THE ROLE OF THE MANUFACTURER IN AIR TRANSPORTATION PLANNING

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Abstract

This lecture deals with the role of the aircraft manufacturer in the airline industry. The process will be illustrated by using a fictitious airline as an example--that is, a case study approach with "Mid-Coast Airways" serving as the example. Both in slide form and with supporting papers, a brief history of the airline, a description of its route structure and a forecast based on econometric analysis are presented. Once the forecast rationale is explained, information will outline the requirements for additional aircraft and the application of new aircraft across the system using alternative fleet plan options. The fleet plan will be translated into financial summaries which will indicate the relative merit of alternative aircraft types, or operating plans.

I'm going to talk about the role of the manufacturer in the aviation and commercial field with particular emphasis on the marketing aspects of commercial aviation.

The last time I looked, our advanced research and systems group had several proposals in various states of preparation or submission to NASA relating to a broad spectrum of projects. These included retrofit programs for the JT3D/JT8D engine, two segment approach programs and studies, experimental STOL vehicular development proposals, composite materials for STOL aircraft and a whole host of wide ranging projects. Now, this relationship has been going on for some time but it's primarily been handled by this group which has previously been part of our military organization. We recently reorganized and brought into an overall marketing structure of what was formally our military sales group and is now called government marketing and I think the emphasis or the shift in NASA's approach to truly commercial problems signals a change in our company where we now, and I represent the commercial side strictly, will be dealing more and more in these kinds of problems. We are presently supplying people to a task organization to conduct a funded STOL system study and I'll talk a little more about that later. But, I think the shift of NASA's interest into

commercial programs of large scope signals or represents growing awareness on the part of the Federal Government through sociological and economic problems and I think that this interest is needed and certainly welcomed by the manufacturers and a discussion I had some time ago with a representative of the Port of New York Authority, he mentioned that the area encompassed by their jurisdiction crosses over some 1500 different political and labor entities and so I think that if we are about to achieve an effective STOL system we certainly need policies and institutions of the highest level for the federal government to cut across these jurisdictions and interests to establish an effective, viable, system where we can have land as required where we can develop safe control techniques or systems. I think that it is particularly important, however, that we recognize that if we are to achieve true sociological and technical advances that it has to be done recognizing the economic constraints that are applied to both the aircraft builder and the manufacturer. We're talking now about programs where the development costs exceed the net worth of the companies that are asked to develop the vehicles. The inability of private institutions to financing these entirely such as the programs of the SST and I am sure that

this will apply to any future major system development, demands that we get better ways of financing funding programs of this type. The second thing in these economic constraints applied to the users of the airplanes and if you look at the foundering of the SST program with the prolonged delays and high speed rail development in this country there is a doubtful future of aircraft like the Concord and I think you can relate more to the fact that those systems have yet to prove their economic merit than you can to ecological considerations although the ecologists may take credit for torpedoing the SST program. I wonder what the outcome would have been if that aircraft really had the economic promise that more conventional aircraft have.

I think that it also is important to remember that whatever the Government does in terms of establishing policies and institutions to assist the industry we have to remember that it will be accomplished through private enterprise, that's the builder and the airline and the banking institutions.

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Q. Are you stating that the Congress was aware that the SST did not have the economic problems?

A. I think that there are many people that seriously questioned the economic viability of the SST. They certainly knew the Concord was not as economically attractive as the U.S. SST, but the cost of the airplane and the technical unknowns about its terms of maintenance and reliability I know had the airlines concerned. I think that that is a big part of the problems involved. If the airlines had aggressively stated the case and I think that this was part of the problem of the entire SST presentation that really wasn't marketed very well. My hunch is that is was because the economic benefits were very difficult to prove.

Q. Are you suggesting that there might have been some kind of a consensus that it was not economically viable.

A. That may be too strong a statement, but in discussions that I had with various representatives of airlines the common theme was concern, doubt as to whether it was really going to be a money problem. That kind of question as far as operating costs, seat mile cost, etc., were never in question with the 747 or the rest of the subsonic airlines and you see now in the Concord to a much higher degree and it's a much smaller airplane, rising price tag.

Q. Of course, that was not a secret that -

A. That's right, but I think the focus was on ecological aspects and the noise factor.

Q. I think that it was also a question on timing, too. Maybe the airlines would have been ready for something like that.

A. Well, that's right, they were saddled with a tremendous investment for 747's and DC10's and L-1011's all at the same time or just preceding it. And then, you throw on that an economic recession starting in '69 when all airlines were all in trouble anyway. All I'm suggesting is that when your technology enables you to propose certain kinds of vehicles, I think that it's essential that those vehicles offer some sort of economic incentive to the user otherwise you might find that the operating costs are so high that they are not marketable.

Q. We followed the vote very closely from the Aeronautic Space Council Staff's point of view on the SST and several votes throughout its history and my observation was that the final vote was more of an economic vote than an ecology vote. The Congressman who had initially voted in previous years against it on ecological grounds was now convinced that the threat was well enough defined to vote against it,but on the other hand, and it wasn't necessarily concensus, but there

was a big uncertainty and they just didn't have the right answers from the manufacturers or the Government on the economics of the aircraft.

A. Although that didn't get us many headlines.

Q. Oh, no, the papers picked up the ecology issue.

A. That's correct. Since 1920 when the Douglas Aircraft Company was founded, we've watched the phenomenon of commercial aviation grow from an experiment to a national necessity of the first priority and because of this growth there has been a great many entrants into the manufacturing field, very few of them have survived. There are three manufacturers today in the United States competing for commercial markets: Boeing, Lockheed and McDonnell-Douglas. Each of those companies has the productive capacity to satisfy close to the total demand. So we have an industry that is characterized by over capacity. This means that the competition between builders is intense. It's resulted in very spotty earnings records through the years, not only for the three that survived, but for previous entrants. It means that there's tremendous competition between them for product differentiation. Each one strives for higher speeds, more passenger service features, larger capacities, all those things that drive development costs upward, at the same time

price competition working to keep the margin between costs and sale price very narrow. It also drives the break even point of the aircraft much higher than the builders would like to see it and this competition is passed on to the airlines because as a regulated industry where they are regulated in respect to what they can charge for a seat to the public they too seek product differentiation and they seek advantages that they can advertise in order to maximize their share of the market. So we have a combination of high development, high competition between both builders and users and it might be argued that what the industry really needs is either fewer competitors or more regulation within the industry. But, I would argue that given those as problems we can still say that the 707 and DC8 are better airplanes because of that competition and that the 737 and the DC9 are better airplanes because of the competition and that the L10-11 and the DC10 are better because of competition. So, I'm submitting that there is a great deal of merit in the basic structure where you have a highly competitive situation in terms of the quality of the end product. I think that one factor overrides the easy way out which would be to control capacity or to regulate it in such a way as to minimize the problems attendant to both the airlines and the builder. One other thing about this competition was the carrier seek or

or the builder seek product differentiation as to the carriers. This means that the airlines are going into re-equipment cycles before their existing aircraft are fully depreciated or obsolete. What I think we need are Government policies which sustain competition, which are aimed at protecting the economic health of both the aircraft manufacturers and the airline.

I mentioned that I am going to focus today on marketing and this is merely the beginning as to where it all started as far as how you go about developing an aircraft. I think that marketing is appropriate here because it is in the marketing area where all the social, technical, economic barriers are brought to focus. It is there that the success or failure of a given idea is going to be achieved. Marketing is also the principal line of communication between the builder and the airline. At Douglas we have a fairly conventional marketing organization. Sales is the most visible group, it's the principal agency of contact with the airline and they are the spokesman to the outside world, but the sales group represent less than 15% of the total marketing organization. The rest is composed of engineers, economists, financial analysts, schedulers, a whole host of specialists that develop and support a case for the aircraft. To this you can add the entire resources of our engineering organization, our legal and contract group and the products support

groups for after sales support. The marketing process encompasses a very large number of men. If we look at the sub groups within our marketing organization we can first talk about our advanced transportation concept groups. Now, this organization is charged with the responsibility of relating technical possibilities downstream against what they see of the environmental needs to be out into the future and they are going out today to about the year 2000. Their purpose is to keep Douglas Aircraft in the mainstream of air transportation and it's easy to get off track as you can see by the number of companies that have been in the field and have somewhere failed to come up with the right product at the right time. We have a similar group relating the cargo development where they're studying the emerging infra structure of inter-modal transport of containerized cargo and their emphasis is todetermine how and when the very large cargo airplane will make economic and technical sense for both this nation and other nations throughout the world. At this point, maybe if we can turn the projector on ....
The advanced transportation concepts group prepared this forecast of world traffic and they've done this in a factor technique where if you say we're at about an index of one here by the year 2000 we're going to be up past 20, which means that there is a great tremendous growth potential world-

wide for air travel. These two lines represent out to this point, the low band and the high band in our market research forecast through the year 1980. Beyond they've taken a number of techniques to extrapolate out into the year 2000. They've used delphi techniques and a lot of intuitive judgement. The band out here as you can see is quite wide so there is, the further out you go in the time the vaguer it gets and grayer it gets, but, even if you assume that the low band is the more reasonable, we're still talking about the factor of 8 times the growth by the year 2000.

There will be a definite break in the period around 1985. I don't know why they did that. It could be that they're saying that at that point of time they can't tell any more but they think that there is a maturing of world markets. The group that I'm responsible for is presently going out to 1981 and these fellows simply take it beyond there.

Another interesting part of this growth pattern though, is what they see as how that travel is going to be accomplished and this is the greatest pointer that I've ever seen. It's very appropriate. What they're saying is that really the classic modes are going to persist clear out into the year 2000 with short range aircraft accounting for about 13% of the total, medium range 19% and transcontinental 13%, interconti- actually coming down, SST is now becoming a very big factor

by that time, long range represents aircraft going some 5000 miles or beyond, equivalent to the 747 or the long range DC10's and STOL now is beginning to emerge as a real factor. I should point out that this is in terms of RPM's. Now you say that 8% of the total may not seem like very much, but it terms of people it could be a great deal. One man traveling from here to London accounts for 6000 RPM's, excuse me, say from Los Angeles to London, and that's the equivalent of say, 20 people going from Los Angles to San Francisco. So we could be talking about a very large number of people but yet generating a few RPM's out of the total.

I think what we're saying here is that STOL and Feeder Aircraft do not necessarily, they're doing the same service but they're not the same airplane. It's a mix.

Q. Is this the world market or is this the domestic market?

A. That's world.

Q. Do you see any VTOL by 2000?

A. No. That did include helicopters.

Q. How do you differentiate the long range and trans-con?

A. Transcontinental is, let's say, 2500 miles.

Q. Is that somewhere in long, short or medium range?

A. This we're talking about 727 type range capability. Out to trans-con 2500 miles, inter-continental is 3500 and long range is beyond that. The Tel/Aviv/New York type are going

above 5000 miles.

Q. If I perceive correctly,you're present short range are in three segments; STOL, short range and medium range on both of the diagrams. Are you saying that the medium to short range are going to be unchanged?

A. But the mix between STOL and DC9 and 737 and the kind of equipment that we are shifting towards. STOL

Q. Does this include charter service?

A. I believe that this is scheduled. Well,no, I take that back. I think it does include charters.

Q. I think a way to look at that is that the STOL Feeder business might be as much as 80% of the day's total.

A. I'm sure it is. You'll see later that I have some forecast of aircraft numbers by type and I think that we're saying that by 1980 that there are some 480 STOL aircraft.

Our Market Research Group is charged with more near term responsibilities and I mentioned earlier that we are working on a funded NASA study STOL system and we have actually assigned or loaned people to a task-oriented group and they're presently going through exhaustive analysis of a major potential STOL system as to what the capture would be within the market. What the trade-offs are in terms of range against surface desireability on the part of the consumer and what the economics of the aircraft would have to be the make of

the craft. It's a rather interesting study and a rather complex one. We went through the same kind of analysis several years ago when we were trying to decide whether to build the DC10 and it all started with an analysis of the potential economics of an aircraft and big discussions with airlines as to what kind of operating costs levels they were seeking, what comfort standards were they after, what kind of improvements in systems in terms of all-weather capabilities and a whole host of trade studies in which you try to determine what kind of an airplane truly makes sense in the market for the period you are designing the building to. Our goal was to develop an airplane that would have as broad an appeal as possible and you achieve this through what we call operational flexibility. This involves a number of considerations, the effective range of the aircraft, its takeoff and landing performance to enable it to work out of a host of airports, the all-weather flexibility, there are a number of keys that we focused on. The total market estimate was very critical to this decision because we knew we were going to invest over a billion dollars in developing the aircraft and that exceeded our net worth, so you have to get to some pretty reasonable estimates of how many of these airplanes you can sell or you are really facing a disaster. When you think of the experience with the 10-11 and the engine problem you find

out how critical this can become. You may recall that at the time we were offering the airplane we said we'd build it if we had a total of 50 firm orders from at least two major airplane manufacturers. We got American Airlines to commit to 25 firm and 25 options. Following that Lockheed, who was also in the race got a spate of orders from TWA and Eastern, Northeast, Delta, and Air Canada, and at that point our program was really on the ropes. United then committed to the DC10 and with that we had our quota. (They bought 30 firm and 30 options). With that we had sufficient orders to commit to a firm program and we started building the airplane. Because of the lead that Lockheed had jumped into we wanted to overcome this and broaden our customer business. We were fortunate in that we had committed to the General Electric Company for our engine development and that they had early in the game come up with a growth version of the CF6 engine. We were able to convert this additional thrust into higher design weights in order to achieve greater range. We now have four models and as you can see, the basic airplane, series 10, which American, United and National are operating today, is powered by a 40,000 lb. thrust engine. It's maximum takeoff weight is 430,000 lbs. and its range is about 3670 nautical miles. When we go to the long range version, the CF6-50C our thrust is gone up to 51,000 lbs.

We can then go to higher design weights, greater fuel capacities and increase the range up to 5300 nautical miles. We also had Pratt Whitney in the competition with their derivitive engine of the JT9-D which produces 50,000 lbs. of thrust and again the same design weights, the airplane is slightly heavier than the GE version so the range is not quite as great but it is actually the next one that will be certified and that will happen this fall. We also went to convertible freighter versions and we've sold those in CF powered versions. They can carry 158,000 lbs. payload for 3150 nautical miles so in the passenger version the range is about equal or in the passenger mode is about equal with the standard passenger airplane, so that's given us additional flexibility and because of this we have now broadened our customer base to 25 airlines. Seven carriers have bought the series 10 airplane: American, Continental, Delta, Lakair is the next one (it's a charter carrier based in London), National has bought the basic airplane, United and Western. Northwest bought the series 20 with Pratt Whitney engines primarily because they believe very strongly in engine commonality. They're a large 747 operator and they felt that the common overhaul line would justify that going to an airplane with slightly lower performance levels. The convertible aircraft has been bought by Martin Air Charter

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which is an operator based in Holland, O & A, Sabena, and TIA and the long range GE power aircraft has been ordered by El Mexico, Air Afrique, Air New Zealand, Alitalia, Atlantus, Fin Air, Iberia, KLM, Luftansa, National bought the long range version for their Miami/London flights and finally SAS, Swiss Air, UTA and Viasa. Now there are a number of carriers that have yet to come into either the 747, the L10-11 or DC10. The competition is very keen for those remaining operators and now we have the A300B, the French-British product, coming into the scene actively marketing in the United States throughout the world within a twin powered wide cabined aircraft.

Q. Do you know the total rack up of the three airplanes?

A. We sold, including options, 240 airplanes. I think the 747 is about 210. I'm not sure on the count.

I might mention here that despite Lockheed's problems, they're tough competitors. I think that their airplanes are going to work fine. They've been hurt because of the engine delays because we've broadened our customer base. But the future looks very bright for them in Great Britain and there are still a lot of people out there who haven't bought them.

Q. As I recall, Lockheed preceded you people in this type of aircraft. Can you elaborate a little bit on that and your view of the 747 and this type of aircraft and why you felt you should go into this type of aircraft as opposed to perhaps some other area. You knew that you were going to get

high competition. It seems to me that when two or three companies are all competing for the same market perhaps they would do better if they would kind of divide their market upsurge. That's an over-simplified way of putting it, but I'd like it if you would elaborate a little bit more.

A. I think there are a number of reasons. One, our growth estimate told us that there was healthy growth despite the immediate problems that were facing us. The 747, we believe, was going to have tremendous passenger appeal and here we were building stretched DC8's that we saw just could not compete around the major routes of the world against the wide cabin airplane, so our choice then was whether to enter it or abandon the field and I think at this point that emotion creeps into it. We just hate to give up without a fight. Secondly, we felt the 747 was oversized for the 1970's. It represented about a tripling in capacity from the standard DC8/707's and this jump and there were reasons why the 747 was the size that it was. A lot of developments on that airplane had been accomplished through the C5 competition. We felt that there was logical gap in size between standard body forms in jets and the 747 that would serve as a better vehicle for less dense routes and that's a compliment to 747 service on off time, off day service and I think we proved right. I think that the airplane is going to be quite successfu

We started out with twin engine air bus and American Airlines had written us back for a twin engine air bus, but when we went around to the other airlines we couldn't find any one else that wanted that airplane. They all wanted more range, more takeoff flexibility. They wanted to be able to operate out of Denver and Mexico City. You just can't do it with two engines and go anywhere so the trade study said that it had to be a three engine airplane. If you go to three engines when you've got the takeoff performance and the enroute cruise performance to go to transcontinental and of course when we got the growth engine we could go a long way.

Q. I have been told that the market analysis groups of both Lockheed and Douglas predicted more than break even sales for both companies building essentially the same airplane. Is that true?

A. Yes, that is true. And I think that the total market is there if we assume that everybody gets an equal share. I think they will. While we've done all this product differentiating we haven't done that without a price either. We might break even here.

Q. What are the numbers up to 500/600?

A. I can't answer that question for two reasons. It's a very closely kept number but at the time of the congressional

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was to reduce their price and they were very successful and sold five of the airlines practically within a week. We met that price and made a comparable reduction and passed that back to American and the competitive factors keep both cards pretty neat. The bankers get involved where they look at your estimates,do they believe the costs estimates of manufacturing. And then in turn do they believe that you are going to be successful. They do have a lot to say about whan an aircraft company can do if it's heavily committed to a long term gap, as to new programs, derivitive programs, developmental programs.

Q. What would happen if you had gotten to a point where you would never break even. What would the banks have to do then?

A. I can't answer that, but I think that it's a pretty fundamental thing, unless you make some money somewhere along the way, you're going to cease to exist. In 1966, Douglas was selling aircraft faster when our bankers forced us into a merger simply because the cost of the manufacturer was exceeding the sales price of the aircraft. Now, what McDonald brought to the Douglas company was a lot of money and there was a lot of restraint on his part as to how to get Douglas Aircraft out of trouble. We elected to middle management and we felt that we had a sound engineering group and a sound basic middle management and they left us pretty much alone with some key people coming in with manufacturers

wondering what they could look at and what we were having some problems with, but within a couple of years we have turned around and we/ve been fairly profitable since and, by industry standards, profitable.

Q. Were you not experiencing a very difficult training period?

A. Oh, yes. We had, I can't remember, I think there was something like 3/4 of the people in production that had been there less than a year.

Q. There was a high turnover as I recall and many people who you were training would work for a couple of weeks and then leave.

A. Turnover was high and experience was low, coupled with some vendor delays of engines and landing gears.

There was a kind of a remarkable recovery but to come back to another question, why did we get in, here is a more current forecast of where we see us going from today up until 1980. It's a healthy growth rate close to 12% per year for total services with a growing in non-scheduled areas as we go up toward 1980. That means that in order to supply that there are going to be a lot of new airplanes built and here are estimates as to what is going to happen to the world fleet composition through the year 1980. There will be a

phase out of the conventional props and turbo props, they'll be down to about 700 by the end of the decade. The DC9, 737, Caravelle, BAC111 still had some growth left in them primarily because operating airlines are still reordering and it looks like we're estimating that the fleet will grow to a maximum of about 1560 by 1976 and at about that time we see those lines closing down and then a gradual decay as we go out into time. 727 -- there is a lot of life left in the 727 and Boeing has done a remarkable job of modernizing that airplane and stretching and increasing its range, making the interior more attractive and it's showing up in the past few months in rather remarkable sales. The older DC8's, 720's, 990's we see phasing out and they've already started going out and will be down quite low by 1980 and the conventional 8's and 707's also starting downhill about now getting down to the low 900's by 1980. To replace that and to accomodate the growth that we have shown on the previous chart, we'll see a remarkable growth in numbers of short and medium range wide cabin aircraft that includes now the A300B, the DC10 twin if there is one or any other competitive twin in the U. S. plus L10-11's and DC10's. Long range aircraft are composed primarily of 747, long range DC10's and long range 10-11's and you can see that there is a lot of aircraft to be built in the next ten years. STOL just emerging will be growing by 1980 to 470 units,

supersonic aircraft primarily. Now the Concord coming in 1976 and we are saying 87 units by 1980.

Q. Would you comment on the USSR?

A. That excludes the USSR. I don't know much about them except that they're beginning to aggressively market in neutral and satellite countries and in some of the countries in Western Europe and they have a pretty good family of conventional aircraft jets. They've got the Illutian family of aircraft, the tri-jets, four engine jets, long range airplanes, YAK-40's. They've got a lot of airplanes and they're trying to sell them. I think they've got some very difficult problems in marketing the Western countries because they have a very bad track record at home and among their satellite nations as far as product support goes. The SST is anybody's guess.

Q. How about Communist China?

A. That's an interesting area, for Boeing, as you know, has had a sales team there and the going export license was granted last week and I think that somebody will sell them some airplanes and we have people in contact with them as well. How much is there and how soon is a difficult question. The country is under-developed in all modes of transport as far as rail and highway systems and it could be argued that maybe air would be the cheapest and the fastest way to get a travel system and a domestic transport building in China

although I don't know their labor costs are bound to be low and maybe building highways would be cheaper, but for foreign international travel they've indicated that they are interested in going into other countries and I think we'll see some action. In the long range the potential is huge, with 800 million people.

Q. What are your estimates as to the passenger capabilities on the STOL feeder jets?

A. That's in the trade study area now, and the last I heard they were talking about 100 seaters. It's very tough to get very good economics with 100 seat STOL aircraft. I think in the long run it might be bigger but then if you do that you cut down on the size of the network so I don't think it's any better now than to just guess from my point of view.

Q. Why did Douglas close the DC8 while Boeing kept open the 707?

A. We just couldn't sell any more DC8's.

Q. I thought that it had the lowest operating costs in the country.

A. It is, the DC8-60. But the problem you run into is one of who are your customers, your established customers? The DC8-61 is not a long range aircraft and I think Boeing production is pretty much limited to their 320B's which is the intercontinental aircraft. Now they're kind of struggling

as well and I don't see so much more in the way of sales for their company.

Q. Will the continued production of the DC8 steal from the DC10?

A. Yes, but if we had had our way we would have delayed the DC10 because we have a very good airplane and a very low cost airplane and we built a lot of them and we're making money on them. Everything argues the delay except the competitive factor with the 747.

Q. You made a reference to the economics of a 100 passenger airplane as pretty poor. Is this an implication that its technology that has to be developed in this area or is this an implication that manufacturing structures are so hard, or have they gotten so big? Has this created a problem, or is it something that just relates to a 100 passenger airplane?

A. I base that on what I understood the study price to be and I think it was somewhere around $12 million. Now you're getting a lot for this, you're getting STOL capability, but with a hundred seats and $12 million the cost per seat mile ran very high so unless you can increase the capacity and once you've got a basic airplane you can stretch it once you've got 50 more seats as this would just improve the seat cost tremendously.

Q. Is the cost of the technology STOL performance as great in the transcontinental area?

A. Sound is one thing, smoke, all weather are all part of the performance. There are a lot of variables and you can compare the costs against all these things and you'll find that you just can't get them for nothing, and eventually it's tested in the market place.

Q. When you say STOL, what band of runway lengths do you mean? Does that include up to 4000 feet (RTOL)?

A. Yes, but we'll say down at 1500, 2000, 2500, 3000 and for each one you've got a different price level and a different engine problem and different augmentor systems. Now let's assume that from our own internal purposes we've got an airplane that needs some real requirements for the future and we're going to go ahead with it but the problem then is to convince the airlines that they really ought to buy it against competitive aircraft being marketed. We see our development sales case as a two faceted problem and the first being performance. We have a large sales engineering group that looks at the aircraft being offered to the airline in terms of the airlines operating environment. We're blessed at Douglas and the same is true of the other manufacturers with very extensive computer facilities that are there primarily because of design and manufacturing requirements but since we do have them we can use them for other things and a lot of our marketing efforts depend on computer support.

When we look at performance of an airplane, we have flight simulation models, which will fly the aircraft over every route that we anticipate the airline using the aircraft and these models compute the allowable takeoff weights, taking into account runway obstacles, temperatures, elevation, wind, they compute fuel burns for the route taking into account any airline ground rules that are in imposed such as enroute, navigational tolerances, delays, reserve requirements of destination, fly through capabilities, it's a very flexible program and it also computes costs for the flight according to the ground rules specified by the airline. So, when we are done with the performance analysis we can go to the customer and with some confidence say yes, the airplane will satisfy every mission which you would ask of it or it will do them all except one, two or how many routes there are or perhaps because of runway lane, all up loading limits on the airfield or routes that exceed exchange capabilities, but anyway the airline then knows what the aircraft will do. But, it's not enough that the airplane can do the job that it has to do in an economic fashion.

That just says that a DC10-10 when compared against a DC8 or 707 has a much lower break even load factor and a much greater profit potential primarily because the seat costs are 25% less. Now it is true that it takes more passengers to break even but if you put in routes where the traffic is

indicated to be reaching levels that will generate some good profits for the airline. This is based on a 140 seat airplane against a 270 seat airplane and assuming a yield of 6¢ per passenger mile and it assumes the transcontinental flight.

Q. Do you mean costs, not profit?

A. That's the fare divided by the number of miles and diluted to account for non-revenue passengers, discounts, etc.

Q. What's the primary reason for the DC10's being more sufficient than the standard jet?

A. It's just a lot bigger and a lot more efficient engine and when you break it down in terms of costs per seat, cost per mile and cost per seat mile, it's just a more efficient airplane and that's the productivity game of the jumbo jets or wide cabin jets are bringing (economy of scale).

Q. Isn't the thesis being advanced that the 727 even with 20% higher SFC that you can have more seats because it costs 30% less per seat comes out to the seat mile operating cost total and that's the interest?

A. Well, what we're showing here is profit based on total operating costs where we're taking into account all the depreciation charges and later on in the financial step I'll show you how interest can effect this total. The original type aircraft we mentioned is.

Q. The 727. It seems that its been hitting the DC10 and

a couple of others head on because of its lower cost per seat encourages 30% lower and because of the economy of scale in the lower SFC of the DC10 and all its tradeoffs don't make it look like its always an economic advantage.

A. Well, we say we'll beat the 727's.

Q. What we're trading off here seems that the airplane costs per chairs is lower on the DC10 but what you're trying to do does not require the larger airplane than the effective seats that you're utilizing have a higher cost than the DC10 and so it's essential that you can't put a big airplane on a low demand market and it's the market that needs replacing.

A. The most critical decision that the airline has is to put the right sized airplanes on routes where traffic will support it in two ways; in capacity we have to have a reasonable load factor and you have to be able to provide a competitive level of frequency. It's a nice balance. Well, so we've proved that the airplane is economic and can make money;there are other ways to improve your competitive posture and one is by offering more comfort and this cross section shows the kind of things we're working with when you're comparing a wide cabin airplane with a standard jet. You get out of the tube, you've got the 8 feet high ceilings, the broad aisles, broader seats, the flexibility that comes under the deck with lower galley arrangements, the contain-

erized cargo possibilities, it's just a much more appealing airplane and the passenger benefits from both of these factors. The airplane can operate under a much lower fare structure than it would otherwise because it has more productive aircraft. The airplanes are more comfortable and are more reliable and have more passenger service features and there are two way benefits. But, even given all this, and I'm coming back to your question, it's a great airplane, it's got a lot of passenger field and still can mean a financial disaster if it isn't matched to the market. What happened to the airlines in 1970 is that they had a tremendous amount of 747's, pre-delivered payments on the DC10's and 10-11's and at the same time a recession occurred and load factors fall out and highly competitive system and there just wasn't enough revenue to cover all the costs that kept recurring. The result was that the industry lost something like 100 million dollars. So, we spend a lot of time at Douglas trying to develop better ways to forecast traffic. Increasingly, as far as forecast in the United States goes, we are relying on econometric techniques and basically we're saying that revenue passenger miles are a function of personal consumption expenditures with the velocity of many being simply the GNP being divided by the money supply. The yield that the airlines charge and the passenger trip length which is

the major service standards. It grows and grows because more and more non-stops services are being provided between cities so that what use to be a 2 or 3 segment flight may now be a non-stop and so that your average passenger trip length is one. Now when we do this, and I'm talking here about forecasting U.S. traffic in total. You're forecasting a lot of other variables instead of the depending variable. We go to the Wharton School in Pennsylvania for estimates of the various economic indices such as gross national product and personal consumption expenditures and then we plug that back in to this variable. The one that has given us the most trouble is yield because its tough to know where yields are going, and I'd defer getting into that for just a few slides because I think that I have a chapter that explains it a little better. But, when we compare what we estimate in the econometric models and this one happens to be a model of the U.S. scheduled service against historic performance where we plug in the achieved explanatory variables we get almost a perfect correlation of the past traffic growth, which says that if you forecast the variables that we are putting into your format accurately you're going to get a very accurate traffic course.

Q. What's the number of years before the actual estimate is made?

A. It doesn't matter when its made. We could make this chart today. All we have to know is what the PC yields, the passenger trip lengths, etc.

Q. Can the estimate be made before the actual or is it a result of correlation of the actual?

A. The task of whether your model is good is whether it can reproduce history. Now the future will only be as good as our estimate of both variables that go into the formula. I should say that those variables are more stable and more subject to analysis than the dependent variable which is RPM's.

Q. So the estimate really reflects the information taken from historical data.

A. The validity of the model depends on testing it against actually what happened in the test. So, using that we can then say that this is a forecast of U.S. domestic traffic and we're coming up with a total of 11.2% for scheduled service within the U.S. These are the eleven trunks. This is the local service plus intrahawaiin and intra-alaskan trunk. Now, we also have models that will forecast actual airline traffic using the same econometric techniques. Now here you get some differences in variables such as what's the historic share of the market, of the carrier within the total industry. But, I've gone here to ficticious airlines because once we get into real airline forecast we're talking about

proprietary information. Now, moving on knowing the forecast, knowing what the airlines are planning to do about its existence, knowing what it has on hand and on order, we can generate a seat mile demand and what current aircraft on hand and on order will supply and this then represents the gap that must be filled by adding on an aircraft and so you can see what Mid Coast, which is a very large airlines, operating both internationally and domestically. We're forecasting a tremendous growth on the DC10 equipments, wide body twin equip, to satisfy the seat mile gap which I had shown earlier. But even this is not enough for an airline to make a decision as they have to have city fare forecasts so that they can relate aircraft schedules to expectant passenger travel. So, we then look at each city pair within the airlines networks and we take into account a host of demographic and social factors, political considerations, competitive factors on their systems and taking historic data to establish a time series. We then project taking into account these influences to come up with a city pair forecast. Once we've done this then we can show how many weekly passengers are expected between each city pair on their system. Given this we can then go to our airline planning group which has got a scheduled planning

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group which has got a scheduled planning and evaluation level which will flow that traffic over the airline system and develop successive aircraft fleet schedules out as far as we care to go and this schematic simply says that on Flight 10 originating in San Antonio and ending Chicago we have 967 passengers in an average week joined by 6 on line connecting passengers from Portland and Seattle, 5 from Mexico City, 23 from Corpus Christi. Those totals then flew to Houston where 695 got off, 1310 originated, 25 connected from Corpus and we got 1647 ending up in Chicago, and we do that for the entire airline system. In short, what we do is develop a liable flight plan and a viable schedule which takes many years of forecasting. Now the model allocates on the basis of looking at each routing and comparing against the total service offered on that route. The variables if it is a daily service, bi-weekly or five a day or whatever it is. The air traffic capacity and the customer attributes of the aircraft, what are the departure and arrival times, etc. Once you develop a rating for that particular flight you can compare it against all the flights being offered in that market and assign it a percentage of the total traffic and that's the way the model flows the traffic. So, given a reasonable estimate of the traffic this is also a reasonable estimate of how that traffic will flow. Once we've developed an operating plan we can then translate that plan into the financial forecast for the

carriers and here we're showing an income statement generated in successive years '72, '73 and '74 for Mid-Coast Airlines where we take into account all the revenues, all the expenses, develop operating income levels and finally net income levels in successive years. This also is computerized and can be generated over night in a very timely fashion. We develop sources and applications of fund statements which show the airlines where the money can be expected to come from and where it will be applied and we can plot then the relationship between costs and revenue over a time frame. This is fairly typical of historic performance by most trunks where they were enjoying very profitable years because of this spread in the middle 1960's and then the tremendous squeeze that was put on them in 1970 and then we're forecasting a return to normal now. I mentioned that the yield is a problem. This reduction in cost per ton mile through the 1960's was achieved primarily because of transition from props to jets. Although we've had larger, more efficient airplanes coming in now in the terms of wide cabin equipment, the productivity gains are not enough to offset inflationary trends so we're seeing 1971 as a kind of water shed year where we're looking at rising costs in the rest of this decade, and we're making a further assumption that the CAB and the airlines through prudent and intelligent fare structure manage-

ment will recognize this rise in costs and adjust fares upward to account for it. If that should occur, then I think we'll see airlines returning to a condition relatively good economic health through this decade.

This shows the picture of the airline and with the event of these new aircraft coming in, how their debt structure is rising to over a billion dollars, but because they're growing tremendously and they're generating profits, their debt equity levels are holding fairly low, just quite a bit lower than they were a few years ago.

Net income. It looks like a pretty impressive gain in net income. Again, the airline is tripling in size, so this kind of level is not terribly out of line and as you'll see on the next chart where we plotted the expected return on investment in the airline where they were down here at practically no return, now rising up by about 10% by the end of the decade. The CAB guide line for a reasonable rate of return from the airlines 12%, so I think what we're saying there is that things are going to get better, but not excessively.

Q. Has the consideration of a four day week entered into any of your discussions?

A. No, sir.

Q. Do you think that might occur?

A. Yes, it sure could.

Q. Are you doing a twin jet?

A. We're talking very seriously about building it, but we don't have it proven, but we are discussing it with many airlines.

Q. If you built your usual quality, twin wide body,do you think you could crack the European market or do you think that they would buy they're own? Will they be forced to buy their own?

A. I might say that some of them would be forced to buy their own and that the preference factor for a European airline for an A300B would be in the order of maybe 15%. Other things being equal you could split the market and I think you would have to bias in favor of a European manufacturer because of the 15%. I think that the reverse would be true in the United States.

Q. Do you think the Civil Aviation Production and Finance Act has solved all, some or none of their financial problems?

A. I'm not familiar with the details of the act.

Q. What is the stopping order of the DC10 twin. Is it the Chairman of the Board; is it a bank not lending the money?

A. It's airline interest.

Q. You can't get 2 or 3 airline orders?

A. I'm not saying we can't, I'm saying we haven't yet, but think if we had the orders we'd build the airplane.

Q. Do you have an idea as to how many firm orders it would take?

A. Yes, and that varies. The Chairman said he would like to have a hundred of them.

Q. How long would it take if you decided to go ahead with this?

A. About two years. We're talking now if we committed this summer. We'd be delivering in late '74, so slightly over 2 years.

Q. Are we going to have 3 companies building them again, do you think?

A. I really doubt it. I think that if we enter it I doubt if Boeing would. Although Boeing might come along with an airplane with a super critical wing or an advanced 727 type or something like that.

Q. You don't believe in a 747 twin?

A. I don't know enough about it. I think that they have to cut the weights tremendously to make an effective airplane with the engine thrust that's available. If you can get the thrust up to say 55,000 lbs., it might be a pretty good airplane.

Q. One more question. Your projections of the passenger miles were that you pretty well assumed that that was all going to be in the long haul of the large jet and that the difference between the characteristics between the large jet and the

smaller type airplane the sensitivities are such that one less larger aircraft means several less smaller aircraft so there's a great deal of leverage there and with a slower less sensitivity (this is one thing that I'm interested in) and the other thing that makes me ask this question is that it looks like a great market in the future are the non-U.S. domestic and non-European domestic but the rest of the world and it seems to me that the market there is for smaller airplanes. Have you looked at these sensitivities and what that means to the profits of the manufacturer? Are the profits low for a smaller airplane?

A. Well, let's tackle the first part first. I assume you're relating to the forecast for MidCoast Airways with the increase of fleet?

Q. No, your general forecast. How many long haul, large jumbo jets are going to be sold and then how many smaller aircraft are going to be sold, etc.

A. We're assuming there that the bulk of that growth and that you're talking about the U.S. forecast is really going to be in the 11 domestic trunk carriers. They represent about 90% of the total productivity of the airlines structure in the U.S. The local service carriers are growing and have grown at a slightly faster rate than the trunks in the last couple of years, but they've got an awful long way to go to really

penetrate or to alter drastically those relationships. Now in that area I would see perhaps quite a shift in the STOL type aircraft, but I guess what we're saying is that conventional aircraft is still going to be doing the lion's share of the work for the next ten years or so.

Q. You didn't say what the future wide bodies are going to be for third generation.

A. I don't really know. I think that there will be super critical wing airplanes, cruising close to Mach 1 and composites, but we're also talking about slow supersonics that swing with a pivotal wing.