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| Length | 62 min (01:02) |

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Speaker: Start the introduction. I thought I was, Robert. Ready? Thank you. Doug did his work with his colleagues on the online system at SRI, but their work enormously influenced what happened in the early '80s at Xerox [inaudible 00:00:24] research center. That, as we know, led to things like Lisa and Mac at Apple, which in turn led to Windows at Microsoft and so on. There's an enormously visible trail from Doug to our industry as it exists today. I hold him and his group personally responsible in the good sense, I want you to know, for building augmentation systems to do outline and hypermedia editing. A very fancy kind.

For computer-supported collaborative work. For inventing the mouse and 2-handed input and TV display technology. All in the '60s, folks. I want you to remember when this was all happening. His was also the shop that I came to that for the first time, really made it clear what the power of good software engineering could be. They wrote meta-assemblers and meta-compilers and all manners of tools to help them build tools to make good things for end users.

He also thought about how tool-building should help the end user. He thought about the process of introducing new tools and how processes must change in the organization. How the organization itself had to evolve to make use of the tool. Got us familiar with the term bootstrapping, bootstrap institute, bootstrapping yourself and your organization.

He and his people put on what is still today in my mind, and other people who remember it, the mother of all demos. It is still unsurpassed. It happened at the Fall Joint Computer Conference. It was beyond leading edge and it came off beautifully. We're going to be privileged to see a little footage from that in a moment.

Finally, very personally, after I learned about him I was privileged to spend a couple of days in his lab, stealing his best ideas and implementing it, many of them in our next hypertech system called [inaudible 00:02:22] in the late '60s. Doug, it's a thrill for me to welcome you here.

Doug: Michael. [inaudible 00:02:35] Thank you very much. This is a real treat and definitely a little bit a wash in trying to tell what I'd like to tell as something that fits into the Bush picture. I think the best thing I can do is go sit down and start giving a presentation. One thing though I can tell you is my first introduction to the Bush thing happened just slightly less than 50 years ago. Maybe 3 or 4 weeks less than that, that there was a young sailor boy that was plunked down on a island in the Philippines to [inaudible 00:03:24] to some local area, work. He was a electronic technician. He'd been 2 years of electronic technician training and shipped out and very interestingly that just as his ship was backing out and steaming around the San Francisco Bay to go out, there were many, many whistles and toots and everything else.

We thought, "Gee, do they celebrate everybody leaving that way?" Turned out that was VJ Day. 68 days later at 8 knots, we got out to the Philippines, etc. In waiting around for a week or something like that, in that camp right part of the jungle, I wandered around one day and I found this Philippine hut. They really are up on stilts and animals live underneath. It was all nice and clean. It said, "Red Cross Library," so I climbed a little ladder. It was a very pleasant room in there. About 20 feet on its side and it actually was a very nicely outfitted little library. With thousands of marines and sailors around like that, there wasn't a single other person in it.

I spent many hours in it. If I found that Life Magazine article on Bush, and I always remember, it was very exciting to see that. I'd have enough technical training by then to look at it and think about it, etc. It didn't become an impact thing that drove me the rest of time. What I'd like to do is go sit down here now and tell you the stories of what to me the potential is and I would very, very much to have been able to work with Bush and talk to him.

I tried once sending him a letter and a outline draft I'd made. I didn't hear back from him. This was in 1962. Somebody had told me that he's already so old and he really was in a rest home or something and probably wasn't returning. Turns out he lived another 12 years and published books, etc. I wasn't aware of that then. One of the things that you have to realize is living way out there in the [inaudible 00:05:45] area, you tend to feel that MIT was the center of the universe then.

Then just to prove it that I'd worked for years by 1962, '63. Really, the my push started in 1951 about committing a career to trying to do the most to help humans cope better with complexity and urgency. Computers and interactive use was the idea that came to my mind. I actually envisioned how that would work. That engineering training and the technology and the radar made me realize that anything a computer, if it could punch cards and could print on paper, it could create any kind of image you wanted on a screen.

It could interact with humans easily, easily interact, etc. I just pictured it working interactive. Of course. This is a very naïve country boy, you understand, that is still a country boy. Anyway, so i says, "All right, there's a direction. I'll go back to graduate school." Berkeley had a research program in computers. They had [one 00:06:54] our contract to build one. I got my PhD 5 years later or something. It still wasn't working by then.

Anyway, the first computer conference I went to was down at UCLA in 1953 I guess. Practically I was that year's computer conference. I think there was 65 people there. Lector hall in UCLA. If you think back in the history of things like that, you have to realize the emergence, very slowly of something the rest of the world wasn't paying much attention to. It was a cost of things relative to salaries, etc. was much higher than it is now..

Anyway for me, that pursuit of saying, "What can you do to help work with complexion urgency?" Which the real problems humanity faces, those are collective problems. From the beginning, it was the collective capability of people to cope better. After, I don't have time to go into all of the odyssey through the years but I SRI until 1977. Then SRI sold rights to the SAML system out in the commercial world. Otherwise we lost our research and they were money and they were going to dismantle it so we got a chance to take it out, some of us. The rest of the people went to Xerox PARC.

We lived in the commercial world selling the service of this system out to TimeNet and ARPANET. A lot of pilots, it was built to support people and work. Then McDonald Douglas bought the time share and TimeNet in 1984 which gave me the opportunity to go knocking on the doors of this heavy, industrial domain. Talking about the kind of things that I'd been wanting to do for a long time and had built. It was very interesting that the architecture's that we'd evolved were the first thing that appealed to them.

It's essentially a very sturdy prototype of the client-server model with very special ways in which you could deal with ... variable classes of work stations. Variable classes of users looking into the same work domain. Then they got interested in the hyperstructure of [inaudible 00:09:28] things too. That just opened people's eyes immensely. During all that time, the we built a system to use it and it evolved into constant, heavy use to do all of our work. By the time we'd gone out and worked with other organizations and seen what happens when you introduce things like that, and get people to adapt themselves to use it, our image about the problems that challenges a potential requirements, etc. grew to be somewhat different from the rest of the hypertext world which was a problem in itself. It made it harder to be part of that world.

Anyway, in 1989 my daughter, Christina and I formed Bootstrap Institute, saying, "The real need here is a strategy for how the world can really go after the potential of boosting it's collective, problem-solving capability." It began using the term collective IQ in a very real sense. The presentation here is all built around these boxes about 8 or 10 of them are paradigm issues of some significance. Had it had occurred to me after quite a few years that to walk up cold to people and start telling them the potential that was there and the path to go after it, we had a great deal of problem because of the ways our minds get fixed about certain things.

We grow up in an environment and we just take much for granted. These paradigms are the important ones. In this presentation, I can just go highlight any of these boxes in this way. I have also the option of saying, "Show me a brief little subtitle under it." I'll march through the subtitles in the orientation and then dive down underneath some of these boxes more deeply to give them a presentation.

The way we're characterizing the objective here really is high-performance organizations. That means the ability to cope with complexity, etc. whether it's developing new products or coping with national issues. If you're going to make a really different in that, it became apparent very early in my studies by the early '60s that you had to deal with the whole capability infrastructure of an organization. Not just think you can make some high-level capability, improve a lot by some veneer, layer-thick, new technology.

In fact, it was really all study that you realize that of all the technology you bring in it, joins the ranks of a lot of artifacts and tools through all the centuries. Anyone of which being introduced, if it's any significance, makes a difference in human organization, structure, conventions. A lot of things there. The real thing is the whole that augments the native human capability is the mix of these. Both in a coherent system. The focus on tools alone, if you're going to talk about very significant improvements in the technology, that focuses not enough to just on that.

We'll go into more of that later. Then the need for a pragmatic way in which both sides of those are going to co-evolve. The human system side is just evolved organically through all the centuries without my explicit attention. When the technology started erupting in the Western world, with explicit focus on it, etc. then it that was driving the world and the rest of it followed.

One says that's going to be very complex issue and problems. If we're going to invest a lot in evolving our organizations, etc., it'd be nice instead of step by step by step investments if we'd had some way to invest in a change that compounded. There would be a huge, social investment really in this change. The technology side of it may only be 10 or 15% of the total cost, if that much.

How do you want the best strategy, etc. like that? Do you want a criteria for investing? Yes. The whole set of them. What came out of this in the end is it'd be very important to make, pay attention to the infrastructure of the way our improvement process and change processes work. Which is a very haphazard way as it is now. Turns out that if you're looking for the most pay-off investment criteria, that paying attention to the improvement infrastructure gives you a real chance to get ahold of a strategy. Out of that comes a strategy of saying, "Look, if you're going to improve the end-capability, for instance in product cycle time, if you also can at the same time be trying to use some of the similar capabilities that you're going to improve. To improve your improvement process. You'll really start bootstrapping."

That's the basic thing. Diagrams I had in my 1962 paper, etc. like that were full of all that feedback between elements and such. Realizing that so it turns out that this kind of collective knowledge work that concurrently developing, integrating and applying knowledge in any collective sense is real key to that. It's an extremely part end-product for organizations to have improve. If you do get some of this going in small groups even and a high level of new capability in that, you can plug that into the improvement cycle to accelerate it.

That's the thing. That's why we call it bootstrapping. Improving your improvement process, taking yourself up by the bootstraps. That's a strategy we're trying to tell the world about. The old guy is still pushing like crazy. Paraphrasing. Then you find out if whatever technologies or capabilities you're bringing in there, they have to have to essentially global interoperability that this is really going to be a collective thing.

The conventions that they were showing about in documents about footnotes, how you cross-reference things, make indices, table of contents, those are conventions that go along with the technology of the time. You bring in a brand new technology and there's a new set of conventions that you want to adopt to take advantage of those. Those, in turn, are dependent upon the structure and conventions by the electronic form of the documents.

Those have to grow into something globally interoperable. As they get those standards, they don't want to be derived by shallow sort of potential uses. There's a very deep, very broad, very high performance in the end. Collective capability you've got to pay attention to. The pursuit of something called an open, hyperdocument system under there is a very, very high order business to be attending to.

We say, "And how should that be done?" It really needs to be done in a pursuit that's working towards this goal. Very interesting item here becomes how do you start best deploying early gains? Down there you realize early gains aren't necessarily going to be the most pay-off if you try to bring everybody in the organization up. If you can bring special teams of people up, well you really explore the potential. They have a role in the organization as it is now. There's a lot of reasons that from our experience. This may not be one of the high pay-off things to consider.

You had choices all the way along of what you improve and where you invest the actual improvement capabilities that you've gotten. In the end, it comes out to be a networked improvement community. Strategically an extremely important thing. That you get a community of people trying, that they're going to share the improvement pursuit within that community. You get them connected to a network and you give them these new capabilities so that they can cooperate upon that improvement process. That says, "Great." Especially if you want to say, "Hey well what about the pursuit of this Kodiak stuff? Why not do that in this same sense as the improvement community?"

At the same time you're really pushing the best open hyperdocument system potential you can. That seemed like a glorious potential thing to do that that's why we started the bootstrappings. To say to people, "Look, there really is something there we can go after." The company that learns best to do this is going to be ahead. The country that learns best how to go after this is going to come out ahead. Maybe even mankind. How much will it impact the chances of survival of a human race that so far, isn't paying much attention to keeping its world something that is a long time survival environment?

The social problems, economic problems, political issues and problems, psychological ones, many kind of issues there are really severe. They're put to test our collective capability. Which if you look at it, isn't a very good scheme. I'll go down under this box a little bit to check this thing. In the early '60s, after a decade of having this dream goal and doing other things in the way, I got a chance to start trying to write a framework paper about, "Hey how can you really augment?"

As I started listing all the really neat things you could do in a tool is when it really dawned on me that you have to list these other things that are given to the raw human being as he emerges into a society in order to be capable of operation. The net capability is the basic human, mental, sensory, motor, bundle of potentials in there that have to be trained, conditioned, etc., etc. In order to be really harnessed. Give them all of this and train them and condition etc. inside of that and this system augments that human.

That's all we have. Tacking things into here have that same fundamental. [inaudible 00:19:40] Already been in the late '50s just realizing that all of my dreams of this depend upon the assumption that computer technology, digital technology, is going to be very much cheaper, very much faster, very much higher capacity, etc., etc. Like that. The only potential is if it really gets much, much smaller. They were talking about the chips, putting all the stuff on chips, etc.

I did, I got a research grant to do a study about the dimensional scaling of electronic components. That means as you cut everything down by a factor of say 10, well different phenomena shift at a different rate. Some of the phenomena depend upon cross-section area. Some upon a linear dimension. Some upon a volume. Each of those characteristics of something is going to change differently with the change in scale. If you have a device that depends upon the interrelationship of this phenomena and this phenomena, as things get smaller, they just might get out of contact. They really will.

An airplane won't fly just by making it 1/10th to scale. Unless you keep a certain combination of parameters constant, etc. One of the things then I read was in biology. A lot of interesting things about the scale in biology. Why north of Spitsbergen there aren't any animals, mammals, smaller than a fox. Turns out that the surface area to volume increases if you get smaller. You make something half the size, it's got one quarter the surface area but one eighth the volume. One eighth of the volume's got to generate, or this metabolism, or heat to lose over a quarter of the ... You've got twice as much space per unit volume. Surface per unit volume to have to support heat. You get down to a certain size, you can't do it.

Many other things. One of the reason lessons of that study, well it was interesting to know. I became convinced. Semiconductors are going to run out of gas at a certain size because it just basic phenomena. There are a lot of other phenomena that'll start being able to be effective. The whole push in nanotechnology is just exactly right. There are inevitable things going to start happening like that so that the speed, price, cost, everything is just going to ... We haven't even started yet.

On the right, you look at things on the right side there and say the change in scale of capability on the right of the tools we're going to be able to have and the domains that can operate in. The pervasive impact in this side are going to be on a scale change we've never experienced before in history. When a terribly, terribly, terribly primitive people found they could harness fire or find they could put skins together and make clothing or make shelters, those were very significant, high-scale impacts on their world. The left side will change a lot.

Since history started and we became aware of how the left side here can change, we've never had to accommodate something such a big transition then. We're totally unprepared. If we were prepared just because of scaling phenomena we'd start looking up and down all this thing and say, "What are the candidates for change in almost any category in the human system?" You find it's ripe for candidates for change. They may do it.

One of the problems though that's been occurring and typified maybe by 1975 when the world started talking about office automation. That's what we're going to do over here. Automate the office. This NLS system sitting over there, my God, what a crappy mix of things that has. So hard to learn, etc. That's way off the beam but it isn't. We're going to be augmenting over here. Which means looking at a particular potential over here, you don't look at it. You should look at it just how it fits today. How does it fit into different conventions and practices, etc.?

You got to look and say, "How are we going to evolve?" It's this human augmentation system plus people gives you that capability infrastructure, and that's an extremely thing to do. Anyway it was that perspective that led us then into saying essentially what you're going to talk about is this dynamic knowledge repository, browsing and editing. This today we're really getting these things in co-involved so that when an ordinary we browser, you can start diving down more deeply into the environment we've been used to or stay out in the web world like that.

Capture management repository and integrating the group where is full of the slant. Where it start, shared files of course. Not for one minute did I think about that. I looked that at language aspect and that human system and said, there seemed to me a very critical thing. As you work with concepts in your mind, there's structure related etc. Lot of explicits and some associatives. When you externalize this concepts you give them real symbols in your mind and you work with them. Then when you externalize that, that's the real way in which you share with people work. Be it verbally or an environment.

What can you do that's new for candidate? Well gee. You can try getting it structure so it tries to map better the structure of the concepts in your mind. It's more than just not linear, it's structured. The relationships between, with a lot of concepts can have explicit relationships. You can interlink them by cross-citing. Those are two separate aspects of it. Also you said oh I don't, I can look for a lot for different views once I have it in there. The computer can help me put it in there. Can help me view it. Not only move around it but view it.

We generated quite a few optional views. One of the things we said, oh the view of looking at a page is literally the last thing we want to do. That's before we publish or something like that. When you're working online, we don't want to bother with pages. Nothing like that. That's something where we right away departed from the rest of the world. [inaudible 00:26:12] We laughed at it. We said later on there's no, the last thing you want to do is make it look like a piece of paper. If you're going to go print it but if you're going to really use it online, there are a lot of things about pages and all that that get in the way of what you can do. Browsing, shared screen was a important thing from the very beginning. I want to be able to work with my colleagues.

The very first concept that was the way. We built that thing into it. If I, one of the things I've got to do is ... Already we're running quite late. If I run another 2 hours ... What should I aim for?

Male: [inaudible 00:26:57]

Doug: Another half hour. Good. All right I'm going to dive into a quick pictures of some of the things we built back there in those days. Here was the first, the second interactive display that we built to run on a second computer. You say well that's a pretty big box isn't it? Yeah because you couldn't get memories in those days that could you give you bitmap memory. You couldn't make a bitmap screen. What you had to do was draw everything you wanted by deflecting the beam.

If you wanted a big tube you had visibility and light beams that was a very high voltage, high accelerated beam that was hard to move. It took big, heavy amplifiers to move it. With those could have very fast response so you could do it quickly was hard to do. This box here, oops. This box here contains the amplifiers to move the deflection. Oh, what generates the display? Well you see this box over here has all this stuff that generates the deflection for the display so the 2 together are the display system. A separate from the computer.

That was, we had to get that custom made from $80,000 in 1963 or '64 money. Which was a lot of money in those days. You says all right, it was, it took expensive to do that research. One of the things we want to do is try different kind of selection devices. This was one of them, Judy's sitting there holding that. We tried quite a few of them. One of them we tried was this beautiful thing made out of wood. Here's another thing in connection with Vannevar Bush or whatever, it's Vann Bush. Which I didn't appreciate at the time but I'd seen when I was an undergraduate a device that's made up of a couple of arm linkages.

You move a pointer around a closed area of some chart you've made and by looking at the wheels that are on there, etc. You can calculate the area that you've enclosed in this tour. I wonder how that works. The professor said, "Well a wheel is moving sharp like that will only resolve the direction it's rolling. If it slides sideways it won't resolve that component." It just sums up the component of displacement in the direction that rolls.

That's all that this was then, is 2 different orthogonal wheels rolling on a surface. It's related to the way that the differential analyzers, all disc stuff work. Like that. I didn't link it back to the expression to Bush at the time. Anyway that's just one of all the nice things even though we tried a neat thing. To move your knee up or down by pushing on the floor or move it sideways. We picked the shapiest knee to get the photograph of course.

I made a head pointer but we the mouse really worked. Another thing is the parallel input. While you're pointing, what are you going to do? We said we'd built this and my kids learned it. We talked to each other. Very simple. The letter A is the first one. B, two of them are C. This one alone's D. It's just totally binary. Turns out kids learn it very quickly. You just draw 1, 2, 4, 8 and a 16 on the fingers and tell them how you count and the pick it up right away. Then say look at the alphabet. That makes a big difference when one's working.

In 1967 we actually had a system going where we were having online meetings this way. We went up, when we're going to get a time sharing system, when scaling again you can get much cheaper, higher resolution, speed on a small tube. We'd get a bunch of them at the time share and put industrial camera routes to look at it. This produced the video out in the room. We time share'd drawing the pictures on these little screens like that. That was an innovation that led us get our laboratory equipment out there.

Merely having 2 big frames like this are character, display generators, 12 workstations out in the lab and it took a lot of maintenance. You have to realize that. Out in the laboratory a simple monitor and the keyset and a mouse and a keyboard, these were standard ways. Standard because of the way things operated was well we experimented with different innovations. This is the typical way. Stand, sit there with mouse, keyset and shift to the keyboard. You get long literals. The speed of operation I don't think has been equaled since.

I may be one of the first people in the world that had a private workstation in the office just to do my daily work all the time. That other people worked out in this bull pen out here with all of them. It was a really interesting social thing which was an important way in which everybody learned together about how to learn it. We wanted to give a show in that 1968 thing. We borrowed some of the cameras and got a tripod up there. Borrowed people to come help make camera working.

Up in the Brooks Hall in San Francisco, we had a big video projector that put something on that screen. You could see a little bit of it now that you could read from the back of the [inaudible 00:32:18] We had to shift, we had to lease ... Go out and put temporary video links from SRI to the 35 or 40 miles up the city to run this thing. Up in the front I was sitting at a console there and there was a camera above looking down. Another one mounted on the console looking at me. In the back of the room was our director building, we put all this together.

While it was running I could be demonstrating things and talking. We'll run a little bit of this footage. It's, you have to realize it's the system we had been using and working with. It could be used both as a presentation thing and as a work example. The world's first picture of a mouse, this was moving there on one half of the frame. You could see the cursor moving on the other. The way in which the controls would work was also pictured like that. One of the things that was important, well Jeff [Rulerson 00:33:13] had been with us a couple years by then. He's responsible for a lot of the architecture underneath.

He showed up today, sitting over here. He now works at Sun. He came online and unfortunately, when I took 20 minutes of clips from that hour and a half and put them together, his I think when Bill [Paxton 00:33:31] came to share screen on it instead of when Jeff did. You could've seen that. Let's run a little bit of that video please.

This is 1968. If I'd known Bush was still alive and active, we made [crosstalk 00:33:53]

I hope you'll go along with this rather unusual setting and the fact that I remain seated when I get introduced. The fact that I'm going to come to you mostly through this medium here for the rest of the show. I should tell you that I'm backed up by quite a staff of people between here and [inaudible 00:34:09] Park where Stanford Research is located. Some 30 miles south of here. If everyone just does our job well, it'll all go very interesting. I think. The research program that I'm going to describe to you is quickly characterizable by saying if in your office you was an intellectual worker or supplied with a computer display. Backed up by a computer that was alive for you all day and was instantly responsible, responsive. Instantly responsive to every action you had, how much value could you derive from that?

This basically characterizes what we've been pursuing for many years in what we call the augmented human intellect research center at Stanford Research Institute.

Look what else we can do in here. I've got this file that's structured. If I want to see what's in there I can walk down. The hierarchy levels and see or return. There's another thing I can do. There's a room type set I have here. Here I'm afraid I'll need to picture the view. Here's what I do with a picture drawing capability here. Slight map if I start from work and here's the route I seem to have to go to to pick up all the materials. That's my plan for getting home tonight.

If I want to, I can say the library. What am I supposed to pick up there? I can just point to that and oh I see. Overdue books and all. There was a statement there with that name on it. Go back. What am I supposed to pick up at the drugstore? I see, interesting. Market. We've already seen that. Additional like that. Gee that's too much. Anyway we have this feature of structuring our material, hierarchically and being able to move around it very well. When we get a hierarchy, such as I can show you here now.

I can do things if I want to. Just say I'd like to interchange produce and canned materials. Bingo! They're all numbered right. If I care to look, interchanging them very quickly. Cans are going to get interchanged with produce. They do it and all gets renumbered. I have ways of studying over, making different views, moving around, going to specify points and modifying the structure at the same time I've seen that I have a repertoire of different entities.

Like character, knock off that character. Replace the character. Make that P. I have entities of all sorts that I can say I want to go operations on. This basic structure that I can move over and study and get about very quickly. That is the essence now. That's the essence of the tool we have. that's a lot of details that I've left out for you. Now I'd like to stop a minute and just make sure you understand we're shifting from a luster material to the real working stuff. In case you wouldn't recognize it otherwise.

We had, we use this tool to do our daily work and it's our system has been built as time sharing for about 6 months now it's been working. In that time, we've gone from getting one console to getting about 6 working now with 6 more due the rest this spring. This is out 4th computer in which we've had this systems. We've learned a lot about user features we want and how to be fairly skillful. This next step about learning when you're faced with having this in your office all day as I now do. In a very exciting sense. How do you put that to work for yourself? How do you organize your files? What kind of things do you do?

To get going on this, let's switch away from the tool we have here and talk about some of the general features of the program. Some of the ways that's built to get back a little later to the nature of the, our usage of it. That program involves about 17 people together with a special laboratory facilities we have. It's sponsored by government agencies exclusively ARPA, NASA and RADC now. In the past, AFOSR and ESD. These were the people that first [inaudible 00:38:52] many years ago.

All right. It's a goal oriented pursuit for many years. I think we can just go off and get a quick little picture I sketched to show this is the staffing over the years from 1950 on. It's had slightly bumpy history. During these years there was only 1 of us. I go back to where I was and say let's continue on in this file. That link took me up to a different file, a statement for that view. I jump back to this file where I was and now within this file I make a link to another. To say the HIRC is pursuing these goals. Basic goal. Improve the effectiveness with which individuals and organizations work at intellectual tasks. What is their effect in this involve them?

Better solutions. Faster solutions. Solutions to more complex problems. Better use of human capabilities. Really thinking about that. A corollary goal is besides improving the effectiveness, what the system oriented discipline for designing the means by which greater effectiveness is achieved. It's very important to us, the approach for this should be result in this system oriented discipline.

Let me just show you how I constructed this file. You notice what's underneath there with that and that. There were just a link hidden here that went back to this view with a slightly different view parameters. To give you that view. All right there's another one hidden there. It says the general approach for us empirical. We're pursuing this monstrous goal, monstrously difficult to. By building and trying empirically, and we're approaching it evolutionary-wise because we feel that it's a whole system problem. You need to get a person in that environment working and looking at the many aspects of his working system that are involved in his effectiveness.

That's many more things than just these computerated tools. In a large system like that, we need to do it evolutionary-wise because we can't be analytic enough about it at any one point to decide what best our next thing should be. We can only decide from here as well as we can analyze it. Where we can invest our next resources to get the most return at an increase to the effectiveness of the system we have. This item down here is the term bootstrapping implied in a slightly new sense.

We're applying that to our approach. Where we're saying we need to, a research subject group to give them these tools. Put them to work with them. Study them and improve them. Aha! We'll do that by making ourselves be the subject group and studying ourselves. Making the tools so that they improve our ability to develop and study these systems and to produce in the end this system discipline.

It's going to, it's a struggle doing it that way but it's beginning to pay off.

I was tempting to run. These are clips taken from an hour and a half. There were a couple things in there I really want to get to but the time's running too short to. We've brought, during that hour and a half, 3 different people were tuned in that faces appeared in here. We were seeing their work or we were sharing the screens together, etc. One of them, I was hoping to get there and show you but these videos are available to people. Might be interested in them.

What I wanted to do is come back to this screen here and to the right. We saw the mix in here. In those intervening years after that, we did a lot of things that were much beyond what we've been talking about here. We got here and we were talking about this is the kind of thing we displayed at the time here. A shared files our software was all being done that way. When Jeff [inaudible 00:43:18] was one who's face was brought up. He was showing the structure and all of the software, etc. like that.

The next thing we did was integrate email. The next 2 years later we started operating on a network with a second mode. We were to provide the network information center. We were providing integrated emailing which these were the hyperobjects that could interlink between email and to the shared file. At the same time, another thing which was a very significant part of our work which I don't see it used yet out there. Just made a immense difference in how the dynamics of the dialogue go on in there.

That when you submit a document to this software and administrative operations system called The Journal, it would get cataloged. You would do it in a very similar to [inaudible 00:44:14] email. With more new fields that could go into a catalog and instead of sending the content in a message, you could just put a link to some other file and that would get cataloged. Then the system guaranteed that any end time ever more to access that file, link to any other way, you were guaranteed you'd get what the author published on that time.

The publication was not just a year like they are now, but a day and a minute down there. A few minutes later, somebody could've put a response in that cited yours, etc. The dynamics of all of that for managing dialog flow was just beautiful. When you watch email and a lot of conference things out there and you realize you can't do that in there. Anyway it's very significant difference to that.

I terminate. I can literally spend hours in all of this and if I want to be any friend of [inaudible 00:45:15] in the future I'd better get to you. Gee what's it worth Andy?

Male: [inaudible 00:45:25]

Doug: The one thing that really helped me a lot and portrayed to people what I sent about all this is to take those 2 major dimensions of a augmentation system. Make it like a frontier. You have to realize that each of these dimensions in turn is a multi-dimensional vector. To array that along a vector line such that you can say that's increasing system improvement would be hard put done. Just picture it that way. We can picture today out here some frontier boundary. We're pretty sure in 20 years there'll be technologies available to harness that way beyond that.

Similarly people are beginning to realize about that process reegineering that's potentially available. The new skills, the new roles, etc. that can go on the organizations. Those all make something in this vector. Our organizations are all clustered down here now. The product people are maybe the most of them are out here some place close to the edge of what organizations can use. They're not going to make things that organizations can't use yet.

What is an organization? If somebody brought a technology that was way out here that could really provide really new changes, would there be any market for it? There wouldn't picture any. There's no market pull from the larger user organizations that clusters of communities that could benefit by this group collective capability. They don't know, they don't have the experience to know what they want to yet. This is an unexplored frontier. Exploration has got to be more than just people writing papers or a few graduate students trying something.

To explore you really have to put up a group of people that's going to live that way to do heavy knowledge work that's representative of what it's going to be like when they're part of a larger collective organization. It's like saying we need outposts out there. Well you can put one out there now that used the forefront of what the technology and the product line could cause. Somebody could bring out some brand new technology and say you can harness that in the most advanced process engineering organization.

Where's this as a frontier? Where's this? Where's the responsibility lie in our society for exploring that frontier? Enough so any kind of interested organization says, "God we got to get out there because if we don't, the ones who do are going to win." That's true for a country too. Who's going to do the exploring? It's very different from a group of people that can make an exploratory technology and demonstrate it. This is where you're going to have people who've adopted their learning and working bases in there that's in a way that's like this is oh that's representative enough of how my own organization's work or some significant part of it. I'll move one department or one division or something out there now.

I have to realize that the cost of moving vertically in this space is much higher than moving horizontally. That if the horizontal thing keeps plugging out there and forces organizations to zig-zag out here, that's extremely expensive. You say, "Ah, industry and the product people would never do that, would they?" Well hah! The personal computer field was about 10 years old before they started doing anything significant with the networks. Yet when they began 11, 12 years ago, it was clear they've been 11, 12, 13 years of experience with the ARPANET where it's very clear that anybody who's going to really work significantly at an interactive terminal wants to be connected. Yet there were no provision for it. In fact it was rejected very adamantly.

Like the guy that went around and says, "Oh geez, none of the girls in this county want to get married." How do you know? "I asked them." I asked these guys, "How about connecting?" I get very flat pictures that that's not what you want to do. Well anyway that's 10 years of lost opportunity for our society to start learning how to harness all this. Thinking about, etc. We've got to do better, and who?

There's several possibilities. Cooperative, collective, end user organizations of communities that get together to start investing in it. A government role could be in there too. A government role could be there to say, "Let's," if we get communities of users that say, enough of us are significant going to want to set up an outpost that they can start underwriting. Some of the technology here that could do that for that group if they get the feedback so they coevolve together. There are endless places in the military and the rest of government where you can apply much improved, collective capability.

That's the end of my presentation for all this. I really kept wishing now more than ever that we had cans, 3 half hour cans of 16 millimeter film in what resulted from that presentation in '68. I really wish I would've known that Bush was still alive and active. I would've sent that to him because it could've made a lot of difference at least for me to get connected with him like that. Great to have respect for what he did, etc. I wish I hadn't had to go off somehow on a lone vector in this.

Now that's it. Andy, are we still friends?

Male: [inaudible 00:51:15]

Speaker: Mr. Modesty as always. What I like to do is since Doug quit exactly on time is give him the 10 minutes he earned for Q&A and some interaction with the audience. Do us a favor and please go to the microphone. Identify yourself and speak up so that you can be recorded for the record.

Doug: Of course you can always just pass on it and we can quit.

Speaker: Anyone to the microphone? Bob Cohn.

Bob: I was thinking, [inaudible 00:52:21] those reels of tape to Vannevar Bush, what kind of reaction do you think you might've gotten back?

Doug: Well, that's a very good question, Bob. I'm sorry you asked it. What my experience had been from the '50s, for many, still often, is people that I wouldn't have thought would get excited about it would get turned off. Would feel like that I was invading some domain as a alien stranger who didn't understand that domain and was talking about bringing toys to bear that didn't seem relevant. One things experience that stands out very much in my mind in the very early '60s, '60, '61, I had a chance to visit. Was invited to come and talk to the group at the Institute for Behavioral Science or something like this.

The people who came on a year's sabbatical to Stanford and sat around and thought and talked about behavioral science. I went over and talked about this time. Afterwards sitting out in the patio at a picnic table with 4 of them, I started to get really beaten up and turns out, one of the guys had been specializing in information retrieval for decades or something like that. He felt honestly felt violated. That here's somebody talking about some bringing some toys in that didn't understand what information retrieval's about. That the professionals have it under control and that I should just get out.

I don't have the same years of experience with that. People in psychology, people in social science, people la la, I would get that very often through the years. If Bush had gotten back in touch, I wouldn't have been terribly surprised if he responded that way. I kept trying. I would have just as delighted if for his experience etc. out there, his contacts, if he could've participated with me somehow. Saying, "Okay, where next?" Did I answer? [inaudible 00:54:42]

Male: Doug if your work had not been interrupted in the mid-'70s at SRI and funding had continued at a high level, what are some of the other things that you think you would've worked on?

Doug: Well we had a program actively started of enlisting organizations that could access us to the ARPANET to start learning and trying. We would've been just going after that bootstrapping where you come into an organization and can't expect them all to go [inaudible 00:55:20] You can't expect just to wheel in a bunch of truckload of technology and expect them to change. We'd started out by saying, "You have to appoint somebody hopefully not a programmer that are going to call the architect of your knowledge workshop."

That has to be a person that the user group that they're interested in respects this person as understanding their work and their job, etc. That person's going to be the architect working together. We support that person. Learn a lot from that person [inaudible 00:55:53] We have a prototype community like that going that all just got clobbered, etc. There are many, many technical things that we just were waiting to do.

We very much would like to have added speech so you could have the product speech inside of there. Of course the graphics would've been better. To learn how to interface with CAD systems and database systems and the like. A lot of evolution. I think it's fair to go after. The things we've been doing now, realizing that the world wide web just gave the world an extremely exciting stimulus. It just was it's a priceless thing.

It would be very nice if somehow that momentum can carry on to say look not just for publishing, but let's move that capability into what we do everyday. Minute by minute. Every memo I write is linkable too. Let's make it so every object in it is addressable intrinsically. That I don't have to go put a tag on it on purpose so if somebody can cite. A list of about 15 things like that I wrote down last spring that ... Anyway.

I'd be giving you the whole lecture wouldn't I?

Male: Just to follow up on this speculation of what might've happened if you've gotten a little bit better communication channel with Dr. Bush, when we found your letter in the MIT archives it was from 1962. From what we could tell, his health had been up and down at that point. He clearly wasn't around when the letter arrived. It was a secretary who responded. Now just also to give a little perspective, there was a large technology effort here at MIT in 1965 I believe called the Intrex Project at the library. Where they were trying to create the library of the future back in the past.

They were doing this with combination of microfilm readers and electronic computers. They made a tremendous effort to get him to both come and speak at a large conference and interact with the people. Thinking that he would be interested because they felt that what they were doing was clearly related to his work. At that point he'd really distanced himself from this. He was willing to come and give a 10-minute speech but he didn't seem to be all that interested in interacting with people who were following it.

I think part of it is this paradigm issue that you were on the other side of. He was very much an analog machine person. He felt rather uneasy with people who were dealing with digital machines because he wasn't the expert in digital machines. He was the expert in analog machines. I think you were, in a way, suffering from that problem. You were a future expert on a technology that most of the experts at the time didn't really understand.

Doug: I just learned a lot. That what I really think is that the biggest limiting factor in where there are society or how fast our society can really integrate the potential of all of this, rests upon the paradigm shift factor. I call it the paradigm shiftlessness. That it's a very natural thing and I felt very injured by it for awhile. Then I, this introspection you're supposed to do, I realized I do it too. That people can be trying to tell me something for quite awhile. Somehow later when I found out that's what they were trying to tell me then it's easier to be angry at them because they didn't really explain it right.

Male: I'd like the privilege of the last question. Doug, what do you think the hardest several research problems are that remain to be solved at this point? What do you think we need to put our focus on?

Doug: Well I think it's the research environment is the biggest thing. Getting it where you've really got groups of people that are committed to really change. In my sense, to get them almost after recruit. Advertise recruit and put through basic training and equipped and trained like you would if you said I'm going to take a bunch of flatland people and train them to be ski group. That's something you got. Equipment training before you can start learning what it's going to be next.

That's what I feel. High performance teams are something we should really go after.

Speaker: with that again, it was terrific. It was a privilege having you here.

Plenty of opportunity to say hello to Doug and [inaudible 01:00:45] during coffee which starts now. We'll reconvene here in 25 minutes. Coffee is upstairs. Bathrooms are around the corner. 25 minutes, we start again.

How did Garret do?

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