Oral History of Jugi Tandon

Interviewed by:
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Burniece: Hello! My name is Tom Burniece. I'm a volunteer at the Computer History Museum and I'm here today with Jugi Tandon, who has one of the more interesting stories I think you're going to hear about in the storage world.

First of all, I just want to ask Jugi, whose full name is actually Sirjang Lai Tandon, when and where did you become known as "Jugi" and why?

Tandon: Tom, this is interesting. As you know, my name is Sirjang Lal Tandon. Okay? First, how my name came about. I was born in 1941 and there was a war, due to the World War II. So, my grandfather named me World War child. "Jang" in Indian means "war" and Sirjang is the guy who leads the war. Just so you know, Tom, I'm the only one who I know with this name. I don't know anybody else who has this. <laughter> So I don't know if it's good or bad.

Burniece: That means war?

Tandon: Yes, but then my parents called me Jangi. You know, they took the Sirjang and made it Jangi. So, when I came here in 1960, some of my professors started calling me Jugi, because that was probably a little bit easier for them to pronounce. I adopted that name from that time, because it was easier. So, from 1962, that's the way it went. You know? A lot of people don't even know. Sometimes I forget my name is Sirjang. <laughter>

Burniece: All right. Well, tell us about your family background, where you're born, grew up, where you went to school and so forth.

Tandon: I was born in a small town [in India]. Small, means there were 40/50,000 people. It was a pretty [poor] town. We didn't have electricity like a city until I got in high school. So, we studied with kerosene lamps.

Burniece: And what part of India was that?

Tandon: That was north India, about 200 miles from Delhi, in Punjab. But that doesn't mean we were poor. My father was a very prominent lawyer, and you know, we had plenty, to have a very good life. We were eight brothers and sisters and we lived on a kind of a farm, even though he was a lawyer, so we had plenty of food. Everything homegrown, everything organic. <laughs> So it was good life - no complaints. When I went to high school over there, the high school had been started with a donation from my grandfather. My whole family has believed in education a lot. After I finished high school, I went to college

just to do a two-year college, which is a Physics and Science major. After that, I left India and came to this country from a small town to all the way to America.

Burniece: I understand you had four brothers, and three of them have been involved with you in most of your businesses. One of them is in the room. Talk about your brothers for just a minute.

Tandon: Well, we are eight in the family, actually. My four sisters and four brothers. And when I came to this country, I came with my older brother. We both came together and we both worked at IBM together.

Burniece: And when was that? When did you come here?

Tandon: We came here in 1960 and worked at IBM in 1965/1966 timeframe. We were both in the technical field, so that's what we ended up doing. When we go into the Tandon family history, I'll tell you more on that.

Burniece: When and how did you get interested in technology? Early on? And who introduced you to that?

Tandon: Actually, in our family both of my grandfathers were engineers and we are a family of either engineers or lawyers. As kids, we didn't have any choice. You can become an engineer, or you can become a doctor. <laughter>

Burniece: All right.

Tandon: This is the way it was. One of my uncles studied in England. He was an engineer. One was a doctor and my father is the only one who became a lawyer. So, we really didn't have any choice. As you know, of course, every parent has influence on their kids and my dad taught us really two values, which are very valuable. One thing is the closeness of the family, and number two, education. There were eight of us and we didn't have choice. The minimum requirement was a bachelor's degree, but mostly a master's degree for all eight of us and we ended up okay from that point of view.

Burniece: So, did you end up with a master's degree?

Tandon: Two of them.

Burniece: And when was that and where?

Tandon: I got an MBA from University of Santa Clara and a Master's in Engineering from Kansas State University.

Burniece: All right, and when was that?

Tandon: 1965.

Burniece: Okay, so when and how did you end up with IBM then?

Tandon: Well, let me give you my whole professional story coming to the IBM, okay? I did my undergraduate [work] and graduated in 1962 in Washington D.C, and became a heating / air-conditioning engineer. <laughs> This is quite different from the technology you're talking about, but in Washington D.C. the only kind of [technology] firms were the consulting engineering consulting firms.

What I wanted to do, was take one year off before I did my master's. So, I took the year off and came and lived in Berkeley. I was trying to go to school at UC Berkeley but in 1962 Berkeley was also a great party town. So, I couldn't study, because I got sucked into too many parties. So, I applied and got a scholarship at Kansas State University, went there and got my master's in mechanical engineering. [Then] I came back to California.

You know, it's interesting that most of the mechanical engineers go look for jobs in the automobile industry or in aerospace making airplanes or something like that. Nobody thought about going into computers, especially if you were a mechanical engineer. That's one of the things always lacking, in my opinion, not enough good mechanical engineers were getting directed [into computers]. I ran into this, when I was in the Los Angeles area and applied for a job in Beckman Instruments. I don't know if you remember Beckman Instruments.

Burniece: Oh, yeah, I remember them.

Tandon: They were making potentiometers, which was very interesting. It was intriguing, because it required material science knowledge . A lot of moving mechanical parts and very small components. With that experience, I wanted to move to the Bay area and this was in Orange County.

IBM was just ramping up the 2314 hard disk drive (HDD) production and I ended up having an interview, where my experience in Beckman came in extremely handy, because it was the right kind experience needed for those magnetic heads. The 2314, which was a ten Megabyte drive, was bigger than a refrigerator or a washing machine, and the controller was another monster. It had a hundred tracks per

inch and the heads were bonded with epoxy, so we had a lot of challenges. I remember at IBM where we would start a hundred heads and be lucky if we got five done at the end of the line. <laughs> It was very challenging and I worked at IBM for almost two years, mostly on heads. Some engineering, but mostly manufacturing process development. It was a lot of fun, you know?

Burniece: So, can you remember some of the people that you worked with in those days? And who were you close to?

Tandon: I met Mike Warner.

Burniece: So, Mike was there already?

Tandon: Yes, he was working on the next generation [of heads], which we called Winchester.

Burniece: Right.

Tandon: Another guy was Mike Hall, who was in charge of that process. I got to know him well but I was a very junior engineer. It was very good experience and I really learned the process of building heads. In my opinion, designing heads is the easiest thing. Manufacturing is the hardest part.

Burniece: Oh, absolutely.

Tandon: So, after IBM, my plan was always to get a further education in this country and get some working experience, then go back to India.

Burniece: That was your long-term plan?

Tandon: That was my plan and my brother's plan, as well. My brother stayed in India and got a job at IBM.

Burniece: So [is that why] you just stayed at IBM for two years?

Tandon: Yes

Burniece: And is that when you went to Memorex?

Tandon: [No], what happened in 1967 is I packed up my bag and everything and went back to India, planning to stay permanently. We only had green cards, so my brother and I both moved back. IBM had an operation in Bombay, which at that time was called Bombay and now is called Mumbai. We both applied for jobs there and both got jobs. My brother decided to stay there and work in IBM in India. I didn't find the same technical challenge, that I got used to in working at IBM [in the USA], so I decided to come back. I was in India about nine months and got married in the meantime.

Burniece: Well, there's a life change!

Tandon: <laughs> So, I ended up here and had spent all the money I had. There was no exchange available. My parents had some money but they could not convert their rupees into dollars, because Indian currency was a closed currency. You could not just go get dollars, since there was a shortage of dollars.

I landed in Los Angeles, with $58 dollars in my pocket and a young wife but no job. <laughter> So I ended up staying with a friend of mine for a few days and borrowed some money for groceries. Then I called IBM [to get my job back]

They liked me at IBM and I was a pretty good engineer. In fact, I had gotten a letter from Watson, Jr, [when I was there] and they used to have those awards. I don't know what they called them but I did something very interesting.…

Burniece: Like Employee of the Month or something like that?

Tandon: Yes. They were very happy with my work, because I had done a lot in the manufacturing processing of the heads. So, I called them and they said, "since you resigned and left, our procedure is that it'll take us two to three weeks to get the clearance to hire you back. We want to hire you back, but it'll take us two to three weeks." and I said, "what am I going to eat for two to three weeks?" <laughter>

So, what I did was started looking up some of the people who used to work for me and I [found] a guy named Ray Bell. He used to be my boss at IBM on the manufacturing side. I found out through some friends that he was going to a new company called Memorex. Memorex was a company that made tapes but they wanted to get into the disk drive business. That was Larry Wilson and all those guys. They were just starting the group then ….

Burniece: for heads?

Tandon: Yes, to get into the disk drive business. So, when I called Ray and said, "I'm looking for a job", He said, "I've been looking for you!" <laughter> and I said, "that sounds good to me!" So, after three days back in this country, I luckily found a job and got myself established.

Burniece: That's amazing! Fifty-eight dollars in your pocket, a new wife and in three days you got a job! That's good!

Tandon: Well, you know, the times were that way. Weren't they? I think the jobs were not a problem in those days. It was so easy, if you qualified, and not even difficult today, if you're qualified. So anyway, I got started in Memorex.

Burniece: So, what year was it you started Memorex

Tandon: 1968.

Burniece: And who were some of the more interesting people you met at Memorex and what can you tell me about some of the stories there?

Tandon: Well, Memorex was a lot of fun. Right after I joined, we did our IBM 2314 equivalent, which I think we called the 660. We copied the head and the main thing which we did different from IBM is we had our own media, which was good, because Memorex was really known for its media …

Burniece: Yes, they were.

Tandon: … and on the first 660 product, we also used a voice coil actuator.

Burniece: Was that the first voice coil in the industry, or just the first one by Memorex?

Tandon: I don't know. My understanding was it was about the same time as Control Data did it and some of the other companies did, [as well].

Burniece: Actually, Control Data didn't get a voice coil [actuator] into the market until [~ 1970]. They were working on it in 1969 [when I joined CDC], but I think you beat them to it.

Tandon: We didn't do any product without a voice coil. That was Roy Applequist's baby.

Burniece: Right, it was Applequist.

Tandon: So, we did the 660, which looking at the Memorex stock in those days, they were doing very well with that. Then they decided to really expand in that business in a big way. That's when they went and got Alan Shugart, Rusty Nagakura and [a number of others], who came to Memorex. I don't know if you remember that, too?

Burniece: Oh, yeah, I do.

Tandon: I was there before that, so after we developed the 670, with a little more capacity, the key improvement was the head technology. We started using glass bonded heads, rather than epoxy heads. We never did Winchester heads, so it was still ramp loading.

At that time, I was kind of getting a little restless, because I was doing the same thing over and over and all the new IBM - Shugart people were kind of controlling the whole thing. The idea of a floppy [disk drive] was [just] kind of floating around but IBM had a floppy drive before anybody else did!

Burniece: Right. They used it for program load basically.

Tandon: Yes, that was a read-only device.

Burniece: Right.

Tandon: So, I went to Alan Shugart and said "hey, there's a desire to be in the floppy business, but let's do a read-and-write floppy drive, okay?" There were very few floppy drives around at that time, and he said, "you think it can be done?" I said, "I know I can get the head and the media done. The rest shouldn't be that difficult." <laughs>

So, I started working with the Media Group, telling them “we need to coat this three millimeter Mylar on one side at least," because we didn't [yet] have double-sided. I used to go on the third shift, because the first and second shift were running the [production] media. They said, "hey, this is just a toy. It's just playing around." I was definitely treated like a stepchild in the whole corporation because I was working on a drive which would sell for maybe $800 and who wants that? <laughs>

But I somehow fell in love with that thing and had an old Chevrolet, so I used to pick up these big rolls of magnetic tape, which we ran all night. I’d bring it into the lab and had a little round section made with an

X-ACTO knife and then put it into cardboards. Then I was able to crack the code of head reading and writing, because there was always a worry about a lot of crosstalk, and I solved that problem.

Burniece: So, tell me how you solved that problem the crosstalk problem?

Tandon: It was just applying a little bit of shielding between head gaps. It wasn't a big deal. . We also had to build an erase core in it, so we were okay.

Burniece: So. was that almost like a one-man project at that point? Were you the only one doing this?

Tandon: Yes, in Memorex, it was one-man project.

Burniece: Okay, so you were buying a fairly wide ribbon of tape …

Tandon: … which was almost four-feet wide web.

Burniece: Right, and you were cutting out an eight-inch diameter ….

Tandon: … circle with a little fixture

Burniece: [That was how] floppy media was made …

Tandon: … with an X-ACTO knife and a little fixture, because nobody would give me any money!

Burniece: And at that point, it was coated only on one side?

Tandon: No, it was coated on both sides. Our idea was that if one side doesn't work, maybe the other one would work, so we were coating both sides. A lot of things came out of that, as you know.

By the way, we'll get back into it later on but one of the reasons that Tandon Magnetics was so successful, was because of the knowledge I gained in the media side – the floppy was a very challenging thing. People don't realize that. There were two challenges compared to ….

Burniece: Hard drives?

Tandon: Yes, Number one was media interchangeability. Any kind of a media any place in the world has to work in any drive. You didn't have that requirement in hard drives.

Burniece: Well, not anymore. At that time, we also rotated hard disks [in packs] between drives, but the hard disk was a fairly thick, rigid platter and always coated on both sides.

Tandon: Yes, but what I'm saying is not with removable media at that kind of cost. We used to have big rigid data packs, as you know, and people used to carry them around. But the reason we went to Winchester heads was so that we didn't have to do that.

Burniece: Yes, absolutely.

Tandon: So, the [floppy was] going back to that [interchange compatibility problem] . That was a big challenge and the second challenge was it is contact recording, so …

Burniece: …. you're essentially wearing the media out.

Tandon: Or the head! It would have been one of those two things! <laughs>

Burniece: Right

Tandon: So, it's funny. I spent many, many nights, working on those problems. Very fortunately for me, I could get media done in-house. I was doing the heads myself.

[One] of things we learned is that you cannot diamond polish the head, because the diamond will be sticking out and eat not only the coating but the Mylar. Once I got the thing working and knew we had good life with the media, plus the head was working fine, we had to put a team together to do the drive

Burniece: How long did all that take to that point where you now had a team working with you to put a real drive together from the time you started it?

Tandon: That was probably 18 months or so

Burniece: So, for a year-and-a-half, you were all by yourself, basically.

Tandon: No, they were doing [the drive in parallel], but they didn't know whether they're going to make it read-only or read-and-write.

Burniece: All right …

Tandon: I was in charge of the media as well as the heads, so the rest of the team was just doing the drive. Once we got that drive done and once the new [two-sided] media was working, then I got some priority in the media factory, because the old media had been running, until they were changing the shift or something like that, so they could run the new media for me.

Until they said, "okay, now we are [really] going to do it", we just were toying with the mixture in this thing and didn't know [if the company was] serious or not. But then corporate became serious and said It looks like there's a demand for the floppy drive. It's looking pretty good, so then they said, "now, we're going to do it properly."

Burniece: And when was that timeframe?

Tandon: This was, let's see, 1972. I left in 1973

Burniece: So, 1972 is when Memorex really got committed to a floppy drive.

Tandon: Yes, we were first one to do a read-and-write floppy drive and I did the head.

Burniece: But it sounds like you also had a lot to do with the media.

Tandon: Yes, a lot to do with it …

Burniece: Which [meant] you understood the media, right?

Tandon: [Yes], so here's an interesting story. They said, "okay, now we are going to professionally do this." I said, "okay, guys, give me a run." So, they went and ran media for me. I brought it back to the lab, made a few disks and started testing. We used to test for wear of the media or the head. Fifteen minutes later, you could see through the Mylar. <laughter> I said, "when you were doing a kind of a kluge operation, the media worked fine, so what happened? Now you can see through the media [after] running just 15 minutes!"

Burniece: Was that just an adhesion problem or did they change the formula?

Tandon: I'm telling you what was happening. So, I went back and said "okay guys, I'm going to go through step-by-step, what did you change?" [They said] "nothing changed" and I said, "I know chemical engineers and you guys are all geniuses. I agree that the oxide and everything is the same but *something* is different", because I never change [more than one] variable at a time. I think every engineer should understand that.

If you're going to change two or more variables, you don't know where the problem is coming from. Even if there are ten different variables, I would only change one at a time and take my time.

Anyway, to make the story short, what did I find out? The milling process they were using with ceramic balls [had been] changed [from] stainless steel balls.

Burniece: So, they changed that for all their processes at that time, or just for you?

Tandon: No, just for my process, although I don't know what was happening on the tape side. What was happening is there was enough debris coming out of the ceramic balls to create a bonding effect to the media.

Burniece: So, the debris from the ceramic balls was actually bonding to the media?

Tandon: Right!

Burniece: Was that a chemical bond?

Tandon: No, just mechanical.

Burniece: But it caused the material to stick it together.

Tandon: Yes, so we started adding ceramic and it solved the problem

Burniece: Wow! So, you developed the very first read-write floppy. Was that still single-sided at that point?

Tandon: Single-side, yes.

Burniece: In the meantime, had Al Shugart formed Shugart Associates, or did that happen later?

Tandon: I'm just coming to that. Okay?

Burniece: Okay.

Tandon: Memorex was getting into pretty bad shape. I think in 1972/1973, all the disk drive companies were getting kind of a little shaky. Control Data was …

Burniece: … getting a lot more competition.

Tandon: Who was that company, where [the IBM] “Dirty Dozen” went?

Burniece: ISS in 1965

Tandon: So, things were getting a little shaky at that time [early 1970s] but a lot of people started demanding floppy drives. That's when it happened and Alan Shugart took Don Massaro and his whole team from Memorex and formed Shugart Associates. That team had been working on the [Memorex 670 hard drive], so none of those guys had been working on floppy drives.

Burniece: Did they ask you to go?

Tandon: No

Burniece: Now, that's interesting, since you had developed the first read-write floppy …

Tandon: Well, actually, they may have asked me, but I showed no interest, because I knew more [about floppy drives] than all those guys put together. There was a sort of arrogance, as people who [originally] came from IBM were Al Shugart's clan.

Now [Memorex probably] put me on the floppy drive, because they thought, "It's not going any place” and they wanted all their top-notch IBMers to work on the 670." As it happened, the 670 technology didn't go over that far on the big drives but the floppy became a big thing.

Those Don Massaro [hard drive] guys, [thought they were “so smart” that they would do a floppy at Shugart Associates.

By the way, Shugart did not take anybody from the Floppy Group at Memorex to Shugart Associates.

I said, "hey, I'm going to do my own" but I didn't have any money at that time. Memorex gave me some stock, which I bought it for one dollar, rode to $230, and rode back to one dollar. <laughter>

Burniece: One dollar to 230 and back to one?

Tandon: Something like that <laughs> So I didn't have any money but I wanted to start my own business. Stu Mabon of Pertec called me.

Burniece: … I remember Stu …

Tandon: … who was running Pertec at that time. He found out about it and called me. He was in San Jose at that time and said, "Jugi, I want you to put a team together for me to build floppy drives."

Burniece: At Pertec?

Tandon: Yes, at Pertec. He said "I will give you stock" and I said, "I'll take cash." <laughter> So I made a deal with him. In those days, Tom, you have to understand that this was a lot of money. If I get them successfully into a complete floppy drive, I'll get a bonus of $120,000.

Burniece: Wow, nice! So, did you cut a deal on that.

Tandon: To me, that was a lot of money in those days. So, what happened is I talked to the guy who was running engineering over there, plus a couple of other people. [It was small group working on floppy at Memorex.]

Tandon: One thing, I never became a manager in any company, because I know the minute I became a manager, I would have quit technology. <laughs>

Burniece: Yeah, right.

Tandon: So anyway, the guy who was running the program, I was doing the heads and the media, was Howard Stoddard.

Tandon: Anyway, I asked Howard and there was another electrical engineer, Bob Monday, who I also asked - saying: "Hey, you guys want to move to Los Angeles? I'll get you guys bonuses, you know, $50,000 a year, $100,000 a year." So, we made the deal with Pertec with no stock, we wanted bonuses. If some people want to move there, they will move. Some people didn't want to move.

Burniece: And what year was that?,

Tandon: That was in 1973.

Burniece: At that time, was Pertec still focused just on hard drives?

Tandon: They were a hard drive company that also wanted to get into floppies, so I said, "give us a separate building and I'll bring my team. Nobody from the Pertec has to be involved. We are going to deliver the product to you and this is the bonuses we expect to get."

Burniece: Now in the meantime, just to keep hose two stories straight, Al [Shugart] and his group had left Memorex to form Shugart Associates and was that to do a [floppy, a] hard drive, or both?

Tandon: No - Shugart only wanted to do floppy drives.

Burniece: So, he went to do floppies, even though he didn't take anybody from the [Memorex] floppy team?

Tandon: [Yes]

Burniece: That's amazing.

Tandon: Even today, I don't understand why.

Burniece: Well, he might have felt that he had some kind of agreement that he wouldn't take any floppy people, even to create a floppy company?

Tandon: No, here's the thing. It's all perception - what did he think engineers were good for? Definitely, when Al brought his team into Shugart Associates, he was very proud of his team.

Burniece: Sure.

Tandon: We were the ones who did not come with him on the team. He accepted us [at Memorex], kind of as a team, but not really. The one thing I was interested in was the floppy, so I volunteered myself to go into this, even though they weren't looking for people who didn't want to be in the more glamorous program [i.e., hard disks].

Al's thinking was "these are the best engineers I have." Herb Thompson was their [disk drive] head engineer. You know, I actually worked with him and used to tease him. I said, "Herb, you're the second best head engineer, in the world." <laughs>

Burniece: And who was the best? You? <laughter>

Tandon: We used to kind of tease each other that way. So anyway, that was the reason. [Al] said, "I'm going to take the best engineers. What is there in floppy drive? If you have done Winchester drives or other hard drives, this should be piece of cake."

Burniece: So, his attitude was, "we got the best engineers, who can do anything you want. You don't have to get guys that have done it before, you just need to get the guys that are the best, and they'll do it!"

Tandon: Absolutely. But they did okay!

Burniece: Sure.

Tandon: So, two things happened. Now so they were doing it and I was at Pertec and we were competing.

Burniece: Of course, Memorex already had floppies, because you'd done it ….

Tandon: Yeah. but Memorex couldn't get out of their own way! In fact, my brother, Jay, was running the program over there!

Burniece: After you left?

Tandon: After I left!

Burniece: Okay.

Tandon: But they weren't serious about it. Their biggest problem was those big companies cannot think small. They don't think that small is very big!

Burniece: Right.

Tandon: You know, this is the whole history of the computers, right? Today everything is [getting smaller]. All the big companies [had to pursue] PCs. There was so much [disk drive] technology in IBM, Control Data, and Memorex but they [initially] ignored the small drives. Every time new people [came in, they would] start thinking a different way. Culturally, the [big companies] could not shift gears [fast enough]. It's the same technology, right? But they could not shift gears. This was my frustration at Memorex.

But anyway, when those Shugart people left, Memorex was on shaky ground, so I went to Pertec and did their [floppy] project. Pertec was culturally a little bit more suitable, because we were given the independence. We were a separate group and all those things.

But then the big thing happened with head technology. IBM originally used metal heads [for floppies] but then came out with a ferrite head. Before they thought the ferrite would wear out, but by that time the ferrite quality had become good enough that you could do contact recording with a ferrite head, because the technology was developed for tapes.

I was still at Pertec and, my contract is up but I made my bonus. I asked the management how much are you committed to this program? It doesn't look like you are committed very heavily," because [you] still want to romance the big drives. You know, there was a bunch of floppy companies that mushroomed up at that time. They were all eight-inch floppies.

Burniece: Is this like the 1974/1975 timeframe? Something like that?

Tandon: Yes, 1974/1975

Burniece: So now IBM and Shugart are in the game and Memorex could [also] have been in the game, but kind of fell aside, and Pertec was not really serious about getting in the game.

Tandon: They were fooling around with it and then the whole company collapsed.

Burniece: Oh, the whole company?

Tandon: They tried very hard on the floppy, but by then there were a bunch of floppy drives around. To name a few, which you probably [remember] - BASF and Siemens, both in Germany, and Calcomp in Southern California.

Burniece: Right.

Tandon: Maybe MPI?

Burniece: Yes - MPI [Control Data] absolutely got into it. I'm not sure how early, but they definitely were into floppies [by the early 1980s].

Tandon: There was also a company called Remix

Burniece: Yes

Tandon: The floppy I've been talking about is the eight-inch floppy, which was becoming very fashionable. Shugart dominated the market, because they were there early, thanks to Herb Thompson, [who] did the heads. Other people didn't have a head source.

Burniece: Was he the top head guy at Shugart?

Tandon: Thompson was the top head guy. He designed the whole head and put it in manufacturing.

Burniece: And was that head significantly different than what you'd done at Pertec?

Tandon: [Yes], he did a ferrite head.

Burniece: So, he did a ferrite and you were still using metal heads?

Tandon: [Yes] but his design was a little bit different, which I think caused him a little problem in the future, because you know what he did? [Without] getting into too much technology here, he did cross erase coils, like they had in the 2314, with two erase coils back of the head, so as to write the track after erasing it. You need that when you're overwriting one track to the other but because of this he didn't have closed loop. So, you needed an erase core but that throws your timing off for industry interchangeability.

Tandon: Getting back to Pertec

So, here's the thing - I now I had some money - after taxes and everything, I had $60,000 / $70,000 …

Burniece: You got your bonuses and had some money.

Tandon: Yeah, I had $60/$70,000 and a good job but one day I came home and I told my wife, "I'm quitting my job." She said, "You've gone crazy!" I said, "No, I have had this bug for so many years, I'm going to quit my job" and she said "when?" I said, "tomorrow and I'm going to start my own [company]." Well, anyway, she was a pretty good soul ….

Burniece: Well, she certainly was. I hope she was happy that you had some money and a plan - you were going to go start a company!

Tandon: You know, my wife passed away about two years back.

Burniece: I heard that. I'm really sorry.

Tandon: She would have been happy either way. I mean, she was just a happy person. So anyway, what happened is I did quit my job. I said, "Listen, when we came here, which was only seven years back, we had $58. We now have that many in thousands!" <laughter> " So if the things don't work, I'll find a job."

At that time, I had two kids, but anyway, she said, "This is what you want" and I said, "but you're going to work. You're not going to leave home. I'm going to bring stuff to you that you assemble - you know, wires and all this. I'm going to make heads, okay."

Tom Burniece: Oh, so you said to your wife that she was going to help you--

Jugi Tandon: Yes.

Tom Burniece: Build the stuff?

Jugi Tandon: Yes.

Tom Burniece: She's going to become your assembler?

Jugi Tandon: Yes.

Tom Burniece: So, you put her to work

Jugi Tandon: At home I put everybody to work and started the company

Tom Burniece: Is this what you called Tandon Magnetics.

Jugi Tandon: Yes, this is Tandon Magnetics.

Tom Burniece: Ok

Jugi Tandon: I just walked away from these people at Pertec and started literally in my garage.

Tom Burniece: And this is 1975 or thereabouts.

Jugi Tandon: Yes, 1975.

Tom Burniece: Okay.

Jugi Tandon: it was a real garage shop. I bought some benches and my brother, my son who was six-years-old, and I painted the benches. I still remember that I ended up painting them blue and then said, "I've got a company. I'm in business." <laughs>

My total investment was seven thousand dollars - that's it. So, I started making heads in my garage and gave away samples. People liked them and there were some Memorex customers who needed refurbished heads, because Memorex had gone away. I made some special heads for them and made some money.

Tom Burniece: Now were these heads a completely new head or was this a similar head to what you'd already developed at the time?

Jugi Tandon: This was at that time a similar head but I started with the plan to make read / write heads.

Tom Burniece: All right, so that was the plan.

Jugi Tandon: By the way, if you don't have them in the museum, you need to put them here. I've got a whole process [that I would like to donate to the CHM]

Tom Burniece: Well, let's definitely do it. [The CHM has a process and forms for donating, which I will sent to you]

Jugi Tandon: Starting from the core all the way up to the full transducer.

Tom Burniece: I think we've probably got a lot of heads of various types, but I'd like to see that.

Jugi Tandon: Yeah.

Tom Burniece: And it would be great putting them in the museum.

Jugi Tandon: Anyway, what happened is I then went and bought a shop, where we moved our desks and all.

Tom Burniece: How long did it take to do that?

Jugi Tandon: About three months.

Tom Burniece: So, you're now up to a handful of people or more?

Jugi Tandon: No - I hired one assembler, one guy who didn't have a job and then my wife ….

Tom Burniece: So, you initially had three employees and yourself

Jugi Tandon: Then I started doing more things and hired maybe three or four later but there was one requirement. Anybody who had ever made or seen a head, would not be qualified to work with me.

Tom Burniece: So, you took exactly the opposite approach of hiring experienced people and said, "I want people that have never [done] this before."

Jugi Tandon: Here was my goal at that time,. You can call it vision or you can call it goal or you can call it whatever**.** I noticed the head guys were trying to sell heads for a few hundred dollars and the customers were only willing to pay $40 for a head, so that doesn't work**.** There's no market for expensive floppy drives, so even when the double-sided floppy comes out, people will not be willing to pay more and we'll go into that in a minute.

Tom Burniece: So, what was your goal?

Jugi Tandon: I said, "I'll make a better head and sell it for $15 dollars. And do you know what happened? I put everybody else out of business.

Tom Burniece: Wow!

Jugi Tandon: Now how I did that? Actually, you should interview my brother Jay someday too. <laughs>

Tom Burniece: We'll do that. Was Jay now a part of this?

Jugi Tandon: No, but he helped me. Since you're an engineer, I wish I could someday give you the whole thing right from the beginning to end, how cleverly we beat everybody. I can also take [some] credit for myself ….

Tom Burniece: Did you document this and also did you patent that?

Jugi Tandon: No. The reason was because I didn't want to give my secret sauce to anybody.

Tom Burniece: Oh, so you kept [everything trade secret]

Jugi Tandon: Nobody was allowed to see my [process]. I will give you an example - you know this little transducer has a crown on it? We are talking about single-sided but I'll go to double-sided in a minute.

Tom Burniece: The idea being that you've got the minimal amount of [head] surface actually [in contact with the media]?…

Jugi Tandon: Yes, that's how we contact and then you put a little pad on the back. This is the way you need [to do it] and, as I said, [you also need to be trained].

Now Shugart made their own heads, as did AMC and Nortronics. These were the [floppy] head companies. They were trying to get into it. So, all these floppy companies had to depend on AMC or Nortronics and they couldn't even produce [a head] at $40 dollars.

As an example, Shugart's Herb Thompson developed a process that took the head and polished it but you had to first make a curvature on it. Then you had to polish that. The way they were making the curvature was rotating the head through a cylindrical piece and that gave you the [curvature] but then you [had to do the] same thing for polishing it.

So, if you want to do one or two heads at a time, it will take a lot of room, a lot of big machinery, and will maybe do100 heads a day. It will cost you maybe $50,000 dollars or so. I could not spend that kind of money on lapping and polishing, so I kept on sitting and thinking and thinking. I said, "there has to be a better way - If I take a big ball and polish it, head on everything is spherical. "

So, what I did was look at how they polish optical lenses all the time. I knew they were not doing one at a time, so I started looking at optical machines and found one for $800 dollars. I called my brother and said, "can you pick up that machine", which was in Fremont, "and bring it to L.A.?" Then I took an aluminum block with a heat-sensitive glue and mounted 70 heads on it. I put it on this lens polishing machine with a little cup on the top which was rotating and I polished 70 heads in half an hour.

Tom Burniece: So, was that machine designed to polish 70 lenses [at a time]? Is that what it was designed to do?

Jugi Tandon: No. It depends on the size of the lens. I had to tool it myself, but that is what I wanted ….

Tom Burniece: So, you figured out how to [lap and polish multiple heads at once but now needed to tool it]

Jugi Tandon: Out of that machine is that motion that the bottom is rotating like this and the arm is going back and forth.

Tom Burniece: So that's the secret?

Jugi Tandon: Yes - that is what I wanted. So, people said "how is he producing that many? Where did he get the money?" Hey, my whole lapping investment was less than $2,000 dollars and I can produce all the heads you want. I have pictures, if you want to see them.

[Note: Jugi has not been able to find the photos, so we decided to publish without them. If he does find them in the future, we can append them to the transcript and cross-reference with a footnote]

Tom Burniece: Wow.

Jugi Tandon: So, because I didn't have money, I become very innovative, and didn't want to spend too much time on this but thought that you would find it interesting.

Tom Burniece: Well, it's actually very interesting and we should go a little deeper. So, how did you scale that up in order to start building thousands of heads a day?

Jugi Tandon: All of my competition used to see their heads and say "they did a pretty damn good job but why are they not working? If you know what a magnetic loop is then you know there is a gap in the back and you are going to have losses. This is a U-shaped core with a gap at the ends, where you put the coils on and then attach a back bar. Those guys didn't know how to put the back bar on, because it is sitting in a little cavity and they have tooled it. What happens when they tool it, is the epoxy that is used to [bond] the back bar can get on the legs and head performance will go way down. They don't know how to prevent that. So, I made a living by buying those heads and removing the back bar and then re-putting it in [properly] and made money, <laughs>

Tom Burniece: So, you actually bought their heads that didn't work and repaired them?

Jugi Tandon: Yes

Tom Burniece: So, what was your secret to doing that? How did you make it work?

Jugi Tandon: You will laugh. I wish you could see this but just to give you an example, here are the two legs (he showed fingers) and you need to put this back bar on with good contact on both of these legs. I was thinking and thinking, then said, "oh, gosh, we have the solution right here." You know those hair clips the ladies use? I took those hair clips and cut the front off, so they would go in deeper than the legs. If you then take the bar and put the hair clip on each leg is loaded automatically. <laughs>****

And then the other thing you have to do along with this, is develop an epoxy which is very thick, so it doesn't run but it's soft. You know, like a lube? You can do it by putting some Cabosil in the epoxy. In those days they were putting asbestos in, which you know is illegal**..** We didn't do that. Cabosil is kind of powdery stuff, so we would put a glob of epoxy on each end and let that sit [until it cures] and you're done.

There are five other examples like this on how we did this and it was impressive. Our most impressive thing was we were the most unimpressive company to look at when people would come and say "you have nothing here." I'd say, "We don't need anything".

There was a Computer Trade show in 1975-76 (I don't remember the date), in Dallas. The sales guy, who I'd hired (Jerry Limbus), and I both went but we didn't have any money to have a booth. I said, "You know what we will do? We are going to hang around our competition's booths," which was Nortronics and AMC. There was one more company from Boston but I don't remember the name of that. So, we went there and we parked ourselves just on the side of the Nortronics' booth.

Sure enough, Charlie was there (I don't remember his last name but he was an MPI General Manager in Oklahoma City)**.** He was hunting for heads (and asked Nortronics) how many heads they can produce. They brought their guys over and Charlie said, "We'll pay $40, $50 dollars, and we need it because my customers are dying and we need heads". So, when he finished the meeting, I tapped Charlie and said, "Sir, I will sell you the heads for $15 dollars and they will be much better quality than any of these people can do." He didn't take me seriously but I said, "You have nothing to lose." So he said okay and went back and apparently gave that to his procurement commodity manager, who said, "It doesn't hurt to try this guy out". Those guys were coming here to go to AMC, which was in Santa Barbara.

Because they had big plans, I got a fax from them, saying that they were coming to survey our factory – a commodity manager, engineering manager, quality manager, you name it. It was seven or eight people.

My Vice President of Sales was Jerry and there were only five or six people in our company, so he asked "what are we going to do?" I said, "I've got an idea". Fortunately, the next door building was empty, with

large bays, like they have in manufacturing, so I said, "Jerry, go and rent all the benches you can." He went and rented the benches and put them over there.

I knew McBain Instruments, the people who used to sell me microscopes. We ended up doing tens of millions of dollars of business with them at the end, because we had hundreds of microscopes going to India and we did business with them for a long time. So, I called and said, "Listen. I need to borrow maybe 20, 30 microscopes from you". They agreed,

So, we set up the benches and put the microscope plus some other parts out. Then I said, "Jerry, now go and get some actors." So, he went to the Studio City, Universal Studio and brought 20 extras. I said, "what do we have to pay them?" He said, "Just beer. These guys are happy to just do it" . We gave them beer and they put their white coats on and were sitting there working.

Tom Burniece: So, you got these Hollywood extras for free, with white coats and microscopes, making your lab people look like they're 25 people or more.

Jugi Tandon: That's what I had to do. I said, " I'm going to [show them] the head quality." So, these guys showed up and saw the head quality but I knew they wouldn't understand anything. What could they understand about some of the things we showed them?

They asked, "when can you supply a sample?" These guys were still not taking us seriously, so I said, "do you just want the head?" They said, "yes", so I said, "why don't I will sell you the head and the carriage?" They had brought two or three carriages with them just to show that this is where it fits in but were looking for heads only because they had their own operation to mount.

I said, "Where are you going from here?" He said, "we are going to go to AMC, then they are going to go someplace else." Within five days, they're going to be back in Minneapolis. So, I said, "okay, I'll send you five samples." They gave me carriages and said they had their own tooling, because they spent thousands of dollars to mount the head to the carriage and as you know, in a removeable media, the head alignment through the travel becomes very important.

Tom Burniece: Absolutely.

Jugi Tandon: Otherwise you're not going to be able to read the data. So, we had developed a phenomenal technique, which required no fixturing, just epoxy. I developed it by myself and it solved this problem. The other guys were spending thousands of dollars to rotate the head and do this alignment. My fixture was costing $150 dollars.

Tom Burniece: <laughs>

Jugi Tandon: They said, "Tell us how much is the tuning and how long will it take you?" I said, "You know, you guys go to AMC and don't worry about it, okay." They went to AMC and before they got back, the heads were already delivered to them - no tooling costs, nothing.

Tom Burniece: So, for $15 bucks, they got heads and they got the tooled heads mounted on carriages for nothing,

Jugi Tandon: They were willing to pay $40 dollars, so you know the end result? Nortronics never (sold MPI) another head, ever, as long as they were in the business. <laughs>

Tom Burniece: It's a phenomenal story and yet you never patented any of it, since you basically considered it trade secrets.

Jugi Tandon: There was really nothing to patent, other than the processes, and all you would do in patenting the processes is give the competition the same ideas.

Tom Burniece: Absolutely.

Jugi Tandon: Once the idea is out, they would just change it around a little bit, so it is very hard to protect it. Nobody really copied me because it looked so silly but now the fun part begins. I've been moving too slow …

Tom Burniece: No, you're doing great. So, now let’s get into the doubled-side floppy.

Jugi Tandon: IBM was making their own heads for their single-sided floppies. Then all of a sudden, they announced the double-sided floppy drive. Of course, the whole industry went into a panic mode. because, that would double the capacity for very little more cost, just the cost of the second transducer.

So anyway, like we always do in our industry, we went and bought the IBM drive so that we could look at the heads. I looked at the head and said, "gosh, what a nightmare - what they did was separate those two heads, in order to get the disk in, so it was not even just to write.

There was a motion that was going one way and then inside that motion, there was another motion so the heads could move around, with the floppy drive doing this. There was also a suspension to track the vibration.

So, if you look at this head transducer, you really couldn't make it for less than $100, because it was so complex. The slider was just sitting there, so you had to worry about the edges. I said this is not what I would do but I have to get into double-sided floppy business, because that is going to make everything happen.

This was strictly my own idea, because I didn't want to build that complex a head but I didn't yet know how to do that and IBM had more resources <laughs>. As I was looking at it I said, "this whole head design they are doing is with the assumption that the disk is flopping around. I'm [not] going to follow the disk wherever it goes - that's a nightmare". It had a disk cartridge (was still an 8-inch floppy by the way), and as I was pushing my fingers on it, I said "you know, this disk in a small area is pretty darn stiff. I can almost assume it's a hard drive." <laughs>

Tom Burniece: You're talking about in the area where the head was contacting?

Jugi Tandon: Yes. I said, "Why do we need to follow the disk? Let the disk come to me." That one simple assumption changed the history of floppy drives. Nothing else.

I said, "now it is very simple – have a fixed bottom head. It's flat, so the disk comes over it and that area is the beginning of your hard disk. I will have a little arm with a suspension on that top head".

Tom Burniece: So, that is how you came up with the idea of one side having a fixed head.

Jugi Tandon: Yes, one side is fixed and that will make the disk stiff [in the area of the heads] …

Tom Burniece: …. and you'll bring the suspension down with the other one.

Jugi Tandon: Yes. you just lift it up and insert the disk and then it will come down. That suspension is just two little tabs, so you don't need [two] suspensions <laughs>

Tom Burniece: Now did you patent that?

Jugi Tandon: Yes. By the way I wouldn't even show what I was doing to anybody until I had patented it. I could not believe how well that worked. So, not only did we patent that but there was not a single double-sided floppy disk drive that didn't have a license from me. Sony, Toshiba and anybody who made double-sided floppy drives had to have a license from us, while IBM had a cross license, as you know, on all the technology. Later on, when people started making the 3-1/2 inch floppy drives they also had to have a license from me. So basically, there was no computer produced with a double-sided floppy drive, without my patent.

One of the mistakes I made, which is okay, was because I needed money for the company in the early days and didn't raise a lot of money, is I sold those licenses outright. In those days, I thought $5 million a year [was a lot of money for a patent].

Tom Burniece: So, it was basically a one-time license for everything they wanted to use it for.

Jugi Tandon: Yes. we were talking about it the other day and, if I had sold them a license on a royalty basis, It would have been $100 million a year for 20 years. <laughs>

Tom Burniece: Wow!

Jugi Tandon: But I never worried about those things and anyway, it was fun.

Tom Burniece: Now was that your first patent? You had done a lot of inventing here in this story already.

Jugi Tandon: That was the first one. I patented several things later on but I never wanted to do any process patents.

Tom Burniece: [Why]?

Jugi Tandon: Sometimes people [think that patenting everything is] a good idea, [especially in a] young company. I will recommend that you patent all [designs, which can be easily copied and / or modified because protecting that kind of intellectual property has a lot of value, but process inventions should be kept trade secret.

Tom Burniece: So, when was the time frame that you brought your patented, double-sided floppy head out?

Jugi Tandon: 1977 [Filed June 13, 1977 - Granted April 24, 1979.

Tom Burniece: I assume at that point, your company really started to take off.

Jugi Tandon: No, we were still just a head company but made a good profit. At the time we started doing the double-sided head, everything was still 8-inch. Until that time, I had only taken investments of maybe $250,000 to $300,000 total. By the way, these were from some of the best investors with the biggest brand names: Don Valentine, Dick Kramlick, Sandy Robertson and Jean Deleage

Tom Burniece: How much did they ultimately invest altogether?

Jugi Tandon: I raised a total of $2 million altogether. I know that Kramlick told me that he put in $200,000 and he cashed out $40 [million] or something like that, so he did okay.

Jugi Tandon: Then the 3-1/2-inch Floppy came out from Shugart, Do you know who drove that thing?

Tom Burniece: You mean within Shugart?

Jugi Tandon: No. It was Dr. Wang who demanded that drive. I went and saw him - an Interesting guy.

Tom Burniece: Wang pushing for a 3-1/2-inch floppy makes sense - he was doing word processing

Jugi Tandon: When the 3-1/2-inch came out that was when PCs started taking off **-** 1977 to 1979, or whatever the time frame was. Until then, there were [mostly just minicomputers competing with Mainframes]. Well, there were some [early] PCs, but Shugart was the only company at that time in 3-1/2-inch floppies.

Now there were two companies that needed a lot of heads for a lot of drives - Tandy and Apple. Most of the floppies were single-sided but they wanted to go to double-sided.

Tom Burniece: Apple was still a pretty young company at that point but starting to take off

Jugi Tandon: Yeah they were but our volumes weren't very big anyway. This was prior to IBM and the PC. I don't know if you remember John Roach or not but he was the CEO of Tandy.

Tom Burniece: I didn't know him.

Jugi Tandon: Tandy did very well in PCs in the early days and the TR-S80 was [successful]

Tom Burniece: Yes, it was.

Jugi Tandon: In fact, Tandy made Bill Gates successful, because they gave him their first contract. John Roach couldn't produce enough computers, because he couldn't get enough drives. So, he went to Orange County, since there were three or four floppy companies in Orange County. Then he goes to Shugart and several other places to hunt for 3-1/2-inch drives. Shugart was committed to Apple, although their numbers weren't that big anyway. Every place John Roach goes they tell him that, "we are trying to get more help from Jugi, so he can give us more product", because he was the only game in town – the only company producing heads …

Tom Burniece: … and you basically had almost a monopoly on the heads, then.

Jugi Tandon: I had a monopoly on the double-sided heads. So, what happened was I was in Chatsworth, doing my thing, and beginning to think that I needed to get into the drive business, because my customer base was so weak. Even if I saved them $30 dollars, they still didn't know what they were doing and Shugart would just eat their lunch. I hadn't done it yet, when I get a call that John Roach who wants to come and see me. I was shocked! He was in Orange County and drives all the way to Chatsworth, which is 70- to 80-odd miles. He comes to me and said, "I want to know who Jugi Tandon is" <laughs> because nobody knows me. That happened to me a few times, by the way. <laughs>

Tom Burniece: Did he know you were Jugi at the time or he was looking for Jugi and just happened to ask somebody, "Where's Jugi Tandon?" <laughs>

Jugi Tandon: No, he was looking for me when he came over and said, "You know, every place I go, they say, "Jugi gave us more heads." So, John Roach said "why can't you give me more heads?"' I said, "John, it is not the head - that is not the problem. These guys don't know what they are doing. I sell them the heads and they spend more money retesting the heads, which they don't need to do. These guys don't have the discipline to be in this business and John said, "why don't you get into the drive business?" I said, "that sounds like a good idea." You know what - I did!

Tom Burniece: Did he say to get in the hard drive business <inaudible>?

Jugi Tandon: No - "why don't you get in the floppy drive business?"

Tom Burniece: Okay, the floppy drive business

Jugi Tandon: I said, "That's not a bad idea. What can you do for me, John?" He took out a napkin and wrote an order for 50,000 drives and said, "Can you do that?"

Tom Burniece: So right there on a napkin, he wrote an order for 50,000 drives

Jugi Tandon: Yes**.** He said "I'll pay you this much and this is the order. Get going." This is not a made up story.

Tom Burniece: Wow! What year was this?

Jugi Tandon: Late seventies. What happened next was, fortunately I had very good investors, although I didn't know at that time they were that good.

Tom Burniece: Oh, yeah. They're some of the best. <laughs>

Jugi Tandon: We already had [several of them] on our board**,** like Kevin Landry. He just passed away and was a very big guy. [Also] Don Valentine, Dick Kramlick and Jean Deleage, who was at Sofinnova. Sandy Robertson came in later on. I said, "Guys, you're always supporting me" and we had sort of a preliminary [agreement] saying they would give me $2 million dollars for 30 percent or some number of the company. These VCs knew when I came to them, that I only had two weeks of money left but had this big opportunity from Tandy.

Tom Burniece: So, they knew you only had two weeks of money at that point?

Jugi Tandon: Yes, and you know that VCs are [typically] going to use you if they know that. At that time [they only had] $250,000, $300,000 dollars into it. So, I went to the board meeting and said, "Guys, I need $2 million" and had kind of a discussion [on] the equity. Then I said "let's do it."

I don't remember [which of] them said, "well, we should get 50 percent of the company." Another guy said, "yeah, we need to negotiate it". I said, "guys, is there anybody in this room who wants to stick to the original deal or shall I just close the company?" They all kind of looked at [me] and Kevin [then said] "I don't need anybody else, I'll take the whole deal." Then everybody panicked. <laughter>

Anyway, to make the long story short, we got that deal done and **[**got the] $2 million.

Tom Burniece: How much did the company have to give away for that?

Jugi Tandon: I don't remember the numbers, but less than 50%. I was very generous to my employees, when we went public. I had 40 line people assembling parts and they were millionaires. It was amazing!

Tom Burniece: So, you took $2 million and soon went public. When did you go public, by the way?

Jugi Tandon: 1980. There was no other investment money needed.

Tom Burniece: So those investors made some money, then, too.

Jugi Tandon: Oh, they made a lot of money.

Tom Burniece: Did you deliver the 50,000 floppy drives to Tandy?

Jugi Tandon: Oh, yeah. By the way**,** Tandy never bought a floppy drive from anybody else ever.

Tom Burniece: So how long did it take from the time that John Roach wrote the order on the napkin?

Jugi Tandon: One year.

Tom Burniece: That's remarkable. So, did you build a factory in India and if so where did you put it?

Jugi Tandon: No, that factory was in the U.S. but then I moved to Singapore. I'll come to that

Tom Burniece: Okay

Jugi Tandon: So, now you know why we were so wildly successful in the floppy business. We did a number of [unique] things but the thing that is very obvious, was we had [the only] double-sided head technology [that worked] …

Tom Burniece: and that was exclusive - you were the only guy in town …

Jugi Tandon: Right

Tom Burniece: Was this the whole thing [that made you so successful?]

Jugi Tandon: [No, we started] hanging out with Bill Gates, John Roach, Don Estridge and Steve Jobs at those Ben Rosen Conferences. Then we would also get together every two, three months in Palm Springs, Arizona or someplace else.

Tom Burniece: You were getting together that often? Every couple months?

Jugi Tandon: Maybe every six months. But we did it a lot of this and would also have EE meetings, where we all got together to see each other. People don't realize it [but] our attitude was one and the same. I'm sure if you talk to some of the other people [who] were there, they will talk about it.

We didn't know whether we were going to make more money. None of us had seen much money [before and] we were not into money that much. We hadn't seen many examples of people who made a lot of money in computer technology in those days.

We were all obsessed with one thing: let's put a computer in every house and I said "Steve Jobs and Bill Gates were the quarterbacks but if you don't have good linemen, <laughs> you're not going to be in the game."

That's what we were doing. We were doing the blocking and tackling on how could PCs ever succeed, if people like us did not put their foot down and said, "we want to make very inexpensive storage."

I'll tell you a little story. One time Don Valentine, when I was just starting in making drives, called me and said, "I want to bring a friend of mine, whom we have not invested in yet, to come and see you." I said, "Yes", so Don comes with this kid with long hair. He wore a suit and tie but he was wearing sandals, Don walked into my shop and said, "This is Steve Jobs." <laughs>

Tom Burniece: Was that the first time you met Steve?.

Jugi Tandon: That's the first time I met Steve and he had his first computer with him, which had a cassette recorder, You remember that?

Tom Burniece: Yes.

Jugi Tandon: Steve said there were no Random Access Storage devices available for that kind of a price. I told Steve he was born arrogant but he had every right to be … <laughter>

Tom Burniece: I've never met him but I've heard the stories.

Jugi Tandon: Unfortunately, I was also a little bit arrogant too and wasn't that much older than him, so I told him and Don that "you have no idea but I'm going to make millions of drives." Steve said “I'm going to make millions of computers." We both ended up doing that, but neither of us believed each other. <laughter>

Tom Burniece: Now at the point, when Valentine introduced Steve to you, were you already making your own floppy drives for Tandy?

Jugi Tandon: No, this was prior to that.

Tom Burniece: Was it before Tandy's order?

Jugi Tandon: Yeah, just before

Tom Burniece: So, you weren't in the drive business yet – you still were only in the head business.

Jugi Tandon: Yes, but [knew I could never sell to Apple because my whole head production would be eaten by Tandy.

Tom Burniece: Okay.

Jugi Tandon: Then, but soon [after that] the whole landscape changed.

Tom Burniece: Well, wait a second. I'm not sure I quite understand what you just said. When you first met Steve Jobs through Don Valentine, you were just getting into the drive business.

Jugi Tandon: Right.

Tom Burniece: and Tandy had suggested it to you, when he wrote you an order on a napkin for 50,000 heads.

Jugi Tandon: Yes, I was still just selling heads.

Tom Burniece: Ok, I thought you didn't get into the drive business at that point but were thinking about it.

Tandon: I probably could have got that order but I couldn't ship anything.

Burniece: Because you didn't have the drives yet – right?

Tandon: This was during that period when Don Valentine had made the investment for heads

Burniece: Ok, got it.

Tandon: Later on, Steve said "come over, I want to show you what I am doing." So, I went to see him and they had a small building. I went in there and said, "I want to see Steve Jobs." The person said, "oh, his office is down on the corner there". So, I went there and I couldn't find him. In fact, my brother was with me. I then said "Steve" and his voice comes from under the desk.

Burniece: He was underneath the desk?

Tandon: He's sitting underneath the desk. I said, "Steve, what are you doing there?" He said, "It was noisy, so I decided to work underneath the desk"

Burniece: You delivered the heads to Tandy and they never bought them from anybody else but I assume they eventually bought hundreds of thousands or more of them, right?

Tandon: Yes, I made millions.

Burniece: Did Steve ever sign up to start taking some of your heads?

Tandon: No, I never did business with Steve because from the day one, he didn't believe me and I didn't believe him. Another thing also happened - after IBM announced their PC, Apple wasn't a very effective customer. You probably remember that.

Burniece: Well, that's true.

Tandon: Let me tell you another story about Steve Jobs, about which so much has been written and movies have been made, but what I know that those people don't know. Steve came to me and I told him "listen, I'm the only one who can [make the volumes that] I did. I'm sorry." He said, "Well, I'll make my own drives." I said, "Go ahead. I don't have a problem with that." So, he puts a team together, which was a total failure, by the way. He was trying to use just one head on one side, because Steve always had the idea that he didn't need to go standard. [He believed that he] could make his own single-sided floppy drive and didn't care about anything standard."

Burniece: He probably didn't want to use your patent, either, right? So, he wanted to do his own thing.

Tandon: Well what that guy did them was very disappointing, since I got to know him and had showed him our people I had gone to India for a couple of weeks, so he came to Los Angeles and hired my whole team.

Burniece: Oh, he did?

Tandon: Yeah.

Burniece: When was this?

Tandon: About the same time.

Burniece: So late '70s?

Tandon: Yeah.

Burniece: So, your heads team actually left and went to go to work for Steve, while you were away in India?

Tandon: Yes.

Burniece: So, what happened then?

Tandon: Well, I said, "Hey, I can manage. It's not a big deal." Because, by the way, not too many people knew the secrets in that company. I didn't need anybody, since I had studied the floppy business

so much that I didn't even have a tool designer doing my tooling. I did the head design, the coil design, all the tooling - everything.

Burniece: So, you had all the Intellectual Property in your head and what he hired were just basically your assemblers?

Tandon: Yeah. I said, " that's okay." I knew when he took that team he was going to fail.

Burniece: He didn't hire your wife, though, I assume. She was still part of the team, right?

Tandon: Yes, my wife never left me. She never really worked [full time] but she used to bring home some pigtails and cables and would sit there knitting them. I also had my brother come over and I'd have him test heads for a dollar every head tested. So, I got a lot of help from my family and we were extremely successful.

Burniece: So, you then got a new team and you ended up going public not too long after that, right?

Tandon: No, we went public after we got the IBM contract.

Burniece: So, when did you get the IBM contract?

Tandon: Gosh, it must be 1979. When did IBM announce the PC?

Burniece: 1981. They announced the PC just after I joined DEC, which was August 1981.

Tandon: Okay, because we went public before IBM [announced their PC], so we went public in 1980.

Burniece: So right in that little timeframe, you went from building heads to getting a major order from Tandy for floppy drives and that got you into the floppy drive business.

Tandon: Yes, I was the only game in town.

Burniece: Steve Jobs decided to go build his own drives and never bought anything from you but he stole your heads team and then you went public - all in a period of a couple of years there.

Tandon: Yeah.

Burniece: So, you got the IBM contract after you went public?

Tandon: Yes.

Burniece: All right, so when IBM decided to go build their own PC they bought your floppy drives

Tandon: I think the first two million or three million PCs IBM built used only my floppy drives.

Burniece: All right, so that's when you met Don Estridge and all those IBM guys and, when they announced that PC product, it had your floppy drive in it? Only your floppy.

Tandon: Only mine

Burniece: So, you now had an exclusive with Tandy and IBM but never got anything from Apple?

Tandon: Yeah but everybody else followed

Burniece: All right, so I know that you also got into the hard drive business not too long after that, right?

Tandon: Right about the same time.

Burniece: So, when did you do that and what was the decision that made you do that?

Tandon: Well, let me tell you something about the drives, okay?

Burniece: Okay.

Tandon: In talking about the floppy drive as the storage for the PC, we always talked about one thing - that we must bring the cost of the box down. We knew everybody was going to bring the cost per bit down as we all had been doing that for ages, right? That was done by increasing density with a better media and / or better head. But nobody was addressing the cost of the box in the hard drive. If the cost of the

box stayed at two thousand dollars, we were not going to get any place. Thank God we did that for my floppy drive, when I said it should go down to 50 dollars.

Burniece: And what were you selling the floppy drive for at the time?

Tandon: One hundred fifty and I said we have to get down to 50 dollars.

Burniece: And you were the first guy, I think you told me [previously], to also get below two hundred dollars.

Tandon: I'm still talking floppy drives and, yeah, we were the first [to get down to $50]. In fact, I called [the 3.5" floppy] the TM50 (Tandon Magnetic 50), because I wanted to sell it for 50 dollars, How we did that was the same philosophy I than took for hard drives.

When we talked about the bill of material it depended what you were talking about. If you're going to get a sample head, your cost is very high. But if you really think about it, that is ridiculous. I wanted to know what is my basic material cost? It's probably a dollar's worth of silica and two dollars' worth of metal in it, because it's got some aluminum and some silicon. So, my philosophy was that if you do vertical integration and make everything yourselves, you can design those products exclusively for yourself. The volumes are going to be there and nobody else is going to benefit from your volumes. I'll give you an example - the stepper motor. When Shugart got into the business of three and a half inch floppy drives, he got a vending machine motor, because the vending machine companies make hundreds of thousands of motors. He would just go and buy one for twelve dollars or something like that.

Burniece: Now just to back up a second - what had they used prior to that on the eight-inch floppy? Something completely different?

Tandon: I'm talking about just the small floppy.

Burniece: Okay, but they bought it from a vending machine company.

Tandon: Twenty-eight millisecond access time, but their philosophy was that there's only so much volume. I went to a German company and got this square motor which had three millisecond access time compared to twenty-eight millisecond access time. I asked this German company why is this a 28-dollar motor. I told my engineers that's what I want and they said, "we cannot compete" This is a true story, They sent me a sample of the motor and I took the motor apart. I did that on many products. I asked my engineers how much this should cost and they said a dollar. I said "Why are we paying 28 dollars?" So, I

send my brother to the other company that was making it, Japan Servo, and told them we want to make motors. Give us a license and we'll work with you, plus give you royalty or whatever." He went and did that. You know how much we were making that motor for - three dollars!

Burniece: So, did Japan Servo at the time build a motor very similar to that for about the same cost?

Tandon: No, we showed them how to build it but they were expensive, because they were building in Japan.

Burniece: So, you licensed their design and built it yourself for three dollars?

Tandon: Yeah.

Burniece: I assume you modified it a little bit, so you got it down to three dollars from what was costing them

Tandon: Al Shugart then went and did the same thing at Shugart Associates. My idea for the floppy drive and the hard drive was to go as far as you can for vertical integration, Once you do the vertical integration, your material cost will become mostly labor cost, so you can go to a low-cost labor base, where you can do whatever you want. As for how far you want to go with vertical integration, we even thought about making our own bearings, which we didn't do eventually. We did our own motors, heads and media, however.

So, my idea at that time, was we needed to get the floppy to 50 dollars and get the hard drive to two hundred dollars. Then we had to further break that two hundred dollars barrier on the hard drive to bring it down to the same price as the floppy. Eventually, when I looked at the hard drive, there was no reason it should cost more than 50 dollars. Finally, the whole world was finding out, as it should.

Burniece: Today, the average hard disk drive costs about 35 bucks.

Tandon: That's where I had the goal at that time and we were able to achieve that. Everybody said that I had gone crazy and I said one of the things people didn't realize, was when the PCs first came out all of them only had a floppy drive. That was the main storage.

Burniece: Yes, that was the only low cost storage at that time.

Tandon: When Alan Shugart started Seagate, they came up with the concept of a 5-1/4 inch hard drive (the ST 506) but it took a couple years to get the cost low enough for the PCs.

Tandon: I did the five and a quarter. You know what the thinking was? The studies that were going on? Our goal was 20 to 30 percent of all of the PCs should use hard drives. I don't know if you remember that.

Burniece: I don't remember that number, but it's interesting that they even had a number, because originally PCs were originally all floppy disk.

Tandon: This is what everybody wanted. You know what I did?

Burniece: [No, tell me].

Tandon: I'll tell you what I did. I don't know how many people know these stories but Tom Mitchell probably knows. There was a company called Sirius in the 80s that had an IBM-compatible PC. This was when PCs only came with a floppy but you could buy and add a hard drive or two floppies. I had some engineers and said we must understand the whole PC and drive system, because that's a fundamental ingredient to bring the cost down and gives you the opportunity to balance your design. If you put cheap tires on a Ferrari, it has all the power but it's not going to run fast and handle well. You are as strong as your weakest link. Once you understand what the application is, you have a chance of doing something about the cost. If you don't understand PCs, there's a problem with your strategy, because you will get tempted to go into that business and have that dilemma. So, what I did was I made a system with a hard drive and took it to Comdex. I said, I want the people the go and look at the system, which works totally differently. A floppy could become a program-loading device but it should not be anything more than that. If you boot it from the hard drive and design your computer around it, it works totally different. People were very impressed that I did studies in all these things but said, "gosh, it's too expensive," because Seagate was selling hard drives for 500 dollars or something like that. I wanted to get that to 200 dollars.

Burniece: Now, when did you do this? When did you go to Comdex on that? Like 1982 or something like that?

Tandon: I think it was probably 1982. That's when Seagate was pushing 5.25” hard drives and people were getting both kinds of computers. So anyway, I had a big impact. The way we did it was we only made the magnetic heads in India. The reason was India was very difficult to do business in, because the infrastructure wasn't there. Singapore had all of the infrastructure and I was able to buy the Rollieflex Camera factory in Singapore, which we out-fitted. It was a beautiful factory and we did hard drives and floppies there. The media we did in San Jose. China wasn’t on the map at that time.

Burniece: Were you the first guy to build heads or anything else that had to do with disk drives in India?

Tandon: Yes, as well as out of this country - I ran into so much racism. You cannot take this kind of technology out of the US because it's very difficult to do - just to train the people over there. By the way, guess what happened - everybody followed me to Singapore. I think the Singapore economy was built because of what I did.

Burniece: Yeah, there's no question that there was a major move to Singapore in right about that same timeframe. But were you actually the first guy to go to Singapore?

Tandon: When I went to Singapore [in 1978 to manufacture our floppy drives, nobody else was there at that time. We also moved our hard drives there in around 1979].

Burniece: Well, it would have to be about that time, because I know that [Seagate moved hard drive production to Singapore in 1982, with Quantum and others not far behind].

Tandon: We were there way before anybody even thought about it. Then they had to and everybody followed me. So anyway, that happened and we had a pretty good run. As we were talking, there was much turmoil, as in any developing industry, with consolidations and what not. So, let's get back to when IBM announced their PC.

Burniece: Right, back to 1981.

Tandon: It changed the whole landscape.

Burniece: Yes, it did.

Tandon: Oh, what a change. You know Apple was in trouble. That's when everybody wanted IBM-compatible stuff. Compaq, Dell and others came a lot later. Tandy got in trouble because they had a MS-DOS machine and IBM-DOS was different than MS-DOS, so they were incompatible.

Burniece: Was that their fundamental problem? That they were never compatible?

Tandon: They were never compatible. Then there was NorthStar [Computers, with its own operating system NSDOS. My core customer base had disappeared but I was an IBM vendor and Tandy was still doing ok. So once again, Mr. Roach approached me and said, "I understand you have some pretty good

computer engineers." I said, "yes, I do." He said, "can you develop an IBM-compatible personal computer for me?" The funny thing was it was a conversation just between me and John Roach and nobody in Tandy even had an idea.

Burniece: Wow. When was that – 1983 or so?

Tandon: No, earlier than that. John had a problem but his people didn't know that.

Burniece: So, he recognized there was a problem in not being IBM-compatible and they needed you or someone to help?

Tandon: John Shirley wasn't there but [Jim] Patterson was and these people didn't recognize that. I came back but didn't have any commitment from Tandy. I had my team, however, because I thought that in order to be successful in the drive business, it was good to know more about computers.

As result, we were the first company who developed an IBM-compatible personal computer. IBM accepted that we had developed our own, because I had every engineer who worked on this sign an affidavit that they would not look at the IBM PC or any of its code and we would not copy anything. By the way, I ended up having a cross-license with IBM on all PCs or whatever I wanted.

Burniece: So, they accepted you, essentially, like a second source, then?

Tandon: Not a second source …

Burniece: But they cross-licensed anyway.

Tandon: You know, IBM always used to do that.

Burniece: Yeah, absolutely.

Tandon: So, my team built a full personal computer, using MS-DOS. I went to Tandy Towers and put it on John's desk. He brought his commodity manager and others in and I said, "This is 100 percent IBM PC compatible. Yours is not." We were now in the personal computer business.

As you know, I had already gone public but only raised about 20, 30 million dollars. If you asked me if I had to do everything all over again, what would I do? I'll give you the answer for that - make sure that I

raised a lot of money. You can go bankrupt when you don't have enough money. I mean, that's the definition of that.

Burniece: Well, let's talk about that a little bit later about what actually happened [when] you were now building your own personal computers [as well as] your own hard disks. You're doing this in Singapore, India and eventually China. You [were also] building IBM-compatible personal computers, so the company had to be a pretty good size by that time. You must have been getting to the point where you were a several hundred million dollar business.

Tandon: Oh yeah, my floppy company went from 20 million dollars to 40 million dollars to several hundred million and we were a four- to five-hundred million dollar company.

Burniece: Did you ever get to a billion dollars as a company?

Tandon: No.

Burniece: But you got to a half a billion dollars.

Tandon: Yes. maybe even to 600 million at one time, but we were already a big company at 400 million dollars in the '80s. That was a big company at that time.

So, here's the thing. I had phenomenal technology and we really knew how to do things the right way. We were making our own media and own MIG heads from scratch, plus we were doing our own motors. We were so vertically integrated it was pathetic. We could beat anybody on cost, as far as the drives are concerned.

We were now also into the PC business, which was very interesting to me. There are a number of reasons why I chose to go to the PC business. One thing was my customer base was getting very weak, as far as the drives were concerned, and I was getting tired of the OEM people's behavior. I was having a hard time in the hard drive OEM business, because Apple and others would tell me, "You can make products for me, but you won't make any money on it."

Burniece: Oh yeah, they always squeezed you on the price.

Tandon: So anyway, if it was the right or wrong thing, I never think back. It probably was the wrong thing [to go into the PC business], because look at where Western Digital is today. I said, "gosh, we can't do

both of them." I didn't want to offend Tandy, so I talked to the board and said, I like the PC business because, at that time, there really were no other players. Apple was doing very badly.

Burniece: Let me just catch something here. Tandy approached you to go do an IBM plug-compatible PC for them, right?

Tandon: Not officially. Only John Roach told me that I needed to do that, because he didn't want to tell his people.

Burniece: So, did John actually consummate there was a deal?

Tandon: I got the deal but only after I had the computer. I had confidence that if I had the computer working, he'll buy it and he bought a lot.

Burniece: So, at that point, IBM was cross-licensing and Tandy was buying IBM-compatible PCs from you, right?

Tandon: Yes, but the floppy business was kind of starting to level off and then going down because hard drives had come up a lot more.

Burniece: Were you selling those PCs outside the United States, so you wouldn't compete with Tandy?

Tandon: Yes, there was a number of reasons why I chose Europe instead of the US to launch. It was a major undertaking, because you can't just launch in California or Indiana, since the whole country is very big. It would cost a lot of money, which we didn't have, so it was bootstrapped from whatever internally we could do. The advantage of Europe was we wouldn't offend our customers and the European market was very lucrative. So, we started in Germany and once we got stable in Germany, then we would wait two months and do it in Spain. Then we waited and did it in France but eventually it came to the point that I had to make a decision if we were going to be in a conflict with our customers.

We could become a PC company or we could remain as a disk drive company. Now, this is hindsight, but at that time the disk drive business looked pretty bleak.

Burniece: There wasn't much margin there.

Tandon: Not only margin, but the customer base was spread too thin among the hard disk vendors. So, I got an idea with my engineers. I said, "the controllers are now just silicon, so why don't we put the controller on our board so that you can simply plug it into a computer?

Burniece: In the drive, basically? Put the controller in the drive?

Tandon: I said, let's find a controller company that we can work with and WD was a controller company, so we put a team together between us and those guys.

Burniece: So that was how you got started working with Western Digital?

Tandon: Yes, Western Digital.

Burniece: It was because they were just a controller company at that time?

Tandon: By the way, they were ready to go out of business, because disk drive controllers are a very tough business. The CEO, Roger Johnson, became a good friend of ours and I said "Roger, either I have to buy you, due to my belief that the controller and drive technology has to be combined, or you can have my disk drive technology and I will just go back to PCs. That includes all of my factories, disk drive technologies, Singapore, everything except I wanted to keep the disk drive head business in my family. As you know, my brothers were running that in India and I consider that my family business, which was still alive.

Burniece: So, just to fill in the cracks here, you were talking to Western Digital about putting a controller in your drives and then you convinced them that they should take the whole disk business instead.

Tandon: I don't know if they convinced me or I convinced them.

Burniece: So, you would go off and just be in the PC business, which was also a great business

Tandon: At that time, it was a good business because nobody else had IBM-compatible PCs. There was a new window open, because Apple was struggling and wanted to go into the IBM-compatible stuff.

Burniece: So, you then sold the hard drive side of Tandon Magnetics to Western Digital in, I believe, 1988, right?

Tandon: Yeah, and by the way, WD had no experience in hard disk drives.

Burniece: I understand one of our mutual friends, Marshall Lee, was one of the first people in Western Digital to be assigned by WD to try to figure out what the disk drives were all about.

Tandon: Yeah, he put them in business, which was good.

Burniece: So, at that point, you supplied heads to them from India and that is why you continued to build heads and so forth for them?

Tandon: We supplied them for a long time. We even supplied some GMRs head to them but Western Digital then did the right thing for themselves and started vertically integrating, so they bought Read-Rite. That was a turning point for WD, I think. When they were going out of business, they acquired Tandon, and then they acquired Read-Rite at the right time. Seagate and WD are the two largest remaining disk drive companies today, [along with Toshiba, who is half their size and the only other remaining disk drive company].

First of all, the original big disk drive companies [in the 1970s] were eventually acquired and / or put out of business by the small drive companies because they didn't recognize [the need to vertically integrate and drive down the size and cost per bit of hard disk drives at even faster rate than Moore's Law did for semiconductor. This was similar to the mainframe computer companies who didn't recognize the minicomputer and PCs [and eventually handheld computers (e.g.: smart phones) soon enough to survive]. The original disk drive business (IBM's storage division)], became part of Hitachi storage and [later that was merged into WD. Several other small form factor companies from the1980s], like Quantum and Maxtor, were merged into Seagate,

Burniece: Also, MiniScribe and a bunch more.

Tandon: Two of the earliest companies who got into the 5-1/4" hard disk business were Tandon and MiniScribe. Tandon was the first vertically-integrated company doing 5-1/4" hard disks, however, and made everything in-house. Some of those other early 5-1/4" hard disk companies, like Quantum and Seagate, had some good designs but in the long term they weren't controlling their own destiny. Western Digital recognized that we were already doing that and, after they took over Tandon Magnetics, they added Rite-Rite to that capability. Seagate later became vertically integrated, as well.

Burniece: Of course, Seagate got that from CDC.

Tandon: CDC?

Burniece: CDC was 100 percent vertically integrated [from the time they entered the hard disk business in 1962!].

Tandon: That's why they survived.

Burniece: Right, absolutely

Tandon: That was exactly what my vision was at that time and someday people will recognize [that was the key to my success]. What was done at that time had so much influence on what we are doing today, from Facebook and Google [to Amazon and the Cloud]. Just think about it, if they didn't have low-cost storage what would they do?

Burniece: Yeah. Well, we are both firm believers that storage is a key piece of the entire computing world.

Tandon: It's the most difficult.

Burniece: It always has been.

Tandon: It's always been the most difficult part.

Burniece: Okay. Great. Now I want to just ask a couple more questions to kind of wrap up on this Tandon Magnetics story. This first one is you now have sold your hard disk drive business to Western Digital and they've asked you to continue to build heads for them, which you were doing in India. How long did you do that and what level of head technology did you build over that period of time?

Tandon: You know, the family was already building heads.

Burniece: Yeah, you were already building heads when you sold it to them, so you just continued that, correct?

Tandon: Yes, from 1987 to 2002 or beyond. It could even be 2004.

Burniece: All right, so I understand you got all the way up to MR heads?

Tandon: Yes, to GMR.

Burniece: Okay, so you got into GMR heads?

Tandon: Yeah, but you've got to understand, what we started making was really full head stack assemblies, because that takes a lot of clean room discipline. We started with the MIG ferrite heads and was winding the coils and all that. Then, we went to the GMR head.

Burniece: Oh, so then you went to Thin film heads, correct?

Tandon: We skipped Thin film.

Burniece: Oh, you skipped Thin Film heads?

Tandon: Yeah, because you know we had our own design which were called MIG heads. Thin film didn't last very long.

Burniece: Well, actually [thin film heads were introduced in the late-1970s by IBM and the MIG (Metal in Gap) head was a ferrite head. Thin film has been the standard head-building process system since the mid 80s, however, including GMR (Giant Magneto-Resistive) heads, which is a second-generation MR Thin Film head, introduced in the late 90s].

Tandon: MIG and Thin Film MR heads were around for a long time, but it was a short period before Western Digital acquired Read-Rite and were building their own heads, In the meantime, we were doing some motors for them. I don't know how long we did the motors after they bought Read-Rite, but they poured everything on heads into Read-Rite?

Burniece: So, when they bought Read-Rite, did your head business go away or did Read-Rite take simply it over and consolidate?

Tandon: They consolidated most of it. We did it for a little bit, longer but not for long.

Burniece: So, the bottom line is when they bought Read Rite, that was the beginning of the end of you building heads for them? They wanted to consolidate and vertically integrate?

Tandon: Yes, we were getting to the point where our value add wasn't there, because the MIG heads required a lot of coil winding and termination. It was a simple process to make any money at but we really wanted to finish it off and get out.

Burniece: Did the same thing happened with the motors, so you started buying the motors from the motor companies?

Tandon: We didn't do that much internally with motors but we were the first big customer for Nidec.

Burniece: You were the first customer for Nidec? They basically took over the motor business for hard disk drives,

Tandon: We were their first customer.

Burniece: All right, so how long did you stay in the PC business, then?

Tandon: Well the PC business we started was in 1985 - 1986 or possibly as early as 1984. The one thing I really needed was a lot of management help and some big guns, so I could be compared with the Yankees owner, Steinbrenner.

Burniece: You wanted to be discussed in the same terms as George Steinbrenner?

Tandon: Yes.

Burniece: [Steinbrenner always hired top talent for the Yankees], correct?

Tandon: [Yes and] I went and hired a top IBM management team to do my PC. We had the basic design done but now we needed to get into the other things, like marketing and general management. Dan Wilkie [became the President and COO, HL Sparks became the VP of Sales and Marketing, and Charles Peddle (former Chairman of Victor Technologies) handled European Operations)]. Joe Ruby and Don Comer had one of the best engineering teams in the PC business. Do you remember this company, Chips and Technology?

Burniece: Yes.

Tandon: I [ran into Gordon Campbell] from C&T who said, "You know, Tandon never bought from us." I said you know we developed our own PC and not only that, we also developed our own drives but we have now gotten out of doing that, so we are now just a PC company.

Burniece: So where would you have ranked in the PC suppliers at the time? Would you have been in the top half?

Tandon: In Europe, we were either number two or number three.

Burniece: In Europe?

Tandon: Yes, we were in four countries in Europe (France, Germany, Spain and England), because that's where most of the market was. We were number one when the Intel 486 came out, because we had the 486 chip set before anybody else had it

Burniece: Now, did you label that as a Tandon computer or something else?

Tandon: Yes. In Europe, people still remember Tandon Computers.

Burniece: So, it was Tandon Computers?

Tandon: Yes, we were very big in Europe - you could see our signs on the freeways and Tandon Computers was a household name. We took that company from ground zero to 600 million dollars, with no money raised!

Burniece: And the 600 million, you're talking about is just the PC company?

Tandon: Yes, just the PC company alone. In fact, my number may be a little off, but we were in the half-billion dollar range in 1991, when we had more profit and sold more PCs than Dell Computers did.

Burniece: You actually out-sold Dell?

Tandon: Yes, in 1991.

Burniece: That's remarkable. Wow!

Tandon: Of course.

Burniece: Now, the company itself, eventually went bankrupt and that was in 1993, I believe, right?

Tandon: In 1994, I think.

Burniece: Okay.

Tandon: Well, let me tell you there are two things happened at the same time. You will remember we had the Iraq war during that timeframe ….

Burniece: Yes.

Tandon: Okay. Now people remember, of course, the second Iraq war, which devastated the whole county, but people have nice memories about the first Iraq war. I don't think people know how those kind of things can have an effect on businesses but during the war, the dollar became very weak. I just remember one number - a pound was 1.9 something to a dollar. Now, one of the biggest problems in doing business in Europe, especially for anybody in the PC business, was you buy everything in dollars. You don't buy in euros. In fact, we didn't even have euros at that time. We had francs or other local currency, so you sold in the local currency, because we were in the retail business with PCs.

Burniece: So, you're buying in dollars and you're selling in their local currency.

Tandon: Yes, the currency fluctuation was a big deal and, if your entire business is in foreign currency, you can't hedge it. How do you hedge that? So, after we won the first Iraq war ...

Burniece: I think the first war was in 1990 and It didn't last very long. Like six months or something like that.

Tandon: Yes, I just remember in about that time the dollar was getting weak and our cost went way down but our selling price was higher because the, you needed more dollars for every pound. But of course, it was not just happening to us, it was also happening to IBM, Compaq, everybody, so they had a tendency to say "the margins are too big - let's lower the price a little bit." But what we didn't know was once they lowered the price, they never bring the price back up.

Burniece: Right. <laughs>

Tandon: So, we didn't lower the price that much but we had to make some adjustments and thought that "we were fine." When the war was over, however, the dollar became the strongest currency - twenty-five, thirty percent stronger. Guess what? Our receivables got reduced by 30 percent and our gross margin on those prices went to 5 percent.

Burniece: Wow.

Tandon: Until that time, we were widely successful and were the company to beat. The biggest mistake we made was, when we had such banner years in 1990 and 1991, we didn't take advantage of that and raise money. That was the time when Dell raised a hundred million dollars. We could've also done that but, maybe the mentality of a small family business never got out of my head or something like that. In any case, we didn't raise money and, if you don't have a war chest in a time like that, just think about losing 30 percent of your receivables in a one month period ....

Burniece: Right.

Tandon: That's maybe 50 million dollars lost and if you don't have a war chest, because you have been profitable, you don't think you need money.

Burniece: So, the bottom line is that the war and the lack of a war chest got you guys in trouble.

Tandon: It killed us. By the way, it also killed Commodore.

Burniece: Commodore was also killed in that time frame?

Tandon: Exactly the same time.

Burniece: Wow.

Tandon: The same thing happened to them, because at that time, they didn't have much of the U.S. market but were big in Europe. You know, the painful part is we were very profitable and had the most fantastic products. Our computer products were really amazing ….

Burniece: Did you end up selling any of your assets then?

Tandon: There were no assets. What assets does a computer company have? <laughs>

Burniece: Well, you've got the design and the best product but nobody wanted to buy that product from you?

Tandon: No, because the design was IBM compatible. We had some intellectual property and did our own chip set but everybody else got their chip set from the outside. We did have our own power supply and our own BIOS [called Phoenix BIOS]. By the way, that team left and started Award BIOS.

Burniece: Is that right?

Tandon: Yeah. They were my people. <laughs> and we had tremendous technology on the PC side. You know we were the first people who started putting write cache into a PC. We were so far ahead, it was not even funny.

Burniece: Well, it seems like those kind of things would've been something that you could've sold as assets.

Tandon: Well we were in Chapter 11 almost for more than a year

Burniece: Were you then in Chapter 7?

Tandon: Eventually.

Burniece: Yeah, okay.

Tandon: That was a mistake – our Board made the wrong decision. I didn't want to do it but at the end of the day you finally get tired and how many people are going to continue to fight?

Burniece: Right

Tandon: I felt we still had a good chance of coming out of bankruptcy and consolidations happen in this business. We weren't that big, if you look at Tandy and Commodore. Those casualties are going to happen in this business and we also had a product called Data Pac, with a removable whole drive.

Burniece: Was that the one you did with Kalok?

Tandon: No, you are talking about JT Storage (JTS). This was Data Pac

Burniece: Was JTS later?

Tandon: Yes. We won many European awards and Data Pac was the biggest selling computer in Europe at one time. In fact, you should have one in the Computer History Museum, because the whole drive could be removed and you could carry it with you.

Burniece: You called that a Data Pac?

Tandon: Yes.

Burniece: All right. We should probably take a look at that but first let's finish with Tandon Magnetics, which at this time was now basically gone

Tandon: The Tandon Magnetics name was changed a long time ago, when it became Tandon Corporation

Burniece: Ok, so it was Tandon Corporation at that point.

Tandon: Yes, in 1994 ,,,,

Burniece: So, in 1996, you founded a company called JT Storage with Tom Mitchell. Tell me a little bit about that.

Tandon: We didn't create that company. There was already a company called Kalok. **It** was a disk drive company [that went bankrupt in 1994 and JT Storage took over the assets]

Burniece: I knew both of the [principals at Kalok - Steve Kaczeus (CTO) and David Pearce (CEO)].

Tandon: You knew David Pearce? He was previously the MiniScribe CFO.

Burniece: Yes.

Tandon: David Pearce had a good concept for a three-inch drive. Of course, 3.5 inch became standard later on. <laughs>

Burniece: Right

Tandon: They wanted to do a three-inch drive, not a 2.5-inch, and I liked the concept, because it had more surface. The optimal size turned out to three and a half inch, however, not two and a half inch, I put in a little bit of money and because of my reputation I was able to raise a significant amount of money for the company. I was not interested in running it but fortunately at that time Tom Mitchell was available so just after I got the money, he came over and he took over the company as CEO and I also stayed with it.

Burniece: So how long did that company last?

Tandon: It lasted about four years.

Burniece: Okay.

Tandon: We initially did pretty well. Compaq and Western Digital put in some money and they both got all their money back. Then we acquired Atari, because they had cash, but we got trapped, because they also had lot of debt. But at that time, we needed the money, so we acquired it for 60 to 70 million dollars' worth of cash and it went public. We were doing good and then another casualty wave came. That's the time when Conner got nervous and sold to Seagate. Quantum then dropped out of drives and Micropolis declared bankruptcy. You know, that was bloodiest thing that happened in the industry. I don't know if you remember that or not.

Burniece: Yes, I do

Tandon: The 1996 - 1997 time frame.

Burniece: Right.

Tandon: I mean, it was blood all over. <laughs>

Burniece: Yes, it was. That was a major consolidation time, no doubt about it, [I had just left Maxtor as SVP of Engineering in 1994, after 25 years in disk drives, and started consulting].

Tandon: That's the time I think, when it was difficult to survive.

Burniece: The industry went down from over 60 disk drive companies in 1990 to just three today.

Tandon: Yeah.

Burniece: It all happened in that time frame.

Tandon: Yeah, every time a bunch of them went away [it got tougher to compete].

Burniece: Talking about consolidation, your brother told me a little bit about the company that you call Celetronix..

Tandon: Yeah.

Burniece: That was a consolidation of all the things that you had in the family, correct?

Tandon: Yes. By the way, while I was at JTS it was not full-time. Tom Mitchell was running that. We were still doing heads but we were also doing some RFID stuff and a few other things. Then, all of a sudden Mitchell started his own company. I don't know if you knew that or not but it was very successful.

Burniece: Yeah. he had a company I think in Thailand.

Tandon: In Thailand, yes - Fabrinet.

Burniece: We've been planning on interviewing Tom Mitchell for a CHM oral history, by the way.

Tandon: So, about that same time I looked at our family business and we had this little operation. Electronic Manufacturing Services (EMS) that was becoming pretty popular. That was really a new way of doing things and there was some concern about China taking over all manufacturing. Every few years people get concerned about China and they were at again.

Burniece: There's still a concern about China. <laughs>

Tandon: That's what I'm saying.

Burniece: For good reason.

Tandon: You know. if China shut down today, Apple would probably go out of business. <laughter>

Burniece: Right.

Tandon: We thought EMS [Electronic Manufacturing Services] would be a good idea, because we had the most experienced manufacturing people in India and had been doing it for the last 30 years. So, we consolidated everything and raised a bunch of money from people I knew, like Dick Kramlich and Flextronics. Even though we would be competing with them, Flextronics put in some money. I said, "someday you will have a chance to merge with us because you currently have no presence in India." We had a pretty good run at it and built a company within 4 years to 450-500 million dollars. We were supplying power supplies to Apple but the big thing we were doing was making set-top boxes.

Burniece: For cable TV?

Tandon: No, EchoStar – for satellites.

Burniece: Oh, for satellites.

Tandon: How that happened was my entire engineering team at Tandon went and joined EchoStar to do all their engineering. In fact, EchoStar was basically started with those guys, so the chief engineer and CEO had worked for me. I said, "hey, we want to take you to India", so we got the business and started doing it. We were doing pretty good but we found out that the EMS business is a very tough business. Its margins are like the grocery business. If you look at Flextronics, Jabil, SEM (Streamline Electronics Manufacturing), those guys work on two or three percent margins and their market values are one-tenth of their revenue.

Burniece: Mm, one-tenth?

Tandon: Yeah. You look at any one of them.

Burniece: Wow.

Tandon: So, if they do 40 billion dollars, their market value is only 4 billion dollars and they can make money for a few quarters but then they lose. If you can keep the company small enough, you can control it enough to do it, but when you start getting that big, with big contracts, they don't want you to make money. If you make things for Cisco [for example], they let you make money only from what you can squeeze out of the material. <laughs> That's about it.

Burniece: Right.

Tandon: Unless you are Foxconn or somebody who has a little club, where are you going to go if you don't buy it from them? They are very vertically integrated and make their own materials. I wouldn't be surprised if they own the mines one of these days. So, we found out that it's a good idea to make some money for the investors. Fortunately, we weren't even looking for a buyer but Jabil came along and said, "We'd like to buy you out."

Burniece: So, Jabil bought it?

Tandon: Jabil bought it and we made money, so it came out okay.

Burniece: When was that?

Tandon: 2006.

Burniece: So. most of the remnants of the businesses that you started, from the time you were building floppy heads all the way up to PCs and the family business building things in India and Singapore, were now basically gone, right?

Tandon: No.

Burniece: So, is your family continuing to do work?

Tandon: Yes, we still have a business within Celetronix in the memory and DRAM business.

Burniece: Oh, the memory business. So that is part of Celetronix?

Tandon: That is part of Celetronix.

Burniece: Okay.

Tandon: We had developed a technology where we can repair DRAM.

Burniece: You can repair DRAM? Are you talking about bad cells that you somehow restore?

Tandon: No.

Burniece: Did you patch around the bad cells?

Tandon: We don't do that now but we were doing it at one time. That's how we got into it

Burniece: Okay.

Tandon: Let's say if one chip has three bad bits and another one has two bad bits, we would take the two chips and make one good one.

Burniece: All right, so you make one good chip out of two flawed chips.

Tandon: Yeah.

Burniece: Okay.

Tandon: Basically, you don't need to do that in flash because with flash you over-provision. You cannot downgrade the DRAM, however. So, we took multiple flawed DRAM parts and made modules for gaming people. Jabil didn't want it, because they didn't want to get into the retail business, Once you are in the OEM business, you don't want to also get in the retail business.

Burniece: Okay. So that was a piece of Celetronix that they didn't want.

Tandon: It was the piece they didn't want, so we kept in the family but split it out between my two brothers, independently doing their own businesses. Some of the things they do together and have had a very good relationship with Micron for many years.

Burniece: Is that still going on?

Tandon: That's still going on, yes.

Burniece: Fantastic. What can you tell us about your son's business?

Tandon: Well, that's the most promising business. <laughs>

Burniece: Great.

Tandon: In fact, I feel good about it that he's going to do lot better than I ever did. <laughter>

Tandon: For a father it's a good thing, right?

Burniece: Yes <laughter>

Tandon: He actually started a company called Xavient.

Burniece: Okay.

Tandon: When we were making set-top boxes for EchoStar, we needed some software work so my son put together couple of software engineers and asked "how can I help you guys." After he started doing that we sold the company to Jabil. He stayed on and built a very big business. His customers include Comcast, EchoStar, and Charter Communications.

Burniece: So, he has got some really big customers and this is a software services company, right?

Tandon: He doesn't have a customer with a market value of less than 50 billion dollars. <laughs>

Burniece: Wow! Good for him.

Tandon: So, he's doing well

Burniece: Well, I guess the "chip off the old block" adage is working there.

Tandon: Well, we must've done something right. <laughter>

Burniece: Well, I think he probably learned a little bit from his dad.

Tandon: Yeah.

Burniece: So, any other entrepreneurs in the family that you'd like to talk about?

Tandon: Well, I'm not directly involved in anything with the family, which means I don't want to be responsible for the payroll. <laughs>

Burniece: Right.

Tandon: But I help my brothers on the business whenever they need me and sit on the board of my son's company. I advise him and help him, whenever he needs it. I have also been making several investments. Some of them are done well.

Burniece: One of them I know very well is Enmotus.

Tandon: I think Enmotus is going to do well.

Burniece: Yeah, I think they're going to do well too.

Tandon: When they came to me, I knew this was the right thing to do, because hybrid is the way to go, They just have a very eloquent way of making a hybrid.

Burniece: Yeah, they do.

Tandon: I don't know how much you learned about that company.

Burniece: Well, I knew quite a bit about it early on but I haven't stayed very close to it lately. When it first got started I talked to them often.

Tandon: I talk to them pretty much every day. We share notes and I advise them, whatever I can. There are basically three partners in it - Andy Mills, Marshall Lee and my son

Burniece: Oh, is your son involved in that one also

Tandon: He's not directly involved. I'm involved on his behalf.

Burniece: Okay. Got it.

Tandon: I wasn't that keen on making the investment myself but we have done some other things together. By the way, we are starting another fund, me and my son, and we'll be looking at some opportunities where we can kind of get some new companies started.

Burniece: What kind of things are you going to be looking for? Are you going to be looking for new technologies?

Tandon: Yes, new technologies. I like to see new things in storage, because I understand that even today, although it has changed so much. I think we are going to have to very actively start looking at it.

Burniece: All right. Good.

Tandon: So, if you come across something which is interesting…

Burniece: I think I may have a couple ideas for you. We'll talk about that later. <laughs>

Tandon: Yeah. Because I think it keeps you young; it keeps you moving.

Burniece: So, you're not going to slow down, you're not going to stop?

Tandon: Well, one of these days I'm going to decide what I want to be when I grow up. <laughs>

Burniece: I have the same plan, by the way, and I think we're about the same age. Neither one of us has figured it out yet, so I Just keep going <laughter>

Tandon: I've also got to figure out what to do. It's not that much pressure, because I'm not trying to make a living or anything. I am just having fun.

Burniece: Well, that's true.

Tandon: Yeah.

Burniece: Do you have any other favorite stories about people that you knew or another story, like the time you only had five people in the company, so you hired a bunch of Hollywood actors to make it look little bigger?

Tandon: There are a lot of stories that come to mind, as well as many interesting people I've met. It is unbelievable, with a lot of characters. One name stands out is Jack Tramiel. What a character. They don't come any tougher or meaner but at heart, a very good man. I dealt with him a lot.

Burniece: I don't know him, so tell me a little bit about him.

Tandon: He was a Holocaust survivor and a self-made man. He started Commodore.

Burniece: Oh, he started Commodore?

Tandon: Yeah, with Irving Gold. Then they had a [conflict], so he got out of Commodore at the right time, with about a hundred million dollars. Then he bought Atari and we dealt with him off and on throughout both companies.

Burniece: Was he competition to you or were you more like partners?

Tandon: We were never competition but he became a partner with me in JTS.

Burniece: Oh, so he was in JTS

Tandon: Yes, because he had Atari.

Burniece: Right.

Tandon: It was always a nice feeling when you think about all the early people in the PC industry, like Bill Gates, Steve Jobs, Mike Markkula, Steve Wozniak. We knew all those people, as well as guys like Mitch Kapor, who did Lotus 1-2-3 and Finis Conner, who was a good friend. All those wonderful memories.

Burniece: By the way, you can help us a little bit there, because we've been trying to get Finis to do a [CHM oral history with Grant Saviers for several] years but he's been too busy [and then Covid hit], so let him know this is a good experience.

Tandon: I think he would enjoy it.

Burniece: Give him little push.

Tandon: Yeah. I'll talk to him. I haven't spoken to him for a while. Did you know his son passed away?

Burniece: No. Recently?

Tandon: No. Finis will be ok.

Burniece: He's definitely somebody we'd like to get.

Tandon: We used to play golf together as friends, when we were not competing in the market, .

Burniece: You did? <laughs>

Tandon: We used to say as long as we don't talk about prices we are fine. <laughter>

Burniece: Wow. If you look back, who would you say were your biggest influences or a few people that really stand out and you either tried to emulate, learn something from them or follow their example?

Tandon: There's no question about it. If you look at my childhood or even until the last day that my father was alive, he was a very big influence on me.

Burniece: Your dad. Okay.

Tandon: Most people I know of think very highly of their dad but I thought my dad was a very exceptional human being

Burniece: Did he live to see a lot of your successes?

Tandon: Yes, he did.

Burniece: Great.

Tandon: I could tell you a story in 1972 or 1973, when I was working as an engineer at Pertec and my salary was $1200 a month, which was good money in those days.

Burniece: Yes. <Inaudible>.

Tandon: I was going to get a big bonus at the end of that time and that was all I was making, so I somehow saved some money and sent a ticket to my parents to come and visit me. I had an old beaten-up Chevrolet and my second car was a little Datsun. My dad loved cars, because he came from Patiala, which is a city in India, where their king used to be known as the King of Rolls-Royces. Rolls-Royce used to send mechanics over there and they maybe had 200 Rolls-Royces. My dad grew up there and was very fond of the Rolls-Royce.

Burniece: Was that his first time they had come to the United States?

Tandon: First time ever.

Burniece: This is like 1972 or 1973?

Tandon: Yes. It was very difficult to afford to come but I was able to save some money and send it. So, both of them came and I wanted to get a newer car, because my Chevrolet was a 1965 and in bad shape. I always bought used cars in those days, so we went to buy a used Buick Skylark.

Burniece: A used Buick.

Tandon: It was just two years old but my dad sort of drifts away, because next door there was a Rolls-Royce dealer. So, he's standing there, looking at the car and he said, "why don't you buy this one?" He was kind of killing me but something hit me and this is true story. At that time, he had no idea that he was

ever going to come back to this country or where the money was going to come from, so I said, “if I buy this one, will you come back again?”

To make a long story short, they spent two, three weeks with us and went back to India. Just after that I started my company. It was doing very well and was just about ready to go public. Sandy Robinson had been calling me and saying “I want to invest in your company.” So, I called Sandy said, “I’ll sell you half a million dollars’ worth of my stock, since I need the money.” I sold Sandy a half a million dollars’ worth of my stock and he made a lot of money out of that when we went public. So, I went to the Rolls-Royce dealer and wrote a $130,000 check for a brand-new Rolls-Royce.

Burniece: <laughs>

Tandon: I then called my travel agent and got two first-class tickets. I sent them to my dad and mom, so that they could come in first-class. Before that they had come in coach. They landed and I picked them up in the brand-new Rolls-Royce.

Burniece: You picked them up in Rolls-Royce?

<**Tandon:** That’s a true story.

Burniece: I wish I had a video of that one. <laughter>

Burniece: What did he say?

Tandon: He was very proud of me, of course. Since that time, he came every year.

Burniece: He did?

Tandon: He came every year because I had money at that time and sent it to them. They always came in first-class and I bought a new Rolls-Royce. <laughs>

Burniece: You bought one every year?

Tandon: Yes, I bought one every year when he was here.

Burniece: Wow.

Tandon: I ended up buying 15 of them. <laughter>

Tandon: Because he liked those cars.

Burniece: Wow! <laughter>

Burniece: That's a great story. I love it. So, what are your proudest moments in your career? If you look back, what were you most proud of in your entire career?

Tandon: You know, we always talk about money but I think maybe lot of people don't know that I had a big impact on what is happening today in the computer industry.

Burniece: You absolutely have overall.

Tandon: At least I feel that way and I'm even more proud of my family. When they saw success, after struggling for their life financially, and the next day they are rich, it throws lot of families off and can do a lot of damage. I kept my family all together and was very worried what kind of kids I would raise, when they see this much wealth. All of a sudden, the kids' minds could go crazy. You'll see people who are self-made and have money but their kids are either totally useless or also very successful. There's no in between.

Burniece: That's true. By the way, how many kids do you have?

Tandon: Three.

Burniece: You've talked about the one son. How about the other two kids?

Tandon: One of my daughters is an attorney.

Burniece: You got your lawyer. <laughs>

Tandon: We got our lawyer and her husband is a money manager. My other daughter has an MBA from UCLA and was a hedge fund manager, but wanted to stay with the kids, so she is not working right now. Her husband is also a hedge fund manager.

Burniece: Okay.

Tandon: So, they all did good. But when I talk about my family, I don't just talk about my immediate family alone. I also talk about my brothers and my sisters.

Burniece: Right.

Tandon: I think you know we ware working-class people. Everybody now is either an engineer, a doctor or some other type of professional and we are becoming a reasonably big business family. My younger brother, Jay, is running a business here. You know my son is running a very large business. My nephews and nieces are all in businesses. Some in the memory business and some in the hedge fund business. One of my brothers is running a pretty large empire in India. His sons are all USC graduates. So, life has been good. <laughs>

Burniece: Well, I would say that's a remarkable story. Just remarkable.

Tandon: Yeah.

Burniece: So, did you ever doubt yourself in any of this? Did you ever feel like you're doing the wrong thing?

Tandon: I frankly never thought about it. <laughs> Everything came out much better than I expected. When I first started the floppy head business, my wife had come from India and was homesick. She wanted to go back to India, so I said if I can make about $200,000, that'll be enough for us to retire in India. As you know, I wildly passed that. <laughter>

Burniece: Well, that was fantastic. What other interests do you have, by the way? Do you still play golf?

Tandon: I have lot of interests. I play lot of golf and all winter I'm skiing.

Burniece: Are you still active skier?

Tandon: Yes - I am still skiing double blacks.

Burniece: Good for you.

Tandon: I'm also very much into yoga but the problem is I'm very much into eating also, <laughter>

Burniece: We all have that problem. <laughs>

Tandon: Every year I go fishing in Alaska and catch some salmon. I also travel a lot to Europe, so I'm actually pretty busy.

Burniece: So, you're doing a lot of things and that's great.

Tandon: Yeah.

Burniece: So, tell me a little bit about the future. What's your vision for where we're going? Where do you see computing and storage in particular going?

Tandon: Well, I think we all know that we are going to be needing more and more and more storage, so there is going to continue to be demand for much larger quantities than we have now, because everything is based on the storage. I know a lot of people who think that disk drives are going to take the backstage but I don't think so, because the price per bit of disk drives is still lower than Flash. You don't need flash drives all over the place [but it is preferred for low latency, primary storage applications]. That's why I invested in Enmotus. My belief is that for a long time the solution is going to continue be a combination of hard disks and flash, with hard drives handling the secondary storage applications. As for archives and tertiary applications, we can't even kill tape, so forget about killing hard drives. <laughs>

Burniece: I agree with you one hundred percent on that.

Tandon: I think there's a long ways to go but hard disk and flash are two different technologies and I won't get into the flash drive business. There is no value add there for me but the flash companies are going to do well.

Burniece: They are going to be totally vertically integrated, no doubt about it, and already are.

Tandon: Yes, they already are and the three remaining hard drive companies are also going to continue doing well, because no one else is likely to enter and their market shares are relatively stable. So, they are not likely to be killing each other.

Burniece: [Seagate and Western Digital each have ~40%share and Toshiba has ~20%]

Tandon: Yeah, there's still plenty of business [for all three, although the unit volumes have been steadily going down]. The problem we had with the PC was there was only one market and If you didn't get Dell or Compaq, you were dead.

Burniece: Right.

Tandon: Everyone had to have one of the two and that's what drove the price. So, if you were sitting in front of the Dell (e.g., when I was with JTS) and the Dell guy said "I'm going to pay you $50" and you said, "no, my price is $54", you could also say "no" to the $50 but either way you were screwed.

Burniece: I've been there and done that. So, what do you think the key challenges are for the computing world and technology in general? What do you think the real big challenges are?

Tandon: Well, I could be wrong here but I think we are squeezing too much out of the old technology and I really don't see any phenomenally new technology coming along. At least I'm not aware of it. The PC was a revolution, when came out - correct?

Burniece: Yes

Tandon: It was a totally different concept and we may have hit a period where nothing revolutionary is coming out.

Burniece: Well, there certainly are some things that are going to be incremental improvements in storage technology, but you've also had some evolutionary things like artificial intelligence that is going to change computing systems a lot.

Tandon: Well, artificial intelligence has been around for a while but so far most of the growth in storage has been squeezed out of the old technologies.

Burniece: Well, no doubt about that.

Tandon: Yeah.

Burniece: All right, I have one last question for you. Any advice that you would give a young person starting out?

Tandon: You know, it's hard to give advice to a young person, when they are doing very well, but on the other hand, not every young person is doing well.

Burniece: Right.

Tandon: While some young kids do well, some of the other young kids get in trouble.

Burniece: Yes

Tandon: The idea of making a quick buck is spreading rapidly among youngsters and not everybody is capable of doing that.

Burniece: Well, that's true

Tandon: It's just the same that every kid is not going to be a professional golfer or basketball player but everybody wants to do something special and if they take that route, sometimes they can ruin themselves, because they didn't get there. Entrepreneurship is very difficult, so you don't want them to say, "I want to be an entrepreneur, so I can make lot of money." That doesn't work. So, my advice to young people is forget about making the quick dollars. If they have a fantastic idea, you don't want to encourage them to make something, just because they can do it. No company fails because they could not do what they said they are going to do. They fail because nobody wants that product.

Burniece: Right.

Tandon: That's where people go wrong.

Burniece: Yes.

Tandon: I have never seen a company fail because technically they couldn't do it but they will fail if they can't sell it,

Burniece: There's lot of truth there.

Tandon: We always see how many people made it, but we never see how many people got ruined.

Burniece: Well, it's a very high percentage.

Tandon: <laughs>

Burniece: Any other last thoughts?

Tandon: I'm going to continue to do what I've been doing.

Burniece: I can believe that.

Tandon: Unfortunately, I don't know much else to do. So, if you know anybody who has really good ideas and is looking for money, we can always look at that.

Burniece: Great,

END OF THE INTERVIEW

