

LSI MEETING - FRIDAY, SEPTEMBER 8, 1967

Attendees: R.N. Noyce (RNN), T.H. Bay (THB), G.E. Moore (GEM), R. Seeds (RS),  
J. Sanders (JS), J. Larkin (JL), M. O'Shea (MO), B. Schriener (BS),  
J. Sentous (John), and J. Hulme (JH).

MO This is the LSI Story.

JL Speaking of LSI ... Schriener's graph, X Axis is the number of different unique designs that will be required per system.

RNN Are you assuming in the hundred thousand dollar design, for instance, that you are designing the entire system?

JL No, this is a micro-matrix complex.

RNN 150 gate function?

JL Right.

BS Right ... an up-down counter or something like that.

RNN One 50 gate function?

BS Right.

RNN Then, what you are saying is that to compete with the discrete design ... then you have to ship 5000 of that particular design over it's life?

MO I believe that is about 170 ...

BS Yes, about 170, that's right.

RNN No, I was looking at this crossover.

BS The cost per gate is plugged into the system. The cost of the gate in the system. We tried to make the thing look pessimistic for array. We chose the numbers deliberately. There's an argument that goes ... that anything that you can put on an array you can put on an optimum circuit and get much better yield in the factory and thus have lower manufacturing costs, so I took forty cents a gate cost in an array.

RNN Ten cents a gate cost in the optimum circuit?

BS Yes, and then it goes, maybe we do a 50K design and we get it down to 20 cents a gate and then we really go all out for a yield improvement you do a 100K design and you get it for 10 cents a gate. Then you say, well what does it cost a guy to plug that gate into the system. So you just amortize the engineering cost and get some feeling where the array can compete on the market.

RNN Ok. Basically, what you are saying, assuming a three thousand dollar design for micro-matrix ... these are competitive in the range of 150 to 5000 units?

BS Yes, certainly competitive in that range ... and this is taking a fairly pessimistic cost on the gates, at 40 cents a gate, that's pretty high. I certainly didn't slant this in the favor of micro-matrix.

JL I think we've all been through this and we understand that somewhere from 10 to 30 thousand units ... it would pay to go to a complete custom design in optimizing for a specific function and somewhere within 100, 200, 500, a thousand units, which will be more our decision, it will still be more economical for a customer to design special functions.

Now ... the second page actually represents the revenue per quarter from limited LSI which we have defined as under 10,000 units over the life of the device.

RNN So really what we have to to have is turn-around time?

JL Whoops ... they're not in the same order as I thought they were.

MO I believe it is further back, about four pages. No, that's units. He didn't get to read the updating .. that's the trouble.

BS Let him look at your copy, Maurice.

JL What we thought we would present were the results, and then we'll go back into some of the assumptions, which is what we want to get agreement on. Limited LSI we could relabel micro-matrix actually. Bulk LSI are designs that will sell over 10,000 in the life of that product. Now, engineering revenue as it is depicted here, was the result of Maurice taking net design factoring in our mistakes, customers mistakes and reworks ... well, at any rate, applying the number of mistakes which we would make on customer's design and that we would therefore have to redo, he comes up with gross engineering designs, he multiplied the next curve which is the estimate of engineering design fees versus time, times gross design. Now, this comes up with engineering dollars which, I think, are a very high estimate.

JS I don't have that curve either.

MO Is that your second curve Jerry?

JS That's my second curve.

JL What's your third one?

JS Engineering design fee.

JL So, if you want to think of this as Maurice's engineering fees, that he shows here as being very large, and then we'll rework it back to a net engineering fee.

THB This is dollars per design?

JL That's right, per design.

MO I think this is a key point and it's something that, as a company in the marketing aspect is, I think, going to be very "key" to us. That is, what is our policy on designs that we bring in which are defective from the customer ... does he pay for them ... how does he pay for them. Now there's two viewpoints to this ... the first one is, classically he has never paid for them ... he's made a mistake ...

THB He's paid for them but he doesn't recognize it because it is his own people's training that he is paying for primarily.

MO Right. Now, the point though is ... that many of these mistakes are not found until after we've gone through simulation and many of the other activities that have to go on in Bob's and my area. Hence, we have to capitalize to handle these designs, I mean in a sense that we have to put in enough equipment and people to take care of these gross designs.

BS Yeah, I think you show that on this other curve real clearly.

MO Right.

BS This is the net finished design that we got as a marketing projection. By net designs finished, we mean these are the designs that actually result by volume parts being shipped. Okay, now then we said that on the average that the customer, say out there in the middle of a period of time, could go through two designs to get the one he really wants. We give him a design and he looks at it and you send him sample parts and he says, "Gee, that's okay but I want to put another gate in here" and he sends it back. This looks as if we made a mistake in the logic and this leads you into going over here.

RNN Yes.

BS So we have to do it over again. The assumption was that you would be doing this on the average of about twice before you had the final one you want. That might be even optimistic. But our theory was that he would pay, if it was clearly his error, in terms that his logician made a mistake and he asks us to redo the design, he would pay for it again. Still we factored in that, plus the amount of time that we would make mistakes ourselves but we couldn't charge the guy. We goofed up in art work or something and we had to do it over again, and that was plotted up here. This says that, at the beginning we goof up about 20% of the time and way out here we goof up only 10% of the time. But you take these two curves and multiply by the net designs finished and you get the gross designs that we have to be able to handle at any point in time.

RNN Yes.

BS A question did come up as to how much engineering revenue we actually get because I think in this net revenue curve that Maurice plotted, he took the gross design less our mistakes and multiplied by the average figure in revenue which is not exactly correct because, in a large percentage of the cases, it may be a very simple thing the customer wants changed. Supposing all he says is, "Look all I want you to do it change these two pins around".

RNN Right. You can start with the original data.

BS Yes. So the net revenue is probably a little bit on the high side because that wasn't clearly defined at the time the curve was plotted.

- JS Jerry, didn't you think it was significantly on the high side?
- JL Yes, definitely, especially in the early stages where we are talking about 25 or 30 thousand dollars per complete design.
- BS There's where your going to get the customer to argue but when your down to the point where he's only paying three thousand dollars for a complete design, how much is he really going to argue.
- JL There, it may be three for the initial and two for the rework.
- BS Yes.
- JL But when your at \$25K you are not going to charge \$25K for the first time around and \$25K for the rework.
- BS But that happens to be the point in time when the engineering revenue reaches these staggering sums and is the critical time we are worried about as to whether curves are really accurate.
- JL Yes, but the engineering revenue is blowing up just proportionately the early revenue.
- GEM Is this your estimate? Your estimate is the ...
- JL This is my total in the early days. My total in the early days is below your engineering revenue.
- MO I think this is important ... I think it's something that we ought to come away with a collective viewpoint. I think from the money standpoint, if we can get this money, we want to get it because in the growth rates that we are talking about in the rest of this plan...we have to get that total.
- JL I agree, if you can get it you want to get it but I am saying that when you are charging someone 25 or 30 thousand dollars for micro-matrix, your not going to be able to wack him for another 25 or 30 thousand.
- RNN How about five?
- BS Yeah.
- JL Five maybe five now ...
- JS Wait a minute, wait a minute ... how many of those initial designs are we going to be doing when we start out?
- JL Let's say two a week when it starts out.
- JS We're going to do two a week?
- JL Yes, that's net.
- JH So half of them will be replaced ...

JL: No, No, that's net.

JH: Fine

JS: That's for the first year, then could we assume 105 designs?

BS: No, not quite because these are rates. At the beginning of '68 we would like to start off at the rate which would get us a hundred designs done. But you see, it's moving up pretty steady ... you would have to integrate.

MO: I've got that integration.

BS: Have you?

MO: Yes.

BS: But the point here is, that to get a net throughput of 100, I would have to be starting about five hundred a year or about ten a week.

MO: At the end of the year you would finish 220.

JS: For the first year?

JL: That's net.

BS: Right.

RNN: Then the total cost of having done this is what? Have you projected that out?

MO: No, we haven't yet, Bob.

JS: But you have projected the revenue you would get from it?

JL: Right.

JS: What did you say the revenue would be?

MO: Well, the reason we did that was because we want to get the assumptions.

JS: Yes, but the revenue that you used Maurice, you took the 500 gross designs times the engineering fee. Correct? .... Or did you take the 500 less the Fairchild errors?

MO: Five Hundred minus the Fairchild errors.

JS: And your assuming that the Fairchild errors were of secondary importance compared to the customer errors.

BS: Yes.

JL: Yes, by far.

MO: Yes, compared to the numbers used ... but weren't ignored. We went through the mathematics.

JS Yes, but I think you said that the customer would be wrong ...

RNN More often than us ...

JS Yeah, but I think you said we would be wrong 10% of the time and he was going to be wrong half the time.

RNN More than half the time.

JL Right.

JS Well, the point I'm getting at, if that's true, your saying that if you have 440 ... 450 designs that the customer starts with to get about 220 out ... then I question that we will be able to find enough customers, who have 30,000 dollars to pay for their own mistakes ... in other words, I'm sure that ...

THB With enough to pay even the first entry fee.

JL Even the first time.

JS Well, I think we can find them when you start 450 designs ... 450 designs ...

RNN 450 designs for 45 customers.

THB That's a lot of designs.

JS That's an awful lot of designs and I think we're going to have to ...

MO Don't forget this is all per year now.

JS Yeah, I know, but when the customers don't change and you get the same customers every year ...

JL But in '68 it starts at 30 and finishes down closer to 15 so ...

JS Well, the point still is, when you go out to start to find guys who are going to fund you 30,000 dollars to do a design and you've got to find 450 of them ... or 220 of them ... I know we can find the 220, but when you start to get past the first numbers of those, the number of guys that are going to be willing to pay 30,000 dollars for mistakes ... are going to be very small. I bet you can count those on the fingers of your hand. I'm sure there are customers like Burroughs who will pay everytime they make a mistake.

MO Well, what's ...

JS But there aren't that many customers like that.

MO What's been said Jerry, is that in '68 ...

RNN How much is it going to cost ...

JS Parden me?

MO In '68 we'll average 20K.

RS That system is not going to be operational until the middle of next year.

John Yeah, I don't understand what you mean.

RS We've already ordered the graphics terminal.

JH That's all though.

John What else?

JH The computers.

THB Oh, he means, your talking about ...

John Graphic display.

MO Because when you switch two ...

John Two which?

JH Just ask Jerry Sanders.

RS Yeah, but one of them is coming back down here.

BS & MO Eventually.

THB That's not because of unwillingness to order the damn things, that's because SDS kicked us in the head. So now the ground rules have changed and we're not getting a graphic display working.

JH How long will it take us to get them, after we order them?

THB Well, the 1130's are ordered.

JH How many?

THB At least two.

JH Oh, I didn't know that.

RS The second one for you guys. They are coming in with the second display. So there is a system integration up there but as soon as the thing is operational you get it down here.

MO That's right, but that won't ... that system integration, according to Mays won't be complete until the end of '68. On a time shared basis in the 44.

RS But you don't need all that bull shit to start using it for layout.

MO He needs it up there to get the software checked out so system three has to be ordered for Mt. View.

THB No, that's never been proposed.

RS I don't believe it myself.

JS Why does he need two systems up there?

THB He's got two ... he'll have three at that point.

BS Yeah, but he's getting rid of the 2250 isn't he? That graphic terminal?

MO Yeah, they cleared that.

RS It's gone already.

MO Well the solution then is to go ahead with this.

THB Yeah, but in addition give Bob and I the inputs on ... what you are saying is we should have an order of forgetting this ... etc., etc., ...

MO And so it ended!