An Interview with

Arnold Spielberg

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Conducted by Anne Frantilla

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Abstract

Spielberg, an electronics engineer and manager in Product Technology Operations for Unisys, discusses product development in the computer industry. He describes his work with RCA and General Electric Computer Dept. in the 1950s; IBM, Scientific Data Systems, and Electronic Arrays in the 1960s; and his work with Burroughs (and later Unysis) after 1973.

Subjects discussed include: point-of-sale equipment; product development and marketing; GE 225; IBM computers; Burroughs computers; Scientific Data System’s SIGMA series; and GP2000 (a cooperative graphics product of Burroughs and Superset).
Arnold Spielberg Interview
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Tape Index

Tape 1/Side 1.............................1
Side 2.................................[22]
Tape 2/Side 1...........................[43]
F: This is Anne Frantilla talking to Arnold Spielberg in Mission Viejo, California on June 23, 1987.

S: Electronics was sort of a way of life for me, because I started playing around with radios when I was about eight or nine years old, when I was living in Cincinnati. Crystal sets were all that was practically available for a little kid. And I always had an interesting connection with Boy Scouts, because there was a Boy Scout who was older than me, and he sort of took a liking to me and gave me an old crystal set that he had. This was about 1926. My uncles had just come to this country from China, and they came to the United States through China from Russia. I'll never forget at my house I had this crystal set turned on to a radio station in Cincinnati, WKRC, and I put the earphones on his ears, and his eyes opened wide. He had never heard a radio in his whole life, you know. I've never forgotten it. So I always was interested in electronics and played with magnetics and made magnets and Erector sets and all that stuff. So in time I became a ham radio operator and that was in 1932 and I used to operate a lot.

I was raised during the Depression and I missed college by an inch. So I went to work and I worked for about seven years in the department store business down in Kentucky.
F: In sales, or ...
S: Well, sales, and then I eventually became a manager at the store. And so I learned that business pretty thoroughly. But all this time I was still working with ham radio. And then in the service I volunteered during World War II and I was sent to India. And in India I was the Communications Chief of a bomb squadron. And so I picked up some more electronics there. And ...
F: For a bomb squadron?
S: A medium bomb squadron, of B25s. Our squadron was called the Burma Bridge Busters because our job was to destroy the communication lines for the Japanese that were coming up through Burma, to try to invade China from the bottom, and into India as well. So, for a while I flew a combat missions as a radio operator, but then when they found out I could fix radios, they grounded me. So that worked out o.k. And when I came back to the States on rotation, I was able to finagle my way into Wright Field. My brother was a graduate engineer there, working in Wright Field, and he got drafted into the service. And so I took his place, so to speak, at Wright Field. And I worked on developing a radio receiver to guide a bomb. Now that was the first time anybody handed me a developmental program. I didn’t know the first thing about how to go about designing something other than one does as a ham, code your own equipment, you know. I never had a college education, and so it was just hands-on experience and it was kind of fun.
F: What technology does that involve? Was that something new?
S: No, it wasn’t radar. It was radio. It was using high frequency ...
F: Guides?
S: Yes, we used high frequency radio signals at 300 MHertz, and the bomb was guided by five different tones. The tones were filtered out and they in
turn actuated a servomechanism which tilted the fins to left or right, or forward or backward, or neutral. That were the five tones. And the pilot sat there with a stick and he watched the bomb go down, and he would steer to left if it was veering, you know, to try to hit the target. And the way a bomb falls, it falls in a trajectory that if you’d fly the plane at the right altitude, you could sort of stay above it, you know, as it goes down and try to guide it in. And it had a technical name, RAZAR--radio and azimuth, range and azimuth control or something like that, I’ve forgotten. But that was my first experience in doing some engineering, so ....

F: Sounds pretty creative.

S: Yes, it was fun, and I was frustrated for a long time because the specifications that they wanted us to adhere to, you know, were specs I’d never heard of, so I had to look them up. What does microvolts per meter mean, and what’s the IF band width, and ...

F: Did most people you were working with know?

S: Oh, yes. There was a lot of engineers there. It was funny situation, because I came back from India as a Master Sergeant, with no college education, working with Ph.D.s who were corporals, you know. Some of them were pretty mad. What’s this guy doing with all this rank here, and no training, and here I am, this hard-working Ph.D. and they drafted me in the army and stuck me right back in Wright Field as a corporal. That kind of stuff. But I got a lot of help and //. And so right after, I decided to go to school under the GI Bill. And I co-oped at a now-defunct company called Crosley, where I worked on television production, engineering production line, first of all doing quality control, measuring all sorts of components to see if they stayed within specifications, and then later on working in the Test Equipment Department, designing test equipment to, you know, to use
in assembly and alignment of radio receivers first, then television. Then when television started to come in, I switched to designing wide-band amplifier-measuring devices, and then designed a signal distribution system for calibrating and tuning, you know, aligning television sets. And the last thing I did before graduation was to work on the line, troubleshooting sets that didn’t seem to work, try to find out what’s wrong and passing information back to Engineering, so they could put corrections into their design.

So when I graduated I joined RCA. I joined RCA to work on television, but they had other ideas and they put me in some radar programs, and I kind of enjoyed that. In 1950 I transferred into a then-beginning computer group there. So I really started working on computers in 1950. And at that time vacuum tubes were the main source of logic. And so I did some interesting work with the RCA tube design group in Harrison, New Jersey, because they were trying to design vacuum tubes that would respond as logic elements. They had one tube designed to be a three-input "and" gate, another one designed to be a two-input "and" gate, an "or" gate. And I built up some circuits with them. My job was to try to evaluate this and see if they were practical, should they continue with designing of functional tubes. And a number of us pretty soon came to the conclusion that wasn’t the way to go.

F: How much contact did you have with other people in the industry? Were there other people working on the same sorts of problems? Was it ...a kind of tight-knit community?

S: Well, there was a large group of people, and RCA, in order to get started there, was hiring people from all over. Some of their main sources of talent were people from MIT that worked on the Whirlwind computer. Which was
the MIT's claim to fame. And there was a bunch of sharp guys, because the

group that came together, RCA came out of research and development

labs. While the development was going on down in Camden, New Jersey,

there was some very original work going on up in Princeton Labs of RCA by

a gentleman by the name of Jan Rykeman, who was the man would claims
to have invented the magnetic core memory. And there was a big patent ...

F: I thought that was attributed to Forrester.

S: Well, there was a day ... that's right. And there was a big patent battle

between Jan Rykeman of RCA Labs and the Hazeltine Corporation which

held ...

F: Hazeltine Corporation?

S: Yes. For they claimed to hold a patent, and the two patents were right on

the edge of contention. And I think J. Forrester won on that one. But I

thought Rykeman was as much a contributor to that invention as Forrester,
because they were just running parallel. And at that point in time I became

a supervisor, and I had a very smart young guy that I sent up to the labs to

learn how to make magnetic cores. We pretty soon came to the conclusion

after this early vacuum tube stuff, that vacuum tube functional elements,

that we would use vacuum tubes as drivers and use diodes for logic,

although we had a contest, so to speak, whether we were going to build

computers out of magnetic elements or diodes and logic elements. And

the industry went diodes. And so that's where we went, too. Then I got

involved with the Bizmac computer and my first job there was to design the

arithmetic system. And then after that I was responsible for designing a

data sorter-merger-extractor, a wired program system, because they didn't

use stored programs on that. They kept the stored program concept for

computers and we did wired logic, were doing special functions. So this is
a huge machine that would fill this room. And the purpose was to take data on magnetic tapes and sort it, or to extract information from magnetic tapes, or to merge data. And this was all in response to a contract that RCA had with the Ordnance Tank and Automotive Center to design a computer system for handling the ordnance operation. And it was in Michigan. And it was a lot of fun. I learned a lot there. A lot of us had a lot of opportunity to write patents. I must have about 10 or 15 patents in my name for all kinds of computer logic and systems.

Then after that program got launched, since I was in the Advanced Development part of RCA, I got a very interesting program, that was the design of point-of-sales unit for a department store. We worked with an associate merchandising corporation and they were interested in sponsoring someone to develop an electronic cash register. And I got picked for that project because of my department store experience. So I was able to be very conversant with department store managers, and, as a matter of fact, I think that was one of the best planned systems, despite the ancient technology we're in now.

F: Would that be something that would keep track of inventory?
S: Yes, it could. I'll just give you a brief outline of what its purpose was. The first thing was designed to capture data at the point-of-sale, like you see in any store you go to now. What we did was make a mockup and went to about six different major department stores throughout the country and set up--what you might say--operating environments, where we'd have sales people ring up sales on this mockup machine, and then critique it, and we had buyers critique it, floor managers critique it, and we took elaborate notes. And then went back and incorporated this in an overall system design. And the overall system was designed to have multiple cash
registers feeding into a central computer. And then the central computer in turn produced data on magnetic tape, which was in turn carried over to the Bizmac computer which was the inventory control computer. So the purpose was to capture data at the point-of-sale and then use it to modify inventory records, so as the store would have a current status of all their stock, and a current status of the sales activity.

F: Sounds like a pretty advanced ...

S: It was. As a matter of fact, it is ... there's very few changes in the current system of point-of-sale operation that we didn't conceive of at RCA, including reading merchandise tags, including checking for bad credit and having a list of credit people on the drum. We used a big drum for the storage of information.

F: You know who made the drums?

S: Bryant, in Walled Lake, Michigan was the original. That drum was about 16 or 18 inches in diameter and about 24 inches long. It was huge drum.

F: Burroughs, I know, used some in the 50s that they bought from the ERA.

S: Yes, that's right. The ERA was a good drum maker then. Well, Bryant was a maker of high-quality bearings and machine tools. And we felt that they could engineer a drum that would spin and hold its own, and what problems we had were usually metal expansion, all that stuff, which was a pain in the neck. But we had it working. I have some pictures of my collection at home of those earlier systems.

But the sales recorder, they used a computer, and it was one of the first times that I've ever known of, other than John Wilkes in England, that anyone built a micro-programmed computer. This computer we built, the custom computer for taking all the data of the sales recorder, was a wired micro-program computer, that is, we used diodes to set up the micro-steps,
and we had a counter that stepped it along, and for multiplication would step along feedback step-along. Feedback is your repeated additions and shift, binary type multiplication. So we literally had a micro-programmed computer, but not like the current technologies, which is stored in RAMs and ROMS. But the concept is similar. That’s what I meant by this business of ideas re-occurring and re-occurring and re-occurring.

F: Did you get other contracts from that?

S: No. What happened was we did try for a lot of contracts. We went to the military, we showed them that we could automate logistics centers at the various Air Force bases. But the problem was very fundamentally that the system was too early. We didn’t even have transistors in it. It was all diode logic in tubes. This was done from 1954 to 1956, and the mean-time-to-failure of that system when it was installed—it was installed as a test system in Higbee’s in Cleveland—and there was 10 point-of-sale units in the sportswear department feeding the recorder’s Central, which was the name of the supporting computer. And it usually would stay together for about eight hours and then it would go down. And somebody would be jumping out to fix it, so it would barely hold together for the day and then the technicians would pile on it at night and try to get it back to life again.

F: There must have been some sort of backup system with it.

S: Nope.

F: During the day if it went down they couldn’t make any sales?

S: When it went down, they had to go use hand cash registers. They left the regular cash registers around. So after a year of trial, they concluded that functionally it was a good idea, that functionally it would work, but that technology-wise it wasn’t ready. And so RCA ate a couple million dollars
worth of costs there, and so did the associate merchandising corporation. And they said, o.k., end of experiment, end of program.

Now, a lot of the people that were on that program went to different companies. Some went to IBM, and IBM set up an operation in Rochester, Minnesota to continue to examine systems using point-of-sale. And some of the original RCA guys became part of that and I ran into them later when I joined IBM. And, matter of fact, they asked me all about it--early days.

I left RCA in late '56, early '57. I joined the General Electric computer department. At that time the computer department was called the Industrial Computer Department because Ralph Cordner said, "You will not join the business, making business computers. I will not allow that." And every time a plan was sent to him that mentioned going into business computers, he would write "No" across it and send it back.

F: What was his reason?

S: His reason was that General Electric is an industrial company, and if you want to make computers, you can make them for the industry. So there was a sharp guy by the name of Barney Oldfield who was head of the Microwave Lab, and he set about to, somehow to make this happen. And he convinced the Bank of America that General Electric could build the IRMA computer that the Stanford Research Institute (SRI) was designing for them. So, after several under-the-table operations in which he had some pretty good names associated with the company, like Dr. Herb Grosch, Dr. Bob Johnston who used to be //, was part of that team. And they hired me to help set up the Industrial Computer Department, because that was the banner under which we flew. But in the meantime, they did sell the Bank of America the concept of building the computer, and GE launched into the computer business despite Cordner's statement that he
wouldn't. And so when they were recording the story, when they finally dedicated the first computer, Cordner came out to attend the dedication ceremonies and promptly fired Barney Oldfield right after the ceremony, for violating his rules. And he gave the company 18 months to get out of the business. You know, gave them //. And there was only about five or six people that knew about that. Certainly not me. But I remember working on a computer for process control, that another guy and I went to the general manager and said, "Hey, we can put a memory in this thing and now you've got yourself a business computer. So // we did it. And that got him started. That became the GE 225 and 235 which was, well, they were both successful computers. I really didn't find out about all that high-level machinations until I went to the GE reunion, where some of the guys that were involved in that spoke about it.

F: Whatever happened to the Bank of America contract?

S: They shipped about 18 or 20 systems. They were problem systems, but they worked. And we got our data sorters, you know, check sorters, from National Cash Register, who in turn got them from // Pitney-Bowes, I believe, was the original developer.

In the meantime, Burroughs was doing their own ...

S: But the check sorters that we used came from National Cash Register.

F: I didn't know they made them.

S: Well, they actually had them made by Pitney-Bowes, and then modified themselves, and GE finally made their own. But then they really lost the banking business because--a lot of things I wasn't totally aware of, but--while their product planning was not well directed, they came up with a middle-range product that I started, called the 400-Series of the product planning // decimal machine, something like our B-Series. But it was not
competitive, it was priced too high, so it didn’t succeed. And then they came out with a 600 line which was pretty good. But by then they just decided to work their way out of the business. And a lot of people thought they lost a lot of money in the business, but as I understand it from some of the people that were involved in finances, they really didn’t lose much money on it. At least that’s the story I heard.

So when they started to ease their way out of the business, that’s when I left and went to IBM. And I joined IBM in 1963 to work on process control—computers. IBM was just really starting to get into process control. And again, one of the guys that got me into IBM was a fellow that worked with me at RCA. So there’s again the old IBM community of people. And ...
machine that we thought would do the trick. And we presented it to management and they bought it. And I ended up being responsible for the design of that machine. And the result that was called the IBM-1800. But the guts of the machine were then flipped over and used in the 1130, which was a very, very popular IBM small business scientific computer, and it replaced the 1620 which by then had died out in terms of the market, in the market. So the 1130, I guess, over its life sold about 15,000 or 20,000 machines. And the 1800 process control computer sold about 82,000. In both cases they met their forecast.

The real problem with getting into process control is the same as it is in almost any company--the marketing end of it. To sell computers in the process control industry requires a lot of custom design because each of the processes have different technologies, different sensors required. The front ends are the most complex part of the system. So when I first started working on this system, I spent at least three to four months writing specifications for what the front end should be, based on my experience at GE. And there were a few good guys at IBM that knew that industry, and so we put our heads together and got a fairly good specification written, and then part of it was built up in Rochester, Minnesota--the high-performance analog-to-digital conversion stuff was built up there. And the low-level work and the main processor and all the peripherals and all the peripheral controllers were built in San Jose, were under my control. And so it was a very intense work, because anybody who says that things are taken easy at IBM is wrong, because I used to come to work at 7:00 in the morning and work until 6, 7:00 at night and come in and work on Saturday, because what happened was when they decided to put the new computer in, they didn't want to change the schedule. So we literally had to discard the first system
and start over again and still keep the same schedule. And it was almost like an Impossible thing, and yet, in a little less than two years, we designed a machine, built the first prototype, built the second version of it--you know, called the B-level, the first was the A-Model and then the B-Model--and we were just ready to release the C-Model to Manufacturing when I got an offer to be a Vice President in Scientific Data Systems, and I said, "Goodbye, IBM." And so I went to work for Scientific Data Systems in Santa Monica.

F: Was there any project that was competing with the one that IBM--the one for process control?

S: The 1800 was a, what would be considered now, mini. But in those days it was a small, medium-sized computer. Small-medium range. And the systems that were similar to it in performance characteristics were Scientific Data Systems' 900-Series--the 910, the 920, the 930--were a competing level of machine. Except they didn't have process control front ends. They were designed to be used in the small scientific and in downrange missile stuff. They did have some special front ends for them, but they were directed at missile simulation, missile data analysis. And that's one of the reasons I guess Scientific Data Systems wanted me--because of that experience there, and also the previous experience at GE, plus several of the guys from GE went to work at SDS while I was at IBM, and said, "Why don't you get Arnold?" That kind of stuff.

So the other competitors to that machine were TRW, the RW-300, that was a little bit earlier machine, actually. And Daystrom had a machine that was--it was a good machine, but they never could market it right--they were always selling at such a low price that they really couldn't make any money off it. And IBM's marketing force just overrode a lot of people. And also they had a shrewd piece of marketing concept: they did not try to use the
computer as a process controller. They used it as mostly a data logging system. And they also incorporated a lot for factory record, data gathering, parts counting, production line control, production line data logging. Every place they could apply it to a data-logging operation, they would not then get committed to run a process. And it's easier to sell in that marketplace. You can build a good base of business, and from there they can grow.

After I left IBM they started a System 7 which was their next generation processing control, but I was no longer involved in that. And I don't even know what happened to it, or whether it's still active or not. I know that while I was there I was often questioned about the point-of-sale system because IBM was doing some planning along that line. // they were very careful not to ask me about real trade secrets.

F: I don't think that would be true today, do you?
S: I don't know about today, but I know then they had a man in charge of, you might say, official information gathering. But when I left GE I had to sign all kinds of disclaimers I wouldn't give out any information. When I entered IBM they said, "We don't want to know anything about what you've done specifically." So the questions they asked me about sales recorders, point-of-sale systems, were not how I built it, or how it was built, but what were some of the concepts in terms of application orientation. That's fairly open. But that was kind of interesting. I stayed at Scientific Data Systems where I was responsible for the whole 900-Series and then the Sigma-Series. The Sigma 2, 3, 5, 7. We were working a Sigma-9 with the French company. They would paying for a lot of them, and that's when they sold out to Xerox. And at that point I left and decided to go with a small semiconductor company called Electronic Arrays. That was a mistake.
They built MOS semiconductors up at Mountain View and they asked me to be a Vice President of Operations in Southern California, in the L.A. area, actually out in the valley, to try to get them into the business of applying their MOS technology. So we had a few small contracts, but the company was very underfunded and the president was a guy that was so wrapped up in semiconductors, especially so wrapped up in MOS, that we had to build all of our systems out of the MOS technology that was coming out of the mountain he planned, even though the costs were so prohibitive that we couldn't make it for a profit. And even though we wanted to use TTL, he said no, we got to use MOS. And he would come up with a logic family of MOS technology that was like the small-scale integration right now. Very small scale. But it was too costly in terms of the number of gates that were functions per dollar. So, while we shipped about 40 or 50 of those systems, the company eventually—well, it was MAL—that was Management Assistance, and they did maintenance and they also did a few products of their own. And their job was do a lot of computer maintenance, or contract maintenance. So we built this IBM controller for them, tape controller, and then when they canceled the contract, fortunately for the company we had a cancellation clause, we collected a million dollars on the cancellation clause. We used that to set up a calculator company, so I had to write the business plan for a calculator company, and we set up and manufactured a four-function calculator, a printing calculator, and then we had two others planned. And that was my first experience in applying MOS into calculators. And at that time we sold a lot of chips to the Japanese, which, instead of buying from them, they were buying the chips from us. That was rather interesting. And this was in the period of 1969 through 1971. '68 to '71, that time. And then the company really got into trouble
financially. We sold the calculator operation to a sort of a broker who tried
to complete the line and then he ended up getting a couple of good
contracts to make some more calculators. But what had happened, the
prices were going down so fast that it was difficult to keep up with it. Our
original plan was that the calculators were going to sell for $398.00--for a
four-function calculator.

F: Wow!

S: Well, that's what they brought. Our plan was the next year they'd go to
$298, the next year $198, the next year to $100. And it came down even
to that. So the price just shot down, because the minute the
Japanese got a hold of it and they started putting high production
techniques in it, the first calculator would have five chips, the next
calculator was designed to have three chips, and of course pretty soon
they were down to one chip. So that was a // adventure that got me
experience in doing plans, and setting up a small business within a
business, and so was the whole small company a business, because as a
Vice President I was laying out printed circuit boards, you know, in the
beginning, when there was only about 10 people in the group. We used to
do everything.

After leaving Electronic Arrays, I went into consulting, and I did some
consulting for SRI, and for some small companies that needed systems and
procedures working, and some technology, evaluations and things like that.

F: You had no problem getting work?

S: It was a bad time then. I would say I was about 35% busy and the rest of
the time just messing around. And then Dr. Bob Johnston had a party one
time. He found out that I wasn't doing anything much. He said, "Why don't
you come to work for Burroughs?" And so in 1973 I joined Burroughs as
the Director of Engineering under Lloyd Tolene. And for the first--oh, I joined him in April of '73, and then until September I spent my time out here in California helping the Galida plant, going through some of the rough starts on getting the 1700-line. That was under Rod Bunker then. And I worked with Dean Ernest and some other guys, that we were just trying to see if we couldn't get the product cost down, because the 1700 was promised as a low-cost machine and it came in pretty high and it took a lot of effort to kind of re-direct it to get the cost down, but never down to the goals.

F: Well, it was definitely one of the most successful product lines ...

S: It became a successful product line, and yet initially it looked very sad in terms of cost. But I guess marketing handled it o.k. And after there I moved to Detroit, and I was involved in all the plans then under the Computer Systems Group. And I was in Detroit for about two years when the DC&L program started. That was a mistake. We involved way too much of the company's product plans onto a technology that was (how shall I call it?). It was best labelled experimental in the beginning, and it looked like--as a matter of fact it had promise. It did have promise, and if we'd have picked maybe one or two products and said let's use these as the target products, we wouldn't have gotten management so nervous about committing all this money and all the programs to a technology that was still evolving and still had a lot to go and had a lot of cost.

F: Is there anyone group or group of people that sort of were pushing for that?

S: Yeah, the focus of the push was really two places--at the senior management level it was under Dr. Bob Johnson and Herb Stopper. Herb really did a lot of the conceiving of the function of the circuit system. The
Rancho Bernardo plant actually did the implementation of the BC&L technology. The packaging concepts were worked out in Tredyffrin under Sid Einhart then, and I think if we had stayed, "Let's build the machine in Tredyffrin and no place else, we'd have had a good chance of success because that machine was big enough so we could have absorbed some of the cost of the water cooling, the liquid cooling, //, it exceeded its cost objectives it would be like the 1700 was. It exceeded its cost objectives a lot, yet it became successful. Another problem that happened with the product is there was a lot of problems initially in the technology at Rancho. And so this kept delaying the product coming to the marketplace. And so what happened was the technology became older without seeing the light as a product that brings some return to the company. Also, the signal level that was chosen under the emphasis of Dr. Stopper, was incompatible with the other ECL technology that Fairchild was sponsoring and that Motorola was working on. So we had no way of rescuing ourself by saying hey, let's grab some ECL from Motorola or from Fairchild and fill in the gaps and make a system that could have been compatible in that sense.

F: You mean technology was changing increasingly fast, or do you just think it took an extraordinary amount of time to get it ...

S: Yeah, but you see, that's true even now. But now they've really cleaned up the art of having very high density VLSI technology. They also have now cleaned up the design automation methodologies for laying down, you know, defining the patterns. In the early days the DA was crude. A lot of stuff had to be laid out by hand. Gate arrays were just beginning to be ...

F: Gate arrays?

S: Gate arrays. That's the concept, instead of doing the design of a chip exactly customized to the function that you want to do, you have an array of
gates that can be interconnected to make the logic. But the array is a fixed pattern, and then you just configure it to the logic that you want. And some of our ... well, matter of fact, the A-3 is built of gate array type logic. The A-10 was built that way. A BCL, the A-9 was built that way, and the concept of having quick turnaround custom circuits just wasn't ready. But now with the silicon simulation technology that they have to go to simulate circuits using high-performance systems, you can have a much faster turnaround. And thus you can go back to some custom circuits.

In the meantime, while all this was going on, the computers on a chip, you know, while I was with Electronic Arrays, Intel was beginning to work on the 8080, or the earliest single-chip computer. And as a matter of fact, speaking about rock, I proposed to Electronic Arrays that we build a three-chip computer, a computer chip, a memory access chip, and an I/O chip. And they said, naw, we don't want to do that. And it was about the same time the 8080 was coming out, I heard Dr. Davidow // at Intel. So I often thought, gee, what would happen ... we never had the money to do it, though. Forget it. We were so lightly funded that probably it was a good decision not to do it. But on the other hand it was a shame. We would have flunked because we would not have had the money to put into it.

So in working on CML, it was a frustrating job because there was a tremendous controversy about using the program. This plant in particular, but then engineering manager, Irv Houk absolutely did not want to use CML. He was probably right, in retrospect. The A-9 program shoved around from one technology to another, trying to meet everybody's various pulls and demands as to what the machine should be. You start off as a CML machine, then they said let's do it on a PTL, but that wasn't enough performance. Then it was back to CML again because it wasn't enough
performance. Then they proposed the F-100, Fairchild ECL technology. That one finally came out to be. But that cost about three or four years of //

F: I could be wrong, but wasn't the company doing very well in the '70s? I mean, it looked like that's when it started being really profitable. Maybe it's more toward the end of the '70s.

S: Well, more toward the end, yes. And also, recognizing the fact that CML was not going to make it, Bob Merrell was then the vice president, started a bunch of programs using PTL technology. They redid ... they gave up on the CTL technology. They redid the 1800, the 17 series of // in PTL. Then came the 1800 and 1900 series. They started a PTL program here that became the 5900. Pasadena continued evolving out of CTL into TTL, and so TTL really became the rescuing technology. And then Rancho Bernardo sort of sunk into limbo for a while. And there was one successful machine that opened out of BC&L in Pasadena, and that was the 4800. It was made out of BC&L-zero. And it exceeded its cost, but it had nice performance. Then there was another machine built out of BC&L-zero at Liege which was a 1700-style machine, but built at Liege out of BC&L-zero. The BC&L-zero was packaged in a conventional package. Instead of a liquid cool pack, it was an air-cooled system. And so it didn't suffer from the problems of trying to make it a good packaging technology with liquid coolant work.

And now there's some of the people who were early proponents of the liquid cooling have come up with a much nicer package down there at Rancho. Gunther Weber's //. And what happened with me is, after the CML fiasco (I might call it that), I officially transferred out here because my ex-wife did not want to live in Detroit any more. So I stayed here and worked on it. Then I went to work in this plant in Systems, and then gradually evolved into an Activity Manager and put together a graphics program.
END OF SIDE ONE, TAPE 1 OF SPIELBERG INTERVIEW.
TRANSCRIPTION OF UNISYS TAPE

INTERVIEW OF: ANNE FRANTILLA WITH ARNOLD SPIELBERG

MISSION VIEJO, CA, 6/23/87

F = ANNE FRANTILLA       S = ARNOLD SPIELBERG

// = UNINTELLIGIBLE PASSAGE

TAPE 1, SIDE 2 OF SPIELBERG INTERVIEW

F: Did you think it was frustrating for people working on CNL?
S: On CNL?
F: Well, it doesn’t seem like overall the company lost that much. They sort of rescued themselves in time.
S: Well, they did rescue, but in reality, we delayed our entrance into the VLSI field by at least three years. I would say we could have been into the VLSI field sooner had we had a little more focus and more development without commitment. In other words, if we had put one product together and looked at it, we could have learned from it instead of diversifying—not diversifying—diluting all the skills and trying to cover a whole bunch of bases, and not succeeding at any ...
F: All right. Talking about who was arguing who, doing what, in terms of BC&L or not, what groups do you think had the most input. There’s marketing people and legal people and engineering people.
S: Well, the market people, in all honesty, I think, really, didn’t really know whether the technology was ...
F: Did they have a say?
S: Well, Product Planning was then under Fred Meier, you know, was concerned that we’re not getting the objectives. You know, he looks at it
and says, "Where's my results?" And the results weren't there. So obviously he became sour on it. Bob Merrell at first was for it and then against it, as he saw nothing happening. Bob O'Connell, who was head of the semiconductor group, was trying to make his group do it, and of course there'd be head clashes while they tried to straighten each other out. And the net result was finally the company said, "Let's go."

F: Was the top-level management?

S: Well, gentlemen like Paul Mirabito were really at the mercy of his people who were giving him good technical advice, imaginative advice. But after a while he said, I'm sure he saw // 'we're not there yet.' And unfortunately Herb Stopper was a very convincing talker, an extremely brilliant guy. I used to work with Herb at GE, so I knew him before he came to Burroughs. He was in our group at GE. And he's an extremely bright guy, but extremely stubborn. And he had the concept that anything he says can be done, anybody ought to be able to do. And so, he never put a product down in the marketplace. And so he would come up with absolutely correct theories, but the implementation was tough, and he'd get totally impatient when it wasn't happening. And he'd start clamping down on people. And Bob Johnson supported him on a lot of that, although Bob's a very sharp engineer also, but also a guy who never really put products in the marketplace personally. And there's something to having your hands dirty and completing a program and making it into the factory and going through the nitty-gritty of getting a product through the manufacturing cycle that is a very--how shall I call it--leveling type of experience. You say, boy, Murphy's Law works. If it can go wrong it will. And you start to work on problem-solving those problems. And unless you carry that out and have some of that under your belt, everything looks ethereal, looks like it can happen.
And then you get rosy glasses. And that's a lot of what happened in the higher level there. There was some rosy glasses at the corporate level of engineering, I think, and some insisted that yes, it can be done. And then at some of these big meetings we have at Detroit, stop work put up curves. Yes, the cost can really be here. It can under ideal circumstances, but not under the practicality of what was happening at those times.

F: It seems like such a complex thing.

S: It is. It was a very complex ... and the industry has matured now and now we know how to do it. And things that seemed to be ... that were very difficult then are still difficult, but the technology is here and the tools are here and the design automation is here and there's maturity in the thing. And we were on the forefront. And when you're on the forefront it's not too hard to slip. And it hurt me.

F: // It's hard to work on a project that doesn't.

S: I got a kick in the butt for it, too. Somehow or other I should have made it happen. That's the job.

F: Someone's got to be the fall guy.

S: Well, a fall guy or what. A number of us took a beating and I was about ready to quit. But then I said, naw, I ain't going to do that. I'm going to stick it out and show them I can do it. And that's what happened.

And so now, well, we'll talk about graphics now, because what happened was the company had decided that it would be a good idea if we had some new product avenues. Graphics, according to the corporate product manager study, was an evolving, an emerging, field.

F: Do you think they're correct?

S: The company was correct in saying graphics is emerging. The company was correct in saying it can be a business. The company is correct in
saying that it would complement our product line. What was wrong was that there was no real training in marketing, in how to sell it. It's such a new concept, and it's a technical concept that has to be sold. And you were not going into the front door to your DPO, operator of data processing operations and say, "Hey, I'm gonna do more business for you. I'm gonna give you a more efficient machine now. I'm gonna crunch the numbers faster for you, or I'm going to do your banking faster," or what have you. Instead you say, "I'm going to give you good reports. I'm going to give you graphic illustration of your data. And I'm going to give you publication quality of all these slides that you can make presentations with." And so that was the marketing end of the thing that really need to be grown.

F: It was kind of before its time?

S: That's A. The company that we selected had a good product, but the product was an older product. And it was at the highest end of the graphic performance line. It was designed to be a high-end system producing very, very high resolution graphics. Very high quality. The software for it was very user-unfriendly. And unfortunately, initially enough of us did not know enough about graphics to know just how unfriendly it was.

F: It's probably a whole different ballgame then ...

S: Well, we began to learn as we got through the program. We began to see that this interact program that was sponsored by E. N. Herschel, who was the then-president of Superset, was a clever program, but it was designed to be run by a Ph.D. And when some of our programmers got hold of this, they said, "Oh, my God, this is user-unfriendly." And we tried to convince them to change it. And we couldn't. That's one. The other thing is the product cost and the market price we could sell it for were too close to each other. And the way Burroughs does business is, we lump in all the
hardware support, and we lump in all the development costs as pre-
production costs, you know. And that added to the whole cost transfer
price such that the costs were too high from the profitability point of view,
particularly since the volume forecasted was low. When I first started the
program, I suggested that we don’t even build any more plants. We take a
small group of us and move us right down to San Diego, move into an
adjacent building right with Superset, we set up a small manufacturing
operation that has low overhead, and we can produce it, and top brass said,
"No way. That’s not our way of doing business." And I still think I’m right,
you know, because subsequently large companies have set up what they
call tiger teams that are put in a little building and go off and do this. I
mean, take away the pressure and you just get this done. And that’s what
we really wanted to do. We wanted to set up a little tiger team and go out
and do it.

And so, as a substitute for the tiger team, we set up a plant within a
plant in Pasadena. They decided this plant was too busy to make it. Ed
Nelson was overloaded. They’ll put it up in Pasadena. So they created a
plant within a plant and had a program manager. And they gave it relief for
one year in charging into it all the high cost of the overhead. So that
brought the cost down. But it was an artificial bringing down because they
redistributed the cost to other products within the Pasadena plant. You
can’t get something for nothing. If you got n people there, the money’s got
to be charged some way. Well, they decided they’d do a favor for the
graphics program and not charge it. But so the other products ate it. But
that’s life.

We had a very good team here in putting this product together. We
had a very good program planned, but the budget was always at the bottom
end of everybody’s desire. So when this plant was given budget money, they were given budget money for all the mainstream products and I got what was left, which wasn’t enough. And yet it seemed like a lot of money, and the reason it seemed like a lot of money is if you don’t sell many, any development costs a lot of money. So it became a circle. And the interesting thing about all this in retrospect is after we canceled the program and turned the work back over to Superset for a while, until it was completely canceled, we had the program here, and then turned the work back to Superset and said, "O.k., you’ve got a lower-cost operation then. You do all the work." The marketing was still not selling enough, and when I talked to Dr. Stern, as I went back to the stockholders’ meeting about three or four months ago, and Fred Meier introduced me to him as a man who helped get the GP-2000 started, so I said, "Well, just at the time when we had decided to kill the program, orders were starting to come in." Now what that does, it ties back to the concept of how you really have to develop a sales force to sell it and it takes time.

F: You also have to work in tandem with what’s going on.

S: Well, there was only two people in market planning to work on this. One guy in product planning and one guy in market planning. And they were fellows who never had experience in direct brand-new program introduction. And so, while they tried hard, it was very difficult to get the market people to make a decent forecast. First the forecast was real high. Then when it came time to cut the mustard, down went the forecast. Up went the cost. The cost forecast played reverse roles. The higher the forecast, the lower the cost. The lower the forecast, the higher the cost. Both are self-fulfilling destruct prophesies. And the lesson we learned out of that, and we’re trying to pioneer, is to help marketing get started early in
a new product program. I remember giving several talks here at the plant to our other activity managers about the experience we had on this program, the idea being to help look for advance clues as to how we can help marketing introduce a product, help get training across, help make the product palatable to the salesmen so they can sell it.

F: You know, some of that sounds familiar to me as some marketing problems they had when they were doing the B-5000. That was part of it, that the salesmen didn’t really know what they were selling. The customers didn’t know what to make of it, so ...

S: And they didn’t know how to sell the graphics programs either.

F: It’s kind of similar.

S: And now I think graphics is a really fascinating industry. An interesting sidelight—I was over to Steve’s house one day and George Lucas was there. This was about three or four years ago. And Lucas had this company making the very highest level of quality graphics, and they were using it for animation. And he was trying to help organize a company under his name. I said, "Hey, George, what are you going to do with that company?" He said, "Arnold," he said, "I don’t know how to manage that company. I’m going to sell it." And he did. He sold it off. It was just too new for him. It was too different. It didn’t fit under ILM, the industrial lights and magic. It had special effects. Because it was prohibitively costly and to get a really good animation into a movie, you almost needed a Cray computer to crank out the data. Now even that’s being helped, because now the industry, like TI especially is coming out with custom chips that are graphics-oriented chips. They’re designed to refresh the tube real fast, refresh the screen, refresh the memory real fast, do bit manipulation, picture manipulation, pixel management that they’re all customized on a chip. So you can put a
system together that works fast and it's cheap. And so what's happening is
the graphics industry is becoming driven now by PCs, except for the very
high end. Then they really need big computers because you got so many
pixels to manage.

Now I'm running a mundane program but necessary called
Engineering Resources. And we have a lot of things to do here. I don't
know how much you want to go into that now. It's not really an archival
thing—it's a current project.

F: It sounds like you're sort of involved in different aspects of projects over
the years. You could make comparisons like between how equipment was
tested over the years.

S: Well, for example, most all the early equipment, the '50s and '60s were all
hand, manually assembled, hand-wired, soldered, and very complex back
panels, large panels of logic, of plug-in ... one functional element was a
package about six inches by six inches by two inches deep or I think it was
something like that. It was a logic // couple tubes on it, some resistors and
diodes and that's a flip-flop. Now a flip-flop is so small you can't even see
it. That's one. In terms of the ... the assembly methodologies went from
hand-soldered to wire wrap to etched back planes. I'll talk about the back
planes. The etched back planes reflow soldering, which means you don't
have to get a new head, just put solder mask on there. I mean solder array
//, then either reflow solder or air heater. And then make the connections
that way. Patching gets denser and denser and denser. Layers get thicker
and more and more layers of interconnect. A back panel used to be a layer
of wires criss-crossing, then the XY edge, then multi-layer, you know. And
that's where we're at now. Multi-layer back planes.
And then mounting techniques were originally everything was socketed and then everything was soldered in by soldering by drilling holes and plate through the holes and putting the components in. And now surface soldering is coming in because it's more compact. And each time you advance that technology, the tools required are more complex. Surface soldering is complex and also the field repair policy is changed. It used to be that a guy would go out in the field, unsolder the wires and take the transistor out, put a new one in, and solder it back in. And then a chip would be unplugged, and assembly of componentry. And now the whole board is changed out. And that means everything can be repaired faster. And since computers are taking less and less space, a board becomes a more, a larger and larger significant part of the system. So the cost of spares are going up, because you can't stock a small component--now you stock a board. And more and more each board becomes a custom board. So often the spares are equal to cost of the machine. For example, we have an A-15 here, and a set of spares for the A-15 is a quarter of a million dollars. That means you now have a new logistics. You'd better make the machine last a long time, so that the reliability is way up there so the need to change out is small. Too, you better have a fast way of getting spares to the spot, because no customer is going to be happy with a machine down more than half an hour. Or an hour at the most. Or they start to scream.

F: Do you think reliability is improving?

S: Definitely. In our future machines we're talking about reliabilities of over a year. And mean time between a system halt of longer than a year. Now when I was in Process Control, they wanted us at first to achieve a 99% up time. Then they raised they the jumping bar to 99-1/2% up time. Then they raised--about every two years they do this--then the next jump was about
99.8 up time. That’s asking a lot. And our companies then would not agree to redundancy in the systems. I often proposed, particularly for nuclear control, a dual system. The military and space program often has three or four systems, all sharing the function, you know, and if one goes down the others take over. But the cost was so much in those days that they couldn’t have the redundancy that they needed. So they used to talk about having redundant circuits. They tried to come up with circuit systems that would path A, if it would quit, path B would work. And very few machines were really built like that. But the most popular machines in the current marketplace are like tandem that have dual systems tied together. But what’s happening is I think tandem’s even going to get by-passed because of the increased reliability of very large-scale integration. So putting a machine together with very few soldered parts, you know, very few plugs, every time you make a connection it’s a reliability focus point. And so the more you reduce that, the longer you can bet on the componentry lasting. And so we’re committing ourselves now for future products to come out in the very late ’80s to be in the one-year reliability range. That’s pretty good. With 24-hours a day running, there was over 8,000 hours.

Now that doesn’t still hold true for some of the physically moving peripherals. Disks are getting that way, though. Disk technology is getting way up there in the $50,000 range, and that’s a lot. You have to figure something drastic right there.

Now, as far as testing things in the factory is concerned, early testing was by oscilloscopes and probes. You looked at pulses and you looked at the wave shape. You said now that’s o.k. or it’s not o.k. or something’s missing here. So scopes and probes and brilliant engineers helping the test technicians on the floor how to test something. And also in the early
systems, because componentry cost a lot of money, you tried to design with the fewest number of parts, and particularly, you tried to design with the fewest number of flip-flops because flip-flops are considered to be unreliable. So that perforce the logic became very complex, the system logic became complex in terms of you would take the same data and you'd use that ... or rather take the same path, try to put different pieces of data through the same path at a different time sequence, so tracing a fault, you had to know where it was in the time sequence as well as what path it was going through. Nowadays, with componentry costing less, you will to be redundant; you're willing to make a once-through path in terms of making the system easier to check.

Furthermore, you now put probes on the end of cards, you know, so you can test the function. You have diagnostics that are getting better and better and betters so that you can exercise the machine with diagnostics more exactly and D-drive and other test techniques like that are homing in on individual parts. But now we back away from that somewhat, because now it's necessary just to show that card is bad. As far as the field is concerned, you can just pull the card, swap it, send it back to the factory where a different level of diagnostics can be used to home in on the particular parts that are bad.

The next thing that's happening, and it actually was happening at IBM when I was there, is the beginning of use of robots to test. Instead of putting peripherals on the line to test the computer going down the line, they'll find a functional robot that will simulate the peripheral, and especially for a high-volume production, just plug the robot into the output and it runs through a whole bunch of exercises // on the tape, I'm running like a tape, or acting like a printer. And we're talking about that now. Also,
a lot of peripherals are disappearing from the scene that used to be
electromechanical, like card punches and card readers, and paper tape
readers and paper tape punches—they’re all passe. And once the main
elements of storage, disks, magnetics, magnetic disk, magnetic tape,
magnetic cartridge, CD-type things, laser, laser-read, laser-written, these
are all very reliable technologies. And what’s coming to the front is
distribution of data. So datacom is becoming more and more important,
the need for long-distance communication, the need for terminals, so
everybody’s remote to the host. So datacom is becoming a larger and
larger portion of the peripherals that are attached to a system. High-
density storage, archival storage like tapes or CDs, terminals driven from
concentrators and high-quality datacom subsystems is what a system is
evolving into. And graphics next.

F: Talking about the telecom, datacom elements, it seems like products within
an industry are becoming more interdependent upon each other. Like the
new contract they did with the graphics company you were talking about. I
don’t think in the ’50s companies really shared resources to come up with a
product.

S: You mean, are we as much vertically integrated as we used to be? Do you
know what I mean by vertically integrated?

F: Yes, yes.

S: O.k. Yeah, plants try to be vertically integrated, but every now and then well
we got smart. We have probably admitted we don’t know how to make a
good disk. Well, we don’t know how to make a good magnetic disk system,
and so we buy them. We don’t know how to make tape any more, so we
buy them. Or, put it another way. A specialty company has passed us up,
so it’s now more convenient and better business judgment to buy the
technology from them. So we’ve become more and more an assembler of componentry and there used to be, early on, early discussed, I remember having sat with some of the people with Intel. They, remember (no you can’t, you wouldn’t understand), you know, if you will turn over the development of this or //, the people let us do their system for you, we’ll deliver you a systems on a chip, you know what I mean? And Poleski was then president of SDS, said, "No way! You’re not going to take away my prerogative design, my kind of computer, you know." But yet 8086, 80386, the newest ones, those are now forcing companies to use that processor in their application, because somebody just concentrated on that. So you might say the semiconductor people are slowly stealing pieces of the show. On the other hand, the name of the game now is the application software, the business end of it, and that’s where the companies ours will continue to shine. We just have to strike the right balance, what we buy and what we make. And so that’s what happening. The industry is evolving into ... every time there’s a new step in the technology, it creates a new set of balances as to how you deal with it in a business sense.

F: It seems like in the early days that it was more possible to trace products by the contributions of specific individuals, whereas now it seems to be almost impossible. You know, people change jobs so quickly and departments are so big. I don’t know if it’s because the technology is not improving dramatically, like it did between vacuum tubes and transistors. It’s harder to trace product developments to specific individuals.

S: Yeah, I agree with you. And yet there’s always some genius somewhere that comes up with the unusual break. But by and large, most of the engineers working in this place here are not inventors. They are applyers. That doesn’t mean they couldn’t under the right circumstance, but most of
the circuits inventions are taking place in semiconductor companies, one. Two, most technology is so complex now it takes a team of people to make it happen. You, to put an idea together, whereas in the early days, I'm thinking of a terminology, I'll use the work the "Bensi-Fetch"--and I know you've never of that. When I was back in RCA, a very bright guy who came to RCA from MIT where he was working on Whirlwind, came up with an idea of drawing information from a drum in clumps of data and transferring it to a core memory where it was operated on the core memory, and then putting the results back on the drum again. He got a patent on that. We called it the Bensi-Fetch. It was named after Lowell Bensi. Nowadays that's old hat. You know what I mean? But yet in the 1950s that was an invention because it was the first time done. I have some patents on library systems for storage retrieval based on looking up a reference and then using that reference to point to another reference and getting that, as a library system for searching for data on tape, with all the front and the back ends of tape all identified on a drum. So I can know which tape to go to. Now that technology is //, nobody needs it any more. Yet it could be identified with a person. Or, while I was working on a sales recorder, when we were storing information on a drum, we wanted to be able to find the data and yet we were looking up some prices. A guy by the name of Phillipi Tonkel, a guy from Brazil, came up with a hashing scheme which everybody uses in the industry now. And we got a patent on it way back then. And it's a scheme of taking data that has an identifying number, and operating on that number and developing an algorithm which randomizes that number in such a way that you can distribute it in various channels, and you can search the channels by taking the unknown number, randomizing it, having a resultant number point to that channel, and go find it. And that's what we
used on the sales recorder, and yet hashing is a common technology now. But it was a marvelous invention and you could point to that guy who did it. Now maybe somebody else did it in other companies, but we didn’t know it. There’s a lot of small invention like that. Circuits inventions, flip-flop inventions ideas. This fellow Chuck Profster came up with a novel way of designing a two-two flip-flop that he could get isolated output from. And he did it by putting a resistor in the cathode of the tube and that change of voltage across the resistor was the output signal. And yet he made the circuits stable enough so it functioned. And that became a patent. So there’s a lot of early stuff that was done that you could name people for. And in the early days of the computer industry, whenever, when transistors started coming in, everybody that could be applied to it was translating tube surfaces and transistors and writing patents on them. But that was RCA. RCA was very patent-conscious.

F: So maybe patents aren’t the way to document product development.
S: Well, patents still are, because there are some really great things happening that people get patents on. But also, I’m sure the guy who invented the CD deserves a patent. And yet, way back then, we worked on thermoplastic recording at RCA. In the early ’50s we were working on a scheme where we coated a disk with a thermoplastic material and the disk (no, I’m sorry, it was the first tape, magnetic tape) and the tape passed into a vacuum chamber through an isolator that squeezed down on the tape, and the thermoplastic was written on by an electron beam which warped the thermoplastic and made it take a shape. And then as it came out, a light was shined on it and you could then, based on the reflection, detect whether it was a 1 or a 0. So we made a thermoplastic board and we tried to apply it two ways: one, for computer storage data, and the other for
television. And yet the change of ... like a laser writing on a laser disk does exactly the same thing with a brand new technology. That's what I mean, re-invent, re-invent, re-invent. Yeah. I guess my enjoyment in this whole computer industry is I was always down in the front of something. It's called the "neck sticking out position."

F: You know, some people don't like that, I don't think, being in that position ...

S: I always took dumb risks.

F: Do you think they were dumb?

S: It was fun, I think that's the main thing, if you do it, you like it.

F: One other thing I wanted to ask you about is your reaction to the merger.

S: Oh. At first I was skeptical. Yeah, I just wondered how in the hell is Burroughs and Sperry going to make something go together. But, I give tremendous credit to Blumenthal. That guy is a genius. Because many of us saw synergies. I mean, you could look at a company and say, "Yeah, they got this and they got that." But at his level--he's not an engineer in that sense--to be able to perceive that somehow or other ... I think it's more than perceiving, it says, when you're at that level of power, and you decide that something's going to happen, and you put enough mental force behind it, you can get it to happen. And I think that's the strength of a good leader. You may not know exactly how it's going to happen. You may see the threads of a connection, but you say I'm going to make those threads solidify. And then you say, hey, you go do it. And it's the go do it part, and the judgment factor to apply as to how much money to spend, how much not to, what to get rid of and what to keep, is the amazing thing, to me, about making the merger work. Plus trying to make it look like you really merged, not one to take over the other, so that the officers of the key
people of the two companies didn't feel threatened, or particularly, Sperry
didn't feel like being a threat and therefore we're on the low end of the ball.

F: Did you get the impression that he worked real hard?

S: And the fact that he changed the name to a completely different name,
whether you like Unisys or not doesn't make any difference, just the fact
that he changed the name, tried to give it a whole new image, is a good
piece of psychology. I'm real pleased with what's happened, because the
stock's gone up, whatever we own in stock is worth more, and that's good.
I'm a person who believes in taking a risk and also trying to get a reward for
it. I think it's gone well and I don't know all the officers--I've just met Mr.
Kroger for the first time when I went back to Detroit. He impressed me as a
pretty sharp guy, but that's all I know. I've met Mr. Blumenthal several
times and he's a bright guy. When they brought Jerry Jacobson in, I
thought ... he's a friend of mine. I thought he was a very bright guy and he
may rub people the wrong way a lot because he's a very cynical sort of a
guy, but he sure has got a good mind. So I think you have some really
good minds in the company and you direct them right, and you're going to
pull results in the end. I was skeptical at first. A lot of us were, I'm sure.
But it's working out. I think also, another thing that impressed me was the
spirit with which data was exchanged. Teams came out here, some of our
teams went back there to meet the Sperry people, they met with us, and
there was a fairly open divulgence of information. That's important to keep
things going on the right foot.

F: Could we talk a bit about your involvement in phase review and how it
compared to what existed before?

V: O.k. Well, when I first came to work here, there was no phase review.
Instead, the process of getting a program started, was called the PDA
program. PDA process was the Product Development authority and the PDA really was a loosely-administered way of defining, or marketing of the product planning. First of all, PDA was started by ... by start I mean it was originated through request from marketing, or product planning, rather, to engineering, to propose to them a product around this description. So the first thing that came out of marketing was a description of what they wanted: Actually I use the word marketing loosely, I really mean what Dow CPM or Product Manager, and then called Product Planning.

It existed before '73 when I joined. And the PDA process then was designed to take this request for a response and respond to it. And the PDA response required that you define what you wanted to build, estimate what it would cost in terms of development cost, define the product in response to the specification that you got from Product Planning, and indicate a competitive product cost of the unit, and then submit that. That, in turn, was reviewed by Product Manager, and it was finally signed off it o.k. by Dr. Bob Johnson and/or, in other words Corporate Engineering, as well as the group, the Engineering Vice President and the group directors. That became the authorization to spend money. O.k.? And the PDA asked for such things as schedule, cost, dates, marketing information, but in a loose form, and had no phasing to it. It asked you to furnish a schedule. Then the schedule would be monitored ad hoc by internal local management and monitored by corporate management, by corporate engineering as part of a periodic review process which was not that highly formalized. When Blumenthal came into the company it was decided that a more formal method of defining product programs was necessary. And there was a prototype in terms of either IBM or Xerox's phase review process. And the concept behind that was that a product goes through
various phases in its cycle: the concept phase, the development phase, the product engineering phase, the release to manufacturing, and finally, the release to a manufacturing and field test, and then finally, a year after the first shipment, a review process that says is this product still good? So a set of guidelines was prepared by a small team in Corporate Engineering in the Systems Management portion of Corporate Engineering. And I think that’s kind of ... Lyle, I think I mentioned, was involved. Tom Carpenter, I don’t think Doug Simmons was involved because he was a corporate field engineer or something like that. And they came out with an early manual on it, and it was fairly well written. And a lot of the ideas were lifted from other companies, but that’s o.k., and was sent to the plants for review. And along with it came an agenda for training a training program, and since I at that time was in charge of the systems management for the engineering group here, I was one of the first ones to go in to training, along with about a half a dozen other people. And the training was designed to be a hands-on type training in which we took a home-created product concept and just wrote a phase review on it, as if we were really dealing with a product.

V: Now, the first product that we put into phase review process here ... this is hardware, software came a little bit later. The first hardware to be put under phase review was the 5900 and I was given the responsibility of preparing that and it was a good shakeout method because it was kicked out and then accepted after we did some modification. And the whole process of scheduling phase review and timing here came to the focus. By timing I mean, first of all, the whole concept was broadcast to the company and so they had it dovetailed and fit in with the various review programs. There was also a problem of concurrency. All phase reviews had to be concurred by the various function that were affected. First of all, there was the various
management functions affected: financial, for overall analysis of profitability, manufacturing for manufacturability, engineering for sound engineering, marketing—is there a marketing plan? field engineering, if there's a field plan. You know, all the elements had to concur and be a part of the review process.

Then they had a lot of guys I considered hanger-ons, who sat there and felt it was their job to keep busy in Corporate and usually reject everything--on the most nit-picking thing you've ever seen. That tended to bottle up the phase review process so that it took time to clear a phase review, that is, theoretically, when you entered Phase 1, you could be in Phase 2 and if you exited, ongoing to Phase 2, to Phase 3, from Phase 3 to Phase 4. So stuff could get hung up except no plant was going to sit there and wait on the review process. So the idea then was to keep the discipline of the phase review, not stop the plant from moving forward unless there was really something wrong. // So the trick was now how to invent ways of shortcutting the review process, clearing up non-concurrences and getting people to pick on the real major things. And, as it evolved, people who nonconcurred out of the area of their expertise were not permitted to nonconcur. That is, if I'm a marketing guy and I nonconcur with a manufacturing problem, forget it. That's not right. If you're a marketing guy you concur or nonconcur with a market-oriented problem.

F: That makes sense.

END OF SIDE TWO, TAPE 1 OF SPIELBERG INTERVIEW
TRANSCRIPTION OF UNISYS TAPE

INTERVIEW: ANNE FRANTILLA WITH ARNOLD SPIELBERG

S = ARNOLD SPIELBERG       F = ANNE FRANTILLA
// = UNINTELLIGIBLE PASSAGE

TAPE TWO, SIDÉ ONE OF SPIELBERG INTERVIEW

S: Legal, in my opinion, never got heavily involved unless there was an issue that had to do with maybe you were borrowing the technology from somebody else, or something that might have some legal aspects. The most involved Legal got was in dealing with patents. The other thing they began to come up with after several iterations like this, is what they call the premeeting. Usually when people came for a meeting, say a Phase 3 meeting, their idea ... you were supposed to send your books in two weeks ahead of time and then all people who are nonconcur got a nonconcur before you have your meeting, so that when you come to the meeting you try to resolve the nonconcurrences and move on. Well, try as one could, and the documents got very voluminous because there was a tremendous demand for a lot of detail. So it was very difficult to put it all together, and that's why those of us in Systems Management were hard-pressed to get the data from everybody. And particularly, it was sometimes harder to get the data back out of Marketing, particularly in the case of forecast. It became understood that you don't want to publish pricing and other confidential issues and broadcast over a hundred books. So the pricing and costing information became the subject of a supplement which was sent to a minimum number of people and came in late and was entered into
a separate circular review process which would meld in to the final review ultimately, but only fewer people participated.

In the course of this evolution, they began to come up with what they called "pre-meetings". A pre-meeting usually occurred two weeks before the final meeting, and the purpose of that pre-meeting was to straighten out the nonconcurrence so that when you had the final meeting, it became only the major issues that involved the most senior people squaring away and concurring, or if nonconcurring, at least defining why. You could always get out of a nonconcurrence by some officer of the company just arbitrarily overruling--he said, "I'm going to ship," or whatever. Because then we'll worry about this nonconcurrence later. So that was a way of shortcutting a possible issue, but setting that issue aside to be solved, but letting the thing move forward.

In the course of doing all that, the phase review processing more sharply defined the cutoff points, namely, a product goes along this far in the development cycle, then you have a phase review. Then this far into the qualification cycle, then you have a phase review. And as the phase review process became more and more adaptive, and when people became more familiar with using it, you could get to the point where you could almost have a concurrence meeting or a phase review meeting via telecon--you know, have a teleconference and review the critical issues and get it over with. So it cut down the number of trips to Detroit, because they were getting horrendous. So I think that was a beneficial thing.

About a year or two after the hardware phase review started, software got involved. The software phase review process I'm not as familiar with as hardware. But essentially they often combined one or two phases in one meeting because the design cycle for software followed a different pattern
than the design cycle for a piece of hardware. And you could often squeeze two phases together. And so software goes through a slightly different phase review process. But these essential goals and elements are still to make sure the product has quality, make sure the product meets its specifications, make sure that the application orientation of it meets Marketing’s requirements, and if it’s software to be sold, that it’s adequately priced, correctly priced, and so forth.

F: Does it also to serve to keep it on schedule?
S: The phase review process fights for schedule. The phase review process has another very positive value. It provides a pretty consistent document in which someone who doesn’t know the program can read everything about the product. I can pick up a phase review book, or the setup, and I can know that product. And there it is in one document—includes the specifications and the schedules and the costs and the price and the market forecast and the reason for it to be, you know, and then the test results and the whole bit. So there’s a real fat book, anywhere from one inch to three inches in thickness, that you can read about a program. So if you were coming into the company, and you want to absorb quickly where things were, you could go through a number of phase reviews of critical products and get a pretty good feeling about what it’s all about, because manufacturing processes will be described, key engineering processes will be talked about, test scope requirements will be talked about. You know, you can get a really good cross-section of a program. That’s another plus for a phase review process.

It also can be used as a good training ground. People can read phase review data and find a little bit about how we operate. I think we don’t do that very often, but it’s for you people to read.
F: Well, it sounds like a good ... from an archivist's or historian's perspective ...
   it sounds like a good way to document the history of the product //

S: Absolutely. Oh, it's an excellent way. It really is an excellent way to do it. 
   But the phase review process is not an end in itself, because the end in 
   itself is how people use it and how well you stick to it, and how well 
   marketing follows the forecast and sticks to their forecast and how well 
   each meets their schedule. So it's all back to Management again. But, it's 
   a good tool--a really good tool, and I like it. It represents a lot of work, 
   because I did work on the 5900, I helped a little on the A-3, I did a lot of 
   work on the A-9. I helped on most of the I/O phase reviews, so I got quite a 
   bit involved. A number of good people have evolved who are experts now. 
   Within our organization here, we'll have key engineers who are systems-
   oriented who are the guys who pull together the phase review. They also 
   usually are the guys who keep schedules on the programs, too. They'll run 
   the master perk chart on how the project is going. And they'll also be the 
   guide in pulling together the phase review. So it's even helped how we 
   organize here a little bit. By virtue of having to meet a phase review 
   program, you organize to make sure that you have the right kind of people 
   to provide that day and at the same time they also can become the people 
   who input to the Management as to how the schedule's going. So that's a 
   positive thing. I don't remember all the criticisms that came in. All I know 
   is that the phase process has been honing and it still is evolving. So I think 
   it was a good move for the company to start. It certainly gives top 
   management a quick snapshot ... not a quick, it takes a while to read one ... 
   but a concise place to find it, and a reasonably concise description of the 
   program, which you'd have to drag out of documents all over the place 
   otherwise.
F: You mentioned that the phase review process was started when Blumenthal
came. Did it have anything to do with him coming, or ...

S: No, I think he brought a bunch of IBM people in and then Dr. Stern came
from Xerox, I believe. So all these people had seen this before. I know
when I was with IBM, I don't remember a phase review process. In '63
there was no phase review process as far as I was concerned in San Jose.
Our product programs were just handled you might say a standard way of
setting up benchmarks and setting up a schedule and monitoring the
schedule. And once the product started getting into release stage,
manufacturing would be involved, field engineering would get involved,
release engineering would get involved. We'd have weekly meetings to
keep things on track. But there wasn't a documented phase sequence of
critical points that had to be met in order for it to continue.

The other nature value of a phase review process is it establishes
cutoff points for the way you should or should not spend money. You
might put $100,000 into a program with an experimental front end, get some
ideas going. At the end of Phase 1 you'd say, "It isn't what I want. Kill it."
Or, "It is. Let's go." And while you budget the whole program, there are
points where you can say, "No. That's it. I'm not going to spend the
money. No, it's done." Or, "Let's go and spend the rest."

F: It also helps to phase out products?

S: Yes. What you have to do in a phase review program is define the product
that it comes from and evolves to, and what the successor problems might
be. So if this is a part of a line of product programs that are going to lead
you into a marketplace, you define the product that preceded it, and what
you expect to find to succeed it. It also identifies what they call "drag"
products. In other words, what products have to be pulled into the game
because they are needed to complete the system. And therefore, what is their impact on these drag products. What’s the business aspect of it? Do we have to manufacture more? How are they tied in? And then there’s what is known as impact. Does this product impact another product line that exists, and therefore, is that product line going to suffer in sales because of the introduction of this product line? And then the financial people can analyze the cutoff costs of a product that’s dying out, or will be impacted by the new product, and evolve a better profitability picture for the whole group of products that are impacted by this target new product. I think the phase review helps focus that.

Then the software then gets locked into the act because you don’t need hardware if you don’t have software to run on it, and so forth. So software is locked into hardware, and hardware is locked into software. And it used to be that hardware led the software. Nowadays I’m thinking software is leading the hardware. So that substantially defines what I think is the evolution of phase review process. There’s a lot of miscellaneous //. There’s a lot of rewrites. There’s a lot of definition of who is to allow to concur and who is allowed not to concur, who can’t concur. There are details of who has to make the contributions to the phase review book, what organizations have to put in for that to complete the phase review process. And that’s delineated on schedules that come in the phase review book.

F: It sounds like ideally it’s a very clean cut process, but I’m sure it’s not.
S: Ideally it’s a step-by-step process, but in actuality, there’s overlaps and catchups and residuals informations not yet solved. The product may still be shipped with a residual problem, but it’s identified by management that its residual problems aren’t enough to kill it. So go slow, but then bring it
up to date. That, I think, is my fairly good shot at trying to take a crack at describing where we are at on phase review.

F: No, that helps me understand the whole process better.

S: We're also supposed to keep a ... for this plant we just start in a week ... we neglected doing it, but we're now pulling together an archive of all phase reviews in the library under Pat Feeney. It'll just be an archive.

F: Will it be a duplicate of what's in Detroit?

S: Yes, but we need one here. But also, we haven't done this yet, but we're beginning to, and that's to destroy old, unused copy that's laying around. So we're trying to do some of that because a lot of it contains sensitive information and it's amazing how that stuff, because you're so busy generating that stuff, you don't think how valuable it might be to an espionage, industrial espionage. I mean, a smart espionage can grab a bunch of phase review books and just size up the company from that--how they work, their spirit, a little bit of how they think. You get a lot of information out of a well-written phase review.

F: Someone I was talking to in Detroit said they threw out all the PDAs // ...

S: I wasn't very happy to hear about that.

F: Well, I thought it would be interesting to compare them with Phase Review.

S: Someplace in this building, I'm sure in the archives, there are some old PDAs. I wouldn't know where to find them, though. As a matter of fact, there isn't any ... I don't think you can ask Pat Feeney for it, because she never really was involved in it. But there isn't any one person that I can name who could say to you, "Here's where all the PDAs are," because it wasn't handled like that. We didn't follow things through a central place and say, "Now you archive them here." Each product and each activity archived whatever they felt like archiving.
Now when it comes to drawing some documentation of products, that's different. It all goes through my records. So that's formal. He don't know how to be formal, but correspondence and documentation and ancillary information is not handled in that organized a fashion. I think it's too much bureaucracy to try to do that.

END OF TAPE 2, SIDE 1 OF SPIELBERG TAPES