

An Interview with
BARRY SCHRAGER, M.B.S.
OH 404

Conducted by Jeffrey R. Yost, Ph.D.

on

24 May 2012

Computer Security History Project

Mountain View, California

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Center for the History of Information Technology
University of Minnesota, Minneapolis
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24 May 2012

Oral History 404

Abstract

Barry Schragger, who has a M.S. in applied mathematics from Northwestern University, is a seminal figure in the design and development of early commercial computer security software products. From 1968 to 1978 he served as Assistant Director of the University of Illinois-Chicago Circle Computer Center, where activity of student hackers on the center's time-shared system led him to investigate methods and tools to achieve greater security. In the early 1970s he became involved with IBM SHARE, and led a committee of emerging computer security experts – SHARE's Data Security and Management Group. Schragger and his group's 1974 SHARE white paper defined access control requirements to achieve security, which led to IBM's 1976 computer security software product, Resource Access Control Facility (RACF). Initially this product fell short of the requirements outlined in the white paper and Schragger and a colleague, Eberhard Klemens, developed a prototype Access Control Facility (ACF) which met the requirements. In 1978 these two teamed up with Scott Krueger to found SKK, Inc. and refine this computer security software product as ACF2 for its first customer London Life Insurance (Ontario, Canada). Soon thereafter SKK sold this product to General Motors and many other major corporations/organizations. ACF2 became a billion dollar product that is now owned by Computer Associates. This oral history concentrates on Schragger's work with SHARE, the creation of ACF2, and his leadership of SKK, Inc.

This material is based upon work supported by the National Science Foundation under Grant No. 1116862, "Building an Infrastructure for Computer Security History."

Yost: My name is Jeffrey Yost, from the University of Minnesota and I'm with Barry Schragger on May 24th, 2012, in Mountain View, California, at the headquarters of Xbridge. This interview is for the National Science Foundation project on "Building an Infrastructure for Computer Security History." Barry, can you begin by just giving me a bit of biographical information; where you were born, and where you grew up?

Schragger: I was born in Chicago and grew up in Chicago. I now live in Colorado and am currently president of Xbridge Systems here in Mountain View.

Yost: Thinking back to primary and secondary school, were there particular subjects that you were especially interested in, or had special affinity for?

Schragger: Yes, I grew up thinking that I was going to be a scientist; so I have a degree in physics. But I didn't meet my first computer until college, and I got diverted (laughs) from physics to computer science at that point in time; although we didn't call it computer science then.

Yost: And that was at the University of Illinois-Chicago?

Schragger: University of Illinois at Chicago Circle.

Yost: So you started as a physics major there?

Schrager: I have a degree in physics. I started as a physics major; like I said, they did not have any kind of computer science curriculum at the time. But I met my first computer and then started doing programming for professors and things like that.

Yost: And in what years were you at the University of Illinois Chicago?

Schrager: I started in 1964 and graduated in 1968.

Yost: What computing resources did the University of Illinois Chicago have at that time?

Schrager: Well, we had an IBM 1620, which was a decimal computer and the scientific counterpart to the IBM 1401. And after a while we started doing some work on the 7094, which was in Urbana at the main university campus. And then we eventually got a 360 Model 50, which is how I got involved with the IBM mainframes.

Yost: Do you recall what year you got the 360 Model 50?

Schrager: The 360-50 was in 1967, I believe. I graduated in 1968 and I went to Northwestern University and started full time on a master's program. And after a few months, the director of the computer center at University of Illinois Chicago asked me to come back, and I took a job as a systems programmer. And then I became manager of system programming. Then assistant director; and we grew to a Model 158, which is

where the MVS came in. And I continued on; got my master's in applied mathematics from Northwestern; and I actually started on my doctoral research.

There was this gentleman by the name of Dr. Gustav Rath, who was one of the professors, not in computer science, but I think in industrial engineering. And he insisted that he did not want a *gedenka* thesis; he wanted me to prove in real life that my theories worked. So that sort of set me back several years until ACF2 was created; and you'll probably want to go through that at a different time. But after ACF2 was created, after about a year, I went back and said it's now being used by General Motors and the Central Intelligence Agency; I don't have to prove anything about it working in real life. But then they said it was too commercialized; so I never did get a Ph.D. (Laughs.)

Yost: You couldn't win there.

Schrager: No, it's sort of like they wanted me to prove the basis for my thesis topic and then that invalidated my thesis; I don't know what they expected.

Yost: So when did you start as a systems programmer at the computer center?

Schrager: It would've been late December 1968 or early January 1969.

Yost: Was that on a full time basis?

Schrager: Yes.

Yost: So you were working full time but also working on your master's?

Schrager: Yes. And I lived in northern part of the city, northern edge of the city. Driving to Evanston was an extra 10 minutes away from my apartment, at the time. So it wasn't really out of the way; and everybody was really cooperative in terms of, you know, I need to leave at two o'clock today to go up and take a class. Things like that.

Yost: And when you started work at the center, what type of programming were you doing?

Schrager: I started as systems programmer, and basically, our job was to support the operating system infrastructure. I worked on several projects; there was a product called the Conversational Programming System, or CPS. And the key about that was that it was an interactive system that the students used, and they were able to write little PL/1 programs to see how it worked. And at that point, I learned about compilers and interpreters, which was the basis for ACF2. So that concept I got directly from there.

Yost: What type of research were faculty members using the center for?

Schrager: There were a couple things that were significant. One was a chemist who was doing some sort of calculations on molecular attractions, and he had a job that took 14

hours per set of data on the IBM 1620. There was a gentleman there; his name was Dr. Norman T. Hamilton, and he was a brilliant mathematician. So he and I were sitting and trying to figure how to do approximations and everything else. And I think I got it from 14 hours to 12-1/2 hours or something like that, per set of data. But then I sat down and I took his calculations, his calculus; and each equation; and I figured out how to maximize; you know if we did the same calculation in three different areas, the old code did it three different places; I did it once and saved the result. And I got it down to 45 minutes. And then he didn't believe me, even though the numbers came out the same. So we had to; we spent like a day going through everything I changed on the calculus. (Laughs.) That was one significant thing.

Another significant thing was I was lent out to the microbiology department at Presbyterian St. Luke's Hospital. And they were doing a joint project with Argonne National Labs on automatic chromosome analysis by computer. Argonne was interested in chromosome damage due to radiation. St. Luke's was interested in the chromosome damage done by microbiological problems, or something like that. But the ability to find the damaged chromosomes is certainly identical. That was done by Jim and Margaret Butler; our researchers at Argonne. And I, and this lady—I'm trying to remember what was her name; she was a Ph.D. in microbiology; I'm trying to remember what her name was but I don't recall—a Dr. Marzenska. Don't ask me how to spell it. We worked on that project together with them. And the strange thing is if you've ever seen an amniocentesis, in recent past, that's exactly what we did. We actually matched them up; and we identified any cell that was damaged. But, like I said, we had no clue, you know;

chromosome number 5 damage—we had no idea what that was—at that time, we had no concept. But it's strange how things come back to you. (Laughs.)

Yost: So you were enabling these scientific applications for computers, as well as . . .

Schrager: Infrastructure.

Yost: . . . more efficiently using computing resources.

Schrager: Right.

Yost: Were there ongoing partnerships between your computer center and the one at Champaign-Urbana?

Schrager: There was a little. For a couple years I was quarter time in Urbana, so I spent like one day every week or two down there. But I think that was more of a reason to get me onboard, because they wanted to combine the computer centers within the university and put it all at Urbana. So they were trying to get me come on along at Urbana. But that never happened.

Yost: At what point did the center get involved with time-sharing?

Schrager: Time-sharing; we had time-sharing, basically, with the CPS, the Conversational Programmer System for development. And then I brought on a product called Wylber, W-Y-L-B-U-R, which was an interactive text editing, job submission and output retrieval system for the system; it actually ran under MVT, and then SVS, and I don't know whether we used it under; I don't think we used it under MVS. But it basically gave all the students the ability, and the faculty, ability to write papers. And if you look at my original papers, I wrote them in that; but it also gave the ability to submit the jobs, and so on and so forth. So two thrusts; one was the Wylbur, and also CPS. And then, in 1969, IBM delivered TSO, the time-sharing option, for MVT. And we installed that and started using that.

Yost: When you first started using these time-sharing systems, was there any thought about computer security at that time, or was that not really a concept you talked about?

Schrager: We first started being concerned about it in; it would've been after TSO. We never thought about it before TSO. But after TSO, we had a problem with, I would call, rogue students. You call them hackers now. But they did a couple things. Number one, MVT, which was the operating system at the time, did not have integrity. So they used to figure out ways, ingenious ways, to be able to crash the system; to be able to get into the system and be able to overlay code, and then to crash the system. And it was funny because Eb Klemens, Eberhard Klemens, used to work for me and they used to ask him to come on over and press "Enter" on their keyboard, and then he would crash the system. (Laughs.) So, after a while; after one or two times; we knew that this was an

issue. And what he did was they came to an agreement that he would take a system dump at the time, which didn't really interrupt things for more than a second or two; and then he would tell them whether their concept would have worked or not, and they didn't have to crash the system to prove that it worked. So it was sort of a win-win. These were what you really consider hackers today, or whatever you want to call it.

Yost: Were these undergraduates, or graduate students?

Schrager: Undergrads. So that was our movement into system integrity. And then we had the problem that these other students were overlaying graduate research student data and professor data. Because professors would set up data for their class to process and the kids would have to write their program to process the data. But then, either by accident or purpose, they would overlay the professor's data. And then the graduate students' data was overlaid, and of course they'd spent their lifetime trying to get their degree.

So we had a two-fold problem. Number one was to protect the professor's data from alteration, but allow a lot of people to look at it. And number two, to protect the graduate student research data from being destroyed by rogue undergraduate students. And so I had Eb Klemens write some code to intercept open/scratch/rename, and things like that. Well, first of all, the security as provided by MVT was useless. All you could do is password protect; what they call password protect the data set. The nice thing about the password protection was that if you were from TSO, it would prompt you for the password. But if you were from batch, the operator had to enter the password. So that

meant when you submitted your job, you had to go to the operations people; give them a piece of paper and say, here's the password for this data set. So passwords weren't really secure; and they were kept in a data set called "PASSWORD," in MVT, and they were kept in clear text. So it was a great, great system.

Yost: Were student hackers hacking in to learn all the passwords?

Schrager: Yes, I mean, we had all kinds of problems; because you could set a password, and your password protected password data set, but still the hackers could attack it. So, I'd have Klemens do the intercepts and what we did was that the TSO data set names are usually "Userid-dot-something;" if the second level next started with a pound sign that said that everybody can read it but only the person whose Userid matched the high level index could update it; so that would solve my professor problem. And then if the second level index started with a dollar sign that said that the only person who could read it or write it, was the person whose Userid matched the high level index. And so that solved my research data problem. And I also wrote a program called Resident Account, which validated the Userid, the password, and gave me some concept of controls over who was doing what. And I implemented that for TSO and batch. And so that was the beginning of my movement toward data security.

Yost: You were not involved in SHARE, at that time?

Schrager: Yes, I started in [at the center]; like I said, December 1968 and, in March of 1969, I was told I was going to SHARE in Los Angeles, and it was the first time I ever was on an airplane. (Laughs.)

Yost: And can you describe that first meeting?

Schrager: First meeting was interesting. You know, I got to talk to a lot of people who knew what they were doing. SHARE, at that time, was a much more interactive group than it is today; and we actually talked about things, and tried to solve problems, and helped each other solve problems. Whereas today, it's more of a presentation and attendee type of thing. Back in those days, it was more of an interactive problem-solving group and so I learned a lot there, and I met a lot of people there.

Yost: When SHARE started, of course, it was primarily aerospace contractors, and then it evolved. When you attended, were there many people from university computer centers?

Schrager: A lot of university people were there.

Yost: Okay. And did you break down into groups so that those from the university computer centers—who might have had different problems than those from industry—interacted?

Schrager: We didn't really break down into groups by industry. We broke down in to groups by subject matter. So in 1969, the TSO Project was formed and there were people interested in how to utilize TSO, and issues involved with TSO, and requirements to IBM for TSO. But it was from all different industries and organizations.

Yost: And with that TSO group within SHARE, was computer security an issue from the start?

Schrager: Well, I mean, the issues of password protection were there. And everybody was; about 1971, it was an issue; and then in 1972—it was either 1971 or 1972—I was asked to form a security project within SHARE to deal with the issues with security, which really had been heightened by TSO, because you know when everything is batch, it wasn't that much of an issue. But as soon as you put time-sharing on it, it opens up Pandora's Box.

Yost: Do you recall if this was the first organized effort regarding a task group on computer security within SHARE?

Schrager: Oh yes, this was the first; because no one was really addressing it before me; and I was the first one who was sort of like pushed into dealing with it.

Yost: In talking to people at other universities, were they having similar problems or how would you rate the concerns and problems at the University of Illinois-Chicago Computer Center versus others?

Schrager: For some reason, I think we were more leading edge, and I don't know why. I think we were ahead of the game in terms of not only the issues, but were trying to address the issues.

Yost: Okay. And outside of university users, what other participants were in this TSO group and what concerns did they have?

Schrager: You're talking about when we formed the security project or before that?

Yost: Before that.

Schrager: TSO was pretty much everybody; but it was everybody from different industries, actually, we had military there; we had Department of Defense and government there. But mainly the TSO group was worried about, you know, performance and functionality issues; not that much security issues.

Yost: Before that task force was launched, were you hearing about computer security concerns from those in industry, as well as those in various government agencies?

Schrager: No, I don't think we were addressing; I mean, the environment was different, then. You know you had your mainframe—what we call; I'm using the word mainframe because it didn't exist at the time—but you had your mainframe computer and you had your 200 to 300 users. You knew all the users; you know, they were part of this closed group within the company, they were all employees. And I think the University of Illinois-Chicago Circle had the issue first because we opened it up to so many people; and we had the rogue students.

But when we get into talking about ACF2, the Pontiac Motor Division was our first site, and Jerry Lyons was Pontiac's security officer. And we went in; first thing to do with ACF2 was sort of a journal of who was doing what, so you could decide whether it's appropriate, and you could tell ACF2 that it is or it isn't. But Jerry was able to look at the journals that ACF2 was producing and say, that's Jack upstairs, he's looking at radio parts inventory, and it's now May, and he's trying to decide how we're going to build out our cars based on the inventory we have of parts. Because you can't put an expensive radio in a cheap car; you can't put a cheap radio in an expensive car. So he knew the person; he knew the data; and he knew the business functions. And this was really a small environment; that was industrial environments of the day, so computer security really never even bothered them that much, at the time.

Yost: In that TSO group, there were there representatives from the Department of Defense and the intelligence communities?

Schrager: Yes, I mean the two people who were running it was a lady by the name of Mary Lasky from the Applied Physics Lab at Johns Hopkins University; and also Bill Griffin, who was at MITRE Corp. But we had people from the Department of Labor, and things like that.

Yost: Okay. Can you elaborate on the context of the forming of the task force? Do you recall if it was 1971 or 1972?

Schrager: It was 1972 that we had our first meetings. We may have started talking about it in 1971. But it was pushed by Mary Lasky and Bill Griffin, and because I was like sort of the head honcho in terms of computer security at the time, they asked me to form the group; the project; and start running it.

Yost: And do you recall roughly what size the group was; how many people were there?

Schrager: Well, SHARE, at that time, had four meetings a year. Two, which were more formal meetings with presentations and some working groups, and then two were just with working groups. The ones with just working group we had like maybe 15 people at; the others we had like 30 or 40 people at. Because that was the way people learned in those days. You sent people to SHARE to learn what wasn't in the books, and the interactive stuff; and companies were willing to spend more money on that stuff. And so I remember we gave a—in 1972—Eldon Worley, who turns out to be the author of the IBM RACF product, and I gave a presentation at SHARE on our concepts for data

security. So I must have been starting before then. And there was a gentleman from Boeing, who also gave a presentation. Three of us gave presentations, and neither Eldon nor I remember the guy's name.

Yost: Eldon Worley, can you spell Worley?

Schrager: W-O-R-L-E-Y. Worley. Eldon and I still talk to each other once in a while. But we gave our presentation on the concepts for data security and Eldon said that it was interesting. I didn't know it at the time, but he said there were some IBMers at the back of the room looking for their customer reaction to data security; and they were trying to decide a couple of things. Number one, whether data security was something that they should invest in. And number two, the system integrity issues. And, you know, I joke with Eldon that we were a success because IBM devoted resources to the system integrity. And the IBM and the SVS operating system was the first one; the first operating system with true system integrity; which is a requirement for data security.

Yost: What were the backgrounds of the people within the group; data security group?

Schrager: You mean at our meetings?

Yost: Yes.

Schrager: I think, to a great extent, they were people from companies that were aware of the need. They just did not know how to go about dealing with it.

Yost: Do you remember some of the individuals, and some of the companies?

Schrager: Well like I said, Boeing was active. But I'm drawing a blank on the other companies. It's was too long ago.

Yost: And MITRE?

Schrager: MITRE was there. We had Defense Department people there.

Yost: From the Air Force? From the Navy?

Schrager: Good question. I think, you know, mainly the CIA, NSA, and those people.

Yost: In 1967, Willis Ware and Bernard Peters from NSA published a paper on computer security. And then there was the Defense Science Board that did work on the problem and came out with a report in 1970. These focused on computer security with time-sharing systems within the confidential community and multi-level [clearances] users.

Schrager: I never saw that paper. (Laughs.)

Yost: I'm just wondering if any of this early work done at RAND or by the Air Force was discussed, or had any influence?

Schrager: No, we actually were really focused on how to provide security for what was then the MVT operating system. What we were to define for IBM what they should do for their future operating systems. We had a problem with MVT because of system integrity. So basically we said, IBM, you have to do a) system integrity; and b) these are the things that we want in a security product, or security system, or security functionality of a new operating system.

Yost: So what evolved into what later was referred to as high assurance, with Bell-LaPadula, that was something quite different?

Schrager: Yes, quite different; we never talked about it.

Yost: Okay. What were some of the early things that you did within this working group? What were the fundamental goals?

Schrager: We wanted to; if you look at the papers I published in 1974, basically it was protection by default because; and the phrase I created and used at the time was "error of omission." If you have an error of omission and you have protection by default, you have a hiccup. And if you don't have protection, by default and you have an error of omission; you've disclosed your data. So I felt that you were better off moving from a situation

where everything was protected and you allowed people to get to it, because then if someone couldn't get to it they'd call you up and you'd say okay, I'll fix that; rather than the other way around which was you forget to protect something. And then the ability to group together users and resources; the phrase I used at the time was algorithmic grouping. Or now the RACF phrase "generic profiles." ACF2 uses "pattern masking." But the concept is the same; everything that starts off with production-dot-payroll, I'm going to protect this way. I don't want to specifically have to protect every individual data set or resource.

Yost: Were you seeing some different needs or goals between the people at university computer centers, those within industry, and those within the intelligence community?

Schrager: The difference was more of the administration of it. The university, we did not want to be in a position where we would be forced to administrate the access controls for everybody. And so I liken that to time-sharing bureaus, at the time, because we wanted to push out the administration. The corporations and the government security, government places, were willing to have a centralized staff that controlled who can access what. So it was sort of what we'd call now a centralized versus decentralized control.

Yost: Were individuals from the emerging time-sharing companies involved at that time?

Schrager: I don't know whether it was at that time, but I know GE Time-Sharing was involved somewhere along the line; I'm not exactly sure when that was. And then I

remember London Life Insurance; GE Time-Sharing was involved; General Motors was involved.

Yost: Had you done more work with computer security than others? How did it come about that you were called upon to head this effort?

Schrager: Yes, I was the first one with some security, as I said, based on the first character of the second on the index; and my, what I call, the “resident account,” which was basically the ACF2 Userid validation password checking. Things like that. You know, I was certainly leading the pack, at that time, and I was active in SHARE so I was sort of like the perfect choice to form the group and run it.

Yost: Was Bill Murray part of this?

Schrager: Bill Murray from IBM?

Yost: Yes.

Schrager: Yes he was. He was the IBM representative to the project.

Yost: Can you talk a bit about him and his perspective on the ongoing work?

Schrager: He was really a good gentleman. He knew the information processing environment. He was sort of like an older brother figure to me, or a father figure to me. I mean, he helped guide me through a lot of stuff and he worked with me on, you know, on developing these requirements, and I can't say enough nice things about him.

It was interesting, when IBM announced the RACF in 1976, we had a SHARE meeting in August of 1976, and that's when I found out it didn't have protection by default, and some other things. And you know, I started sort of complaining to Bill; and Bill said he agreed with me, but he said that IBM had done a survey and they asked; and this is the pure, the perfect example of -- if you asked the wrong question in the survey, you'll get the wrong answer. So they asked their customers, if it cost you more and more to protect more and more of your data, what percentage of your data would you protect? Okay? And I've heard numbers; Bill, I think, told me 20 percent; but I've heard numbers that said five percent. So IBM, with that question, they get that people are not willing to spend a lot of money, but they have some data they want to protect that they're willing to spend some money for it. And Bill told me that he didn't agree with that but he couldn't do anything about it.

Yost: Do you recall what year that survey was?

Schrager: It was sometime between; it would have to be sometime between 1974 and 1976. Maybe even probably; maybe 1972-1973; 1974; those years.

Yost: Was it 1974 that you gave a presentation on the committee's work to a larger SHARE group?

Schrager: Yes, there was; I gave two presentations. Number one at the SHARE, and number two at the; IBM had a Data Security Forum series -- they had a meeting in Denver and I gave a presentation there. And both those papers are stuff you have.

Yost: And can you discuss the reactions to; well, first outline key elements to what you produced, and then the reactions of those communities to what you presented?

Schrager: Like I said, the key things were protection by default; and grouping of users and resources based on some algorithm, pattern matching, whatever you want to call it. The ability to have a multi-user system interact with the security system. In the case of IBM terminology it'd be something like CICS, because each user has a different authority; and the ability to control by transactions, what we now call resource names. I think I actually called it resource names, at the time. And everybody was like, yes, that sounds great. (Laughs.) But like I said, we were sort of just emerging from the time/era of a couple hundred users in the industry of the computers, into the massive usage we certainly have today.

Yost: And to make sure I understand what you said about the IBM survey, it was; five or 20 percent that said that they would have use (pause)

Schrager: No, no. They would protect 5 or 20 percent of their data, which is what IBM used to justify the protection by exception, or protection by itemization, that RACF came out with. Now, Eldon Worley claims that IBM had created a project within IBM to develop a security system—and I forgot what it was called—Resource Access Control, or something. And that flopped. And they went; IBM went running around looking for something; and they found Eldon. And Eldon had written; he was working for Santa Teresa Labs or someplace there in California; and he had done his own security system, which was like an addition to archiving, and did all sorts of data set management. But it did have data protection by default and some sort of grouping of resources. And they took Eldon's code and used that as a basis for the IBM RACF product; but they took out, basically they gutted it and just did protection by exception, and things like that. And if you want, you may want to interview him. He would be a good person to interview. I can give you're his contact information.

Yost: Yes, we definitely would. And was this; was it sold to IBM? What was the nature of it?

Schrager: Oh, Eldon's thing?

Yost: Yes.

Schrager: He was an IBM employee and he was working in a lab as one of the support people in the labs.

Yost: Oh, so he was just stationed there; but he was an IBM employee.

Schrager: Well, no, I mean it wasn't; Santa Teresa Labs or wherever it was, was an IBM facility and he was a systems programmer at that facility, and he was interested in data security just like I was.

Yost: Okay, I was not aware of that name—precursor to what became IBM Almaden Research Center I bet. So he was involved with SHARE's computer security effort.

Schrager: Yes, he and I gave the presentation. He really didn't show up at SHARE all that much, but whoever got together that session got him; found out about him and got him to give a presentation, also.

Yost: You talked a bit about it but can you tell me what you know about his project to develop...

Schrager: His project was mainly, at the time, it was an internal IBM facility and they were running it; data security was only part of what he did. But if you think about it, he did; what we are considering the migration packages today, you know how you move stuff off that hasn't been used and all sort of management facilities. And so there was a small part of it that was data security and he was interested in it. Now, whether IBM

needed it, and he was reacting to something; I don't know what the genesis of his efforts were, but he's a brilliant guy. And he was also is one of the originators of this.

Yost: Do you have a sense of what resources IBM was committing to this effort at that time?

Schrager: It was basically him.

Yost: It was basically him. Okay.

Schrager: Sort of like I was doing it on my own; he was doing it on his own.

Yost: And did you see the development of RACF as a direct outgrowth of what was going on within this SHARE group?

Schrager: Oh yes. We thought RACF was IBM's response to our requirements, and we were really disappointed when it didn't meet the requirements.

Yost: And what specific requirements did RACF fail to meet?

Schrager: Protection by default; what we called the algorithmic grouping of users and resources. And then IBM did deliver the; we called for a secure journaling facility, which

was the SMF. And that sort of; and that's when SMF was delivered, but that's separate from the security product.

Yost: And do you have any sense of . . .

Schrager: Oh, and then there was protection of resources, which wasn't in there; things like that.

Yost: . . . why RACF wasn't created as more of a robust security product, given what had been identified within this computer security group at SHARE? Was it cost?

Schrager: Well, I think that the IBM survey tells it all. IBM was under the focus that if you protect too much, you're going to get too much overhead. I was at a computer security conference; the RACF Users Group up in northeast; someplace in Massachusetts; Sturbridge, Massachusetts. And I was giving a presentation and for part of it, I was sitting down and watching the other presentations. And I sat next to Rich Guski, who had just been forced retired from IBM about two years ago. And Rich said IBM really was happy that ACF2 was taking the lead on protection of resources and protection of everything, he said, because that way IBM could point the finger at SKK, which was our company, and say they're causing the overhead, not us. So that fits the mentality of, you know, as you protect more and more, you're going to cause more and more overhead; and we can't put that on our customers.

Yost: So IBM, of course, is interested in getting more and more customers; and being able to sell their systems; and security is seen as an added cost retarding sales efforts.

Schrager: Correct, yes. And they didn't want to be in the middle of doing that.

Yost: When RACF comes out; and that's 1976?

Schrager: Correct.

Yost: What was your reaction, or did you immediately have plans to develop something more robust?

Schrager: Well, my feeling was I had to develop something to show that you could do it more robust. So they came out in; you know, I found out more details about it in August of 1976; and that led, literally, to my basement where I sat down and spent afternoons, and evenings, and weekends designing a way to have algorithmic grouping, or ACF does pattern masking, and production by default, and those things. And I had a prototype running at the University of Illinois in, say, beginning of 1977, late 1976. But it was sort of a kluge. I wrote the ACF compiler, which produces an intermediate entity, or thing; and then an interpreter that interpreted that in real time, you know, when you had to determine access. And so I wrote the compiler and PL/1, and the interpreter in assembly language. And I had done the resident account stuff before, at the university, for validation of users. And I got that running; and so I had a prototype running; and I proved

that you could do it. And I gave a presentation at the March 1977 SHARE meeting; what we called Birds of a Feather Session; a Birds of a Feather Session is like an impromptu session; you didn't have to schedule in advance; and, you know, they were usually at the end of the day or in the evening. And you basically said I'm giving a presentation or we're going to have a discussion group on this topic, and then people showed up. And I got a lot of interest.

And then I went to the University of Illinois Foundation. Actually, my boss went; Dr. Tom Brown; and he said this is something that seems to be a commercial requirement and people are asking for it. Do you want to support making it into; or *will* you support making it into a commercial product? Because we had done that before; there was a thing called J/TIP; for TSO; when TSO first came out there was no good way to submit a batch job and look at the output; which we felt was a necessity. And so I had created; well, actually, we had borrowed some code from Wylbur, when it was on MVT, to do that; because Wylber did that. And in MVS, I rewrote it completely and the unique thing about that was that I was able to take a JES2, or HASP output data set created by one job, and fudge things so that you could read it just like it was a data input file from another job. So that's how you can look at output, okay?

So there was a product we developed called J/TIP, the JES2 Interface Package, and we licensed it. And so we had already created the concept within the university that we were going to license code and basically sell it. Now this was not a big moneymaker because we only charged \$1500 for a five-year lease. But the point was that we had actually

started it, and so my boss, Dr. Brown, went to the university foundation because this was going to take a lot more than just sideline work; the work on the side to create a commercial product out of it. And they basically said, they asked him, is it a commercial product now? He said no, it's going to require some work. And they said we don't want to have anything to do with it. So, I went to; that set me back a bit, so I went to General Electric Time-Sharing.

Yost: And you had created what you refer to as ACF?

Schrager: Yes, ACF.

Yost: ACF2 was the later product.

Schrager: ACF2 was the commercial product. ACF was the prototype. And so I went; one of the customers of the J/TIP product was General Electric Time-Sharing. They used it as their entrée into the IBM time-sharing business because they had to have people; their customers had to be able to submit jobs and look at the output; and things like that. So they had a license; so I went to them and they said they didn't want anything to do with us. (Laughs.) They were going to go with RACF, okay.

And then one of the attendees at the Birds of a Feather was this guy named-Ron Murray—~~not Bill Murray~~—from London Life Insurance, and Ron kept pushing me and pushing me and said please make this into a commercial product. And finally he said look, you

come up here and we'll pay your expenses and give you computer time if you make it into a commercial product, okay? And so in February of 1978 we went to beautiful London, Ontario, Canada—in the middle of winter (laughs)—and six weeks later, we had a release of ACF2. So, basically, Ron Murray and London Life were the ones that pushed us into making a commercial product.

Yost: And when you say “we” (pause)

Schrager: Well, I had; the two people working for me was Eb Klemens, who had done those intercepts at the beginning; and Scott Krueger who did JES2 support, and the SMP, which is the system maintenance program packaging of the product. So Eb and I went up in February and then Scott came up like in the beginning of March and did his part. And by, I think, middle of March or April, we were running in production.

Do you know what GUIDE is?

Yost: Yes—IBM's other major user group organization.

Schrager: Okay. The head of the security project within Guide—I forgot his name, but he was from General Motors—and he and I, of course, were communicating. And he invited me up to give a presentation to General Motors. And in January of 1978 I went there and gave a presentation on my concepts. They didn't want to subsidize the development of it, but they did say if you ever get it working let us know, okay? But to

give you some idea of the problems they were running into, Delco Division had RACF installed for 18 months and only had three percent of their data protected. But again, IBM never conceived of doing a lot of data and it was just they couldn't get the percentage up. Corporate audit was taking the position, you know, we don't know what percentage is justified but we know three percent ain't it.

So they were interested; and it's interesting because there was a GM auditor called Martin King, who I worked with later on developing the first computer system auditing product, what we called SKK's Examine MVS and CA now calls the CA Auditor. But he told me years later, you know, they weren't really that interested in getting ACF2. He said what they're interested in doing was pushing a hand in IBM's face and forcing IBM to improve RACF. So, he said, they weren't looking to buy your product, they were really interested in getting IBM off their butts, to fix RACF.

GM basically said if you ever get it working let us know; and then in March or April, GM audit dragged Jerry Lyons from Pontiac Motor Division up and said you're installing this thing. They dragged him up to London, Ontario to see it. And so we installed at Pontiac in May of 1978 and again, this is more to get IBM to fix their product than to buy ACF2. But Jerry had a hundred percent data protection at three months. TRW Credit was installation number three; and Pontiac was two; TRW Credit was three; and then we went to General Motors Assembly Division and did that as four; the fourth site, because they were so happy with the response at Pontiac. And General Motors Assembly Division was like two or three months also, to a hundred percent. And the same thing happened at

Chevrolet and some other GM divisions. So like within six months there was an explosion within General Motors of usage, and GM corporate audit sent out a letter to all the divisions saying, data security is important to us. The two products we've reviewed and accept are ACF2 and RACF. However, you must justify the percentage of data you have protected. By the way, thus far, General Motors Assembly Division, Pontiac, and Chevrolet, and so on, with ACF2, have 100 percent of their data protected. Delco Division, with RACF, is now at four percent. We don't consider four percent adequate. Pick a percentage. We know 100 percent is adequate, but we don't consider four percent adequate. So pick a product and install it. (Laughs.) And so all of them picked ACF2 from that point on.

Yost: Was RACF something that IBM sold or was it just bundled in for customers that wanted it?

Schrager: It was a monthly lease when we first started with ACF2; RACF was like \$1350 per month. So we came in with ACF2 on a lease basis at around \$1000, and then IBM reduced the price to \$750. (Laughs.) But it didn't make any difference. People were getting a perpetual license for ACF2, I think it was \$27,000 for a perpetual license at the time.

Yost: Were there unique needs at London Life, or at life insurance companies? Why did this company see the need to protect data at an earlier stage than other companies?

Schrager: You know, I don't know. I do know they were interested and General Electric was interested because it was basically served outside customers. But I don't know why London Life was so pushy on it and was willing to make the effort, the contribution.

Yost: And what kind of financial commitment did they make to you, and Eb, and Scott to get this up and running?

Schrager: They basically gave us computer time. And they paid our expenses. They capped it at \$5,000 but I think that we ended up spending six or seven thousand; but they paid the whole thing.

Yost: When you were creating ACF2 was it an entrepreneurial mindset that this could be an enterprise and this could make money?

Schrager: No, I think we weren't; our mind was not that; it was sort of like we were forced into it. By the university saying no, we were forced and I was just so dedicated to doing it. I sort of laugh at the university because, you know, this would've been a billion dollars in their pocket. But after they failed on this, or made the wrong decision on this, they created a division called University Applications. And had that been in existence, this would've gone into that at the time. And so I might still be working for the University of Illinois, at this point in time. What was the question now?

Yost: When you designed the prototype...

Schrager: Yes, I was not thinking about this company, I was thinking of just doing this.

Yost: Okay. And at what point were there ideas evolving toward forming what became SKK?

Schrager: We formed it at the time. I had flown back to Chicago; while we were all up in London, Ontario, I flew back for a couple days in Chicago to do all the paperwork. My brother was a lawyer. So I flew back and we formed a company; and then I flew back to London and went back to coding.

Yost: So this is early 1978?

Schrager: This February 1978 we did this.

Yost: Okay. And you mentioned some of the things that Eb and Scott had worked on before. Were they both colleagues (pause)

Schrager: They were both working for me at the Computer Center at University of Illinois-Chicago Circle, at the time. And Dr. Brown was great; you know, he basically said you guys have a lot of vacation. Take it and go up there and do your thing.

Yost: And Dr. Brown was the director of the center?

Schrager: Yes.

Yost: And he had helped try to get the University of Illinois (pause)

Schrager: Yes, he made the pitch there.

Yost: Do you know if the computer center at Champaign-Urbana had developed any software that set a precedent within the University of Illinois system for licensing software products?

Schrager: Yes. I mean, one of the things that Scott had done before he joined me at the computer center, he worked in Urbana and he worked on a project called Project PLATO [Programmed Logic for Automated Teaching Operations]; P-L-A-T-O, which did the graphical interface for kids for learning systems. And they licensed that and he was getting a royalty check every three months from that project. Now, he was a small part so he was only getting \$100 or \$200 every three months, but that was our concept of creating ACF2 within the university and getting the royalty checks from the university as money flowed in from it.

Yost: By that time, there was a lot of excitement about PLATO, if not a lot of revenue. But that wasn't enough to influence University of Illinois-Chicago?

Schrager: I have no idea. I mean, I don't know whether it was because we were in Chicago and Urbana was the beginning; we were a small player in it; or, whether it was because they didn't understand data security. Because PLATO was part of the educational thrust, so they understood that. Yes, because that was our concept with the Project PLATO as our prototype.

Yost: And how long did you, Eb, and Scott stay on as employees of the University of Illinois-Chicago computer center after forming SKK?

Schrager: We formed SKK and we pretty much left in June. I think I got paid until September because I had a lot of vacation coming. The university gave six weeks of vacation a year and you could accumulate up to double that. So, you're talking about three months of vacation you could have accumulated at any one time. And then Dr. Brown was really cooperative and, we just sort of like moseyed our way out. We opened up our office and (pause)

Yost: How many people were at the computer center?

Schrager: We had like 20 people.

Yost: Okay, so it could still operate, losing three people.

Schrager: Yes, lose three people, yes. And we opened our office in July of 1978 and I remember we opened it up just before July 4th weekend, and then just after July 4th weekend Procter & Gamble insisted upon coming to visit us. So we had used furniture; we didn't have any phones (laughs), but they were installation number eight and they were successful also.

Yost: And where was this?

Schrager: This was in Rosemont, Illinois, which is directly north of O'Hare Airport. As a matter of fact, there was Higgins Road, there's O'Hare Airport, and there's our office.

Yost: So, it was a small office space that you were in.

Schrager: And it was the only place that would give me a month-to-month lease. You know, because most places wanted a year's lease signed, and commitments, and of course, we didn't have any money.

Yost: And was there any, besides the computer time, was there any support that London Life provided to forward this endeavor?

Schrager: No, no money at all except our expenses for developing the product when we were there.

Yost: Okay. And did you seek any venture funding at all?

Schrager: We did. We signed an agreement with a company called Cambridge Systems Group. They had a product called ASM2, which was a migration product. I never thought of it in those as that, but that's the terminology we would use today; working with data sets that hadn't been used in a certain amount of time and migrate them to tape. And they made contact with me and wanted to sell it in the U.S. and Canada. And so I entered into an agreement with them, and as part of the agreement they'd give us \$50,000 up front. I mean, that's sort of what you would mean as a venture funding.

Yost: Okay. But you didn't have to give away a piece of the company.

Schrager: No.

Yost: And when you came out with ACF2 I assume you were still active in SHARE.

Schrager: Yes. Now the problem was with SHARE at the time was they didn't allow any vendors other than IBM to attend. So as soon as we came out with ACF2 and formed SKK we basically were banned from SHARE.

Yost: Okay. So your association with SHARE essentially ended at that time.

Schrager: Yes. And then started up again in like within the last 10 years. But yes.

Yost: For a long time they had a ban on having . . .

Schrager: Other vendors.

Yost: . . . Competing vendors. Can you talk about early marketing that you did for ACF2?

Schrager: Yes, I ended up hiring this guy named Bob Hass, H-A-A-S, and we ended up having some advertisements in *Time*. (Laughs.) I'm not certain that was the right place, but we did that. And it was basically the word of mouth and some presentations. It was basically going from prospect to prospect. There wasn't an idea of; there wasn't like any local users groups you could go to at any time; and for some reason we never thought of like having a big thing in Chicago. Hey, everybody from Chicago come in and, you know, see a presentation; it was basically going from company to company.

Yost: And I assume ACF2 was a product that got updates frequently?

Schrager: Oh yes; massive updates. We ended up with 164 or 165 employees; of which a good 60 were developers.

Yost: And can you talk about how quickly the company grew and roughly how many employees were there in, say, '79?

Schrager: Well, we started with three. (Laughs.) And then we went to five, because this lady, Jean Mazur, who was the administrative assistant at the computer center came. And this kid, Dennis Fitzpatrick, who I remember when we first opened up the computer center he used to be standing with his nose on the glass wall, looking in. He was in high school at the time. So he came. And we pretty much stayed there; and we ended up in 1980 we had like 25 employees. We opened up offices in London and Sydney, Munich, and Brussels, for some reason, in the next three or four years. And then, you know, we just slowly grew; 134 employees were in Chicago in that same building. So they did a good job leasing us month-to-month on the place because we ended up taking three floors. And then, you know, about 30 employees were overseas.

Yost: Over the years, have you noticed any differences in attitudes towards computer security within companies in Europe or various countries within Europe, compared to the United States?

Schrager: Well, in the United States, the thing that helped us a lot was in the late 1970s—now, the company was formed in 1978—and about that time Congress passed a law called The Foreign Corrupt Practices Act [1977], which mandated any company doing international business had to protect their accounting or financial data, which was a blessing for us (pause)

Yost: This wasn't something you lobbied for . . .

Schrager: No. (Laughing.)

Yost: . . . or anything like that.

Schrager: No.

Yost: This was a gift.

Schrager: This was a gift. (Laughs.) And there's that; and then I think, you know, other countries started following suit with that stuff. And so, you know, Sarbanes Oxley wasn't there at the time, but the financial data was the key push on this stuff.

Yost: And you mentioned that GM was the number two customer, and then TRW Credit?

Schrager: TRW Credit was number three; and General Motors Assembly Division was four; and USDA was five; and I know Procter & Gamble was eight. Six and seven is escaping me at the time. But the key is that; and I think in 1979 we got the Central Intelligence Agency. And that's a funny story because there's this guy named Barry Lewis, who I had known; I forgot who he was working for at the time; but then he went to the Department of Labor. And they were MVT at the time but he asked me to come out and give a presentation. I gave a presentation; talked to them; and basically, they're

MVT; ACF2 doesn't work with MVT. What I didn't know at the time was he was going to get a job at the CIA, but they placed him on hold in the Department of Labor until they got him a security clearance. So this was sort of like a temporary stepping stone for him.

And when Barry went to the CIA he brought ACF2 in for trial. And it's sort of a funny story, because we shipped it to him and then a month later, or two months later, he calls up and says, Barry, I got some good news and some bad news. I said okay, Barry, give me the bad news first. I said I can't believe you're doing this to me. So he says listen, you know we found a way to bypass ACF2, okay? And I said, okay, well Barry, tell me the what you did and we'll fix it. And he says, well it really wasn't your fault, it was IBM's fault but you could've blocked it. Okay, I said, well tell me what I got to do to block it. He says, nah, we may use it. So this is the beginning of the hacking mentality.

The CIA was doing this in 1978-1979. One of the reasons they brought in ACF2 was to find out if they had to go break into an ACF2 site, how would they would do it? Okay, does that sound familiar? (Laughs.) So I said what's the good news? And he said the good news is we're going to buy it and we're going to recommend it to a hundred or our collaborators and subcontractors. So I said well, if you give me their names I can contact them. He said no, I can't give you their names; you'll just get calls. (Laughs.) So we got NSA, Britain's MI5, and Australian Department of Defense, and all sorts of places all over the world that we didn't even know were going to call us.

Yost: And with these intelligence agencies, you've said the CIA, a primary interest was offensive, in terms of intelligence gathering.

Schrager: Well, no; that is probably defensive, too. But, you know, that was one of the reasons they brought it in was to find out how to break into it. It's really interesting, when you think about it.

Yost: Was that true with the foreign intelligence agencies that you dealt with, as well?

Schrager: You know, we only dealt with the friendly foreign intelligence agencies, okay? You know if Russia would've called up, we wouldn't have shipped it to them. (Laughs.)

Yost: Right. Export controls would have place restrictions (pause)

Schrager: Well there weren't any export controls at the time, that I can recall; but, you know, there's a loyalty that I have that I'm not going to violate. (Laughs.). In fact, there was one prospect, in a country I forgot, but the sales person told me that this company was half owned by the Soviet Union. We did not sell to them.

Yost: You mentioned that shortly after coming out with ACF2 at \$1000 a month, IBM reduced the price of their product. Do you recall when that was and did that materially impact your ability to sell?

Schrager: No, because it turned out that the places were more; we almost sold no month-to-month. All we sold were perpetual but we did a month-to-month price that they came in under instead of over.

Yost: Okay, did RACF also have a perpetual?

Schrager: No, there was always a month-to-month.

Yost: Okay. And what was your perpetual price again, was it \$27,000, and what did it cover?

Schrager: The base price was \$27,000 for the first CPU; \$18,000 for the second; and then I think a 12 or a 14 percent maintenance fee for the annual, you know, for years thereafter. And interestingly General Motors, they did not negotiate. The only negotiation they did was, you know, we don't want to pay the \$27,000 for the first one at the second site; so everything is \$18,000 at General Motors, but, you know, we had 135 sites in General Motors. They could've sat down and negotiated, they would've gotten a much better deal but it sort of like snuck up on them.

Yost: Were there unique elements to particular installations and configuring it for particular customers and clients? Or was it more of a standard product used in a standard way?

Schrager: It was a standard product used in a standard way. We had, I remember; well you know, there were companies that used different services. I remember Eb Klemens and I did a coin toss, because now we were going to start protective transactional level control within IMS and CICS. And he got CICS and I got IMS. So when things came up; and then JES3 came up, and Scott had to go out and deal with JES3. So it was more like securing different components of IBM systems rather than, you know, by industry or anything like that.

Yost: So you're competing against IBM, but you mentioned that in certain respects, at least, some people with IBM were happy that ACF . . .

Schrager: ACF2 was taking the load, yes. (Laughs.)

Yost: ACF2 was taking the load. Do you know if there were mixed opinions among leaders in the computer security field within IBM?

Schrager: Yes. There was dissension within IBM and my understanding is that in 1983 or 1984 IBM decided that they were either going to kill RACF altogether or put money into it and develop a real competitive product. And that's when they took Eldon's product and brought Eldon in for a year or two to supervise the development of a commercial product.

Yost: And what was the result of that?

Schrager: Well now all of a sudden RACF had protection by default, and it had generic profiles, which was I called algorithmic grouping, and it had resource control. So, I mean, it's sort of like they took the hot items from ACF2 and said our product is going to have these things.

Yost: Moving back to the development of ACF; turning it into a well working prototype, how many months did that development process take.

Schrager: I called resident account at the time. What I called resident account, at the time; which was you would think of the job entry validation, and TSO logon validation, and things like that. So the user authentication, okay? The ACF2 was unique in that I would spiral off, in terms of what I thought; but when I designed that part and the database that that used, I was thinking how do I make it so it's sort of like independent in what the database looks at. And I was thinking well, IMS must do it this way; and it didn't. But what I created was, with the resident account and later with ACF2, everything was referred to by a field name. So when you had the TSO command to update the database, it said field name, and then it had the field value afterwards, it had no clue where the name was in the records and didn't care. And that gave us the ability to like add fields real easy; and installations could add fields. At the time I never thought of it. But it all worked really well. So, I mean, that was all there; in my basement, the PL/1; the design of how the ACF2 access controls would be designed and specified, and things like that. Basically, I did it in six months, part time.

Yost: Do you recall roughly how many lines of code?

Schrager: (Laughs.) Um . . .

Yost: the program?

Schrager: The interpreter wouldn't have been much more than three, four, five hundred lines of code; maybe a thousand lines of code. And the PL/1 compiler is probably 2,000 lines of code. We're not talking about a lot.

Yost: And do you know how that compared to the size of RACF?

Schrager: No I don't. You know, and then, because I had Eb Klemens; I had him do the intercepts; it was really at this point in time; you know Eb, instead of doing that check, in addition to it, called this routine and it'll tell you yes or no. (Laughs.)

Yost: And when you split out, creating versions for the leading IBM database/data communications products, CICS and IMS, can you elaborate on that effort?

Schrager: What did you do for? I forgot what we did for CICS; we ended up having to rewrite it with a much more sophisticated version in the early 1980s; but for IMS; IMS had a concept where you had a profile or something equivalent to that. And basically,

when you signed on, that profile was assigned to you or you specified which one you wanted. And so I basically did the equivalent of a resource validation; can this user get to this profile? So I did it that way. For CICS we eventually ended up having; looking and doing a transactional level evaluation on it.

Yost: And, you know, these are obviously products that really took off for IBM, what impact did they have for SKK, in terms of sales?

Schrager: The IMS and CICS; it was all part of ACF2, it wasn't separate.

Yost: Okay, but did it lead to many more installations?

Schrager: I wasn't; you know, yes, I think so. I mean, my goal was not to sell the world; my goal was to service our customer base. And our customer base, you know, two people ask for it or three people ask for it; you did it.

Yost: Can you speak a bit about the finances of SKK in the early years? When did the company really start to take off financially?

Schrager: I remember one of the things that sticks in my mind was that I owned 50 percent; or 52 percent; and Scott and Eb each own 24 percent. And I remember at the end of 1978 we set it up so that we got, quote, royalties, so the company didn't have to make money and then pay tax; and then we had to pay tax. And the royalties were adjusted,

based on how much money was there. But I remember Eb, Scott and I sitting there in December or 1978; I owed Eb \$90,000 in, quote, “royalties.” Remember, at the University of Illinois, he was only making like \$20,000 a year. For some reason, I wrote it in three checks; figuring he would have one to put aside for taxes, and who knows what. And I remember him looking at the first one, being really excited; looking at the second one, getting more excited; look at the third one, was really, really excited.

But we had sort of like ups and downs, you know, there’s some years we made \$2, 3, 4 million profit. Actually, I remember one year where we made no profit at all. And the issue that we had been trying to deal with this was that our Rosemont expenses, for just the Rosemont office, were a million dollars a month. And now; and from a tax point of view, you had to get rid of all that money in December. And so what happens if you don’t have enough money in January and February? And one of the things; you know, they should finally fix things for developing companies in the United States; there should be a way of, you know, okay, I’m going to carry over some money. I’m going to pay taxes on it if I don’t need it but I’m going to carry it over just in case. (Laughs.) You know, it’s not the most supportive environment; tax environment is not supportive of little companies trying not to make another dime because you gotta figure out how you’re going to get that money in January, February for the payroll and everything. You know you don’t want to pay 30 or 40 percent in taxes just to carry the money over. And I don’t know what the solution is but there should be a way of doing it.

Yost: When did you expand overseas?

Schrager: We opened up in London, first, in I'd say 1981.

Yost: And what was roughly the breakdown in terms of number of domestic versus international customers in the early years, compared to the later years, say, in the 1980 to the 1995 period?

Schrager: Oh, God. I'd say almost, you know, six to one; where six is North America, including Canada.

Yost: You mentioned Bill Murray was an early mentor.

Schrager: Yes.

Yost: Did you have a continuing relationship with him?

Schrager: No, I lost touch with him after SKK and SHARE. How do you know Bill Murray? Is one of the people you interviewed?

Yost: For our project, we assembled a team of about seven or eight advisors, pioneers from computer security, that advise us on important topics to cover, as well as people to interview. So he's on our advisory committee members for this project. I've haven't met him yet, but we've exchanged emails and spoken on the phone.

Schrager: Okay, yes. I cannot say anything nicer about Bill Murray.

Yost: Okay. So once SKK is a competitor, you no longer can go to SHARE(pause)

Schrager: Well, my main contact with him was SHARE and I couldn't go to SHARE anymore.

Yost: Right. And I assumed that was true with GUIDE as well, that vendors could not; competing vendors, could not be members. Let's take a short break.

Yost: Ready.

Schrager: Okay.

Yost: Continuing this interview with Barry Schrager at Xbridge Systems in Mountain View, I'm Jeffrey Yost. Can you talk about; you mentioned that as customers had certain needs, that you were serving these customers. What were some of the updates and refinements to product that you made for customers, and were there certain ones that were particularly involved or challenging?

Schrager: Well, there's the; although the early SHARE requirements called for resource control and transaction control, the original product did not have that in there; and so we

added that, which was a whole different concept for resource control. Datasets were one thing; resources were another because now we had types of resources. RACF calls them “classes,” and everybody uses classes now but ACF2 was first and it called them “types.” And ours were three characters; theirs were eight characters, so now ACF2 has to translate. But, the idea of creating resource access rule sets, or resource rule sets, and things like that; so that there was a whole basic infrastructure within ACF2. And then, of course, there is the support within each of those products to call ACF2. The partnership between the information delivery system is where it handles multiple users, and the security system has to be there to support it.

Yost: I ran across something that listed both RACF and a product called “Top Secret” as a competitor of ACF2. Can you give me some background? I wasn’t able to find much on Top Secret, so I don’t know much about that product, and where it came from, and how it came to compete with RACF and ACF2.

Schrager: Yes, it’s interesting. All I know is there’s a couple of guys named Mike and Wally who developed Top Secret. And I know more about this gentleman Vince Re, V-I-N-C-E R-E, he’s now a senior vice president at CA, but he was one of the early employees after the founding of the company. They formed some small company, which was then purchased by CGA Allan in 1981; and that’s when I first found out about it. Basically, their goal was to sort of mimic RACF, and produce sort of a better product than RACF. The unique thing about Top Secret is it’s sort of an inversion to ACF2 and RACF. Whereas ACF2 and RACF have a resource -- dataset, transaction, whatever it is;

and one way or another you specify which users can get to that resource, and under what conditions, and what they can do with it. In Top Secret, it's the inverse. You basically; for users, you define which resources they can get to and you can have groups of users. So if you think about it, they all meet in the middle where the rubber meets the road, but one manages data one way or another.

And we are forever faced with the issue of okay, what data can Jeffrey get at, okay? And from an ACF2/RACF point of view, that's a lot of work, okay, because basically we have to go through every resource or every rule in the system to determine what Jeffrey can get at. For Top Secret, that's easy, okay? But on the other hand, you ask the question who can update payroll, for ACF2 and RACF that's easy; but for Top Secret, that's difficult. But, you know, when you ask a specific question during execution, that's efficient from both sides.

Yost: Earlier you mentioned the Foreign Corrupt Practices Act. Can you expand a bit on the degree to which that changed the market for your product?

Schrager: Yes, what it did was it forced every company doing international business to show; or to—I don't know whether to show or whether it just said "you must"—have controls over your financial data. By that time we had established credibility in the marketplace, in General Motors, and Procter & Gamble, and those places. So now when these companies were looking around; well, we'll just install a product; what product should we install? This company with three people in it over IBM? Oh, but people are

happy with this product from these three people. I think we were 20 people, or 30 people at the time. But that's where that came in.

Yost: Okay. And in say, 1979 or 1980, what was roughly the market share between installations of RACF versus ACF2?

Schrager: I can tell you, when we sold the company in 1986, at the end of 1986, we had a 60 percent market share against IBM's RACF and, at that point in time, CA's Top Secret. So they split the 40 percent. I don't know what that split was. I think it was a majority of RACF. Nowadays, CA's done such a good job, RACF has 75 percent of the marketplace, and ACF2 and Top Secret from CA share the 25 percent.

Yost: And can you give me some idea of how, during the 1980s, ACF2's market share grew?

Schrager: You mean where did it start in; well, it started at; well, I don't want to say zero, because there weren't that many sites out there, in those days. But, you know, the only numbers I really have are; I know RACF was getting beat badly and that's why they took; they had a restart in 1984 because they felt it wasn't worth either doing the product at all unless they did better. They gave salesmen bigger bonuses and they allowed them to give it away for nothing.

Yost: So by the '80s you were doing major market share.

Schrager: We're doing major market share and then two things happened: the IBM restart of RACF and the discounts; and then CA had bought Top Secret in 1983, 1984, 1985, something in that time frame. And what they did is they started bundling it. So they were bundling it with a series of products that everybody; and basically their position, they went into sites that had no security product and said look, you've got these five products of ours, we'll bundle in Top Secret free. It doesn't cost you anything; you may as well try it. Sort of a restraint of trade thing, if you think about it. (Laughs.) Because what it does is it stifles innovation and so that's what they did.

Yost: Is that type of bundling considered potentially anti-competitive, in terms of breaking anti-trust regulations?

Schrager: You would think so, but I don't know whether they ever did it. What we ended up doing was we ended up combining with UCCEL; who was an active; and they had everything but a security product so we would; a lot of times a salesman would combine with them. And I don't know how we split the money, but we did that. And we ended up selling to UCCEL because I wouldn't talk to CA, because I felt that their practices were not ethical.

Yost: And when did you start working with UCCEL?

Schrager: Probably 1983, 1984 when we started getting the issues with CA giving away Top Secret for nothing. It's hard competing with nothing, and it wasn't a bad product.

Yost: And what was the detail of how that relationship worked with UCCEL?

Schrager: It was very informal. We did not have any formal relationship at all, but basically, they were running into situations where they were against CA and had everything but a security product, and basically said come here. (Laughs.) So that would be so we could present to them that they could include a security product.

Yost: Can you describe the development of ACF-VM, and when that occurred?

Schrager: Yes. We were already doing well; we were making money; and we started getting some requests for VM support. And Charlie Kao, K-A-O, was brought to me. And Charlie lived in Chicago, and he was a VM expert. And so I hired Charlie to develop a VM product and, I don't know, I think he had like 8 or 10 people working for him. And he did; Charlie's a brilliant guy. He's still living in Chicago.

Yost: And what did this mean for SKK?

Schrager: Well basically, we now; we had no competitors in the VM market. So anybody who wanted security for VM came to us. And basically, he used common parts; compiler,

interpreter, and things like that, but all the interfaces were different and some of the concepts were different.

Yost: Can you discuss Examine MVS?

Schrager: Yes. Now that was in 1981 or 1982, a GM auditor by the name of Martin King came up to us and basically, his story was, you know, I go in and audit the GM sites—because he was basically traveling all over the world—it's a lot of manual labor and I think this could be; a good portion of it could be automated. Our goal was to create an automated operating system auditing product. So Martin led that development and created Examine MVS. It's now called CA Auditor.

Yost: And your relationship with UCCEL was always informal? Or when did that change.

Schrager: No, they ended up purchasing SKK and the three products; and six months later they were acquired by CA. I often wonder whether that was all planned and we just jumped up at the price, when they got us.

Yost: You obviously were not pleased with some of the practices of CA. Would you have listened to offers from CA?

Schrager: I refused to take their calls.

Yost: Okay. So they probably would have been very interested in acquiring SKK?

Schrager: Oh, yes, they were. But on the other hand, it wasn't clear to me why they were in the situation, because they already had Top Secret and I felt from a competitive standpoint, we were worth more to UCCEL. But I never realized that UCCEL would end up getting purchased by CA. But it happened six months later, which meant that I had to be talking to them.

Yost: Can you expand upon UCCEL as a company, and what areas it was involved in, and roughly what size company it was?

Schrager: I don't know how big it was; I mean, it was much bigger than SKK. They had a tape management product, job scheduling product, you know all the standard range of what I call MVS management products that you would need in order to run a site, except for security. And CA had the same thing on their set, but they had Top Secret on it.

Yost: And was UCCEL; did that evolved out of University Computing Company, Sam Wyley's (pause) . . .

Schrager: Yes.

Yost: . . . corporation or was that just the new name for University Computing?

Schrager: I think that was just a new name; they renamed it.

Yost: Okay, that was a pretty sizable company.

Schrager: It was a pretty sizable company when we joined them. They just didn't do a good job of assimilating me into it.

Yost: And roughly, can you describe the terms of the deal between SKK and UCCEL; the acquisition?

Schrager: Yes, they paid \$27 million and, you know, they basically got SKK and the three products; development organization; things like that.

Yost: At the time, did you feel that they were just acquiring products or also the talent?

Schrager: More of a rounding out their product line, because like I said, they were competing with CA, who had Top Secret; and my feeling was that they needed SKK as the addition to their product line for competition purposes.

Yost: Okay. Of course, these products of SKK are being updated regularly, and the knowledge of how best to do that probably resided with staff.

Schrager: With staff; and a lot of that staff is still there.

Yost: Okay, so some of the staff did transition to UCCEL (pause)

Schrager: You know they went through the UCCEL acquisition, then they went through the CA acquisition of UCCEL, and there are a whole bunch of people who I'm connected to on LinkedIn—I don't use Facebook that much—who are still there [at CA].

Yost: Other than the Foreign Corrupt Practices Act, were there other moments in either the late 1970s or early 1980s that had a dramatic impact on how the corporate world and other potential customer communities saw data security and valued the need for it?

Schrager: I think the Foreign Corrupt Practices Act caused enough companies to get it; and then I like to say it created what I would call a standard of due care. So that forced everybody to say, God, I should be using some data security product and we ended up with, you know, for example, the Federal Reserve System uses it exclusively. And that basically set the stage for the banking industry. And so now you're a bank, and you figure you do need some data security, and, you know, who can I do better than the Federal Reserve System? So, I mean, I think that it became having a data security product on your mainframe became a standard of care, good business practices. And you're not talking about a lot of money, you know, they were sold relatively cheaply.

Yost: And were there other data security products that grew to substantial size that focused on other type systems that you weren't targeting?

Schrager: Oh, you mean Windows and those things?

Yost: Yes or CP/M.

Schrager: No, we never looked at that. In 2007; oh no, 2003 or 2004 John Moores, who was the originator of BMC, contacted me and; actually contacted Peter Schaefer, who did the OPS/MVS product, and then a product for him called Shadow. He wanted to create a new software company that was more responsive to the customer base and things like that. They got to talking and Peter told him he needed a mainframe security product, so I put together a team that developed a product called Deadbolt. And Deadbolt really addressed a lot of these issues, in terms of things; and it also, one of the things we wanted it to do was we wanted the mainframe to act like a hub, and for all these external servers to access; to have Deadbolt on them to do analysis on it; but basically it would go back to the mainframe; collect the rules, in terms of controls; and if things got updated in the mainframe, then it would send out a little message, you know, "this rule is deactivated. Next time you need it come back to me for it." So we did; I mean, we moved in that direction with Deadbolt, in providing an enterprise-wide security system. But Deadbolt died, thanks to the bad mistakes of John Moores' close staff.

Yost: What about with the rapid growth of mini-computing; were there products that specifically were used with certain mini-computing systems?

Schrager: Not during SKK's lifetime. We were lucky to have a PC that worked.

Yost: Okay. Are there certain lessons about centralized authentication, and simplification, and default protection from the past that you think are particularly pertinent today that some have failed to recognize?

Schrager: Yes, the first one is operating system integrity. This is the Windows problem. That's why you have to keep running virus scans, and everything else. If the operating system does not have integrity you cannot have a multi-user system and have data security. That's just sort of like a premise that I talked about in 1972 and 1973 that is just true today. And it's the reason why the IBM mainframe is the most secure platform, is because it does have the data integrity, system integrity; and IBM has a commitment to maintain it and fix problems that are found. That's not true with the case of Microsoft.

Yost: Is it the size that operating systems have grown so large to that make it impossible to have real integrity, what do you think?

Schrager: Well, there are integrity issues. One of my former employees, Ray Overby, has written a product that pokes and prods MVS looking for integrity holes. And he's found about 100, of which like 80 are in IBM code. And what they tend to be is like; IBM uses

a language called PLS for development; its own internal development. And what we've seen is basically most of the problems tended to be the programmer not telling PLS that this is an SVC or a PC, and then PLS compiles the code assuming it's a subroutine. And if it's a subroutine, for example, register 15 is the entry point of the subroutine; your subroutine for a program was calling you; you could trust it. Well, if it's a PC routine, or an SVC routine, you can't trust you because it's set by the guy in problem state, and he's calling you. And the same thing with PC routine. We found one or two that use; that take an immediate branch off of register 15 around the cache at the beginning. Well, that's a subroutine linkage. You trust register 15 because it's part of your gang who's calling you. If it's a PC routine you can't trust it and you have to take different approaches. So, you know, it's sort of a thing; I say it's like the quality assurance guys at IBM have sort of fallen down, in these cases. Then there are just acts of ignorance or stupidity by the developers where they don't go into the user's key before they put the exit data, so you can give them a data area, and he just blithely stores to it, and it could be a system area. Or, he doesn't go into the user's key before he fetches data because that, in a case where if I'm going to fetch an encryption key, that should be protected from me. If I can get an SVC or a PC routine with authorization, use its authorization rather than mine to get the data, then I might be able to get a hold of it and use it. So now I can look at communications. So there are programming errors; but not a lot. And IBM is committed to "if you tell us about it, we'll fix it." But there are independent software vendors who make the same mistakes and, you know, people that aren't trained all that well; the developers are not trained all that well.

Yost: As SKK grew, did it begin to use different practices with marketing products
(pause)

Schrager: We had such a reputation in the security industry; you know, because of IBM's failure we were the only game in town for a long time. Then we started running into the competition with CA giving away Top Secret, and IBM actually developing RACF, and giving big incentives for getting it in places so the marketing and sales got a little harder. But like when we introduced ACF2/VM, we were the only game in town. Most places who had VM already had an MVS side of the shop, and so a natural progression there.

Examine/MVS was a much harder sell. We were hoping that the auditing companies would use it and we created the concept of a traveling license, whereas, you know, at that point I'm a Big Eight company; can buy some traveling licenses; go around; use that as part of their auditing. And then we thought that sites would then want to buy the product themselves, just to randomly or regularly look at things. That was a much harder sell

Yost: At the time that UCCEL acquired SKK, what percentage of revenue roughly was coming from each of the three products?

Schrager: Don't know. The vast majority was ACF2 MVS; second was ACF2/VM; and finally, was Examine.

Yost: Did all three of you founders of SKK leave or did some make the transition to UCCEL and then to CA?

Schrager: Well, in 1981 or 1982, Eb Klemens wanted out of the company so Scott and I bought out his interest. And then about a year later he came back. So he was an officer of the company, but not a stockholder. So he stayed through; Scott left right away; and they wanted me to stay a year but they just didn't make it easy for me to stay. You know, I had been working my butt off for eight or ten years on this product and, you know, they're saying you can't have more than three weeks' vacation. (Laughs.) I said, I need; I'll get you started but then I need a month off. And then I will come back. No, you can't do that. So it was like we get into this big fight and I ended up leaving after three months. But they didn't support me; it's sort of like companies really need to create a; sort of like a help for founders, in terms of transitioning and they were just ornery.

Yost: And that's once UCCEL was taken over by CA or before?

Schrager: No, I left and the transaction took place December 31st, 1986, because tax laws changed on January 1st. And I stayed until March. I was supposed to stay a while year and in like June or July, UCCEL sold to CA.

Yost: Okay. So you left before, to your knowledge, there were discussions between UCCEL and CA.

Schrager: Yes, I never knew about any discussions.

Yost: Okay. And was it EKC that (pause)

Schrager: Eb founded the EKC, Eberhard Klemens Company. So he stayed with UCCEL, and then CA for a good number of years. I think he started EKC in like 1992 or 1993.

Yost: Okay. And is that where you went to, as (pause)

Schrager: Well, I had; the problem is I had a five-year noncompete, as part of the sale. And so I basically went into real estate development and did everything but computing. And then Eb called me in 1995 and asked me to help him, so I went to work for him.

Yost: And can you describe that company?

Schrager: Yes. It was originally developed to do add-ons for ACF2 to make things easier for people to administrate ACF2, to do reporting on ACF2. Tom Carneal, who was there, was the developer of the great ACF2 CICS support. But at EKC he did a bunch of reporting, like the top 10 things you should be looking at today and things like that. And as part of that, I did access analysis for ACF2 and RACF, and stuff like that.

Yost: In your opinion, was CA providing very good service, backing the ACF2 product?

Schrager: You're going to get me in trouble. (Laughs.)

Yost: If you don't want to answer that, that's alright.

Schrager: Well, I mean; you know, the problem with a lot of large companies is they stay so focused on the bottom line, and you know, that's what public companies do. As a private company we're more interested in advancing the science and helping our customers; as long as we made some money it was fine because it was more than any of us would ever expected to make anyway.

Yost: But in a way, EKC existed because there was a need for support.

Schrager: Yes, there was a need for additional add-ons for ACF2. And the same thing with the company I worked for last, Vanguard Integrity Professionals. They make their money selling add-ons to RACF; that's their business.

Yost: Okay. And then you moved for about five years to Neon Systems?

Schrager: Neon Systems. We talked about the Peter Schaefer and the OPS/MVS product, and the Shadow product. Peter created it such that the PC or server just thought it was talking to an SQL database. So it used SQL to make the inquiry and it got back a result set, when it had no idea what's going on behind the scenes; that actually it ported over to

a mainframe. And it could've been a CICS transaction, or going to DB2, and so on. And so it was a really easy to use a transparent interface for the PC or Server. And, for them, I did the DB2 two-phase commit support, and finished the ADABAS support, and whole bunch of other little features in Shadow.

Yost: And from there you went on to JME?

Schrager: JME Software, that's when John Moores talked to Peter Schaefer and he wanted me to create another security product; that was Deadbolt. The big problem with Deadbolt was the intermediate management people. (Laughs.) Because John Moores had other things to spend his attention on; I don't know how he picked the middle managers, but they were terrible. I basically told John from day one—that was before he even hired me—I said John, I can create a better product than ACF2 and RACF, but I don't know how you're going to sell it. Companies like Vanguard are charging \$250,000-\$500,000 to convert people off ACF2 and put them on RACF. And now you're going to create another product from a little software company that could get acquired by CA and they'll be back in the same situation again. And John said; you don't worry about that, you just create the product and let me worry about that. Okay?

So I put together the team to develop the product, which included Charlie Kao, who did ACF2/VM; and Martin King, who did Examine/MVS; so I mean I got the minds of the thing. And so we did create the product, and through my efforts—not John's or his managers'—I got a trial set up at this little place in Washington, D.C. with only a

hundred people in it, called the U.S. Senate. (Laughs.) And they had scheduled a trial for January of 2007. And in December 2006, the guy calls me up and says, we can't do it in January, we've gotta push it off to May, or something like that. And I also had set up a deal with one of the largest banking organizations in the country—I can't mention their name—but they said that they will bring it in for a trial because they had both RACF and ACF2, and they couldn't get either of their sites to move and he thought maybe if we moved to a third product, which is supposedly better than the other two, we can move them there. But, he said, I cannot be first; there's absolutely no way I can be first. So I said, if I get it into the Senate, would that be enough? (Laughs.) And he said yes.

So, then I; in February of 2007 I get this call from one of the middle managers and they basically said, you're terminated; don't come to Chicago for your meeting. Okay? They also terminated Charlie Kao and Martin King. So, they terminated the three people with the stellar reputations in data security. They gave me six month's severance. And it was interesting because this was Saturday, and Monday I got a call from Amy Novotny—I don't know if you've run into her yet—she is the editor of *Mainframe Executive Magazine* and *z/Journal Magazine*. And Amy says, someone didn't deliver an article, can you write an article in the next two weeks for me? And I said sure, but you know, I'm not with JME Software anymore; and she said, great, that'll give you more time to do it. (Laughs.) So I go write the article for her; meanwhile, they go into the Senate in May and they make some excuse for why I'm not there. Okay?

Before then, Vanguard had offered me a job and so I called up Vanguard and started with them. And the article now had the trailer at the bottom, which showed me being with Vanguard instead of being with JME Software. So they go into the Senate and make up some lie about why I'm not there, and my contact there—who I sold—was reading the article; hey! It's an article by Barry! Okay; so he reads, and he gets to the bottom and finds I'm no longer with JME Software, and he kicks 'em out. (Laughs.) So they never got that first site. They never got the reference site and they ended up closing shop. But it was interesting because Peter Schaefer said he was part of that discussion, and he said there was some discussion as to whether it was John Moores who got the Senate, or me that got the Senate. But what was weird was that they never called John or [me] to verify it and they decided it had to be John, because he had all the connections.

Yost: And so Deadbolt didn't go anywhere.

Schrager: Deadbolt died through all sorts of things that had nothing to do with the product. (Laughs.)

Yost: So when you started at Vanguard, was that the first time that you had had directly worked with RACF?

Schrager: Actually, at EKC I did the Access Analysis for both ACF2 and RACF. But, yes, in terms of administration support; supporting products and things like that.

Yost: Was that an easy transition or not (pause) ?

Schrager: Yes, I mean it was relatively easy. You know I had to spend more time learning RACF but a lot of the stuff was more philosophical, you know, how do administrators work, what kind of reporting do you want.

Yost: And can you describe the company you're at now, Xbridge Systems?

Schrager: Yes, Xbridge Systems, the concept behind our—well, I told you a little bit about the history—the concept behind our DataSniff product is that one of the good things about mainframes is that the COBOL program you wrote in 1970 and compiled in 1970 will still work perfectly today. That's the good thing about it. And the data it operated on will still be operable on today. The bad thing about it is that it's been 40 years and no one's been forced to clean house, okay? And what's happened is over the decades—I'm not even going to say years—copies have been made and data has been copied or created, and it's still there. It may be in a migrated state.

So if you think about it; if you're an application programmer and I tell you to go change this production job, okay? The first thing you're going to do is you're going to make a copy of all the production data it touches so you don't screw up anything; and you're going to write your program; and you're going to test it. Same thing is going to happen with QA; you're going to make a copy of the data, and you know, what's going to happen to that data? It gets left around. So now we have copies of data going back 40 years,

which have been copied. And it wasn't really until say, two, three, four years ago that I ever heard of data masking, or field level of encryption, or format preserving encryption, or tokenization. That's all recent, okay?

And I was at some company who shall remain nameless, who blissfully copied some 8000 volumes of production data for a test, okay? So now I have data that's out there that contains credit card numbers, Social Security numbers, and medical diagnosis data. And the credit card numbers are covered by the PCI DSS standards says, first thing you have to do is identify all locations of cardholder data, and then you have to prove it's protected and encrypted and, you know, all that other stuff. Well, you don't even know where it all is.

And from a Social Security number thing, you know, the Social Security and address, you start giving out the private information; we have one of our customers who is an insurance company who handles both credit cards and medical data, and we were dealing with the credit cards, but they're also interested in medical data where you have a sensitive diagnosis that you could link back to a person. So, for example, two years ago I broke a bone in my foot. I don't really care if it gets out; but if I had HIV, I would worry about if that came out. And so they're worried about medical diagnosis and a name; or medical diagnoses and address; and even medical diagnoses and a zip + four. They feel like it gets down too close. So we have a program that goes and scans volumes of datasets, and picks out the ones that contain credit card numbers, or Social Security numbers, or whatever you're looking for, and basically it becomes a to-do list that you're

going to have to assign somebody to to go fix things up. But that's there; and, you know, for example, one of our customers just finished a short test scanning like 70,000 datasets and tables, because it does database tables too, and found 1400 that have to be remediated one way or another.

Yost: Moving back to the SKK days for a moment, were there particular methods used to evaluate and learn about vulnerabilities, too? Or was that more informal, just listening to customers? Did you, as a company, have your own tiger team, so to speak, try and figure out ways to penetrate through security (pause)

Schrager: We never really; where you thinking about vulnerabilities like integrity holes, we never worried about that. I mean, we sort of took on good faith, the IBM system integrity statements, but we never really looked for vulnerabilities. What we were mainly reacting to was a company saying look, I gotta protect this and how do I do it?

Yost: Are there areas that I haven't covered in this interview that you feel are important to understanding the work that you've done, and SKK, and ACF2, and other work?

Schrager: No, I think it's more of a, you know, the problem is that a lot of companies—and that's the way it is in our society—they focus more of the growth and selling and profits rather than really servicing their customer base. The objective, I think, is to sort of do a good balance of it, and sometimes they forget that.

Yost: As a somewhat smaller company, you were able to do that more effectively or were more committed to it than some larger companies?

Schrager: Well, at SKK, we didn't have any outside financing so the only people we had to look at in a mirror was Scott and I, in a mirror; because Eb was gone by that time. And the issue, like I said, was just this continuing to make payroll, and stuff. And like I said, if Congress wants to do something, they should make that easier for little companies to deal with the boundary, the fiscal year boundary issues.

Yost: Okay. Well, thank you so much; this has been really helpful.

Schrager: Okay. Thanks for coming all the way out to California.

Yost: Nice to be here.

Schrager: In the middle of the winter.