

An Interview with

Laszlo A. Belady

OH 352

Conducted by Philip L. Frana

on

21 November 2002

Austin, Texas

Charles Babbage Institute
Center for the History of Information Processing
University of Minnesota, Minneapolis
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21 November 2002

Oral History 352

Abstract

Belady discusses his early life and education in Hungary, escape to West Germany during the 1956 revolution, and work as a draftsman at Ford Motor Company in Cologne and as an aerodynamics engineer at Dassault in Paris. Belady covers his 1961 immigration into the United States, where he joined International Business Machines and did early work in operating systems, virtual machine architectures, program behavior modeling, memory management, computer graphics, Asian character sets, and data security. He also discusses his tenure as Vice President and Program Director of the Microelectronics and Computer Technology Corporation (MCC); as Chairman, CTO, and CEO of the Mitsubishi Electric Research Laboratories, Inc. (MERL); and as Executive Director of the Austin Software Council.

TAPE 1 (SIDE A)

Frana: This is an oral history conducted with Laszlo Belady on November 21st, 2002, in Austin, Texas, for the Software History Project.

[pause]

Frana: Les, you were born in 1928 in Budapest, Hungary, is that right?

Belady: Yes.

Frana: What did your father do?

Belady: He was a civil engineer.

Frana: And your mother?

Belady: My mother was the favorite out of the two. My mother listened well and showed interest. She shared literature with me. It was a very pleasant childhood. She was very social, so as a consequence I'm not a typical engineer. Frau, she actually was at the home most of the time. She never worked—at least I don't think so.

Frana: Now did you learn to be a good engineer from your father?

Belady: Yes. I even remember when I said that. He was a civil engineer north of Budapest, which is in fact part of Slovakia now. He was in charge of that whole country, so to say. He was chief engineer for bridges and road building and maintenance and all those things. I declared as a young man, or a young child even, that I would become a real engineer—a mechanical engineer. I didn't consider my father's profession to be very exciting.

Franá: What were your father's politics?

Belady: He was apolitical.

Franá: What do you remember of the Second World War?

Belady: I worked as an auto mechanic apprentice my last year of high school. In 1945 and 1946 I salvaged bridges on the Danube that had been blasted by retreating Germans. I graduated high school in 1946.

Franá: You received a B.S. in Mechanical Engineering, then an M.S. in Aeronautical Engineering at the Technical University of Budapest. Then you were drafted into the Air Force technical staff for three years of service, designing equipment for MIG-15 fighter planes. When was this?

Belady: Between 1950 and 1953.

Frana: What do you remember of those times?

Belady: We were in uniform, but engineers never had more than one or two weeks of military training. You know, the Soviets did that too with their engineers. They put everybody in uniform. Many of my classmates are very good friends, even today. We come together every five years, and 13 of the 15 are still alive. They are like my brothers. We suffered out there because the MIG-15's were the first jet planes we'd ever seen. We were extremely interested in that. But what happened was someone had to translate the Russian manuals page by page before they disappeared. A friend of mine was the chief engineer of that unit and then came the Secret Service. Do you know a little bit about the Soviet systems?

Frana: A little.

Belady: Which corresponds to the GPU or the—

Frana: —GPU, isn't that what they were called at that time?

Belady: No, no, in Hungary they called it—

Frana: NKVD?

Belady: NKVD, right. That was the Hungarian correspondence. No one knows this, but they actually held him for a month, and the funny thing was that he was the only guy with a really proletarian background! I was an intellectual and so forth, so I had much more exposure to other ideas. They took me too for a night or so because of other reasons.

Frana: So you actually left Hungary in the 1956 revolution?

Belady: Two hundred thousand people left Hungary within a couple of weeks. And they were mostly educated people because they knew they could survive anywhere because they had something to give. The criminals left too, because during the revolution all the criminals were freed. Nobody knew which were the political prisoners and which the common criminals. The hardened criminals all wanted to come to America because they had heard about the gangsters, and thought that would be the right place for them. Still, the majority of emigrants were educated people.

Frana: Did you leave with your family then?

Belady: No.

Frana: You left alone.

Belady: I left by myself. I left everything behind. I came with a satchel you know, with one change of underwear and my graduation paper, which incidentally during my whole career was never asked for. I never showed it to anyone, and no one ever asked for it. It's funny isn't it? They just believed that I could do these things.

Frana: You went to West Germany then?

Belady: Yes.

Frana: And where did you end up in Germany?

Belady: Kiel. I signed up for Germany because I was fluent in German. Originally, I wanted to come to America because I spoke English too, but it was a one-way language for me at the time. I supported myself at the Technical University by translating English technical literature into Hungarian. I was quite proficient at it, but I couldn't talk—just from English writing to Hungarian. But the real reason why I didn't go to America was because in the refugee camps in Austria there were all these criminals, and they wanted to go to America. I was in line with all these common criminals, and I said, 'I don't want to go there.' So I went over to the German line and signed up for Germany. We went to the Hanover area, which was the distribution point to different states in Germany, and they asked, 'Where do you want to go?' One of them said, 'Well, we are from Schleswig-Holstein' I had never heard of it. And that is how I got to Kiel.

Frana: But somehow you ended up working at the Ford Motor Company in Cologne.

Belady: Kiel was a poor area and a fishing town. There was nothing interesting about the place, but people were nice. I had to work, so what I did was to get in touch with Ladislao Di Biase. Well, he's a very interesting guy. He's my best friend today still. He was a son of an Italian diplomat who came to Hungary after WWI. His father fell in love with a Hungarian aristocrat woman who became his mother. They went to Germany where he was placed as a consult-general to Berlin. Vladimir was born there, and he started speaking three languages at the age of three—until that he didn't say a word. His father was Italian, his mother Hungarian, and everybody else around him was German. To this day he still doesn't know which is his real mother tongue. Hitler was really stinking already, and the old man decided to move the family to Hungary because of his wife. They spent the war years there. After the war they stayed there, and his father went into the import-export business.

I met Vladimir in Budapest when we signed up for the University. We were both accepted right after WWII, and became good friends. Now, when we graduated he went to work for a while, but that was in the middle of the worst of Stalinism. One night the secret police arrived and said, 'Mr. Di Biase, you are Italian?' He replied, 'Yes, I have been an Italian citizen all my life.' 'So you are an enemy of the people. You must leave in twenty-four hours.' He had already married a Hungarian girl, so in 1951 they left the country, settled in Viyanu, and started working for a German company. At home he

spoke Hungarian, in business German, and everywhere else Italian. So he continued these three languages.

Frana: That's a remarkable story.

Belady: In 1956, his father was a consult-general in Cologne. So I got in touch with them—we radicals have to have this kind of contact—and they immediately sent me money and said, 'Just come.' I knew the family, you see; I was like a brother to him. I took the train. I went there, and they called the local general manager of Ford Motor Company in Cologne who immediately hired me. But they didn't believe I was a real engineer. They didn't ask, 'Do you have a diploma?' They were like, 'Hungarians—what do they know.' So they hired me as a draftsman for very little money, but it was huge money relative to Hungarian conditions. I worked as a draftsman, doing other people's designs. Then I started proposing changes to the designer, and one of them discovered I had good ideas. They moved me directly to the advanced labor department, and this is where I worked. But then it was still just cars and not airplanes.

And then I made some contact with Theodore von Kármán, the father of supersonic aerodynamics. He was a NATO advisor and head of NATO's scientific branch in Paris. He was also the founder of the Jet Propulsion Laboratory in Pasadena. Von Kármán came to Aachen, a city west of Cologne along the border of Holland and Belgium. He invited me to a dinner because his girlfriend, who was a German aristocrat, had a castle there.

Belady: Frank Malina, an American engineer and the inventor of jet-assisted take off (JATO) was also there. The conversation was in English, and Kármán started telling jokes. At some point he said, 'I can't finish it. It's a Hungarian joke.' But he continued it, and I was the only person who understood it. When it was over everybody laughed, but they couldn't have possibly understood it. He said to me, 'You look to be bright enough. I recommend you talk to Marcel.' Now who was Marcel? Marcel Dassault, the aircraft company owner. I went there and they gave me a job. This is how I got to France.

Frana: You were in Paris then?

Belady: Yes, I lived there for two years, until 1961. I was restless there because I didn't like the French.

Frana: Now, was that the first place you came across IBM mainframe computers, the 704, 650, and the 1620?

Belady: Yes, yes. The first time I saw computers was in 1958 in Brussels because that was the year of the World's Fair in Brussels. There was this big computer on display, and they told the whole audience, 'Look at the computer, how big it is.' I had no idea what a computer was because I was still at Ford. I had just visited Brussels to see this World's Fair. Then the announcer said, 'Ladies and gentlemen, in ten years we will be able to translate English text into Russian automatically!' Well you know what actually happened. Of course, nothing happened.

In France I was in the Avant Project, which is actually the advanced thinking division of Dassault, located in a western suburb of Paris. There I had to use computers. I had no idea how they worked, but they gave me a plug board Burroughs 101 computer with needles to wire programs. That was my first computer. I built program loops because it also had a paper tape. I started liking it right away, but it took me a week to understand what was happening because I didn't want to ask anyone. They gave me a manual, and this is how I learned. The manual described a simplified version of FORTRAN, and discussed statements like 'A=A+1'. 'My god,' I thought, 'what the hell is this?' Finally I figured out what it was.

By my second year in France, I actually liked programs. I solved differential equations, ordinary differential equations, and partial differential equations—whatever was needed. But I didn't like the French; I wanted to go to America. By that time I had a wife who was also from Hungary, and a son who was born in Paris actually, on February 3rd, 1961. A few months later we got a visa at the American Embassy in Paris. We had to go through a medical check, and they found a spot on my lung. I barely made the immigration visa because in Hungary there's so much tuberculosis around. Everybody probably goes through that, and it becomes calcified and that's it. Anyway, I made it. I came into America with an infant son and \$1,000 in my pocket, and that's it.

My wife had two sisters living in New Brunswick, New Jersey. So we lived with them, and from there I found out that a good friend of mine was in the Boston area. He invited

me to come up there. I didn't like New Brunswick, a very uninteresting place, but there were lots of Hungarians around. At that time half of the population were Hungarian because Camp Kilmar collected all the Hungarian refugees in the New Brunswick area. But I went to Boston anyway. My friend was living with another friend, and they gave us a room. My wife cooked for the whole bunch and I started sending out resumes. I had to buy a dark suit, a white shirt, and a tie, which was strange because in Europe no one wore a dark suit for work. Out of a hundred resumes I sent out, I got response back from ten—the others didn't even answer. And out of the ten I had five very polite letters. But finally I got three interviews, but none of them was interesting. Then a letter came from Dick Clippinger of Honeywell. Honeywell was still very much in the computer business at that time. He hired me.

But before I signed a contract, I learned that IBM Research, which at that time was an empty shell in Yorktown Heights, New York, was interviewing in a Boston hotel. My friend says, 'Why don't you apply?' And I said, 'Come on! IBM—what am I to IBM?' He said, 'Why don't you just go tell them you invented IBM.' And I said, 'Well, I didn't do that!' Obviously, he just wanted to emphasize that I had to have a big mouth. I went to the interview. There was an Englishman there named Mike Roberts, a member of the original FORTRAN group for a while. He interviewed me, and got interested in my story. Finally he asked the question, 'Do you like computers?' I said, 'I certainly do!' I mean, what else should I say? I had a hungry family at home. And he said, 'Fine, then I will invite you to Yorktown Heights. You will hear from us.' Sure enough, they invited me. So I went to Yorktown and interviewed with several people and I got two offers. One of

them was in the Computing Center where I would be a programmer and help a physicist and others—who have no idea what computers do—write programs. The other job offer was for an exploratory group, which was more research-oriented. I selected the latter post. This is how my actual career started.

They were wonderful people. Some of them, three or four, were members of the original FORTRAN group and I just had a ball there. I learned a lot. I learned English; I learned a way of thinking. One member of the FORTRAN group was a very shy man from Iowa named Bob Nelson, and he was a heavy smoker. Unfortunately, he died at the age of 50 because of this smoking. Right after the war he was in Vienna and London as a code officer for the State Department. John Backus hired him and they created FORTRAN, all eight of them. He was having ideas already for some kind of a new architecture and I learned from him. That led to ultimately in 1965 to my first report on paging, and paging algorithms, and then in 1966 to a paper that has become a citation classic as the most referenced paper of all time. I still get letters from graduate students about it.

Frana: This is the paper on page replacement strategies in the *IBM Systems Journal*?

Belady: Right. Yes. That was it. The system had many papers written about it. I spent many years in that group. But then I got tired of it, and in 1968 I got interested in computer graphics. There was already an ongoing computer graphics program, which was quite young, operating under Herbert Baskin. He was the creator of the computer graphics group. He gave a course on that because IBM had a voluntary education system.

You know how important it was to me? Look, I was an aeronautical engineer. I never learned probability, statistics, discrete mathematics, nothing. But IBM Research offered these voluntary education courses, which were given by world-famous scientists. I attended them to fill in these gaps in my education.

One of the classes was on computer graphics. I liked it so much because I am very visual. I still think visually. Sometimes I read a book and I don't know which language I am reading it in after a while. So I liked it. When Herb Baskin left for Berkeley, I took over the computer graphics group. Ultimately, I had about fifteen people working with me. I still tell this story because we did interesting things, even animation with this incredibly expensive machine, the IBM 2250, which worked together with the 1130 because that was the predecessor. The whole damn thing cost \$700,000 and served one person with very, very rough graphics. Still, we did wonderful things with the 2250. I became a manager at the age of forty in 1968.

Frana: How did that project end?

In late 1970 Arthur Anderson, who was the head of IBM Research at the time, came to me and said, 'Les, the axe has fallen.' I said, 'What do you mean?' And he says, 'We are discontinuing computer graphics.' I said 'What?' He said, 'Corporate management decided that there is no future in it; there is no customer. It's too expensive, and nobody's interested in it.' I said, 'Fine, but we'll do research, perhaps something will—' He said, 'No, no. No research. You have to reassign your people.' So IBM in its infinite wisdom

killed computer graphics in 1970 and discontinued whole product lines and research. I tried to argue, 'What does it cost IBM to have a few people working here, there's so many other unnecessary things going on—' but that was it. I was so mad I wanted to quit. I felt confident that I could leave because I was so well known through my paper. I decided to take a sabbatical and go to the university. So I went around, and talked with Tony Oettinger. Do you know that name Anthony Oettinger? He was a giant of computer science at that time at Harvard.

Frana: Sure. He's a Trustee of my Institute.

Belady: I talked with Tony because he did graphics at that time. So they were interested in me for a sabbatical at Harvard. Then I went to my other friend, Ed Coffman. I don't know whether you know his name?

Frana: Yes. He's working on our NSF software history grant right now.

Belady. He was at Princeton. Well, first he was at Pennsylvania State, University Park, or something like that. I got an offer from him. Then I went to Berkeley, and Berkeley fascinated me because I hadn't lived in California. So I accepted the Berkeley post and went on sabbatical to Berkeley from 1970 to 1972.

Frana: Herb Baskin invited you?

Belady: He actually recommended that I go there. But then he left Berkeley, and it actually it turned out that they didn't like him too much there. He's still living somewhere in California. Still, I enjoyed it. I had to give a course in Computer Science 101, my own course, and obviously it emphasized storage management, memory management. It was the first course in the science and technology of storage—the software of it, and the architecture aspects of it. At the end of the academic year IBM said, 'Wait a minute, we are working on IMS—this huge database system—at Menlo Park, and they have to go over to virtual memory. Now no one knows about it yet, but you go there and help them move over to virtual memories.' So I stayed the whole summer of 1972. We moved to Los Altos Hills and rented an apartment with my family. It was fun. The kids were happy because we had a swimming pool. I discovered some very interesting things. I learned a lot about some very interesting problems. You know about the 'Belady Anomaly'?

Frana: The 'Belady Anomaly.' Yes, I've heard of that.

Belady: I discovered another anomaly, but I never published it. Then I went back to Yorktown. I had another friend, Manny Lehman, an orthodox Jew. I'm not religious and I'm not a Jew, but somehow we became very good friends anyway. He had a similar IBM history in the sense that he created, in Yorktown, a parallel processing research group, which they also killed. He was on the director's staff. The director at that time was Ralph Gomory. You are shaking your head so you know the name. He's also of Hungarian origin by the way. Gomory is a Hungarian name. He was born in America, but his parents were immigrants. Brian Randell was also on Gomory's staff. You certainly know him

because he is the only computer historian I know. He was also in Manny's group. I was not, but Brian is an old friend. You see, I have known these people for decades. This is why they want me to write the book, because I know all these people and so many anecdotes about them. I really want to write that book.

Frana: From what I've heard so far, you appear to be the glue that holds computer history together.

Belady: I know so many of them—Tony, Walter, everybody.

Manny Lehman at the time was 'on the shelf.' Do you know this expression? IBM never fired anyone. Instead, they put them 'on the shelf.' That was IBM jargon. And so he had to do something. He looked into OS 360 and discovered interesting things. He came to me because he knew that I always was interested in crazy things. Everybody thought operating systems were good forever, but he started discovering that more and more people were needed all the time. He left IBM on February 29, 1972. He wrote a few papers, and then he left. Later on he invited me to London because he went to Imperial College in London, and became a professor there. He now has emeritus status, but he's still active. A good guy. He was born in Germany on January 16, 1925, and he escaped from Hitler as a small child with his family and went to London. He needed my unusual thinking and I needed him for his well-organized writing. We made a good team and so we developed this new idea, which we called 'Program Evolution' and we have a book on that.

Frana: Why did you call it ‘Programming Growth Dynamics’ first?

Belady: Because the stupid editors told us. They have no idea. Many people attacked Dynamics. It’s stupid because it was the dynamic nature of that thing which is called software and programming—not just crazed dynamic execution of programs, but it itself is dynamically changing and adapting itself. I went to London for a while, and then I came back do to research in reducing the cost of programming. That was the essence of it. So Ralph Gomory came to me and we started this study. Four of us formed a team and for two years or more we were actually going around the world, and talking with NASA people—everywhere where launch programs had developed—and asking them, ‘What is the problem?’ No one knew. And that was the beginning of the famous problem of software productivity, which is still an issue.

For a long while I was doing research in software productivity. We began asking, ‘What is wrong? And why is it so difficult? Why is it so costly? What is complexity?’ It led me to interesting research, but nothing happened. We did not discover how to formulate or mathematically express the idea of program complexity. Not program complexity in the sense of algorithmic complexity—NP-complete problems and all that jazz—but the complexity of programming. I spent years on that. With some difficulty I came up with some graphic representation of program complexity.

Frana: Again, your sense of visual learning. GREENPRINT was one of those—

Belady: —Yes, right. You remember better than I do. Then we poked around with the decomposition of modular systems and how complexity growth by more and more connections, and all the values, and how to assess that, and we became evangelists and published papers.

Frana: Now what was Fred Brooks' reaction to this? He published *Mythical Man Month* in 1975 right?

Belady: Right. Manny Lehman and I are mentioned a couple of times in that book.

TAPE 2 (SIDE A)

Belady: I almost forgot—let me tell you a little anecdote, which I skipped. So many things I skipped. In 1964 we were working on the virtual operating system project, you know, that Bob Nelson led—

Frana: —the M44/ 44X machine?

Belady: The M44/44X, yes. We all went to the announcement of OS 360, you know, Gene Amdahl, Fred Brooks—all those guys. We went back and started thinking, 'Well, what's going to happen to us?' Because of this operating system software does not tear and wear; it's forever. IBM's new architecture System 360 can't generate any future

computer: we will be out of a job. No one will need systems from us. We were not alone in thinking this. All of humankind did not know what would follow, so our discovery of growth dynamics was profound. They didn't even believe it when we first found out about it. 'What the hell, we fix and so forth,' they thought. You can never predict the use of the next technology. So that was the end of my interest in predicting anything.

So I proposed a certain line of research to IBM: that we take apart the OS 360 and rejuvenate it, and learn in the process why it went wrong, and then rewrite it in a much better performing, more easily maintainable way. And we picked VTAM, which was Virtual Telecommunications Access Method, which was a huge problem. You know, the communications functions were growing, so more and more code was added to it and so forth. I don't know how many thousands lines of code it had—perhaps 300,000. It was monumental. I hired people for that research internally.

So in 1981 I suddenly I became corporate program manager for software technology, a high-level staff guy, and I never went back to real detailed technical work again. In retrospect, I would say that I don't mind because I found out that I work very well with people. Maybe I'm a creative computer scientist and so forth, but ultimately what I really like is working with people. And from then on I was an executive. I still drop off a couple of ideas here and there, but it's not a full-time activity. It was an infinite budget in Armonk at the time. We just traveled around—IBM was at the top of its success. I reported to B.O. Evans, the vice president of engineering, programming, and technology, and I had worldwide responsibility for innovation in software technology.

Frana: Did you know one of the System A guys working there at the time, Mike Blasgen?

Belady: I hired Mike Blasgen to the company. I still keep in touch with him. He's retired now, but he went to Sony.

Frana: And Jim Gray. Does his name ring a bell?

Belady: Of course. Jim Gray is now with the San Francisco Group with Gordon Bell and some other friends. I know most of them in that group with Microsoft. Jim Gray is a California hippie. I knew him in Berkeley because he was a computer operator there. I knew everybody.

Frana: When you were teaching.

Belady: Right. So going back to Bob Evans. But in the meantime—Hisashi Kobayashi, does that mean anything to you?

Frana: Hisashi Kobayashi, sure. Les, you do know everybody. You must write this book.

Belady: You say that too? But there are so many things to do instead of writing.

Not only did I do algorithms work, but I did lots of work with computer performance people, mathematical modeling, so I worked also with Hisashi. Hisashi wanted me because he had in late 1982 started the Tokyo Research Laboratory, which was then called the Japan Science Institute, JSI. So I went to Tokyo. Evans was mad: 'Why do you want to go? I won't let you go!' and so forth. Because I was motivated, I said, 'Bob, I like change.' I crossed my fingers and hoped they would sort it all out, but finally I went there. That was my last two years in IBM.

Frana: And what did you do in Japan? You worked on Asian character sets, I believe.

Belady: Yes. I had a wonderful invention, but it was late and IBM couldn't use it anymore.

Frana: Right.

Belady: I did many other things. The character set business was very interesting. What I invented was a relatively cheap hardware trick. But it was too late because IBM had already committed itself to a complex, pure software solution. By then I felt that IBM was going down the drain. I really felt that.

Frana: You tried to create a software engineering research group didn't you?

Belady: Yes, yes, yes. We talked a lot about it, but that was one thing IBM rejected. Then I tried to convince the top management to give up the focus on computers and go more and more into software and services. I spent months on that. I had to go out and try and orchestrate it. My god, I hated it. They finally kicked me out. Not literally—they said, ‘Belady, get out of here. Do you know where your salary comes from? From the Big Iron we are selling in Poughkeepsie. What do you want with your software and services?’ Now you know what happened ten years later.

Before I even went to Japan, I started exploring opportunities for a new career in teaching. Fred Brooks wanted me. Fred told me, ‘Les, come and visit, and I will interview you.’ I got an offer there at the University of North Carolina, Chapel Hill. He already had two Hungarians on his teaching staff, very clever guys. He said, ‘I need you Les, because you always have a different view of things.’ I also got an offer from Georgia Tech. I resigned from IBM and made a last trip. I made a presentation to two or three IBM vice presidents, and then went on a trip in April 1984. I was interested in these characters: the ‘end bytes’ problem I called it, not the two bytes, because it was really a generalized solution. I had to go to Florida for a conference, and I ran into a number of Austinites who were already brewing MCC.

I haven’t mentioned how active I was in IEEE and the computer science branch either. I was chairman and program chairman of many other things.

Frana: You were editor-in-chief of *Transactions on Software Engineering* between 1979 and 1983 too.

Belady: Right, editor-in-chief. I've forgotten all that. I made lots of professional friends all over the world.

Bill Curtis and some others already committed to MCC were in town and they caught me at the conference. They said, 'Les, we heard that you were retiring from IBM. Here is something exciting going on, its called MCC.' So I said, 'All right.' They said, 'Why don't you talk with Bobby Inman [who recruited me to MCC]?' I said I couldn't do it because I had to go to New York. They couldn't find him. I flew through a big snowstorm, got to New York late, and had to give a presentation to a group of vice-presidents. Then I got a message that Inman wanted to see me at the Admiral's Club at Washington National Airport.

I gave the presentation and rushed to meet him at National Airport. Inman talked to me for an hour at the Admiral's Club. He had a drink and was standing—there's no sitting there. Inman convinced me that this was the right thing to do, but I said, 'Let me think about it.' I'd already seen my future office at Georgia Tech; the name was on the door.

Frana: This is in 1984?

Belady: Right, it was early in the spring.

As soon as I got back from Washington to Tokyo, an invitation from Inman was there already. He wanted me to meet the shareholders in Austin immediately. Would you believe I arrived in Tokyo, and immediately the next day flew back again to Austin? I had arrived on a Saturday night, or Sunday morning, and they lost my bag. I was in a shabby outfit. At that time there was still a blue law, and nothing was open. I couldn't even get a clean shirt or anything. So Monday morning I went in my shabby outfit to interview executives from the different companies. And then I went back to the Hyatt Hotel at the end of the day. There was the man with my bag. I didn't even open it; I flew back to Tokyo.

I flew back because I still had a couple more months to do. Every night at the kitchen table in our very nice Tokyo apartment my wife and I were thinking, 'What should we do? Should I be a professor or take this challenge, a big job with great exposure?' My wife was very much for MCC. But I hesitated. I said, 'Wait a minute. I would love to go back to research and doing technical thing again. I like working with students.' We couldn't decide. Inman called me every other night too. Finally I accepted the job. And then I had to undo this thing at IBM. I created lots of enemies, but I've converted them over the years and we are good friends again. I had a wonderful job with MCC. It was very exciting.

Frana: You must have all sorts of great stories about the Japanese and software. There is a very short piece you published about it called ‘The Japanese and Software: Is It a Good Match?’

Belady: I still give copies of that to people. I wrote about Japanese design and planning and quick execution, versus the American style of mixing and improvising and so forth. I still believe that.

Frana: What do you think of Cusumano’s book?

Belady: I know Cusumano. That was about the software factories. Actually, we were together at the Senate Committee testifying about the competitiveness of the software industry. The chairman of the Senate Committee was Al Gore. That was four months before he became Vice President.

Frana: This would have been well after—

Belady: That was when I was with Mitsubishi already.

Frana: What about Ed Feigenbaum, who wrote about the role of software technology in the Japanese Fifth Generation Plan. Did you know him?

Belady: Oh sure, Ed is a great guy. I still have a copy of his charts on that. Is Ed still around at Stanford? His wife is Japanese—you know that?

Frana: Yes. He is at Stanford, but spends a great deal of time in Japan.

Belady: He's an AI guy, essentially, but he was interested in the Fifth Generation. I didn't even talk about that. I knew all the Fifth Generation people.

Frana: I don't know if you have read his piece, 'Where's the Walkman in Japan's Software Future?' He argues that because software isn't tangible, the Japanese really don't know what to do.

Belady: Oh yeah, I buy that. I've done studies on that because I worked for a Japanese company later, and was an insider and so forth.

[pause]

Frana: What did you learn at MCC?

Belady: The major thing that I learned is that research is easy. The real difficult part of it is the commercialization of research results. I finally learned this. The emphasis should be on how to make money out of that research. It's not just a technical issue; it's sociology and psychology and politics and it's a very complex process. That fascinates

me, and this is what I like to do now. Bob was my best boss ever. He came to me and said, 'I hired you because you are good. I won't get into your hair. You just do your thing. But I don't like surprises.' Bob Evans was something like that, but not to the same extent.

This is how I learned about the whole commercialization 'gap': I had a chart, which I still show. I created it probably in 1987 or 1988 to show to some CDC executives. I explained to them that the graph actually shows how an idea is born, how a prototype is made or whatever, but then what do you do? Someone has to build a product out of it and manufacture it. You have to build a software organization around it, and marketing, and a sales organization. This piece is ten times more expensive than the original research.

There's a huge gap and it's still there. It's still there, but no one really worries about it. At least people know about this problem. At that time they didn't. They gave us money very generously. I had a budget, ten million dollars a year at first, and twenty-five million later on.

Frana: How many members were in the consortium?

Belady: I believe it started with seven or eight members and grew to fifteen. But they thought that once they gave you money, you had to turn around and give them a product. We tried desperately to get in touch with people and say this is what you should do. They said, 'We are not scheduled for that. There is no budget for the productization of the research.' They missed the whole boat. So from there it went down and down and MCC

died because it was not a good business model. Besides IBM had Research, Bell Labs had Research. All our participants had no real research, certainly not in computers. They had no experience in research, no understanding about what it is. Instead, they became more and more suspicious about the whole thing.

Frana: But Corporate Memories came out of MCC didn't it? That was a spinoff. Wasn't it fairly successful?

Belady: No, that went down also.

Frana: What about Leonardo?

Belady: Leonardo. That was the name I gave to the whole effort. You see, I was still in the mode of doing something about productivity because that had been my job. The shareholders said, 'You have to improve program productivity by two orders of magnitude.' My question was, 'Which, binary or decimal order of magnitude?' But that was the job. So what I said was. 'Look, I don't want to go down to the programming level where you code and so forth. This is not where the real gains are.' We focused on the 'upstream,' the requirements, design, and all of this, and tools to visualize them. I gave the name Leonardo to it, from da Vinci. Design was very important for us. I created four groups and every group contained the word 'design.' It was 'Design Tools,' 'Design Systems,' 'Design Visualization,' 'Design Process'. We did interesting work and there were spin-offs from that. Later on I acquired a computer architecture branch. We had

‘Software Technology,’ ‘Computer Architecture,’ and then ‘Compiled Design Hardware,’ and ‘Packaging.’ Computer Architecture had four groups in it: ‘Parallel Computing,’ ‘Database,’ ‘Human Interface,’ and ‘Artificial Intelligence.’ Still, there was no return on investment for the company. A booming business came out of the holography project in the computer architecture department. So there were successes, but they did not make the impact that was expected. There was a total misunderstanding of what I call the innovation process: how to go from research to commercialization.

So then I retired a second time. I resigned from MCC in 1991. I thought I would write a book; that was my first thought. But then I got a call from Andy van Dam at Brown University. He called me and said that a Dr. Nita had approached him from Mitsubishi who wanted to form an R & D center here in America. Van Dam recommended me. So then Dr. Nita called. Dr. Nita has good English but is obviously Japanese. He asked me if I would be willing to come up. I said yes. So Dr. Nita waited for me at Logan Airport and then he took me to the Mitsubishi Electric Information Technology Center America (ITA) in Cambridge. I accepted the job. Many people said, ‘What? You were with MCC. That’s an anti-Japanese outfit. Now you work for the Japanese?’ The *New York Times* even interviewed me and asked, ‘How can you do that?’ I even consulted with Bobby Inman. He said, ‘Well look. If they really employ American scientists exclusively, and are not just secretly doing things and siphoning off our ventures here, then it’s probably okay.’ Still, I had to be very cautious what I said.

Frana: The way they sold it to you was that they really wanted to know American R & D process—

Belady: Yes, yes. Actually, here is the story: They said, ‘Look, we’ve been accused of copying everything. We want to learn how to do research because we don’t know that, and therefore we want to do it here. Besides we cannot do it the other way around.’ Japan’s culture and accommodations are not such that they can easily get American staff living there. And they said, ‘Besides, the conducive atmosphere for research exists only in America and not in Japan. We have to do it here.’

Frana: So did Cambridge seem like a good choice at that time?

Belady: They had chosen it already. They probably had, as the Japanese do, thought about it for ages before deciding. After my first residence in Boston—you remember when I came to America? That was—

Frana: Not too happy?

Belady: No. I’ve never liked Boston. I don’t like it even now. But I took the job and then I acquired some already existing development groups, and finally I had four laboratories. One of them was the headquarters for ‘Fundamental Research,’ but I said I don’t believe in that. We don’t need fundamental research, universities do that and we apply it. Everybody assumed, including the Japanese bosses, that I would continue working on

software productivity and all of these things. But I said, ‘No, that’s enough. I think the future in software is in applications. Computers will penetrate into more and more aspects of human life. It’s pervasive. So we have to be on the leading edge to come up with interesting applications.’ So I created a vision, and the vision was two-fold. One was that we have to focus on how people can work through computers together, because computers are not personal until people are connected by computers into a system of people working together—not just a collection of people. And the second thing is life-long learning. These two points I gave as a vision statement for my time there.

Many things could be mapped into that. Just to give you a flavor, one of my policies is that if you want to have really creative researchers in an applied research institute, you have to have a focus on these two visions. But about one third of the time, every researcher deserves what I call an ‘activity.’ The activity is whatever he wants to do. And that I still believe is a very good idea. You cannot really totally buy a person’s whole talent and not let him do projects on his own. He could do them quietly in secret, but at some point in time he may want to propose it and then he becomes a partner. There should not be this double standard where we talk about a ‘free institute’ and then turn around and ask, ‘Why is he doing that?’

I think that was the best job of my life. We started with a few people, but new people would have to be hired. We interviewed lots of people. And what was the interview process? The interview process, which I invented, started with only four or five people in the existing staff interviewing the candidate in private. Then we discussed the person

around the round table with the whole research staff present. Sometimes it was twenty or twenty-five people. And instead of saying, 'Now, what do you think?' because then some people became passive, I said, 'What do you think, what do you think, what do you think, what do you think, to each person in turn.' It made for a valuable discussion; everybody had to say something about this person. There was reluctance at first, but then they just loved it. It was tough; you had to speak your mind, and be honest. It was interesting to see the comments form in such a wide spectrum. Some people were enthusiastic about the guy, but others invariably said, 'No way I can work with this guy,' and so forth.

Another thing I insisted upon was that I will listen to all your opinions, but I decide. I decided based on their opinions, but sometimes I decided against. We didn't vote. This is not democracy, this is business, and I'm the leader. So I did that for seven years. And then I hired Jim Foley. I talked him into it. I said, 'No matter what you do later on in your life, this will be a wonderful experience.' So I hired him and the last two years of my time in Mitsubishi we overlapped. I gave him one of the four laboratories; I did the same with the three others. When I left he took over.

TAPE 3 (SIDE A)

Frana: Jim Foley is at Georgia Tech now though isn't he?

Belady: He went back unfortunately, but that's another interesting story. Jim did that for a while, and then got a big offer, which he couldn't resist. I was the first person he called

when he got the offer. I had been gone a year and a half and he called and said, 'Les, I have news for you, but you will not like it. I got an offer from Georgia Tech. The state wants to become the next Silicon Valley, and they want to make me a commissioner statewide of this and that, leading the effort.' I said, 'I have to be honest with you Jim. I'm not happy about it because I think the Japanese are much more long term-oriented and they will not take it well.' And I told him, 'By the way, you're experienced in industry, you've been a professor, and now you want a government job. Watch out, or else you will be eaten alive by the politicians.' So now he's a professor again. But Jim is a good guy, a very good guy. Do you know him?

Frana: Yes. I have talked to him on the phone a couple times. Foley is the student of a guy at Michigan—

Belady: Herzog, Bert Herzog.

Frana: Bert Herzog. Right.

Belady: He was already a big name when I was in graphics in 1968. He was one of the few. I don't know if he's still alive.

Frana: He's not in the best of health now, but he's still alive. I haven't talked to him in a year.

Belady: That's good. So then I came here, back to Austin. I knew I would be back. I just love Austin. I didn't like Boston.

Frana: You kept your home here, right? I read that story in the *Austin American Statesman*—

Belady: I never sold it. I kept the house because I knew I would be back. I live in the same house I bought when I came here eighteen years ago. I like it here. Now what do I do? After a year someone calls me to help envision an Austin Software Council and be their leader. So, reluctantly, I accepted on a half-time basis. I was already committed to many other things. Board memberships here, this and that, and I still flirted with writing a book.

Frana: Are you still teaching at UT?

Belady: I don't teach, but I'm a visiting professor, whatever you call that. I'm active with the business school and being on committees here and there. I led the Austin Software Council and internationalized it. I had a one-year contract and at the end of it I resigned because I had to do too many things I'm not talented in, like fundraising. I hate that. I have no idea how to do it. I'm still on the board. This morning we had the quarterly board meeting. I tried to make it broader than software, but I failed.

Frana: And now they have changed the name.

Belady: And now they changed the name! They were so resisting; ‘No, we’re software!’ But you see, I’ve been giving talks already for more than five years on the merging of software and hardware engineering. I was in Japan last month and gave four talks at different places. The title of my talk was ‘Beyond Software, Beyond Engineering.’

I continue to be very busy, but I don’t have to go to work everyday. But another thing happened: my wife and I bought an apartment in very downtown Budapest and remodeled it. Last year, I just calculated, I spent one third of my time there. The reason is because I’m involved with a couple of Austrian companies, and the board meets four times a year. I leave again in two weeks to go to Budapest, and to Vienna. I work with Slovak start-up companies and commercialization. That part of the world is loaded with technical talent, but they are uninterested and naïve about commercialization. So that’s my swan song: commercialization. The most recent thing is that my alma mater, the very good Budapest University of Technology and Economics, redesigned itself and they invited me in as an external expert. So I go back in January again for a two-day meeting on how to modernize the University. Many years ago after they changed from Communism, they made me an external member of the Hungarian Academy of Sciences. They also established an Academy of Engineering, so I’m a member of that too. I enjoy working with them. I’m so much American now; they are so much Hungarian still. So I’m building bridges for them.

Frana: What's the Center for National Software Studies. Is that something you participated in recently?

Belady: Oh yeah! No, remotely. Almost all the people in that are in the Northeast and most of them are around Washington, D.C. This is very much a different story. They insisted I be a member so we have monthly conference calls and discuss things. The idea is to improve the status and stature of software in America. So I drop advice here and there and I propose this and that. I care about Austin, so I'm a member of the Greater Austin International Coalition, which is a mixture of academics, city officials, and industry—many things. And I enjoy that too.

Frana: Do you do things with the Austin Technology Incubator?

Belady: Oh yes. I work with 'incubatees' there. One of them has created a hardware and software product, which they are successfully selling now in Turkey and Korea and some Latin American country. So I left out a lot, but are you satisfied?

Frana: This is wonderful. You tell the story in a very natural way.

Belady: It was an interesting life, and I am very happy to have had it. I was lucky to live all these things. I'm happy that I'm still alive and in good enough health to be in love.

Frana: You mentioned you were not a futurist—

Belady: No, but you see, I speak up. I don't believe in predicting the future. What I do believe in is experimentation. I think Schumpeter said that capitalism is the only sane system because it is based on experimentation. You see, you don't claim that you know the future; you just form a company and do something or fail. So perhaps you succeed the first time or the second time, and if not—then the third time. All of this is based on experimentation. Do two or three things and see what happens. Once you see that one of these things seems to be winning, reshuffle your resources. And this is what I told the Japanese when I started the Mitsubishi effort eleven years ago. They said, 'What will be the thing?' I said, 'I don't know, but my goal is to have this organization be known as the best in the world for X, but I don't know what X is.'

Franca: Perhaps we should stop there. Les, thank you for your time.

Belady: Sure.

END OF INTERVIEW