester research. And it had a couple of technicians. And it had Lynn Conway, who had come to PARC after her debacle with IBM and so forth. And that's-- cancel-- I just canceled that project. And I asked Lynn-- by that time, Ivan had gone to Caltech and was with Carver Mead. So, I had met Carver. And I thought that-- well this-- and having done this stuff at Lincoln on chips, you could see that sort of the semiconductor world was coming along. And so, there was some talk, "Well, what should Xerox do about semiconductors?" And the answer was not much, but we should understand them. So, I asked Lynn if she'd start a little research group to do that. She had been designing computers for Memorex before she came to PARC. And so, it turned out that's how that started. And it's turned out very nicely as history will tell us.

Brock: Was Icarus already there on the Alto by the time this started?

Sproull: No, that was part of what became--

Brock: It was part of the projects.

Sutherland: Yeah, that was part of what Fairbairn did to-- I think it was Doug.

Sproull: Yeah, it was, yeah.

Sutherland: Doug Fairbairn did Icarus as part of a mask layout kind of thing to do.

Brock: Okay.

Sproull: But this happened fairly quickly. I mean Icarus was running by '77.

Sutherland: Yes.

Sproull: So-- and yeah.

Sutherland: So, that came quickly. And then the CSL guys had a funny time thinking, "Well what the hell are you doing with integrated circuits? We're not going to do that." So, there was-- we had friction between the labs. But that's-- in every swimming pool, there are a bunch of sharks, but they go along with the turf, or the liquid. But we managed.

Sproull: So, you had-- there were a bunch of smaller but no less exciting projects. Dick Lyon was in the lab. And did a--

Sutherland: Dick Lyon came-- well I don't-- I think we recruited him.

Sproull: Yeah.

Sutherland: Lynn managed to recruit him for the chip things. And what Dick Lyon wanted to do was signal processing. So, he was part of that. He's been a terrific participant. I'm trying to think of what else. Give me some more hints, Bob.

Sproull: Well you hired John Brown a second time.

Sutherland: Yeah. This is my second time to hire John Brown. I had hired him-- brought him into BBN, and at BBN with two PDP-10s got from Irvine. So, we had increased our leased computer center by a good amount. And then finally, I-- we had the speech stuff that Newell and Allen, and all that, and John Brown was doing cognitive learning kinds of things. So, I hired him to-- a second time into Xerox. And there's a funny story how that all happened, again, which is part-- you'll find part of my recollections are all tied in with the management of this stuff. Xerox-- shortly after I came, Xerox had a RIF, a reduction in force. The Xerox budget had gone to hell that one year. And George Pake was forced to remove a bunch of staff. So, George told me, "Bert," he says, "You have to release three people. Choose three. Release them." So, I looked around at what was going on. And there were a number of things that I had canceled, people had left. I said, "George." I said I'll make a deal with you. I want to RIF seven people. Now, three of them will be the ones you want. Seven of the people-- four of them will be people that I just need to move along. And one of the old sayings goes is never waste a good RIF. And I'd learned this trick from one of the advisory committees. I was asked to be on the Argonne National Laboratory Advisory Committee. And I did that with George Dodd from GM, where I'd been a consultant at earlier days. And I forget the other guys. But Argonne had gone through a RIF. The first three-year appointment on this visiting committee, first year, they'd just gone through a RIF, doom and gloom. I mean, the world was terrible. It was awful. We'd never survive, etc., etc. Second year we came back, it wasn't so bad. The thing is the Argonne director, the guy that I was consulting for, had had the wisdom to get rid of his dead wood. So, the second year we came back, there were four or five new slots for new people. Oh boy, was that exciting. We could get some new blood. We could get some change. And so, what it's-- the four slots that I got, I took and hired John Brown, Alan Bell, Richard Burton, and I forget someone else. But anyway,

so I got this cognitive group to come in and do stuff. And with the speech recognition people, and John, they got together and did a project where you could voice in a query about the moon rocks.

Sproull: That was at BBN.

Sutherland: That was at BBN, excuse me. Yes, I--

Sproull: It's okay.

Sutherland: I mean--

Sproull: That was the first John Brown hire.

Sutherland: That was the first John Brown hire. We did moon rocks for NASA. Here we did cognitive stuff. And-- oh, and I hired Alan Henderson, and Paul Rovner, and some others to do the cognitive kinds of things. And they associated a little bit with—Bobrow had gone by then. But this was a Lisp crew as well. And Alan Bell was a very good systems guy. And he found security flaws in TENEX etc. So, it was a-- he's been a terrific guy. But anyway-- so--

Sproull: Let's go back to PARC.

Brock: May I ask a quick question about that reduction in in force philosophy? Is that the concept that there's going to be pain and heartbreak anyway? So, you might as well take care of this--

Sutherland: Yes, I mean--

Brock: Differed personal opinions.

Sutherland: When you're going to have a RIF, it's going to be painful.

Brock: Right.

Sutherland: It is no thing. And you have to choose. I mean it stresses the manager to choose what he wants to keep so that he can regrow. So, yes, that was certainly part of it. On the other hand, the dead wood really needed to go.

Brock: Right. This provided a cover, if you will.

Sproull: Well, careful. You have to be a little cautious technically here--

Sutherland: Right.

Sproull: About how you refer to this. You can't call it cover. What he did is he RIFd three people, and he canceled projects with four people.

Brock: I see.

Sutherland: Yes.

Sproull: And the net effect was felt to be a RIF of seven people.

Brock: Right.

Sproull: But it left behind four hiring opportunities.

Brock: I see.

Sutherland: Yes. The whole business of managing people and preserving their rights etc., is very tricky.

Sproull: But in the research lab, the key thing is promoting enough flow, and change, and new opportunities. And it's a constant management challenge to do it.

Sutherland: That's right. You need the flow through the lab of new blood, of new thoughts, new thinkers, etc. And at Xerox-- yeah, at Xerox, we formed a technical advisory board. I mean there was one. There was one that had a bunch of people that-- I'm sorry, I leaped ahead with this point to Sun.

Sproull: Okay.

Sutherland: But you can see, I'm eighty-one years old. So, it's confusing. I have accumulated too much stuff to remember. But I've got a good memory across here.

Brock: No, no, that's great. Thank you.

Sproull: So, let me just come back. A thing I want to do actually is go through your roster a bit because I think a lot of people mistakenly think that most of the high-powered people at Xerox were in CSL. And in fact, it's not true. First of all, SSL had some really wonderful, first, great people.

Sutherland: Oh, you bet.

Sproull: A lot of them. And secondly, the other thing that people don't often recognize is how much work went on across-- maybe the managers didn't get along. But the individuals sure did. And they did a lot of work with each other in many different ways, not in very structured ways often, just by helping out.

Sutherland: Right.

Sproull: So, for example, among other people there was Martin Newell.

Sutherland: Yes.

Sproull: William Newman, whom I worked with, for example, a lot, even though we were in different labs. Dave Boggs, the co-inventor of the Ethernet, I think he was hired originally on POLOS, wasn't he?

Sutherland: I think so, yeah.

Sproull: And he was a hardware engineer. But he and Metcalfe got along--

Sutherland: And one of the reasons that some of the Ethernet came out the way they did is he is also ham radio guy.

Sproull: That's right.

Sutherland: So, he understood about jamming, and heterodyne interference, and I can't read you because some squeal started up.

Sproull: And John Shoch, whom you mentioned.

Sutherland: John Shoch.

Sproull: Did networking in SSL and then went on to do-- have management assignments in Xerox.

Sutherland: Yeah, John helped-- at PARC helped Bob Kahn with his packet radio--

Sproull: In the Bay Area Packet Radio Lab.

Sutherland: They were a packet radio network.

Sproull: Yes.

Sutherland: And funny from that, Bob Kahn said, "I've got to find some spectrum to use for this packet radio network. So, he said, "Oh." He said, "This range is used by the radars." So, he went to the FCC and said, "I'd like permission to operate this experimental network in this radar band." And they said, "Oh, no, no, no. The interference is too bad," and everything. And he said, "You'll never see it on the radar," because it was spread spectrum stuff that they were beginning to use. So, that was running. And I think SRI had a station.

Sproull: Yeah.

Sutherland: And some others. So, but again, that was ARPA and Bob Kahn and John Shoch.

Sproull: And more people, Jeff Rulifson, who came from Englebart's group.

Sutherland: He came-- it's from Englebart's group.

Sproull: Lucy Suchman later.

Sutherland: Lucy Suchman, yes.

Sproull: To more of the cognitive and social-- Mark Stefik.

Sutherland: Mark Stefik was the one that-- that's how I got fired from Xerox.

Sproull: We'll come to that. And then one that figures for you and me anyway was Jeanie Treichel.

Sutherland: Oh, Jeanie Treichel. I hired Jeanie as my first secretary. We had a-- I had to have a-- interview the two candidates. And Jeanie was sort of clearly the right one. So, she became my secretary. And she was terrific. She managed to do everything. She could type like a machine gun. And she manipulated the Alto very nicely.

Sproull: Well, and unflappable generally.

Sutherland: Yeah.

Sproull: You know, so--

Sutherland: She kept things going.

Sproull: Yeah.

Sutherland: And she arranged the meetings and the picnics, and sort of the-- she was the social mother for the lab.

Sproull: So, two events happened during your time in SSL that we really need to talk about separately. One is the famous Steve Jobs visit, which was December 1979.

Sutherland: Yes.

Sproull: He came to see--

Sutherland: Smalltalk.

Sproull: Smalltalk at the invitation of--

Sutherland: Abe Zarem. Abe Zarem was the-- he was part of the electrical-- Xerox electrical opto--

Sproull: EOS.

Sutherland: Electrical optical systems.

Sproull: Right.

Sutherland: Division in L.A. He was also a business guy. Bob just discovered he's a member of NAE. And-- but he ran a little venture operation for Xerox. And it turns out Xerox Ventures owned some five percent or something of Apple at the time. So, in order to help this Xerox investment, he invited-- he pressured the higher-ups in Stamford and down through Pake to invite Steve Jobs to come to PARC and look at Smalltalk. And Alan Kay and Adele were livid. We can't do this. This is really good stuff. You're giving away the store, etc. But he came, and he viewed it. And Alan did his usual kind of demo of all the different things you could do. And Jobs went back, and the Macintosh was born from that visit. And finally, they also hired-- Apple-- for a while, Apple hired Larry Tesler to go down to Apple. And he actually came to be a vice president of something down there.

Sproull: He has had a number of different assignments. So, the other one was fall '77, so a little earlier, was the big management meeting in Boca Raton, the Xerox World Conference.

Sutherland: Right, the Xerox World Conference. And basically, PARC was dragooned into showing everything we had to show how wonderful the future could be.

Sproull: This was an internal conference. This was not public.

Sutherland: Yeah, it was not a public conference. They invited all of the Xerox leaders from China, from Japan, from Central America, from-- anyway. And it was in Boca Raton, Florida. And so, we moved basically, most of the Altos.

Sproull: And most of the staff.

Sutherland: Altos down there. And the staff. It was a very expensive operation. The hotel exhibit hall where everything was set up was not air-conditioned. And so, all this electronic equipment moved down there stopped working. So, John Ellenby said, "I can fix this." John was, I think, in charge of moving PARC to that. So, he went down to Eastern Airlines, got a refrigerating truck that they used for cooling airplanes, brought it up to the thing, and cooled the hall with the Eastern Airlines refrigerator, which then made it work. And it turned to be-- it was allegedly a smashing success. And-- but I got through it. I didn't have to deal with it.

Sproull: Well, so I don't know. Was this attributed to you? But one summary statement about the day is, "The execs didn't get it, but their wives did."

Sutherland: A bit, yeah.

Sproull: That part of it is that many of their wives had been secretaries. And they looked at Altos and said, "My goodness. This could make a huge difference."

Sutherland: And the printer.

Sproull: And the printer.

Sutherland: The laser printer.

Sproull: Yeah, but the execs didn't see the business model. They didn't see products. They didn't see anything that was going to help their world.

Sutherland: Right. Well, Xerox, at the time, was really a very focused copier company.

Sproull: Yeah.

Sutherland: And that brought the patent issues to the fore because what Xerox was living on was the Haloid patents for xerography with selenium drums and ways of statically holding toner against the-- in the pattern that had exposed-- changed the charge on the selenium drums. And so, patents were a very big deal. Anyway, go ahead.

Sproull: So, I think now we can get to the point where you decided to leave PARC and what the circumstance was.

Brock: I would, would just one-- I would be interested in what you're thinking about the NoteTaker project.

Sutherland: The NoteTaker was something that Alan Kay wanted desperately. He had made this little aluminum frame Dynabook prototype just to show that you could have something this size, now about the size of an iPad, but thicker because it was three quarters of an inch aluminum picture frame with a cardboard inside. And he said-- he keeps talking about this. So, he said, "Let's see if we can do one." So,

I said, "Okay. That sounds like a good project." And Doug Fairbairn agreed to do it. And actually, I think at the time-- so, Doug ordered a bunch of the memory chips for it. And at the time, MIT was building its Lisp computer. And so, as I recall, I bought an extra set of memory chips on Doug's purchase thing and donated them to the MIT-- to those guys for their--

Sproull: Was this the Lisp machine they were building?

Sutherland: The Lisp machine they were building there.

Sproull: Okay.

Sutherland: And the other-- John's other guy I hired was his youngster-- the name will come back. I met him at the haircut place here several months ago. Anyway, so we built the NoteTaker. Alan's constraint was it had to be luggable. And it had to fit under an airline seat. And it ran Smalltalk of course. There was no OS, just Smalltalk, raw Smalltalk on the machine. And it worked okay. And Alan went off on a tour once and came back happy with his thing. He'd showed it off all over the place. And there were several, then, other luggables that were made commercially afterwards that-- I don't-- when you're working in a time of rapid technology change, nothing lasts very long. The luggables were not done because you could then make a smaller thing. And now, we have iPads and so forth. So, nothing sort of lasts very long, but you have to try. That's another thing about research if you want to think about it is the function of research is to make the companies mistakes early while they're still cheap. Then you can say, "Oh, I shouldn't have done that, but I should do this." And that's important.

Brock: Thank you.

Sproull: So, let's go to leaving PARC.

Sutherland: Leaving PARC. Well, after we had the success with all of Lynn Conway's chip design things and so forth, I sent her off to MIT to teach her-- she and Carver did this class work. So, I said, "Lynn you have to go to MIT and teach it." At the time, I was on the MIT visiting committee for the EECS department. So, it was not too hard to arrange. I paid her salary. I paid her living expenses, etc. to send her off to teach this class. And it turned out to be a smashing success. We made all the-- you've got a history down here somewhere of that stuff. And then we did several more of those for a while. And one-- the last one I think we said every university offering the course, "You send us the files, and we'll make the chips for you." And so, it was a success-disaster is a good way to describe it. We had to get out of it. But the Xerox Corporation wanted to be able to make some chips. Or they thought they wanted to be able to make some chips. So, they said, "Bert, take your people and make us some product chips--"

Sproull: Chips for products.

Sutherland: For product chips.

Sproull: This was-- these were not experiments--

Sutherland: These aren't experimental stuff to prove something. These are things we want to ship for customers. And I said, "I can't do that, no. You'll stress the team. It won't work. They'll be just-- it's a disaster waiting to happen. So, I'll say no early," which is again something you learn running research is you have to say no early. So, I said no. Well, that's fine. I got essentially sidetracked out, and they said to me, "Go do something else." George Pake donated me as a charitable donation to go help Jim Gibbons at Stanford's IC lab. So, I was-- six months I spent being associated with Jim Gibbons over in the EE department who's an absolutely terrific person. And but then finally I said, "Well, that's all." And part of what helped push me out was Xerox had-- I wanted to hire Mark Stefik for-- I think it was for John Brown's group. And I'd negotiated with him. We settled all the details and everything. Finally, Xerox said, "No, you can't have a slot." And at that point, I said I sort of promised it to Mark. So, I said, "Mark, I'm going to sign your requisition." And I went to the HR people and said, "I know I don't have the authority to do it, but I've done it. And you can boot me out if you want." Well, push came to shove. And after being with Jim Gibbons for six months, I went and joined my brother Ivan and Bob Sprout in Sutherland, Sproull, and Associates for a little independent consulting gig. And we were partners with Advanced Technology Ventures, a venture fund. And I and Jeanie moved into the Menlo Park office of ATV, the venture fund. And Bob was in Boston, which is the Boston offices. But he stayed with Sun and was running the Boston version of Sun Labs. And Ivan was floating around wherever he was at the time.

Sproull: I was still at CMU.

Sutherland: What?

Sproull: I was still at CMU.

Sutherland: He was still at CMU, okay. So, he was-- but anyway, so we did consulting gigs and a variety of things like that. It was a good experience to run the business.

Sproull: So, this was also the time when you got to know Wiley, I think.

Sutherland: Yes, I joined the board in '87, I think it was, of John Wiley and Sons, the technical publishers. And again, you go through all this and it's incestuous as hell.

Sproull: <Laughs>.

Sutherland: I once asked Brad Wiley, "Why did you invite me to be on the board?" And he said, "Because our board member, Bob Sproull, Sr., told me to." And but the Wiley [advisory] board was started, again, at Bob Sr.'s suggestion. And they hired Licklider, J.C. Licklider, and Bert Sutherland, and Pete Jenkins from Georgia Tech to constitute a technical advisory board for John Wiley and Sons publishers. And we did that for a couple years. We visited various places. Bob-- one of the things Wiley had never done was any desktop publishing. And Apple had just come out with desktop publishing stuff. So, Bob and I went to try and fit out Wiley with a desktop publishing. And pulling hen's teeth was to get the capital approved to buy the laser printer. How could you go into the modern world without understanding a laser printer, on-demand printing whenever you want. And so, after a while, the board [of directors] had changed. So, they asked me to join it for real. And I served on it for seventeen years as the independent outside director. It was very interesting. It was a family owned company, family controlled company with A and B shares. The B shares-- the family basically owned the B shares. And the public owned the A shares. And there were two prices. And the B shares the family owned had all the voting rights, basically. I mean it's-- it was a classic way of doing this.

Sproull: Yeah.

Sutherland: Classic financial way of getting public finance to-- but retaining control. And Wiley's still going strong. I mean the book survived. One of the benefits, as a director, is I could ask Wiley for a book, and they'd just send it to me. And it went on the overhead of the head office, I think.

<Laughter>

Sutherland: It had to be charged for. So, anyway, I finally left Wiley, I think, in 2003 or something, after I was retired from Xerox.

Sproull: So, I think the other-- and again, we don't need to spend a lot of time on Sutherland, Sproull, and Associates. But the thing that was wonderful was going on consulting trips with two of you rather than one of you. It really took the pressure off. It made it a lot more fun because you were with somebody you were calibrated about it. And you knew what they knew and what they didn't know. You could count on Bert to be the guy who would always want to inspect the chart of accounts.

Sutherland: You bet. I'd go into this technical review with a company and say, "Good. The first place I want to go is talk to your controller." "Why do you want to do that?" I said, "Because I want to look at your chart of accounts and see how you count the beans." "Why do you want to do that?" I says, "Well, it'll tell me what you can notice in the company. And if you can't notice it, I'm sure you're not managing it." And the chart of accounts is a fascinating thing when you see sort of the detail at which they're willing to push

the numbers through the system. And it was astounding the kind of things you could find in the chart of accounts. I mean, they'd have an "other" thing that would just be a mess of stuff that they hadn't bothered to split out because they didn't think they needed to. And, if you want to know what something is really costing you, you've got to know all the ingredients of the cost. What's the labor? What's the-- etc. So--

Sproull: And "other" was sort of a trailing indicator, wasn't it, of how the chart of accounts had diverged from what the company was actually doing?

Sutherland: You bet. You bet. They were trying to use the old accounting system for some job that really needed a new breakdown of accounts. I mean that was the trouble that I had in Xerox. Have we got to Xerox, yet?

Sproull: No Sun. Sun, you had this trouble.

Sutherland: Oh, Sun, I had this-- yeah, Sun, I had the trouble. The accounting system people did what they wanted to do. I thought, "Well, I'm going to teach my guys about fixed and variable costs." So, when I make the budget at the beginning of the year, you know pretty much what you're going to spend on later. You have no idea what you're going to spend on parts they're going to buy. And you can make a guess about how much travel you're going to allow and stuff. So, there's a set of fixed costs that has nothing to do with managing. It's just existing. And I wanted to put that in one account for each of my groups. And the other account was where I put the travel money and the parts and the expense things where you want to-- I put the students for summer students, etc. But it didn't matter because the accounting people, when they saw oh so-and-so sorted this out, that's his department, and they'd put it in the fixed cost place. I mean that's where it would show up. Now, I could have got my accountant to do an after the fact transfer and correct it, but it turned out not to be practical. I would have used him up to redo all the accounting that the accounting department was supposed to have done right in the first place. So, I mean-- I'm sorry. You'll find I have been much more focused on accounting.

Sproull: No, the reason I'm shaking my head is you were fighting a much bigger roadblock than you had any understanding of.

Sutherland: Yes, you're right. I had no idea that that was what the problem was. The accounting system did not operate the way it advertised.

Sproull: Well, and was fundamentally intransigent. I mean there was no way you were going to get a voice in how they worked.

Sutherland: That's right. I could not get the accounting department to follow their own procedure about where you put the numbers depending on the account numbers you put on the form.

Brock: Was that a factor of just they were contending with just the growth?

Sproull: You know, I think Bert would have been unhappy anywhere.

Sutherland: Probably. Probably. Yes, I'm a difficult, ornery person.

Sproull: On this topic, yes.

Brock: Okay. All right.

Sproull: He's countercultural.

Sutherland: Well, it turns out in all of the companies I actually liked the accounting department. They are good people. They are very sensible. They're honest. They're Boy Scout, trustworthy, loyal, helpful, friendly, courteous, kind, not obedient.

<laughter>

Sproull: All right. So in 1990, so the Sutherland-- I'll tell this a little bit. So Sutherland Sproull and Associates had been doing really two things-- well, three things. One is advising ATV, doing due diligence and this and that. And--

Sutherland: Yeah. I mean well, some years I read 700 business plans.

Sproull: Yeah. Exactly. And countless meetings, especially for you, 'cause you were actually in their office.

Sutherland: Right.

Sproull: And the second thing is we had commercial consulting clients. And the third thing is that Ivan and I and some occasional others, but under Ivan's leadership had put together a little research program in asynchronous circuits, which was funded by four or five companies in a pattern after the way he had

funded the Silicon Structure Project at Caltech. And this got old for those companies after a while. After two or three summers of teaching courses on this topic they'd had enough. And so it was getting harder and harder to sustain that path. And I think Ivan's summary is that he had found that the whole exercise was consumptive of intellectual capital and it was time to--

Sutherland: Do something else.

Sproull: Yeah. To rebuild that capital some other way. So we went looking for places we could all go to work. And there were essentially two offers, one was from Digital Equipment and one was from Sun and we signed up with Sun. So I'll let you describe that, Bert. You were the guy out here at the time Ivan and I were both living in Pittsburgh.

Sutherland: Right. And so we signed up to join Sun. I think, Eric Schmidt and Wayne Rosing were the co-leaders of the Sun part. And Eric previously, I had known Eric previously, 'cause he was a graduate student at PARC while I was still there running SSL. And so we came, we started this lab. Sun, Wayne Rosing was running it. I guess I was hired as the vice director, assistant director. And we collected a bunch of people out of Sun doing different things. And we finally got a building in Mountain View on the--

Sproull: Building 29.

Sutherland: Building 29. It's on the-- we were right next to the lake on the-- so I think Intuit's in that building right now, as we speak. But it was a good time. We had-- let's see, what did we have? We had--

Sproull: So it started with some projects from Advanced Development.

Sutherland: Right.

Sproull: One was Greg McLaughlin with the Multimedia Project.

Sutherland: Right.

Sproull: One was Duane Northcutt with the high-definition workstation project, which was ARPA related, wasn't it?

Sutherland: Yes, ARPA paid the money to buy the--

Sproull: Right.

Sutherland: -- first high definition television set. I mean it was a beast. I don't know how much it weighed. It took two or three people to lift it up. Its cathode ray tube was about three quarters of an inch thick of glass all around. It was really, really heavy. But they were very successful. It made beautiful pictures.

Sproull: Yup.

Sutherland: And there was arguments about the standards for high-definition television at the time that Sun-- we played a little role in that. But again, I don't know all details.

Sproull: Yeah, I don't either. I don't remember any of the other West Coast projects.

Sutherland: Well, of course, there was a bunch of people who wanted to do operating systems things. Anyway, it evolved.

Sproull: But, say, remember Scott McNealy directive about starting and running this thing.

Sutherland: Oh yeah, Scott McNealy said to me when we started, he said, "I know about research labs." He said, "They're black holes for money." So he said, "I want to start you small. I want to keep you small until you prove you're worth something." And so he said, "Hundred people. Hundred people max, that's all you can have." And he said, "And I know really how to control you." He says, "I'll give you Building 25 on the campus. Don't ask for more space at any time soon." And as- as it turned out the hundred people limit was terrific. It was a great help because in order to start something new we had to stop something old.

Sproull: Ah.

Sutherland: The hardest thing about managing research is how do you stop stuff that's outgrown its usefulness in time? A diligent researcher can think of five million new things to do to push his day job a little further, and you got to cut 'em off when the time has come. And the way being in Sun as this was a very useful help because we could in theory transfer people into the corporation and free up space in our hundred limit. So and we finally made actually one of the metrics for reporting our success to the company the number of people we had transferred out of the lab into the company. Because that, what you've done is you've taken brains with new knowledge and stuck it, infected the company with the virus of the new way of doing things. And one of our projects with Yousef Khalidi had been to make a sort of a multi computer version of Solaris, our operating system, so it could run seamlessly on a bunch of Sun machines. And we moved that into the Sun software operating system people, I think seven or eight

people. And that turns out to be hard in ways you don't know because the group that you're going to want to give it to doesn't have the-- they can't have or the budget. They haven't planned for it.

Sproull: Yeah. In fact, let's go back and talk about that one a little bit. Because one of the third projects we started off with was the Spring operating system--

Sutherland: Was the Spring Op?

Sproull: -- that Jim Mitchell was running.

Sutherland: Yes.

Sproull: That was from early on. And this was an object-oriented operating system based on interfaces using the CORBA standard.

Sutherland: Right.

Sproull: And the idea was this was going to be Sun's next operating system, at least that was the dream of the group. And they did transfer into SunSoft.

Sutherland: Yes.

Sproull: But the transfer didn't stick.

Sutherland: No, it didn't work. But I think I still-- what I was trying to do was just to say is okay, so I've got this budget with these people, I want to transfer them into the company, and but the company doesn't have the payroll budgeted to pay them. But I do. And it's company money. We-- one feature of Sun's lab is it was company funded. We did not, except for one funny ARPA contract we did not take outside money to do research. And with that it was all Scott's money. So I could say to them. "Okay, I'll pay for-- I'll give you my six people, but I'll pay. I'll give you the budget for them till the end of the year and you have to budget them next year." And it was good for me because the money was being used for the company, even though I didn't control them. But I then had the potential to use the slots for new people that I was going to hire eventually to do something new.

Brock: Got it.

Sutherland: And it- it was usually, it was quite interesting. There was a group here in the Bay Area, it was the Bay Area Research Directors. And we used to meet quarterly, I think. Maybe it's semi-annually. But the guy from IBM Research and Lockheed, and everyone around knew they had a research lab. And we'd have dinner and we'd talk about things. Number one, technology transfer is hard. You do the work and the research and then the company doesn't care. And the other one was they thought my way of dealing with that was funny. Because I said, "Listen, this company..." See, a lot of their money was not company money, in which case you can't do this.

Brock: Yeah.

Sutherland: It's hard to get rid of people in a research project that someone else is paying for.

Brock: Right.

Sutherland: If the company is paying for it, it's much easier just to give them-- give them away to the company. It makes sense. So we used to talk about that. But anyway, go ahead.

Sproull: Well, I was going to say the other interesting thing about Spring is it didn't stick, really.

Sutherland: It didn't stick, right.

Sproull: But, Khalidi, Yousef was part of that and came back to the lab and did sort of round two of that, which was this multi computer thing.

Sutherland: Right.

Sproull: And it transferred out and--

Sutherland: And it stuck.

Sproull: -- and it stuck. It became a product called Sun Cluster, which actually in terms of overall impact to the lab was probably one of our better--

Sutherland: Better stories.

Sproull: Yeah. Another example, why don't you tell the story about Sun Ray?

Sutherland: Yeah. Duane Northcutt-- the high-definition TV guys had decided that well, Sun is not going to do it. Well, one thing that they did do was the HDTV server. So Sun actually had a product that was a HDTV server for companies to--like you go into the--into your motel and there's a server running all of the stuff that you can call up to watch.

Sproull: Right.

Sutherland: So they built one of those and that did move in and so was a product. Again, I don't know how successful, but it was productized. So these guys had the idea that said listen, why don't we make a gutless wonder as a display? We've got the Ethernet all throughout the building and you could run things remotely on the-- I mean you could run your UNIX thing on the server through your UNIX terminal on the desk. But they said, "Why do we need all that stuff on the desks?" So they made sort of a gutless wonder that said basically was an Ethernet display, Ethernet driven display, and all the guts were back in the server. And so that turned out to be a good idea. And one of the things I had done was send Duane Northcutt, who was the leader of that group, to spend a month with the head of Sun's computer division.

Sproull: You mean the IT group? The--

Sutherland: Not the, not IT.

Sproull: Oh, no, no, no.

Sutherland: -- through the product division.

Sproull: Okay. Okay.

Sutherland: And--

Sproull: SMCC.

Sutherland: -- and shadow him around, go to these meetings.

Sproull: SMCC. Yeah.

Sutherland: And the head of the division was delighted to have it. He had this bright kid to come along and work with him and ask questions and all that stuff, so he enjoyed it. And, but Duane came back and said, "Listen, we don't need all the UNIX stuff on the desk. We can get rid of it." And it's back in the server. So the display is fast enough and if we do a little compression and careful enough we just run it as a display. And so we built a bunch of them. They did that. It worked fine. We built a bunch of them for to proof of concept. And they came and said, "Bert, we want to build a hundred of them." And I said, "No, you can't build a hundred. You have to build 200 of them. A hundred is not enough." So we built 'em and they moved in, they started to go through the company. It was offered as a product. They sold lots of them. And- and again, those guys moved into the product division to steer-- steer and make that work. And it was sort of a good example. I paid for them for I don't know how many years.

Sproull: But in the spirit of cueing you, this is an opportunity for your little speech about how there's a difference between transferring technology and transferring products. <laughs>

Sutherland: Oh, yes. I mean product is different than technology. Product has had the bugs run out of it. Product has the cost figured out so that it could be sold profitably.

Sproull: Product has documentation, it has training, it has marketing collateral.

Sutherland: Material.

Sproull: It has a work-- a sales force that knows what they're doing, etcetera.

Sutherland: I mean there's- there's a huge amount of difference between a product concept and a developed sellable profitable product. And boy, I mean the researchers were not very attuned to that distinction.

Sproull: <laughs>

Sutherland: Oh, it works, it works, it works. Right. But will it work on Saturday night when the power goes out, kind of issue sort of thing was that. So, I mean again, part of running the lab in a way that would be good for the company was to try and introduce the researchers more to the practicalities of the company. Because after all, the company-- its company-- if a company didn't support the research lab it could have that much more profit. And so the research lab better be focused on helping the company whatever its needs.

Sproull: So that's a great segue into the next topic. So we're kind of tiptoeing around here exploring different modalities in which the lab turned out to operate, vis-a-vis the company.

Sutherland: Right.

Sproull: So tell a little bit about the asynchronous transfer mode trials.

Sutherland: Well, there was a time when that was going to be the latest telephone-- digital telephone kind of thing was the asynchronous transfer mode. So we were building-- we're building out our new Building 25 lab and the telephony buffs in the company were saying, "Well, what you should do is put in this new asynchronous transfer mode for networking kind of system, a communications system in the building." So fine, we got the right kind of cables and we put it in all the rooms and everything else. But we couldn't make it work because sort of nobody was really-- you couldn't buy any switches that would run and so forth. So we- we worked at making it work and it didn't work. So we just used our Ethernet and it worked. You- you could improve it and speed it up and be careful about it and it worked well enough. So we avoided the whole business of going down this asynchronous transfer mode dead end and investing a lot of money in stuff that we sort of early on discovered it couldn't work.

Sproull: Well, yeah, my recollection is A, the products for the switches were not there, as you said.

Sutherland: Right.

Sproull: But B, it was very clear it was going to be a whole lot of client side work in the operating system required before any of this stuff got to be as easy and seamless and ubiquitous as the Ethernet.

Sutherland: Well- well that's right because the Ethernet was sort of a peripheral. It just give you bits. And this stuff had to have control.

Sproull: Had to set up circuits.

Sutherland: You had to have all the--

Sproull: Set up circuits and manage it and it was another whole world.

Sutherland: It was a bust.

Sproull: Yeah.

Sutherland: Yeah. <laughs> Absolutely.

Sproull: Okay. So moving--

Sutherland: That was a useful thing in the lab.

Sproull: Yeah.

Sutherland: Make the mistakes early while they're still cheap and then don't do 'em.

Sproull: And by the way, this had nothing to do with what some products might have been. This was just a piece of like invest--how you run the Sun.

Sutherland: Right.

Sproull: We saved them some money by avoiding a mistake. That simple.

Sutherland: Mistake in putting AS-- this asynchronous transfer mode in all of Sun's buildings.

Sproull: Yeah. So another mode, again, I'm sort of quoting from Bert here--

Sutherland: Yeah, that's good.

Sproull: -- is-- was to find passionate technical often leader types and hire them and let them-- give them a run at their passion.

Sutherland: Right.

Sproull: And so one was Tom McWilliams.

Sutherland: Right. Tom McWilliams had built a lot of the Livermore computer stuff--

Sproull: The S1.

Sutherland: -- over there and he was at loose ends, so we-- I hired him to come. And what I told him is Sun has lots of computer things etcetera, poke around and find something you think is interesting you should do and do it. So he poked around for a while and I have to try to remember what he wanted to do.

Sproull: He set out to build, so this was a simulator for chips.

Sutherland: Right. He-- right. He was, right, yes. He was-- Sun after a while started a semiconductor group to make SPARC chips and all that kind of stuff.

Sproull: Right.

Sutherland: They contracted out to the manufacturing to make the chips, but you could still buy a SPARC just like you can buy an Itanium processor, you can buy a SPARC processor and put it in your thing. I think it's, I don't even know how much it's still running, but I mean that was the mode for a while where you used the thing. And, but, so he was going to make this simulator for the chips. And I had hooked him up with the chip making-- the SPARC chip making division. But they didn't really click and nothing sort of came out of it, but it was-- it was the idea and something. But we make mistakes with the lab.

Sproull: Well, we eventually built a big machine.

Sutherland: What?

Sproull: We eventually built a big machine, Phaser.

Sutherland: Yeah, I guess we did.

Sproull: And the problem was that we collectively thought they really needed this. And they were using their own software tools or on occasion they bought some commercial things that did a portion of their job. But we kept thinking they're going to need more, they're going to need faster, the chips are getting bigger, they really need this stuff, and it's better technology. And it does a better job of simulation. But ultimately, they didn't want it.

Sutherland: So I mean you have-- another sort of research lab needs to be able to do is accept rejection by the company of what they-- what we think they want. And it turns out they don't want it. Now, that can be-- they may still need it but they don't want it for whatever, I mean the people involved. And so, somebody can have a prejudice and decide they won't do it that way. They just don't want to do it that way.

Sproull: And I think that a much shorter with a less expensive ending was John Ousterhout with Tcl.

Sutherland: Yes, so I hired John Ousterhout to come here. And I had two sort of pseudo businesses inside Sun Labs, one was Ousterhout to do Tcl. But the lab is not set up with a marketing department and everything, so--

Sproull: So you should say that at the time we hired John, Tcl was out there. He had done it at Berkeley, I guess, and it was available pretty much as open software. It wasn't a business. It was very-- but a very nicely engineered scripting environment.

Sutherland: Right. And John wanted to promote it but it was not something that Sun really could afford. But having John Ousterhout onboard was a fantastic ad for the lab's people. Well, finally, he just got fed up and left because it wasn't doing what he wanted.

Sproull: Well, I think, well, John hoped that Sun would be a vehicle to launch Tcl into a higher orbit, let's call it that and it didn't really. It didn't work out.

Sutherland: No. My other pseudo business was Alberto Savoia who had made-- essentially taken the Java specification. And Java, "write once, run anywhere," it became available. So what was the standard Java? You could have various derivatives, various things he had so he started a thing that we called SunTest, which was essentially we could certify that your Java met the Java standards. And he would test your implementation with all the tests that he did, and I actually got him to offer it for money to people. And there was a time when Sun had just started JavaSoft to actually commercialize Java and SunTest with Alberto had more revenue than JavaSoft for one year, which was kind of amazing. And then part of the other thing was then they needed a leader for JavaSoft. And I said to them why don't you take Alberto, he's terrific. And they interviewed him and everything but decided not to. And at that point, I think John went off-- Alberto went off to I believe it was Google, it was somewhere. He's been at Google. I mean it's kind of funny, and then from the accounting viewpoint it's pretty funny to figure out where in the books this research cost center in our lab would put revenue. I mean the accountants' guys-- the accountants said, "Well, what are we going to do? He's got revenue."

Sproull: So I was-- to come- step up a little bit, I thought it might be useful and you've mentioned some of these, but I thought it might be useful to kind of go through the various steps that you experimented with

for coupling lab and lab people to the rest of the company. You mentioned getting people to accompany salesmen on sales calls and that was certainly one. I must say I did that occasionally and I did it during the time we were having trouble with cache memory parity errors, those were not comfortable calls-- meetings.

Sutherland: No.

Sproull: We were on the hot seat big time.

Sutherland: Well, there was a technical thing. These were-- what I wanted my guys to do was to go out with the salesmen.

Sproull: That's what this was. And the problem is all these guys wanted to talk about what's parity errors <laughs>.

Sutherland: You're right, okay.

Sproull: They didn't want to talk about buying more equipment <laughs>.

Sutherland: Okay.

Sproull: We were in trouble. A second thing, which you haven't talked much about, is the notion that each project should try to find its engineering customer and engage them in certainly in oversight and so on throughout the life of the project.

Sutherland: Yes. So I wanted each of my projects to have some contact in the company with sort of a plausible way that it could move out of the protective lab into the hard world of customer engineering or like project engineering, to have better understanding of that. So I assigned various people to the obvious. For example, I sent my brother Ivan to sit in on the staff meetings of the head of the SPARC chip division. And he actually turned out to be-- I mean Ivan has been a venture capitalist, he started companies, so he turned out to be quite a useful guy for the VP that was running that. And he could come back and talk about what they're not understanding and what they need and that stuff. I sent Duane [Northcutt], I think, over to the computer division. Ted Goldstein went to I think to JavaSoft. I mean there are a bunch of places but it was important to get them out into the company to talk to the other people.

Sproull: Right. So I put that down as sort of getting-- there's a set, the canonical example there is attending staff meetings. But the other, the more specific example is each research project really had to

have sort of a target customer. I remember, for example, when we were working on search and that sort of the idea was at the time, we were distributing our manuals on CD-ROM with an application you could bring up on the workstation, to find the answer to your question in the manuals. So the obvious customer for our search work was the group doing the technical documentation. Well, when the technical documentation people changed their minds and went and bought somebody else's search engine and they said, "We don't really-- we don't think excelling at search is something we need to do," well, suddenly the rationale for the research project has to change. And this was true of every project in some sense, you really asked people to be in constant contact with one or more potential customers.

Sutherland: In the company.

Sproull: In the company.

Sutherland: Right. And the process of transferring research into the company is also very expensive, because the people that they are going to have to change their behavior. I mean, again, that was sort of one of my views. The purpose of a research company is that the company change its behavior. Because if you don't change your behavior and you do the same thing over and over and over, what difference did the research make? So I mean it's funny. So here, running this research operation and it's really behavioral change agent.

Sproull: So in a similar vein you also experimented with different ways of asking the company to evaluate its laboratory.

Sutherland: Yes.

Sproull: So explain about some of that.

Sutherland: <laughs> So here's a laboratory. Our budget was-- I gave you four million in Boston <laughs>. And I mean the budget was 30 or $40 million and if they didn't spend it on this, the other parts of the company could use it for development or something. Or they could just drop it to the bottom-line and have profit because we were basically an overhead expense, if you want to be sort of crass classification. So, again, one of the things we had then is usually yearly sort of a what have we done for you lately in the company publication. And a very strange sets of things we coming at, like…   Now, you were steering me in a slightly different direction. Let's go back to it.

Sproull: Well, I don't know. So the problem is very often people try to measure research with things like counting papers and patents and this doesn't mean a thing to the company. It's the more academic--

Sutherland: It's the academic side of things

Sproull: -- side of things.

Sutherland: How do you build the people's reputations? Yeah.

Sproull: So Bert would, for example, sometimes take surveys of the other senior management.

Sutherland: Yeah. Sun, like all companies, had some kind of a bonus program. And so what I chose for the lab people was I'm going to take a survey, I'm going to send around a voting survey to other parts of the company, most of the vice presidents, most of the division heads—whatever, a suitable 50 or a hundred people, and ask them to rate the lab on this benefit for the company on a scale from one to seven, and the criteria zero were not worth a damn thing to the company. Number seven is we're pretty terrific. They love having us on board, we're glad you're here. We can get you to solve our problems, et cetera. And we can get a score between five, six. Never got a full seven, I didn't ever expect one. But we get a few zeros, the guys who didn't like us or whatever. But the score was usually four to five, roughly in saying yeah, you guys are okay but you're not wonderful but you're okay and we're glad you're here. And then that would trickle down into the bonus pool of how much everybody got. And so that was one and--

Sproull: I don't know. So I'm reminded of your comment though that this is all about the rest of the company perceives us.

Sutherland: That's right.

Sproull: And--

Sutherland: <laughs> The view of the company about us is the perception that they come to-- is not the issue. It's the only issue. You really have to have a company like you as a laboratory.

Sproull: Because there is no metric that's going to capture what a lab does in all respects. I think probably one of the ways that the lab was most valued is showing up in the customer center during customer meetings, especially the ones where they brought a large fraction of a senior team to Sun to show off their wares. And it wasn't so much touring the lab but it certainly was touring the lab staff. I mean it was seeing some of the lab people talk about--

Sutherland: Whatever they're excited about.

Sproull: -- things they were working on, yeah, and listening and engaging with the challenges that the customers faced.

Sutherland: I mean that was good for my guys to listen to the customers. And I mean so we had a customer center and we'd have people who could go over there and show things. One of the things I was interested in the lab was digital money, and so I went-- I had met some of the people in National Westminster Bank in England, who were interested in Mondex, which is one of the early digital money trials with a smartcard. And I talked them into giving us a whole bunch of stuff. And we-- see, the Sun Ray finally made this possible in an interesting way. Because the question was how are you going to identify yourself to the Sun Ray when you sat down at the terminal that's got this wonderful display terminal, to connect up to your UNIX process back in the server? And the thing that made that possible were smartcards because we had begun to move our ID cards at Sun into smartcards. And the way that happened was through National Westminster Bank. So the Sun Ray was the first place in Sun that was a ubiquitous smartcard reader. It was cheap enough that you could put another 20-buck smartcard reader on it and it didn't change the economics of the thing. So I talked to Nat West into giving us a bunch of their Mondex smartcards, which we then made into Sun Badges. This is a Mondex smartcard and but it's a Sun badge. And it's actually a Sun badge for Bob Sproull <laughs>. But you could put this into your-- you could go to any one of the Sun Rays in the lab building and just stick this in and you are back at the place you just left. So I could pick it up, go have lunch with someone, stick it in over here and I just continue.

Sproull: Well, I'll tell you a time it was really nice is you're going to give a demo, you sit in your office and you get it all ready, you pull out the card, you walk over to the place, the conference room you're actually giving a demo, you stick it in and it's up on the screen in front of everybody.

Sutherland: Yeah. So I mean this helped the transition. It turned out that we did a lot of-- thought about how you would use it inside the company. And I had hired a girl, Diana--

Sproull: Neiman.

Sutherland: Neiman, right, out of-- she was an escapee from accounting department who had fallen astride of the VP in charge of accounting. So I said I'm interested in digital money and said to her why don't you come over and help me with that? So she came in and she was actually a director, so it was a very senior gal but she's also a chartered accountant. And so we looked at this digital money stuff in this Mondex system and it turns out is a perfect sub-ledger double accounting bookkeeping system. I mean this view was this is like a little-- this view was a branch bank of your money system and it lived in this card. And you could do things in and out with withdrawals and transactions and audits and stuff. But it would have been-- and I wrote a long paper about this. But it would have been really great because you could give me my training budget, which I could then distribute out. You want to go to this class, here's your tuition, go stick it in and use it up doing the training. And as an extension of the accounting system

you could have devolved a lot of the decision-making down to where it really mattered, with people who had to decide. I mean I'd give Bob a budget in Boston and it was his job to divvy it out to his projects. And the project manager said the job of divvying out to what they wanted to spend it on, et cetera. And--

Sproull: So I just realized you just wanted to control chart of accounts on those chips <laughs>.

Sutherland: You're right. You're absolutely right.

Sproull: That's all it was <laughs>.

Sutherland: Yes. That's I mean my advice to a lot of people is you think you're going into business, I says you want to play the business game? "Oh, yeah. Yeah. Yeah." Well, learn a little bit about accounting because that's the business game. Go take a basic accounting class and learn about credits and debits--

Sproull: And general ledger.

Sutherland: And learn about depreciation, guys. No, I mean I was-- it was really important for the lab. PARC got into a lot of trouble with their accumulated depreciation because no one had paid attention to it, except Norb Beyer the finance guy. But he couldn't control the spending. I mean PARC, George Pake wanted the spending to be down with the guys who were going to decide what to buy, never mind accounting for it afterwards. And what I told my guys is look, I says, I don't buy your equipment. You want to buy some equipment, great. I don't buy it for you. You borrow the money from the McNealy bank, the company's bank, you buy it on time just like you buy your car from the finance company at a time and you're going to pay it back. Most of that stuff we had was three-year depreciation. I said you're going to pay it back in your budget for the next three years. And I'm not-- I'm not going to say yay or nay on this but you'd better plan ahead three years, because that's what it means. And one year at the lab, I got a request for $4 million of capital, three-year depreciation. I said no, you guys can spend $3 million. I'll approve $3 million capital. Oh and, by the way, guys, you don't know it but the three years of depreciation, $300,030 a year, that's your raise money next year because it's not in your expense budget. You can use it as raises. Use it for raises. I mean it's funny how I think it's really important to get the basics of how our society calculates and uses the money that we slosh around so wildly.

Sproull: So let's move on to some of the assignments that you had toward the end. I think Jim Mitchell became technically the lab director and--

Sutherland: Yeah. I left the lab and they turned it over to Jim, who's a very, very good guy doing it.

Sproull: So you went to work for Mike Lehman who was--

Sutherland: I went to Mike Lehman who was the--

Sproull: He wasn't the CFO.

Sutherland: Yes, he was.

Sproull: Was he? Okay.

Sutherland: He was the CFO. I mean I'd had a very good relationship with the finance department because I was the one technical guy that took them seriously. I mean I don't know if that's true or not. But I mean I obviously took them seriously. So I went to Mike Lehman and said I'd like to come over and work for you, because the lab had gotten being managed very funny about bonuses and stuff. I think they-- was it Greg Papadopoulos that got a seat as CTO? Anyway, so I finally got fed up with the management of the lab and said I want to do something else. So Mike said, "Sure, come on over." He said, "I'll assign you to the-- our new CIO," who was Bill Howard, brought in from somewhere, I don't remember. And Bill was a very pragmatic guy. He was good. He's a hard-nosed business guy, no nonsense. And so I sat in on his staff meetings, and in some cases was sort of the neutral referee on some sets of problems and so forth. And but probably the most interesting and important thing for me was it turns out he was a retired Navy captain 06, senior guy, in the Seebeas-- CB, Construction Battalion. So they were the guys who went ashore in Okinawa and built airports, and that kind of stuff. And he said, I like to drive the bulldozers and tractors around. It was very fun. And Sun sales force in Washington had come to me a while back and said, "There's this wonderful program in the Defense Department where they send senior officers for a year's temporary duty assigned to a company." And this started with Bill Perry down here at Stanford, who was Secretary of Defense. And he said, "We should have some senior officers in the military, who understand civilian business practices." Because this was when all the scandals about military, you--$400 coffee cups and that kind of stuff, about the kinds of people who didn't understand overhead and that sort of thing. So he said, "We'll start a program and we'll send two Army, two Navy, two Air Force and a Marine." Although the Marine is naggy, but he was identifiable enough to be separate. "We'll send them to-- for a year to companies. Instead of going to their senior service school at the war college or something, they can go get a graduate education in the military." So we started that program in, I don't know, '95 or something. And somewhere along the line they had to come-- the Sun salesman had come to me and said, "You can get a-- for sort of breadth of viewpoint-- you can get a military officer to come for a year." And I said, "Sun, and the way it's screwed up and various things," I said, "I wouldn't want him. That'd be mean to that officer to put him in this environment." So but Bill had a better attitude, right? Mine was kind of a cynical attitude. But Bill hired-- attitude was good, and he said, "Sure, I'll take one!" He said, "You know, 06 or 05," that's the grade level in the officer structure. He said, "They're good guys! I mean, they've been in for 10 or 15 years, they've survived. They've got to be good, or they wouldn't have been promoted!" So he said, "I'll take one!" So we got one! And it turns out that's when I'd just come over to

work for Mike Lehman, and he said, "Go sit with my CIO, and help him understand Sun." So I got this Air Force Lieutenant Colonel, named Darren McDew. And he was a transport pilot and he said he'd had a very interesting-- I didn't know-- I mean, he came in, and he walked in. Had no idea. He turned out to be black! He was terrific! Fantastic guy! He's been a very good friend ever since. So we sat around-- he sat on the staff meetings. He heard the arguments about how do you support the software? Sun had a policy of running Sun on Sun software and Sun systems. Says, "If we can't run it-- you know, it'll prove to the customers that we got good stuff. Because if we can't run our business on it, they probably won't think they can run their business on it, either." So I mean, that was-- in fact, that was just such a thing, such a mantra with Scott McNeely that it got in the way sometimes. Because all of our Sun people didn't have first-hand experience with Windows commercial software. Because we weren't allowed to run it. We couldn't-- I mean, you just couldn't do Windows stuff. But anyway, so he did that. He went to visit the customers. Customers loved to have him, because he could-- I mean, he was an excellent leader. And he gave talks on-- throughout the company on leadership and the HR people. We had a Leadership Council at the time. Which was sort of a bunch of vice presidents who were chartered with how do you improve Sun's leadership and accountability. I mean, that was another of Sun's major problems then was accountability. But anyway, so he did a fine year, and then he went off, and he's been a good friend ever since, but he's now ascended to-- he's now a four-star general. But I mean, it was a very successful thing. And we'd had several others since. We've had another Air Force guy who's now a general, too. We've had a Navy captain of the U.S.S. Benfold come, and he was-- again, they fit into the company, and it's a terrific program throughout the country. And it's expanded hugely, there's something like not just seven of them, but this year I think there are 14 or 15 of them. And in fact, I was listening to a Senate grilling on C-Span--you can listen to the hearings. There was a Senate hearing with the senior financial guys from DOD, the controller, two different controllers, two different versions, etcetera, talking about things then. So the senators asked, "Well, what can we do to help?" And what he said, "Well, the Defense Department has this program of sending these senior officers to companies." He says, "Triple it!"

Sproull: Hm!

Sutherland: That was the witness's advice to the DOD, "Triple it!" He says, "It's great!"

Sproull: Maybe the finance people in DOD had the same attitude as you, namely, "The rank and file and the leaders need to learn more about accounting!" <laughs>

Sutherland: Yes! That's true! I'm sure it's true! I mean, the DOD accounting has got to be really something. I mean, they're still struggling for the last couple years to have an audit. A functional, valuable audit of the Defense Department. They haven't done it yet. I mean, so. I mean, that's another thing about the company, though, I really like the auditors. No, in the company, I'd send people ordered--

Sproull: Oh, yes!

Sutherland: -- over. I'd send my staff people, my researchers over to do an audit with the audit people of the IT system in the company. How do you look and see that you're billing things, you're not losing money? How do you do an audit of a functioning operating system inside a company? And they came back and were amazed at what you all had to do, and they learned a lot. So, I'd send people out to the company like that for instruction and for education. I mean, you have to understand how the company worked, how did it make profit?

Brock: Did you do the same thing yourself? Did you give yourself that same sort of assignment, or--

Sutherland: Oh, yeah, I was-- in many ways, I was sort of Scott's acting proxy.

Sproull: Well, you got some management. Yeah, some acting assignments that were full line jobs.

Sutherland: Yeah, I got acting assignments. I ran the chip business for six weeks until they found someone else.

Brock: Okay.

Sutherland: And it was really funny, because one of the things I did was Sun had a rating in the engineering world called Distinguished Engineer. It was an attempt to provide sort of a higher paying job without having to do performance appraisals of all the people in the group, etcetera. So I-- so the chip business had five or six Distinguished Engineers. So they stuck me in as the manager to hold the fires for a while, and I said, "Well, the first thing I want to do is--," I called the Distinguished Engineers together. Said, "What do I need to know about this business?" Said, "What's it doing well? What's it not doing well?" They were amazed! No one had ever asked them before.

Brock: Hm.

Sutherland: They were amazed to have been recognized and called in to provide some advice from what they knew about chip design and chip testing, and I mean that's complicated stuff. And they-- some of the managers in that group were in the habit of spending money without finance even knowing about it. And Helen Yang was the controller of that division, and she used to-- was tearing her hair out, because people would buy a half a million dollar chip tester or something, and it would appear all of a sudden later when the bill came in. You know, which is, there's the committed funds problem, that's well done. Someone makes the decision, I'm going to spend this money, and I'm going to take this trip and do that, but you don't see the numbers until the trip is over, and they've turned in their expense account, and it's been processed. So there's a span of sometimes even several months or several years between the money's committed and when it's reconciled. And I said to Helen, I said, "Helen," I said, "You will never

have to do that when I'm running this division." Because in the lab, I basically told my secretary, Mary, I said, "I don't want to see any reports-- requests for my signature that don't have a sign-out for HR, Legal and Finance. Because they-- I'm not going to sign something and spend money and surprise my finance guy. That's not right! I just won't do it! So Mary, don't even take the slip!" If people will come up to me in the hall and say, "Bert, will you sign this?" I'd say, "Let me see the Finance signature, the HR signature and the Legal signature." And they'd say, "Well, I don't have it," "So, go away. I'm not going to sign it."

Sproull: And just to be clear, that wasn't principally about authority. It was about notice.

Sutherland: That's right. It was about notice. I didn't want to surprise my helpers. Because I mean, when I temporarily ran Xerox PARC, Jack Goldman had called me in-- the boss of the research establishment-- called me and said, "Bert, we ought to do this." I said, "Jack, I'm willing to do it, but you and I have to make a deal. No surprises. When you're running around and visiting all the wonderful scientists and physics guys down on the first floor," I said, "Don't sign anything!" <laughter> I said, "I don't want to be surprised by having to come back and try and counteract your signature that should have followed mine." So no surprises was the deal I had with Jack Goldman. He was pretty good about it. But I mean, that's really important! If you want to have good delegation to your deputies, you can't surprise them by doing something without letting them know! I mean, again, this was common sense Navy stuff. But--

Sproull: Well, so but let's reflect on that for a moment, because it's always struck me that any place I've been, and maybe any place you've been in, too, even the Navy, it's the kind of the management is all-- they're all amateurs. They weren't really trained in these techniques. You didn't go to management school. You're not an MBA. In fact, it's not even clear that in business school they teach you these things either!

Sutherland: Well, that's right. But you, at least, I've observed that the best way to simply and smoothly run an organization is to have enough process and procedures and definition of roles in place that it functions smoothly. And you can't-- now, when you have an emergency, then you got to go outside the thing and be as ingenious as you can to solve the problem. But as a routine matter, suffering with chaos in the ranks is just not a good-- it's a waste of time and energy.

Sproull: Hm. So I thought we have a little bit more time, and I thought what we'd do is kind of go through-- so you might want to hold this up as Exhibit A. This is a thing you wrote after leaving Sun, called what? "Management of Industrial Research."

Sutherland: "Management of Industrial Research."

Sproull: And you can find it on the web. I'm sure we can--

Sutherland: Yes.

Sproull: It's here at the museum as well. If not, it will be shortly. And I love handing it out to people. Ivan wrote a similar thing, not about management, but about-- his is called, "Technology and Courage." And I hand them out together.

Sutherland: Okay.

Sproull: Partly because they're from brothers <laughter> whom I know well and admire. But also partly because they're really two sides of a coin! <laughs> In many ways. Bert, as the manager of research, and Ivan as a researcher. So I thought we'd just-- I'd just kind of go through a few of the topics in there with an outline-- sort of an overview of the things you say, and get you either to echo the--

Sutherland: Just say them again, or say them in a different form.

Sproull: Exactly! And the first one, and you've said it-- you've almost said it today, but you used to say it relentlessly, which is, "A research lab is a teaching institution."

Sutherland: You bet! If it hasn't done its job and infected the company with new ideas, new knowledge, new ways of thinking about things, then it's been a failure. So the job is to take new knowledge, put it in a form where it can be understood and disseminated. So I mean, it's a teaching institution! It's supposed to teach the company how to cope with the future.

Sproull: And putting it in a form in which it can be disseminated, is like a curriculum.

Sutherland: You bet.

Sproull: And this is exactly what you encouraged Lynn to go off and do with--

Sutherland: Yes. I mean, Lynn figured out a lot of that herself. And I learned some from watching her figure it out. But they finally decided, "Well, how are we going to impact of all these new ideas we had? Well, we'll write a textbook!"

Sproull: And teach it! And learn to teach it!

Sutherland: Well, I made her teach it.

Sproull: And tune it up! And tune it up!

Sutherland: I made her-- I mean, Lynn, I mean, it's worth just recognizing, Lynn used to be a guy, and he went through a sex change thing, and lived as a lady. And I remember Mike Wilmer came up-- but when she was at Xerox, she was hiding that desperately. And when Mike Wilmer came up to me and said, "You know, you should know this about Lynn." And I said, "Okay. So what?" And then Lynn later came up to me and said, "Well, you know, I got to confess to you this." And I said, "Oh, yeah, I already know. So what?" I mean, it didn't matter to me! There was a good brain in there that worked just fine! And who cares what the package is? <laughter>

Sproull: All right. So now on to other things. So a project. A project in the lab has three things. A new idea; an idea relevant to the sponsor.

Sutherland: Right.

Sproull: And it has to be hard enough to have some risk. In other words to be worth doing. But not just fooling around in a sandbox-- it's not--

Sutherland: That's right. It's not a-- right, it's not a hobby. It's got to be something serious that you'd like to do.

Sproull: That's right. And you have to be able to explain it.

Sutherland: Right.

Sproull: A second thing you have to have is a dedicated champion.

Brock: Mm hm, yeah.

Sutherland: Somebody who cares.

Sproull: Well, and who's willing to commit a piece of their career to exploring the idea.

Sutherland: Right.

Sproull: And for piece, you think, I mean, two years is a good--

Sutherland: -- is a good number.

Sproull: Good number. And we call those people Principal Investigators in a direct pun on the academic world.

Sutherland: Right.

Sproull: And this person, by the way, is also the Principal Teacher of whatever they learn.

Sutherland: Absolutely! He's a Curriculum Developer.

Sproull: That's right! And the third thing is adequate resources. And to execute a plausible plan. That is, there have to be some concrete steps that the researcher has foreseen to start making progress. Again, this is a-- in contrast to just fooling around.

Sutherland: Right.

Sproull: And those are the three things. And those were the three things we always had to demonstrate. Not just at the outset, but continuously.

Sutherland: Right.

Sproull: So that was-- so that's the project. Another topic you cover in here is growing leaders, which is, the lab as a training ground for managers, and--

Sutherland: For managers and for scientists. I mean, you get to be better at what you're doing after you've made a bunch of your mistakes. So the research lab is a place to make mistakes. Because that's how you learn, and then you go on and do the right thing.

Sproull: Well, and I think the rota-- so transfer out into the company, and maybe even with an option to come back if things don't work out, is also a training.

Sutherland: And we had some of those, too. Yeah!

Sproull: -- iterative training cycle. And finally, and you've mentioned this this earlier, is the issue about really delegating responsibility.

Brock: Hm.

Sproull: So that you have the full budget transparency, etcetera. And where the person who's expected to be responsible and exert leadership, has the authority and responsibility to do so!

Sutherland: Right, and the money to do it with.

Sproull: That's right. The next topic I have written down here is accounting, but I think we've heard enough about that. <laughs>

Sutherland: Okay. I will turn off the accounting.

Brock: If I may, ask a question about projects?

Sproull: Yes, yes!

Brock: In the plausible plan, when I was talking to Gordon Moore about how he was doing a similar job at the Fairchild R&D Laboratory. He said that one of his jobs was to encourage people to run the crucial experiment. That oftentimes that would-- that would really show--

Sutherland: Whether you could or couldn't.

Brock: If the project would have legs. And he said sometimes he would find people doing everything they could--

Sutherland: To avoid the crucial thing.

Brock: And I wondered if that was part of--there was this balance between giving it enough time to grow so you know what it is, but then at a certain point, guiding people to just do the--

Sproull: That's a great question!

Sutherland: Yeah, no, that's a good point. I-- I think I was more the kind that said, "For a little while you can have a lot of freedom. But then after a while push comes to shove and you got to stop. You either got to decide to do it, or I've got to tell you to stop."

Sproull: And by the way, a part of that is you start off as a single person, say, with an idea. And part of that early flexibility period, you may go out and recruit other people to help you, informally. And if you can--

Sutherland: That's good! That's really good!

Sproull: If you can, that means--

Sutherland: Because the idea has spread.

Sproull: And you've got other people who are going to commit pieces of their careers to it.

Sutherland: Right.

Sproull: And that, in itself, is a ratification--

Sutherland: That's helps a lot.

Sproull: -- of-- that you've done the crucial experiment. At least in the eyes of some others.

Brock: Right, okay.

Sutherland: Right, right.

Brock: Okay, interesting.

Sutherland: Yes.

Sproull: But I don't think we ever couched it-- that's a very fascinating phrase.

Sutherland: Yeah.

Sproull: Maybe not--

Sutherland: See, in the software world, sometimes there was a crucial experiment to demonstrate that you could do this.

Sproull: But maybe not.

Sutherland: Or sometimes it's just a matter of polish, that you've got to do enough work to really get it into shape!

Sproull: Right.

Brock: Right.

Sproull: I mean, a good example might be Sun Ray. I mean, as Bert said, the issue was was it going to be fast enough to have the display remoted over the Ethernet. Well, you can do some back of the envelope calculations. That may or may not qualify for you as a crucial experiment. <laughs>

Brock: Right.

Sutherland: But that would matter. It would certainly matter. Yes, you could do that. And it turned out it was.

Sproull: Yeah.

Brock: Thank you.

Sutherland: No, that's a good addition. Thank you for being here.

Sproull: So the next one was technology transfer. And I think we've talked about most of that, except there's one phrase that I know you really liked that we haven't talked about, and that is that the lab produces "technical options."

Brock: Hm.

Sutherland: Yeah, this is the kind-- we had a lot of these discussions in the Bay Area Directors Group. You know, how does the lab make something useful and then see it move out into the company? And in many cases, the-- you have to explain to the company what it is, and maybe it'll take--the crucial deciding point is whether you gather a following.

Brock: Mm hm.

Sutherland: And if you can gather a following and everything, it'll go. And if you can't gather a following, and don't teach people enough about an important enough program, or problem, then sort of nothing happens. And then what you can present to the company, again, a good way to think of it is you give them an option. "You could choose to do this, company. Hey, company, I've got a new idea, etcetera. You can choose to do this, or you can say it's too expensive for what you can afford now."

Brock: Hm.

Sproull: So the way in which I think this idea is most forceful is to remind the company that more investment is needed. You're never going to take something from the lab and find that it immediately contributes to the bottom line as a product.

Sutherland: Right. You can take it immediately and use it to prevent further expense.

Sproull: Yes.

Sutherland: But you can't take it immediately and sell it to someone else. And that's part of the option is, "If you want to exercise this option, you'll have to spend this much more money."

Brock: Right.

Sproull: Right.

Sutherland: So again, in fact, that was one of Paul Strassmann's real points, he says, "You never give the company a fully described, fully fleshed out business plan, which they can then decide to do or not. What you can give the company--," I mean, he wanted us to do that.

Sproull: Yeah.

Sutherland: Now, I saw one project in Xerox, back in from a project in Rochester, and I forget the guy's name, but what he wanted to do was make magnetic-- not electrostatic-- attraction of toner. He wanted to make magnetic extraction of toner, and do the image onto a big magnetic belt, and expose it, and put magnetic toner onto it, and squeeze it onto a piece of paper. And Xerox didn't do that. And doesn't do that. But this guy had written a fantastic business plan for just that with costs, how much it would cost to do that, how much would it cost to make the belts, what would be the lifetime of the belts. You know, etcetera, etcetera, etcetera. And he really did it. It was a fantastic option for the company to do magnetic xerography. And they declined to do it. But it was a beautiful, well-thought out, formatted option.

Sproull: But the guy must have spent an awful lot of time and energy to put that together.

Sutherland: He did! He did. It was a beautiful prepared; this was fully completed staff work. If you understand the term. And a lot of staff work is sometimes done, but not completed. <laughter>

Sproull: So another thing, you-- again, we've kind of glanced over, is contingency funds. Is having some slack. And that's not just money, it's often people.

Sutherland: It's people, it's whatever. So a research lab is supposed to be thinking about the future. And the future has got to have some things that you don't know, otherwise why bother to think about it. So supposing something wonderful comes up that you could really do that would help the company, and you're fully committed with the budget, you don't have any spare change. So that's sort of denial of your responsibility to look forward into the future. So if you run your research lab with no slack, then you've sort of said, "Well, I'm not thinking about the future." So why have the research lab? So a fully chock-full broke for anything new research lab is not really doing its job. So you need some amount of contingency money that says, "Yeah, I don't know what will happen, but something will probably happen." And I viewed my 30 or 40 million dollars of Xerox money-- not Xerox money--

Sproull: Sun.

Sutherland: But PARC-- Sun money as a bunch of the company's contingency money. Because I could not do a project, one of the minor projects and something. Or I had somebody who was transitioning into something else, so I could first spring him loose. So sort of the ability to deal with an uncertain, unplanned future is really an important thing to get sorted out and prioritized. I mean, that's another way to go. You want to go inspect a lab, find out what their contingency money is, and if the answer is zero, you can say, "You're not doing a very good job."

Brock: Hm.

Sutherland: "Preparing for the future!" So I mean, that's an important point. It's a very broad spectrum of things you have to deal with, and I mean, I have been known in Sun to give my money to somebody else for a good technical thing that they needed, it was important to the company.

Brock: Somebody else in the company.

Sproull: Yeah.

Sutherland: Other parts of the company.

Sproull: Yeah.

Sutherland: That is not my budgetary problem, not my-- but it's a good use for the company. One year, I mean, one of the questions you had earlier, what was I proud of? One year in the lab, this is Sun, I was able to run under budget by about 100,000 dollars. Maybe it was a million dollars.

Brock: I think it must have been a million.

Sutherland: I think it was a million dollars.

Brock: Yeah.

Sutherland: And Sun, at that time, had about 100 million shares of stock. So-- and Sun was very nice. This would not happen in just any company. I actually went up to the controller, who was a good friend, <laughter>, and said, "I'm going to run under about a million this year." I said, "I want to give it back to the company, because I don't need--I'm not desperate for the money to do-- now I can certainly spend it and waste it, but I think it'd be better for profit." And that yea-- that quarter-- that was a quarter, I was a million dollars under in a quarter. And that Sun on a hundred million shares was ten million-- was ten cents a share was the profit, of which one penny was my million. And I was-- and I think after a while the finance people actually noticed, because at other times I wanted to say, "Hey, I'm going to overrun $200,000 this year," and the controller looked at me and he smiled, and he says, "That's okay, Bert," he says, "This is going to be a good quarter." <laughter> So again, the confidence with the management of the company, I think is a really important job that they know you're down there trying, in the trenches trying to work help the company be frugal. You know, help the company be profitable, etcetera is, again, a very important part of the job of greasing the environment so that you can all slide forward.

Brock: Hm.

Sproull: Go ahead.

Brock: Another quick question. I recently was talking to some authors of a book about Hewlett Packard. And in this book, Tom Perkins discusses how he took the operating mode within Hewlett Packard of how to start a new operation, or how to start a new product, or a new area. That that was exactly the model he adopted to do in Kleiner Perkins. It was essentially, he did venture investing the way that they did their work at Hewlett Packard, which I thought was very interesting. But listening to you, I'm just thinking about you coming into Sun Labs after this period of reading 700 business plans <laughs> a year for advising venture investing, if there's an overlap between, in a way, the way that you managed the laboratory and the way you would approach venture investing, or analyzing those opportunities. Is there any connection there?

Sutherland: There are similarities.

Brock: Okay.

Sutherland: What I learned out of reading the business plans and everything else, it's much more dependent on the people.

Brock: Ah!

Sutherland: I mean, you could have a super business plan with a bunch of schmucks, and it's not going to go. So in my mind, the venture business is all about picking the right guys/gals to start it. Because you're going to have to see it through all kinds of rocky problems. You probably have to do something different. You know, you got to be dedicated, etcetera, etcetera. So 80 percent, in my mind, of the venture thing is, "How's the team?"

Brock: Ah!

Sutherland: "Is the team-- can the team work together in something where they don't know exactly what they're doing?" I mean, I like the Wernher von Braun thing. I put this in the paper. "Research is what I'm doing when I don't know what I'm doing." <laughter> So what you can be sure of is the business plan is not going to happen the way it's written down. It's going to happen in some different way, and can these guys manage that change?

Sproull: That's right.

Brock: Fascinating. Thank you!

Sutherland: I mean, that's the secret in that. And like my venture experience with ATV, basically, is when you go in a thing with a single guy, it's probably not going to go. You need a team, because I mean, that's what Ivan thinks about, "You don't do a venture investment with one guy. You need three backers. Three-legged stool. Because someone has to be able to say "no" to the other." You need to be able to stop stupid moves. You can't-- you can encourage good moves. But you got to stop stupid moves.

Sproull: No one can have veto power is really what--

Sutherland: What?

Sproull: No single actor should have veto power is the three-legged stool--

Sutherland: Right.

Brock: Right.

Sproull: -- lesson. Yeah.

Brock: Thanks.

Sutherland: Okay, Bob, have you g--

Sproull: So the last one I want to talk about a little bit is curiosity, which is a hot button of mine, I guess, a little bit, too. You mention in here somewhat wistfully, that you've often thought that you wished your researchers should be a little more curious about the rest of the company, their customers, even the project that the guy in the office next door is up to.

Sutherland: Right.

Sproull: And that perhaps research projects tend to get a little bit too stove-piped for their own good.

Sutherland: Yes.

Sproull: You want to say anything about that? And do you have any cures, by the way? You could really shake the world if you give us--

Sutherland: Well, I can tell you what I tried in the lab once. I says, "We're going to have the Quarterly Project Reviews. And each presenter will be from another project." <laughter> So that was my cure. I said, "You're going to stand up and you're going to talk about *his* project and what's good about it or not."

Sproull: I don't recall that this survived.

Sutherland: This was an East Coast thing. I mean, a West Coast thing.

Sproull: Oh, okay. But it didn't survive, did it?

Sutherland: It didn't survive very well. It was too much work. And after a while, you get enough complaints from the troops, and you think, "This is probably not a good idea. It's morale deteriorating."

Brock: Yeah.

Sproull: I was trying to think, at PARC there was a sense of a shared mission that I think helped this a lot.

Sutherland: Yes.

Sproull: Because it meant people really talked with each other more, because to some extent the overall goals were more aligned. At Sun, that wasn't the ca-- I mean, yes, the company, there was certainly a shared loyalty and belief in the company. But there was much more, much broader, more diverse set of objectives that the lab was after.

Sutherland: Yes, and the company was run much more independently. I mean, Sun, as a company was a-- sort of a conglomeration of different interests.

Sproull: Well, maybe, too, the other thing about PARC is it was so insulated from the real company! <laughs>

Sutherland: Oh, that's right! It didn't have any--

Sproull: It could behave any way it wanted!

Sutherland: It was done on p-- that was done on purpose.

Sproull: Yes, indeed!

Sutherland: Jack Goldman put it out there to be well away from Stamford and from Rochester.

Sproull: About as far as it could be!

Sutherland: Yeah, right. Well, he could have moved it to Guam. <laughs>

Sproull: So, Bert, I wanted to end by just a personal note, which is probably out of place here, but I'm going to do it anyway.

Sutherland: Go ahead.

Sproull: Which is speaking for myself, but I think for many people who worked for you, it was a tremendous pleasure for many reasons, but one was you trusted us way beyond, I think what we would have been in any other similar situation. You trusted me as you said with four million dollars a year. You weren't leaning over my shoulder. We weren't on the phone every day. You weren't countermanding me. You weren't asking for stupid reports about this or that. And I think you treated everybody in the lab that way.

Sutherland: Well, yeah, I mean, that was my style. I probably should blame that on the Navy as a flyer. You get in the airplane, there's a pilot in command. You're stuck with him. And you guys were stuck with me! So why should I make your lives more difficult? They're hard enough to do the right thing, etcetera. So, it means much more to me-- as a board member, I learned the other lesson. You got a CEO, he's running the company. Now you can back him or you can fire him! And but there's not much in between!

Sproull: Right.

Sutherland: And I've done both. I helped fire the CEO of one of the companies I was the board on. And I've backed them in difficult situations. And if-- it's sort of a binary choice. Either you want him to run it--

and that was one of my troubles with when I left Sun. They didn't want me to run the lab. They wanted to have the finance guy in charge of the lab, but he didn't know anything about people, and etcetera. I mean, and I finally said to some of them, I said, "Okay, fine! You run the lab! You know better to do it than I do. Good! Go do it! I'm going to have to go find another job! Do something else." So I mean that's really kind of my philosophy is you find people-- it's hard to find good people-- find them, and then let them do their thing, because as Dave Evans said to Ivan, "There are two ways to get things done. By yourself, and wrong." <laughter>

Sproull: Yep.

Sutherland: <laughs> So you know, thank you, Bob, those are very nice words. No, I do thank. I mean, one other thing that I'm proud of is I think that a lot of people enjoyed being in the lab. They certainly did good work. And I'm very proud of the fact that I could help create an environment where that could happen! And the various people that have supported me and provided funds, and all that stuff, it's been terrific! And but, we all were there in the lab to do new good things. And I think we did!

Sproull: Yep, yep.

Sutherland: So I mean, it's been an excellent cruise. <laughter>

Sproull: So let me see, so as I recall the last page in there says three things, "Technology is fun!"

Sutherland: Yes.

Sproull: "Interesting colleagues are essential!"

Sutherland: Yes!

Sproull: "Cherish and develop young minds."

Sutherland: Yes, you bet!

Sproull: So maybe that's how we should end.

Sutherland: Okay. And please all do that with the young minds. There are lots of them out there that are eager and flexible, etcetera, and steer them and guide them and support them, and let's move into the future.

Sproull: Yes!

Brock: Excellent!

Sproull: Very good!

Brock: Excellent!

Sproull: Thank you.

Brock: Thank you!

END OF THE INTERVIEW