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PP: It might be a comment on today that when you say honor, I almost have to ask what does that mean?

BE: Well, what does it mean in our world today? What does it mean by saying, people were straight-forward.

PP: What did honor mean at that time?

BE: To me it meant, as I said, that people were straight-forward. They told you what they thought, they knew what they were about. You could argue with them, disagree, but you trusted them. I think that's the foundation of the word honor in my opinion. What do you say Jay?

JF: I think probably in my meaning it also carried the connotation of being useful, in the public interest, and within MIT something that was innovative and not routine.

PP: My presence here, I'm going to be trying to write about culture and its evolution over time. So I'm interested in trying to somehow make clear to people who might be reading a book about the history of this time what it was like to be operating in that environment. What it felt like as a young engineer or as a person with a vision and an idea about bringing it to fruition. Today it seems like there's many, many more checks and obstacles, and the strategies that have to be trucked into place to get something done.

JF: Well, at that time when we came out of World War II and began the work on Digital computers the general atmosphere of the wartime research still prevailed.

Which was that the main objective was to get the job done, get it done quickly. And there had not yet been created the barriers, and as you say the checks and balances that gradually came into being when in due course enough people began to abuse the system. But it seemed as if those checks had to be installed. Actually, I think they are extremely inefficient and probably do not pay for themselves. But more and more you have restraints of all kinds. You see it in an article I just read today that 25 percent of all of our medical costs go into paperwork, which is essentially the checks and balances and approvals that go with the whole process. There was very little of that in World War II MIT, and not much in the succeeding several years. You go back to the extreme case when I first began to do wartime research around 1940. MIT didn't have a purchasing department, at least not one that dealt with what we wanted. It did not have any kind of security or guard system. So when I wanted to buy something I would call up a supplier and order it, and take an MIT purchase order out of my desk and sign it and mail it to them. And because classified work required guards and we didn't have any guards, I still have my Cambridge Police badge, and I suppose someplace my Cambridge pistol permit so that I cover as a guard.

JP: The work was so cutting edge at the time, and a

small team, that there wasn't time to put all these constraints in place.

BE: Well, I think it's because it was new. And in general if you look at new organizations we start out small. They start out without large numbers of these restraints and restrictions and auditors and whatnot. And as time goes on, people put restraints and reviews in. Partly as a reaction to, as Jay said, somebody does do something wrong. And instead of finding it and getting rid of them and going on, people put in a process to prevent that from happening again. And there are lots of people who do this and like to do it for a living. And in general all organizations as they age and grow build up things that are called bureaucracies, toxic waste or...

PP: Are you equating that?

BE: It's very difficult to fix it after it's happened. You almost have to start over. So I think the advantage we had is that we were able to essentially start over.

JF: Well, also, you see, if you're working at the front edge of an entirely new field as we were in digital computers, there are simply not very many people who presume to involve themselves or interfere because they

don't see themselves as having the competence. I have sometimes said that I think it was much easier to design a North American air defense system in the late '40s and early '50s in spite of the lack of any available technology than it would be to do it today. Because today there would be ten layers of people all of whom would think they could do it as well or better.

BE: That's absolutely right. You know, you mentioned 25 percent paperwork in the health business. John Rittenhouse who runs the defense part of General Electric chaired a Defense Science Board Task Force that was looking at the acquisition process, which people have been looking at the acquisition process for as long as I can remember. And it has only one characteristic and that is that it gets steadily worse, because it's steadily built up. Anyway, he said that their estimate was that 40 percent of the money went to paperwork. That may be a low estimate.

PP: I suspect it is.

BE: And if you just had to write an extra check for 2/3rds of the money it wouldn't be so bad. But this money is spent on buying things and people and activities which get in the way of the relatively small number of people who are trying to get something done.

PP: In Digital's early days where did that boundary start to come into place with bureaucracies maybe needing to be imposed to help control the growth of the company? Sometimes the abuse of a balance is not an intentional misuse of power by a person. It's just the dynamic of so much growth and success that it loses control of itself. I wondered if there was a certain place in Digital Equipment Corporation's early days that it was necessary to create a remedial bureaucratic move?

BE: I wasn't involved in the early days at Digital. So anything I said would be speculation. But Jay was...

JF: Well, I was on the board of directors for approximately the first ten years. Which meant that I wasn't really operating inside of the company. But I would expect that during that ten years it was relatively free of what we're calling the bureaucratic layers. That probably came in later because up through the first ten years the work was rather intimately in the hands of the founders and a fairly small group of people working together. So to whatever extent that problem exists at the present time, and I don't have any first hand knowledge of it, I would say it probably developed in the period after the first ten years, between then and now, in all probability. But again it's without too much in

~~the way of firsthand information.~~ I think one of the characteristics of the atmosphere at MIT that you were asking about a while ago was that the whole structure in the division of sponsored research, which did the work on contract with the government and outside agencies had the characteristic of an organization in which bad news flowed uphill. And that's the presumption that otherwise things were all right and you didn't need to push good news uphill. The idea of bad news uphill was that there would be people to help out when there was a problem. And the layers up to Matt Sage, Sr., who was director of the Division of Sponsored Research, was really the people there to be helpful, and to help solve problems just as Bob was saying about McCune when he was chairman of Mitre. And this is very, very different from an organization in which when there is a glimpse of bad news pressures come down from above and criticisms come down, rather than help and assistance.

JP: Was Gordon Brown of the same nature as Nat Sage? Can you comment on their styles going into your own?

JF: Yes. Gordon, of course, was my mentor and very largely responsible for my career, even up to the present moment, because he's been picking up my work in the last few years and introducing it as a basis for a new kind of junior high school education. And I've been drawn into

that phase of it, partly because of his now extending my own field that far. But there were big differences in laboratories at MIT, and even within the electrical engineering department. There were laboratories in which the research assistants that went in, came out not really becoming very effective in the later world. And there were ones like Gordon Brown's where a very high percentage came out to have major roles in their later activities. And the -- Gordon Brown's laboratory was very effective in developing people's leadership and initiative. It was turbulent. It was a shock to go into it.

JP: Why, because it was chaotic?

JF: It was very free-wheeling. There were a multiplicity of projects. Gordon Brown himself was a project leader on a number of projects. Other people had projects. You had to argue with and stand up for the laboratory director to get resources for your projects in competition with his projects. But he... he had the great respect for the people that would stand up. And became helpful really in proportion to your degree of independence. I think we tended not to have a very great respect for the subservient people. So he encouraged people in their own individual projects without trying to either dominate those projects or closely monitor or

direct them.

JP: Did you feel that too, Bob?

BE: Yeah. I was in Jay's part so I never dealt very much with Gordon although his presence was always felt around the place. I certainly got that impression, there were lots of projects going on all over the place. Lots of interesting things. And Gordon, he had a tendency to push everybody until they pushed back. And that was a measure I think he took.

JP: And you succeeded and you've maintained a good relationship with him to this day, so obviously you did the right amount of pushing back.

BE: You don't need to worry about Jay pushing back.

JP: Well, how do you respond to this comment. Ken said, "Jay was a bashful, yet flamboyant leader full of ideas. Bob was always sober, always right. They made a wonderful team."

BE: I never thought of Jay as bashful. I was not always right either, especially when he was arguing _____. It was easy. He offered me a job. It was the summer of '42. I graduated from Duke, from graduate school, the

war was on, and it was pretty clear I either went to work in the labs or I went to work in the Army. So I said, I want to go to work in the labs, and Jay hired me. So he was scraping the bottom of the barrel. He would have hired anyone. So I went to work for him. We were working on the hydraulic shuttle (?) that he worked on for many years.

JP: You said in your interview before that you placed a high premium on initiative and courage. But that those were hard qualities to judge. How did you find them then?

JF: Where did I find the people?

people
JP: What would you look for, based on the fact that you placed high premiums on those two qualities what would you look for?

JF: Well, a lot of people admitted to the electrical engineering graduate school were admitted on the basis of their applications and references, and with little or perhaps no personal contact or real investigation ahead of time. But... those people that I wanted out of that stream to work with me in the -- originally in the _____ mechanisms laboratory and later in the digital computer laboratory I usually telephoned a number of

references and placed them on the character and what their weaknesses were in the people. And to gather information that wouldn't ordinarily be found in references and to the extent one could then judge their qualities on the basis of getting information from people who knew them. That's the way I found out that I was on the verge of hiring a man who had created his whole personality. He had transcripts from the University of Iowa of high grades. And when I called the registrar's office to ask them questions about it they said, that man is living in California. And sure enough he was. He wasn't applying to my location at all. It was someone else that was applying.

BE: I remember that. You know you read today how very often people don't check resumes. I don't know exactly what it is. One of the troubles though it's very hard to get an honest opinion about somebody than it used to be. You could get sued for it. This is shut off from the _____, real information flow inside the system.

JP: Speaking of the information flow you placed a very high premium on open communication. (And Patrick and I were saying on the way over that there were three things that had come out. You had bi-weekly reports so people had to sit down and have the discipline to report on what they'd been doing and share that with other people. And

of course if they hadn't been doing much that would also be kind of clear one would think. You had teas and you had people, I think Bob you mentioned that people moved around offices and sat in different places so they'd get a sense of what was going on in other areas. On that subject of open communication, it seemed to us that you wouldn't have an agenda at these teas. You'd just have people show up. So it was very clear that the assumption was people had tons of great and interesting things that they wanted to share with other people. Once again a kind of a bottom's up approach.

JF: There were always an ample number of problems and difficulties to discuss. Well, another characteristic, I think of that whole MIT organization at the time was that in addition to the idea of bad news flowing uphill and probably a part of the same general set of concepts no necessity for information to go through channels. That the director of the _____ sponsored research might drop in and talk to people that worked for me. Gordon Brown would talk to them. I would you know, come in at the lab bench level, and look at what people were doing, talk to them about it, even though they worked for someone else. And so there were not the barriers to communication that one sees in a lot of organizations.

PP: When you were talking earlier about Gordon Brown's

lab set-up were there people ever replicating each other's efforts without really being aware of what others were doing?

JF: No, I think everyone was well-aware of what other people were doing. It was not that big an organization. Someone might have grown in his laboratory to 30 or 40 people. But break those up into a dozen projects and they're still essentially all on the same floor. And at that time a lot of the places had open office spaces, desks located in open areas. I think there was a good idea of what was going on. And then later in the Digital Computer Laboratory everyone was playing a role developing a device or doing something relative to the final computer. So that everyone had his task and knew where it fit into the final objective.

PP: So they all had a sort of shared vision of the objective out there somewhere?

JF: That's right.

PP: I think it was your transcript I was reading of a conversation last December, you remarked that people had... the vision and the power to carry it all the way through to the end. When you were just talking about you didn't have to go through channels, it sounded like it

was a very conducive environment to, if you had a bold idea and personal initiative there were really few obstacles.

JF: Well, a part of that you see is that there was a core team there. Bob and I and several others, Bob Weezer, Steve Dodd, who had gone through several projects from basic research to end use in the field before we came to the big job on the Sage Air Defense system. And so there was a team there that knew what was likely to follow every step they were engaged in. And furthermore, expected to go through all the steps and be there at the end. And this makes a very great difference to how you do business. If you are the recipient of what you're doing rather than just passing it off to someone else it gives you a very different feeling for responsibility and doing it right because what you don't do right you're going to have fix later rather than turning it over to somebody else to fix later. This makes a tremendous difference in organizations and as they get bigger part of the bureaucracy that we were talking about before is the subdivision into frozen activities. There are people in research, there are people in design, there are people in development, people in tooling, people in production, people in sales, and those never come together. And every step is done blaming the people in the prior step and creating problems for the people in the next step.

And there's no one, you see, that has any sense of responsibility when you're through. If it goes well, there's no identifiable hero, and if it goes badly there is no one who in fact learns the lesson. Because everyone said well, you know, I wasn't involved, and in fact there was no one that was involved in all of it. So there was not much learning out of mistakes in many organizations. By contrast I think we had an organization that had gone through that whole cycle as a team. And knew what it was like at the other end.

BE: I was going to say that same thing about the team. I think it was very important that it was a team of people who had worked with each other for a long time. And understood each other's strengths and weaknesses, so that you automatically sort of gave the right jobs to the right people, and you knew where to go to get help. And it wasn't a fixed organization. It was this team of people. And you expected the job to change. And the job flowed by and the team configured itself to do whatever had to be done at that time. And that's a very different way of looking at it than most bureaucracies where as Jay says the people own some particular job and they own some particular group, and nobody owns the thing as a whole except maybe somebody so far up that he hasn't got any grasp on what's going on at the bottom.

PP: It's interesting. You've perhaps heard the word empowerment used for organizations. And it has arisen in cases where people are nearly completely without power to do anything. And suddenly they're given more responsibility to see the project from inception to design. Or maybe a step in that direction. I mean to listen to you talk, and I don't have a lot of experience in business, but the last seven years I've been working in Digital and watched even in that short period of time increasing layers of control and obstruction. And as the obstruction has gotten worse we suddenly start hearing about empowerment. I wonder just in general how you might apply the kind of operating dynamic that you had in the '40s to just business conditions today? Do you think that kind of team approach could still be effective in today's kind of very different environment?

JF: Well, I think it can be, and I have been a proponent of this for a long time. I have _____ a classical paper written in the mid-'60s called "A New Corporate Design" that I, in fact, wrote as part of my interest in the board of Digital Equipment and it was revised each year for two or three years as I discussed the ideas with the board. It eventually was published. And it, when it's all said and done, it's essentially bringing inside the corporation the legal structure of the outside world. You start by erasing the idea of the superior subordinate

relationship. Now a lot of people say that can't work. But there is no superior subordinate relationship between your dentist and General Motors. There is no superior subordinate relationship between any of the legal entities in the economy, why should there be inside a subdivision of the economy. Now you can carry that same set of concepts inside in principle, and I think you can in practice, where you see some occasional exponents in that direction, they can be quite dramatic, but it is hard to maintain that philosophy when you have so many people that have grown up in the bureaucratic structure. So you have the spectacle of _____ and Sherman's and major corporations giving impassioned speeches about entrepreneurship and the free enterprise system, while they run some of the biggest socialist bureaucracies in the world. Another way of putting it is that every person wants to have authority decentralized down to his level and centralized up to his level.

BE: Sure, that's clear. The people above him don't enough detail, and the people below him lack good...

PP: This applies no matter where you are.

JP: Exactly.

PP: It's an infallible compass.

BE: Let's make the proper distinction though between separable parts in the organization. Anybody who worked for Jay understood about somebody being the boss. The boss, the leader of Jay's organization was Jay. And this meant among other things that there was a clear vision of where we were going and what we were trying to do. And the rest of the organization had to fit into that. And you know, if you're going to make an automobile you can't tell George, well, you build an engine, any kind of engine you want. And if you get it done, that's fine, if you don't get it done, well, too bad. I mean you can't build automobiles that way, and you can't build computers that way and you can't build air defense systems that way. You can separate dentistry and the automobile building. So there is this question about breaking it up. If you break it up and broken it up in too many pieces and these pieces are in fact intertwined then you run the risk of the conception as a whole will not come true.

JF: Except that if you do break it up it tends to discipline the special occasions of what you want from the different parts. Very often we see organizations begin to work on all the pieces of something before anybody has decided what the something is to be, or how the pieces are to go together.

BE: I absolutely agree with that. But it seems to me the job of the person at the top is in fact to define what it is you're trying to do. And see that the goals are properly set up. And that people know what they're supposed to do. And pick the people. And if that's done properly then the thing will run. From then on you can just keep an eye on it and help each of them... if you just say, well, let's all build a computer and everybody builds whatever he feels like, then you're not going to build a computer, you really aren't. You'll get some wonderful pieces, and you'll get some wonderful gaps. And this is a problem which Digital has. Ken is trying to break the company into pieces, but it's all intertwined. And you also have this problem that I think is important that I mentioned earlier, and that is that the existence of the team of people who understand each other and have been through things together. And if you have a team like that then you can in fact break it up, because the people know what they're doing, and they know what the problems are, and they see that the interfaces are properly defined. If somebody gets in trouble _____ group as a whole and ask for help. But if you do not have a team, but just have a scattered group of people that you've brought in or that just appeared here, and ask them to do the same thing they wouldn't even understand each other and they don't trust each other.

And so you're running the danger of getting into very serious troubles before you find out about it. But this is a real conflict, a need to make sure that you get the things that you need for the large systems, and at the same time getting the people who are working on the pieces and it has to be broken up into pieces, sufficient freedom so that they can in fact get their jobs done.

JF: Well, part of that freedom to get the job done is to run an organization that has a certain amount of slack in it. Where there is money and space that isn't overcommitted. I paused on that because we were overspending our budgets and always having to fight for mine, but on the other hand I think the atmosphere in the laboratory tended to be that there was support for what people were expected to do, so that they weren't in the position of feeling that they'd been given this responsibility but without the authority and resources to do it. And that makes a very big difference. You see people are essentially frustrated by being given the freedom so-called, because they aren't given anything to exercise that freedom with. So in fact they haven't been given the freedom.

BE: That's right. It seems like... they've been told they're responsible, but then -- And it's very important to have slack. It's one of the troubles big

organizations get into. The biggest organization I deal with is the Department of Defense, which I've been involved with for many years. It exhibits all these difficulties too, to an extreme. And one of its problems is lack of slack.

PP: Is that sort of a synonym for trust?

BE: No. It's done by having competitions amongst the pieces for things. Which tend then to end up each group having too little money and too much commitment. It's sort of a normal result of the way that the job is divvied up and the money is divvied up. If somebody is smart enough and shrewd enough to squirrel off some money people will come and take it away from them. We're not supposed to have any extra money. You're undertaking this program and you don't know how to do it? You mean you don't know what it's going to cost? You're spending the taxpayer's money, risking the lives of our fighting men, and you don't know what you're doing? Of course the answer is yeah, I don't know what I'm doing. Nobody knows what he's doing when you're on the leading edge. You can know pretty well how to do it. And this results in great overruns, because it costs more to build a thing if you've got less than the money you need than if you had the money you needed, because you don't, you aren't... you don't have the resources to protect

yourself, to put in backups, to try different things. You're forced to gamble that everything will be all right. It's never all right. And when it turns wrong then you've got a big problem on your hands, because all these other things are going on. So it costs, it takes longer and it costs more money to have it all carefully planned and every scrap of money taken out. That's the worst possible way of doing it. And it's done as a normal uniform thing in the Department of Defense, most of whom don't understand that it's wrong. And I believe this is true in most organizations, large organizations.

PP: I've never encountered that idea anywhere, but I'm sure that you're absolutely right. If one has to meet not quite the step one would make to meet a situation for lack of... I can just get by this step and you build a whole project on not quite fulfilled responses to problems then you end up...

JF: Another reason that it costs more and takes longer when there are not adequate resources is that a larger and larger percentage of time goes into arguing about the resources and fighting for them rather than doing the job.

BE: I was at a _____ science board meeting last week. And Deputy Secretary Atwood came to see us. And

one of the subjects that came up as we were about to go through another cycle of stumping and fixed price development contracts and going to cost _____, and he says, you know it's pretty sensible that the _____ were losing their shirts on these fixed price contracts. And that's unreasonable. They get in all kinds of trouble and they miss their schedules. So they have to go back to the cost mechanism. So I told him, I'd watched that cycle take place several times in the last 30 years. And I didn't think it was going to fix the problem. The problem comes from having too much specification, and not enough resource. Now that is going to get you in trouble. If you do it with fixed price contracts the trouble will appear in the industry. And if you do it in cost-type contracts the government -- the problem will appear in the department of defense where it is anyway. So you're bound to have the trouble. What's needed is some way in which some designer can make trade-offs as he proceeds and learns and sees what he's up against, that he can change the design and the specs to match whatever's demanded. If the specs are really firm, then you've got probably enough money to do it. And if you don't want to then you have to allow the specs to change as the money rounds out. Now you can have either kind you want. If you have the fixed price contracts it implies that the industrial designer makes the trade-offs, and if you have cost type contracts it

implies that the project officer in the government makes the trade-offs. And you know you can do that or some combination thereof. But you could at least make it come out right. But since, as far as I could see, he had no intention of changing the requirements process or the competition for money or all the other things that go on that cause this fundamental trouble I didn't think he was going to get anywhere.

JF: So what did he say?

BE: He didn't say anything. I don't think he understood what I was saying.

JF: To go back to the idea of the teams, which I think is tremendously important, you have the whole folklore against this. They're called cliques. The people try to avoid. They're looked upon as bad. And one reason they're looked upon as bad is that a real team has great power. And probably would insist on a great deal of independence, intends to clash then with the organization. And so you have almost a conflict or trade-off between being successful and fitting in, nevermind the success.

BE: One of the things you have to watch out for in these situations is that you try and discover what the real

names of the organizations are. They say they're to get things done and to be efficient, but they don't act that way. And in fact in most cases they're... well, I'll give you an example. If you take the department of defense, it has all these regulations. And it's well-known, generally accepted that if you followed all the regulations you couldn't get anywhere. Your ability to get something done depended on your ability to get waivers from regulations. The more important the job is the more waivers you can get. Until it's important enough they won't make you follow any of these rules. Now you think that's backwards. You'd think the more important the job the more important it would be to follow the rules. Or if it's unimportant you don't care. It's the other way around. Why is that? It's because the rules do not help you do good work. They are for other purposes, to divvy up the money around the country to make sure the competitions are fair. They have the small business set-asides to make sure you can waste a million dollars, but you can't steal ten dollars. There are a whole bunch of things of this sort which are in fact the real drivers on the organization.

PP: This really sounds like business today. How would you define then really good leadership? What is required in a really dynamic good leader? And that's probably true back then as well as now.

JF: Well, I think it's that independence. The entrepreneurship that I mentioned that I'm not sure whether Bob was disagreeing or not. But I think you could have the kind of entrepreneurship that I was meaning even within the goal of a clearly defined and articulated program. But we've already covered it. It is a match between the responsibility, the authority and the specification of what you buy. And this is a _____ level. I mean what the defense department buys from the corporation, what the project leader buys from an engineer, that this gets clearly specified, one thing it implies is you thought about what the whole thing used to be before you get that far. And a lot of programs start before those decisions have been made as to what the whole thing is for even, or for how the pieces fit in. And you can't give the... you can't give the authority, resources and specification the clarity that I think is necessary without having done a lot of thought as to what it is you're after. And if you've given enough thought to that and its... and what the interfaces are then you can essentially give a challenge to people where it is, what they accomplish is primarily a reflection of their ability and not a reflection of how they have been impeded by other people. And I think people do respond to that. They like to work in that kind of a setting.

BE: It's more than just thinking in many cases. You have to do a lot of work and run a lot of experiments and try a lot of things. And not only to find out what the desirable characteristics are of what you're doing and what kinds of fundamental materials and technologies. But also the character of the people and the organization you've got which is doing these things. It gets back to this team business. I think it's very fundamental if you want a team of this sort, the people really have to understand each other. You see this in college sports where they bring in the stars from all -- in football, they bring in the stars from all the teams. It turns out that a teammate of the stars from all the other teams is not as good as one of the teams, because he doesn't have the time to really make the team up. So the team implies that people understand each other.

JF: I think in this kind of frontier research and development it probably takes ten years to create such a team. It's not something that you do in six months or a year. Because you've got to see the mistakes and the shortcomings and the successes of the members and arrive at a point where that it shared, even the person with a shortcoming knows that he has that shortcoming and other people know it, and everyone knows then that the objective is to avoid that being important. In other words use that person's strength. We had people that

were very good in outside political contacts, not particularly good at developing people. We had people very good at developing their own people that we tended to keep out of the external world. Had all of these differences, where if you can combine the strengths and essentially neutralize the weaknesses you get a powerful organization. You can have organizations that combine the weaknesses and neutralize the strengths. And that's a different sort.

[END OF SIDE A -- BEGIN SIDE B]

BE: This is much better than trying to put a group together that doesn't understand each other and you don't understand, and try to make up for it by having auditors and review groups and all the other things that people invent to try and make incomplete teams, not _____ . The idea is sort of simple. And then you say well, I have all these specs and all these standards and I'll have all these review groups and I'll have all these tests, I'll have all these financial auditors, and I'll have all these people that are running around making sure that nobody is stealing anything. And if I surround this group with enough people of that sort I can make it work right. And it turns out it's not true. Because you really can't make up for it if the team is a poor one you can't make up for it. And if it's a good one and you

don't _____.

JF: Well, I saw the plan for some new military airplane that was in the newspapers the other day and the nose section is going to be built by one company and the mid fuselage by somebody else, and the wings by someone else. And the electronics is coming from a different company, and the tail from a third one, and the tail fins from somewhere else, and I must say I wondered if it would ever fly.

BE: That's not a problem. All airplanes are made that way. Boeing Transports anyway, some of it's made overseas. But there is a strong central design team that makes sure that all of this stuff is perfectly defined. And I don't think they give the contracts to the lowest bidder. They give the contracts to people that they understand and have worked with. That's another problem that DOD has, they're always competing things. The fact that an organization has done a good job and has a good team that understands the business and delivers on it, carries almost no weight when they come to a big contract. They'll give it to somebody else who doesn't know anything about it at all, and then they'll be struggling and what can we expect. And this comes down to this thing I said, they are not acting like somebody who wants to save money and get good service, they're

not. Because that's not what's their big issue. It's not fair to say they don't care. They don't care. It's just they have a priority list and that stuff falls below that cut level. They talk about it. I used to think that way about the Congress. I thought the Congress had no values. But it's not true. They have a sense of values which is different from mine. Raised as an engineer like Jay here, I believe that efficiency and economy and good work and stuff like that is important and who gets what is not important. And their value structure is the other way around. Who gets what is important, efficiency and economy is not important. And once again it's not that they would be opposed to it. Somebody with efficiency would be all right, but it just doesn't come up in their daily life.

JF: Well, it's much easier to understand who gets it than to understand how to be efficient.

BE: That's true. But it's important to a politician that has to do with how he gets elected and things. Well, efficiency is not very important.

PP: What do you account for in Gordon Brown's the lab in which you all worked, that so many of the people that were your students became strong industry leaders in themselves?

JF: Well, in some ways it was the chaotic nature of the laboratory which seemed very unmanaged at the time. But in fact it gave people the opportunity to do something that surrounding chaos in the particular case also meant the freedoms we're talking about. It tended to be relatively disorganized and so each project leader tended to provide the organization and the provision and the reality within his own area for what he was doing.

BE: Yeah. I feel it was an unusual combination of circumstances. It was right after the war, so the government was interested in supporting things. It didn't have all this bureaucratic mechanism for getting in the way. A large fraction of the people in the lab came out of the _____ graduate students. There was a superb group of people that graduated from... with bachelor's degrees before the war and spent the war as radar officers and things and had grown up in the process. Had gone back then to school on the GI Bill, it was a very highly select group. And because we were working on such an interesting thing we had a very highly select _____. So the raw material that came into the lab was really superb. And then as Jay said, these people were really given an opportunity. They weren't sent off to solder for two years and then sent off to do something else for two years or being -- there was so

much to do that anybody who demonstrated some ability and initiative and willingness to work he rapidly got all that he could possibly do. So we learned all kinds of things. And as Jay said earlier, when we started working on the computer there wasn't all this marvelous test equipment that people have nowadays. We had to do everything ourselves. Make the _____, the whole job. And you might think that's a drawback. And if you had to design a modern computer with the tools we had you couldn't do it. But to build the first computer was an imminently doable thing. Partly because we could design something that we could build. And we could build the thing that we've designed. And these were -- this combination of marvelous raw materials and a really open environment and a wonderful job... just, that's a very unusual set of circumstances.

JF: A very significant part of the core team had in fact gone through the entire circuit mechanisms laboratory World War II experience. And that was a free-wheeling approach that I guess we assumed was the way that the world -- what was. And we perpetuated it even as the... as the times were changing. For example, in the laboratory as we would design hydraulic equipment for controlling gun mounts, I would be in charge of design, the blueprints would be made, I would sign them in the block reserved for the chief of naval ordinance and mail

them to the factory. Which is probably not the way it's done today.

BE: Yeah, that's very unusual today, although once again it is done...

JF: I was a research assistant. I hadn't even got my masters degree yet, and I was signing them for the chief of naval ordinance.

BE: And that does happen today on important programs, usually in the black, that means highly classified. Which is a kind of an underground economy in the department of defense, for the same reasons. The chief designers are given a lot of -- you know, the 117, the Stealth fighter that was so effective in the Gulf was done that way. Everything was done by a small group of very experienced people at Lockheed with a first class project officer in the department of defense. And they made the trade-offs. And the airplane came out the other end looking significantly different than it went in the front end. And it had somewhat different characteristics, but it turned out to be a very valuable airplane. But if it do it in the open you have to specify it all in advance before you knew what you were doing. And then break your neck to try to live up to it. And that would have been all kinds of trouble.

PP: And then fighting every time something needed to change to make it.

BE: Yeah, the other thing is that they lost a couple of the first ones in accidents. Nowadays if you lose a couple of airplanes in the front end you're liable to get the whole program cancelled.

JF: You see this kind of atmosphere we're talking about every once in a while in organizations that on the whole do not reflect the atmosphere. I was a consultant for a period of time for a very large corporation that had divided its work up functionally. And _____ tried to go into a new market, and they'd failed twice, and I came in on their third try. And I started to argue that a lot of their problem was research followed by development, followed by design, followed by manufacturing and then eventually you give it to sales, and why didn't they put somebody in charge of the whole thing. And they said, we wouldn't dare give that much responsibility to one person. Now they'd failed twice already. Wouldn't dare give that much responsibility to one person. I said, now I knew the organization very, very well. I said let's sit down and make a list of the people in the company regardless of their present jobs, regardless of whether you think they want it or not. But let's just name the

kind of people in the company who could do it, so we can see what we're talking about. So he said, well, so and so, but he doesn't know much about marketing. So and so maybe but he hasn't had any... anything in research. And so we got maybe six or eight names, each with a major qualification. And then I said, let's think about the people that have been in this company and aren't here anymore and see if there are any of them that would qualify, and they said, oh well, there's so and so and so and so and so and so, and we got about 12 names without qualifications. Then we went back over to see why they weren't in the company and why they got on the list and why they weren't in the company. And every one of them had had the experience of doing something, usually against opposition, that he'd had the vision for it, and he'd pulled it off successfully and everyone recognized that it was a success. And he'd either gotten outside funding for it, or he'd stolen money inside to do it without anybody noticing, and he had succeeded. And then he had stepped on enough toes in this process that he either went to the corporate version of Siberia, or had left and felt this was so much fun and he wouldn't have a chance to do it again there, so _____ a new company. So here you had an organization that recognized the kind of person... recognized the kind of person immediately. But had a social filtering system that repelled such people and failed to draw them in. And an organization

is a tremendous... it's a tremendously powerful filtering process. It rejects the people that don't fit. It repels the people that don't fit, don't come in. Those that do come in get conditioned to fit, so that...

BE: And if they won't be conditioned it throws them out.

JF: So you get the character of an organization and its internal attitudes strongly self-perpetuating. And if you have an authoritarian kind of organization where the decisions are made at the top then you get the kind of atmosphere you see in many corporations where people feel helpless, why propose something. You know, you can't get it through all these process of layers, and the extreme case is to see the kind of inefficiency that's being revealed in the Soviet Union. I mean it's basically the Soviet Union structure and the major corporation are in principle the same structure. Central... central allocation of resources, central subjective promotion and rewards for people, lack of internal freedom and initiative are basically the large corporation and the authoritarian nation are fundamentally the same organization with similar problems in varying degrees. You have somewhat more discipline through mobility. People are somewhat more likely to leave a corporation than they are a country. And there is some greater freedom from stockholders, but in fact not much because a

stockholder that doesn't like what's going on sells his stock but he doesn't have much effect on changing the organization.

BE: It seems to me that almost all organizations are this way. It's very unusual to have an organization that can stay... They almost all go through this and eventually get bad enough so that they die. Industrial organizations go bankrupt or are bought up.

JF: I remember somewhere finding out the other day that the usual and typical life of a corporation is less than the normal life of a person.

BE: The Russian government and our government aren't that different. And theirs is worse and has gone faster, and it's now reached the point where it really has to be killed, and start it over. There's no way that Gorbachev can fix it. And that's going to very tough on the populace. Part of the theory of democracy is you can change the government without having _____. Our government has fixed it so that's very difficult. You can't get rid of the legislators, you can't get rid of the bureaucrats, you can't get rid of the judges. The only guy you can get rid of is the President. And if he was really running things that might be important, but he's not. So eventually, but we still have that. If

things get bad now, we will in fact throw out the rascals and put in new _____. And that's important.

JP: Because you're allowed to do it.

BE: No, because it's different. It takes the new gang a while to get in the same hole that the old gang got into.

JP: Exactly.

BE: But it's unusual to have an organization that will keep itself _____. I had an organization in my area, boy, you could just see these things going on. And we get some fairly fundamental things to put it off. But it's guerrilla warfare.

JF: One of my ideas in my new corporate design was to have for every function competition. And so when it came to approving projects and funding them, there should be several people in the organization that had the role of investment bankers, each of which in fact had full control over some fraction of the assets of the organization. And someone with a new idea could go to any one of these independently. And you see an interesting trace of this, I think in the 3M company. I don't know it personally. So I'm speaking only of what I have been told. But it certainly has the reputation for

much more innovation and a flow of new products beyond what you see from many companies. And as it has been explained to me, there is an 11th commandment in 3M, "thou shalt not kill a new idea." And then what does this mean? It means that the burden of proof for disagreeing with an idea lies with the person who disagrees, not with the person who is pushing it. And if you bring an idea to your superior and he does disagree there is an entirely independent division for the development of new ideas that you can go to separately, and if they turn it down there is in the corporate offices another group to look at new ideas. If you get turned down by all three you probably should pause and think about it. But every _____ that makes a decision under the threat that somebody else will back it and prove it to be a good idea. And that's really different from the person who says no, and that buries it and he will never be shown to be wrong.

JP: Going back to the lab, Ken has said on a number of occasions that a number of ideas that came out of the laboratory were the basis for Digital. One of them was the environment. And he says, which almost had the feeling of a religious order, and I need to get some clarification from him about what he actually means by that. Maybe you could shed some light too. But he said, mainly the passion for reliability and discipline. And I

guess I think by reliability he's referring to hardware reliability of course. The discipline is another issue which has always interested me, because once again it's the youth... young people there doing very creative things, and I guess only with discipline can you be truly creative.

JF: Well, discipline has many meanings. What do you think the meaning is in the context you're talking about?

JP: I guess that my sense of it is the ability to work smart, hard, and go after a goal you've set for yourself, I guess is what it means to me.

JF: That was true in the early days of Digital, but there are lots of... there are lots of stories circulating in the outside world now. And I don't have any insight where that tends to be much less true than it was originally, where people may have a project, something to do, then they find that nobody accepts it, or wants it or puts it into production, and therefore maybe they have succeeded but feel that it was not worthwhile. And that's not really a discipline. And I don't know what the story is but certainly there are many kinds of discipline. There's the kind of just looking over someone's shoulder and telling him every step to take. That's a very suppressive kind of discipline. The

ideal kind of discipline I think is where there is a clear goal, which if the person succeeds in meeting it there has in fact been an important lasting consequence and contribution from it. It's not sufficient to meet a goal and then find it is unused or ineffective or doesn't fit with other people's plans. It doesn't... it doesn't hold people's loyalty for a long... through very many of those cycles.

JP: What's your definition of discipline in the Digital Computer Laboratory?

JF: Well, I think it's tied up with the long-term versus the short-term view of what you're doing. We tended to look upon high reliability for military command and control systems as the overriding issue. And I think my version at least of what I think I saw in IBM when we were working with them illustrates what this may mean. We had... there was a contract between the Air Force and IBM that required all the drawings that went into the IBM factory were signed by us here at MIT. And that was rather galling to the engineers there who felt that was hardly necessary. And it led to arguments almost every step of the way as to what had to be done to get reliability and differences of opinion. And we kept telling them that they shouldn't look upon their job as delivering this device to the shipping room platform

which I felt was what they were doing. That they should look on it as something for which they were responsible for its working in the field and if we had our way IBM would in fact be responsible for it in the field. And they assured me that their company would never accept the responsibility for military equipment in the field. Well, we bore down on the Air Force pointing out that this thing they were buying couldn't possibly work unless they had competent people to maintain it and that they should negotiate with IBM for a contract for permanent _____ . There came a day when the Air Materiel Command and IBM announced that they were signing a contract for IBM to maintain this system that was being built. It turned out in about one week we had no differences with these 300 engineers, because they looked around and said, who is going to maintain it? And everyone of them could see himself in Saskatchewan some winter morning at 3:00 with the thing he was designing. And it just made a complete turnaround in the attitude of the organization, which is to say that the ultimate goal that people face is highly determining.

BE: That's true. You have to set that goal.

JF: Did you see that, that process?

BE: Yeah, that's right. You have to reach an agreement

on what you're trying to do. I think the discipline at the lab was a two-way discipline. The people committed themselves to do things, they had to do those things. And they couldn't change their mind over a weekend. They couldn't _____, which I've heard Ken say he thinks is one of his current problems, people commit themselves to something and then change it. Not casually but because somebody talked to him in the hall and said something different and then they could work on something different. That wasn't allowed at the old lab. And I think as Jay says, that the discipline worked down as well as up. You tell a guy to build something and that was a part of the computer, and then if he built it right it either got used or you had a tough time explaining to him why you didn't use it. You couldn't just say, well, that's right, you were working on that, weren't you. Thanks a lot. I don't need it anymore. You don't do that very often with good people. So it works both ways. It's kind of like a contract. But that contract has to be signed. Just having a contract, and insisting that people live up to a contract if the contract isn't signed. So it has to be deliverable in the sense that the technology is at least possible and it has to be deliverable in the sense that the people who are doing it are capable of it and they have to have adequate resources, and there have to be mechanisms for changes, facing up to the unforeseen difficulties when they

happen. So if you have a good sound contract, that's good.

JF: I think another characteristic of the laboratory was not feeling that we had to save face by sticking with our prior plans and commitments because those plans and commitments did change many times as we saw that the old ideas weren't going to work or weren't the best. And that to be willing to essentially say well, we were wrong now, here is what we will do instead, is something that a lot of organizations push home. They don't want to admit that they had made a mistake, and so they keep going down the road that is the mistake.

JP: And it's only through good and open communication with your team that you allow yourself to admit, and re... not go off in a different direction but realign your goal to meet the changing needs, and recognize them.

JF: Some of them may be going off in a different direction. The early days of the Whirlwind project were a computer, an analog computer. I mean, an analogy computer or an aircraft analyser. And it turned out to be a digital computer for a combat information center. There wasn't really anything that survived from the first

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BE: What's a computer?

JP: That brings me to another comment that Patrick and I had. This was on the technology side of things. That it was interesting to both of us that Jay, you had said that you had lived through the pioneering days of the computer, well, both of you. And that the percentage increase in performance during the decade of '46 to '56 was far greater than any decade since then. And that you felt that you had sort of done it and seen it all, and therefore moved into your management work as opposed to computing. Can you comment on that a little bit more in light of today and some of the technological changes in computing today? Your unique position, inventor of the core memory which was the real gating factor that basically saved the business, as far as I can tell from a lay person's...

JF: Well, if you take some multiple of speed and reliability and storage capacity, I think it probably is true that more was gained in that decade, a larger multiple, maybe not far larger, but a larger multiple than in decades since. But the multiple has been large in decades since. No doubt about that. But the processors in those succeeding decades would be pretty much a repeat of the processors before. I would say it's not the same kind of pioneering. It's pioneering of

improving components within a purpose and a structure that is evolving, but I would say computers since that time have been a production process. Production of incremental improvements, production of machines. I don't think it's had any of the atmosphere of doubt, opposition to the vision, the belief that people, the first four computers, it would saturate all conceivable need for such machines, which was held by one person. I mean those kinds of times with very different visions and for the most part visions that were either not shared or actively opposed by most people, pretty much ceased to exist after 1956. And this opposition to a new idea that I think is part of what I would call the pioneering atmosphere, the pioneering phase. After that it's steady, maybe major improvement, but fairly straight-forward. The solid state electronics, transistors had been developed in that decade. We didn't use them in our computer or Sage Air Defense system because we felt they were untried at that stage, and I think probably it was still a correct idea for that time. But of course they did, you know, they did improve. They came along and took over the field from the vacuum tube, shortly after the big air defense system.

PP: I'm curious. For probably a lot of people younger than myself with not much sense of history at all it might commonly be thought that computing didn't really

start until the '80s with personal computing. Before that it was just a few big machines somewhere. I'm curious what you think some of the most significant developments in computing have been since say '56 or so. Some of the main kinds of watersheds in computer evolution?

JF: Well, by '56 the idea of a general purpose internally programmed computer, of course, was well established. So if you pick up -- and that was the big thing. If you pick up after that I expect the appearance of the desktop machine, the private desktop computer may be the thing that's going to have the greatest impact. Because it's pretty much essential to what we're now doing, bringing my own field of system dynamics into high schools. It brings computers to the point where large numbers of people can use them. And that may be the biggest break. Of course bringing solid state electronics was necessary to reach that point.

JP: And then of course the miniturization of those components.

PP: I think MIT still works as a catalyst for taking ideas that are possible and moving them out into the mainstream somehow. I think of Danny Hilles and the Connection Machine, which I guess is a massively parallel

process of computing. I wonder if you're at all familiar with those developments? Any sense of how the environment at MIT... using the Danny Hilles example, how does his experience, I wonder, with the MIT research lab moving into entrepreneurship with the Connection Machine parallel with Ken's experience of moving from MIT into Maynard with the fledgling Digital Equipment Corporation?

JF: I don't know. Why don't you go ask them? You know, MIT there's been a long history of this kind of thing coming out of MIT. You have such transitions now going on in biology, which I suppose is the present version of the Digital computer setting of 50 years ago. In other words, it's a new frontier that's not understood, not explored, _____ it's not clear where it's going. And there have been a number of things out of MIT in that area.

BE: Of course a lot of the new stuff has come out on the west coast as opposed to the east coast. Partly because the technology changes so rapidly, I guess. It's still possible to start a computer company and have it grow very rapidly. I think they used to draw a picture of the computer business... if you're familiar with the usual picture of the big fish eating the middle-sized fish eating the little fish. It's the other way around in the computer business. The big fish is being eaten by the

middle-sized fish who is being eaten by the little thing. And my feeling about computers is that it was possible back in the '50s to sort of get a picture of how the business was going to end up. It was going to end up with everybody with a computer and those computers networked together and connected to intermediate servers of some sort, being called servers. And those in turn hooked up to things which were big compute, and files... the file machines and things of that sort. And since then as the technology has advanced you can see it all moving in that direction. First you could only afford a single great big machine. And then it got so that you could have... as machines got cheaper, minis appeared, time sharing came along, which gave people a rough approximation of having their own machine. Little machines like the PDP-8's appeared. Then eventually PC's appeared and workstations. So now we're in a position where we have, people can afford their own machines and those machines are in fact networked structures, servers and communications and stuff of that sort. And it turns out that some of the old stuff is left. It's easy if you walk around Mitre it's kind of like the Olduvi Gorge. They've still got some IBM mainframes that make out the payroll. And it's got a bunch of VAX's all linked together, and they've got Suns and Macintosh and all kinds of stuff. And I've run out of vision. I mean that was as far as I could see. And I'm not sure what's going

to happen next except that this stuff is all going to improve. But the PC's are really... they're not at all user friendly. Even the best of them. And fixing that is going to be a bottomless pit of innovation of processing and storage and most people seem to be working on language inputs, so you can talk to the machine. I don't think that's important. I think what's important is to have a machine that knows enough so that it can understand what you're talking about if you don't spell it out in every last detail. I usually talk about this as if I go to my secretary and say, "You know that letter I wrote to Joe what's his name a couple of years ago?"

JP: It was about you know...

BE: Yeah, and she finds it. Computers have to do that.

JF: As a matter of fact mine now does that fairly well. If you can just specify some words that might have been in it like his name and the subject it will in fact find the letter.

BE: They're making progress. But that's the kind of thing that's necessary. If the secretary treated her boss like a computer treats its owner the relationship would break down almost instantaneously.

JF: Like, you told me to mail it to Joe Smith, you didn't tell me to write his address.

BE: So this is coming along. They're getting better, they've just got a long way to go. Another thing that's very important. We tend to think about PC's and banks and stuff, but the imbedded computers, the real time computers may be the most important thing that the computer offers.

JP: How did you do on your list?

PP: Well, I have to go talk to somebody else, I guess. Culture is such a nebulous thing anyway. It's inescapably present and powerful, but I'm particularly interested in trying to somehow contrast some of the strong seed ideas that were so present in Digital's launching and early days and trying to discern any sign of those still that were in the present day corporation. It's a completely different business environment. And trying to trace the story of how even through great change those seed ideas can still be present, can still be found, and maybe still have power. And if I can achieve anything it would be useful perhaps to reintroduce, or reveal again, some of the founding ideas that have such strength as a way to understanding a way forward in this very different time.

JF: Well, you might find them in the corporation in the same way that I related my experiences with a different corporation, you might find them if you can find corners in which people are doing things on their own initiative without general approval and support toward a goal that is important and where they do manage to carry through to success. I don't know whether this is going on or not. I would suspect in an organization as big as Digital worldwide there's probably quite a bit of that in the corners. But you see, it's not part of the standard process. And I'm reminded of a study that we made many years ago of a Stop & Shop grocery chain where the goal was to find out why five or six stores in the chain were recognized by everybody. Other store managers, management, everybody. Those five or six stores were the successful stores. And why was it? And to make a long and interesting story short, it was that these five or six people had known the Rabbs when the chain was small. These managers. And so when the middle level bureaucracy would come around and beat on them to do things right they would first of all do it their own way instead. And then when the middle level managers got sufficiently persistent and annoying the store managers would pick up the phone and call Mr. Rabb and said, look, call these people off, I'm tired of them. And in fact, you see, they were succeeding by doing all kinds of things that

were contrary to the official rules. One, for example, one store manager was being criticized very heavily because of the losses or lack of profits in his flower or florist department. And why? Well, he was sending a bouquet to every customer on her birthday and... charging it to his florist department. And the customers were astounded. How could he possibly know when their birthday was? Well, everytime they cashed a check and presented their driver's license for identification their birthday could be taken down. And you know, he had his loyal customers and he probably got his cost of the bouquet back a thousand times over. But it didn't show up in... it showed up in a different department.

BE: And so did Stop & Shop take this to heart or did they...?

JF: Well, you see, it's not clear anymore than what you do in the Soviet Union, it's not entirely clear what you can do with the manager who has just been following the rules. Can you ever get him to change? And they are... they're not ones that have had the experience of growing up with the chain and they haven't had the experience of independently running a store their own way. And knowing it was their own way and feeling like telling the middle management to go away when they were causing problems it's a different kind of person. They would have to

spend a long time developing managers of that type. And unless they have an organizational form that does it you will get into the kind of corporation that isn't able to generate enough talent even to replace its own needs, because everyone is managed and suppressed and doesn't have the experience of running an organization. Running it in the sense of having an initial budget that's guaranteed and sufficient, where it's their responsibility to operate within it and succeed. You find that disappears as most organizations grow.

BE: Well, I'll give you an example. It's an interesting _____ . You read in the Gulf War about joint stars. This is the airplane that sees ground targets. And it's been being developed, the program is over here at ASD and Mitre supports it. And they've reached the point where they've built two prototypes and those were being tested and they were working. Now some people say you ought to take the prototypes to the Gulf. Well, the people who own prototypes, they don't want their prototypes going to the Gulf, they might break them or something. And so they resisted. And this argument went on for some months, and finally Schwartzkopf asked for them, and whatever Schwartzkopf asked for he got. So they sent them on over. They put in radios and things and all that. So they used them. They flew 12 hours a day apiece. They were just prototypes. They flew 12 hours a

day apiece.

[END SIDE B -- BEGIN SIDE C]

BE: I think that there's one theory that in order to live you have to change, and when it gets to be too much trouble you die. Well, all living things die. And get replaced. That may be too morbid, but...

PP: Well, IBM for instance, I wonder whether whatever is IBM bears any resemblance to the IBM of the first 40 years.

BE: My opinion of IBM is that it's amazing they've done as well as they have. They have tremendous resources. All that installed base. You've heard the joke, you know why God was able to build the universe in six days? No installed base. Anyway they go around and neaten the place up all the time and try to get people to do it right. And then _____ the outside world. They almost never did. So some innovator in the outside world took a look around the organization, and they discovered that there's some group in the organization that they hadn't found and shut off that was working on this. Then they pour money and resources into it and catch up. And then when that's over they go back to beefing up the organization.

JP: I've always been interested in how a freewheeling kind of -- as Jay used that word several times, a freewheeling kind of atmosphere, granted there was a lot of discipline, but it was an academic atmosphere of MIT could pair up with the IBM bureaucracy even in the early days or even 30 years ago in the early days of IBM? When Ken, for instance, went to work in Poughkeepsie, on the Sage project, it's just two different kinds of mindsets responsible for a major project. That's always been interesting to me.

BE: Well, mostly IBM engineers were MIT engineers too.

JP: But were they given the same kind of freedom to...

BE: I don't think so. But I think they were given a lot more freedom than they are today. Because IBM was relatively small in those days. And the piece of the organization that built electronic digital computers was smaller still. And so I would think that the arguments were less that the cultures were different than that two engineers were _____. And in the early days of the computer business...

[BACKGROUND DISCUSSION]

PP: These Groundstar prototypes, they immediately accelerated the...

BE: Well, they sent them over there along with contractors, well, clearly some Mitre people. And they had some _____ and they worked very well. And they worked so well in fact that I believe it was the Air Force general commander said he would not go to war again unless he could have joint stars. So now, of course, the two prototypes are back to the project office. And the project office announced that all this slowed things up by a year, and that it will be six years before the initial operating capabilities in the field (?). Because they've got to go through things like operational test evaluations.

JF: You might think they would already have had that.

BE: Yeah, they flew through a real war. And that proved that they were very valuable. And the commanding general says he's not going to go to war again unless he can have them. I wonder if he knows it will be six years. He'll probably retire. He can't afford to have another war because you can't get them.

JF: Well, maybe he can get two prototypes again.

BE: The general attitude is well, you know, we have all these steps that we have to carry out in order to get these things. By taking it away from us for several months you put a big dent in our schedule and we're trying to recover. That's the way they look at it.

PP: Without taking us too far afield, this seems like a general commentary on the ability of American business to be competitive in the world since there are so many obstacles or procedures for trade and for import/export to do business it seems must be...

BE: Well, of course that's usually a different pattern, however we do sell a lot of military gear overseas. Fortunately, the people who have built military gear overseas have the same problems we have. It depends on who you're competing with. These problems are very serious problems in international trade and competition. The previous undersecretary of defense for acquisition _____ and he told what I call the fender story. Which is that Ford had discovered that one of the reasons they were having trouble getting the cars out, when they decided they wanted a new fender it took them three years to get the fender in production. And so they laid out all the steps. There were 2,000 steps or something, which included going out for tooling three times. And they cut out half the steps and now they can get a fender

in 18 months. My reaction is, I think even the DOD can get a fender in 18 months. And this is after they decided they wanted a... It would take the DOD six years to decide it wanted a fender, but then 18 months would be perfectly reasonable for getting them.

JF: The DOD would start with only a thousand steps.

BE: He had gotten _____ to start laying out all the steps. It was kind of funny, because they set up this group and then they want some contractor help and they got all this information, and it took them six months left to contract the contractor.

JF: The search for the steps had to go through the steps.

BE: You've got to keep your sense of humor. But wonderful things got done in the Gulf in a very short time. The United States can do things. They just let them do it.

JF: Well, in real stress like World War II, you know, all of that bureaucracy disappeared. And when Schwartzkopf says he wants two airplanes the bureaucracy disappears.

BE: Yeah, he called up and he said he wanted beach buggy tires, and he went to the people who buy tires and they said, oh, it will take us 18 months to get the request for a proposal out. Ten days later shiploads of beach buggy tires were descending on Schwartzkopf. And everybody agrees that this was done not only quickly but it was done at less cost than if they had gone through the normal process. It just proves what I said that doing things officially is not a high priority matter.

JF: Well, we had that example you know, during World War II with our radar equipment. The stabilization control that you and I worked on that went onto that fighter director radar. It was an experimental unit set up to show how it would work and the captain of the Lexington saw it at MIT and said, I want that, that one. And he got it. And it worked for nine months or so, then he got into some trouble and so I volunteered to go out and find the trouble, so that's how I ended up in the invasion of Turala, and got turned down through the Marianas with the Japanese objecting to having their airports bombed.

BE: Yeah, you got torpedoed, didn't you?

JF: Yes.

BE: That's what we're really asking you Jay...

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