The Engelbart Hypothesis

Dialogs with

Douglas Engelbart

Valerie Landau and Eileen Clegg
in conversation with
Douglas C. Engelbart

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Preface by Doug Engelbart

It has been a pleasure working with Valerie and Eileen on this book. I once got in trouble with librarians by predicting the end of the book because a book does not offer the capability for interaction. But it is a beginning. I am hoping this will be a beginning of a dialog with you, the reader. A few of my friends and colleagues have contributed their perspectives in the following pages. I would like to thank my wife, Karen, and my longtime secretary, Mary Coppernoll, for their help on this book, and all of my colleagues and friends for their support.

Appreciatively,
Doug Engelbart

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Introduction

By Valerie Landau and Eileen Clegg

Engelbart is often called the father of personal computing. In 1968, he produced an event so groundbreaking it earned the name "the mother of all demos." At the Fall Joint Computer Conference in San Francisco, Engelbart and his team demonstrated a powerful integrated personal computing system complete with robust collaborative features (some of which did not yet have these names): word processing, document sharing, trackback links, hypertext, version control, integrated text and graphics—and, of course, the computer mouse.[1] These innovations have become the foundations of personal computing. He has received the highest honors for his contributions, including the 2000 National Medal of Technology from President Clinton.

Engelbart is most famous for inventing the mouse, but his legacy lies with his conceptual framework that foreshadowed the shift from the Industrial Age to the Information Age. He is considered by many to be one of the 20th century's greatest visionaries. Over the past 50 years, he has maintained that the mind-set of the linear book, the alphabet, and even the Web page no longer

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1 Bill English, Cheif Engineer of Engelbart's ARC lab, explains other features presented at the 1968 demo, "Video conferencing, multiple windows, and networking were simulated. You might say the demo gave us a glimpse of things to come and how they might be used in an integrated system."

suffice for serious intellectual pursuits in a global context. To raise the collective IQ (a term of Engelbart's from the 1960s that caught on decades later) he calls for new ways of communicating: new symbols, new ways of structuring arguments, facts, and evidence. This paradigm shift will enable us to tap into our collective perceptual capabilities for large scale collaboration, creating an evolutionary step well beyond Web 2.0 into a new paradigm for solving complex global problems from environmental threats to war.

Engelbart has always been far ahead of his time. Imagine reading his works in 1962, when room-sized computers, with disks the size of tractor tires, could cost millions of dollars. That was the year he described portable electronic devices connected together, enabling people to look up and share information on any subject.

During the dot.com boom at the dawn of the 21st century, bits and pieces of his framework emerged in interesting and unintended ways. Blogs, wikis, hypermedia, and networked communities of practice using dynamic knowledge repositories, such ass the Center for Disease Control website, the Human Genome project, and Wikipedia proliferated. But the haphazard, market-driven diffusion of technology lacks Engelbart's foundational philosophical framework for augmenting human intellect for solving complex problems.

These writings by Engelbart and his colleagues place his well-known technology achievements in the context of his grand vision for a paradigm shift in our thinking. We believe that Engelbart's philosophy is at least as significant as his inventions. His inventions were a result of his philosophy, thereby proving its validity.

What Engelbart wants most—and we want for him and for the world—is for his philosophy to be understood, applied, improved upon, defined, and understood in a new way, to again be applied, improved, defined and....on and on. He calls it "dialog." As a man who has always had ideas before words caught up to him, Engelbart has longed for discussion to help articulate his vision.

We responded to Engelbart's call for dialog. This edition is the latest synthesis of our years of conversation with him (Landau's goes back to 1985, Clegg's to 2004). We've published several versions, starting with an online book in 2004. We have devoted a chapter at the end of this edition to describe how we continually "improved our improvement process" to work with Engelbart.

In addition to choosing the best of Engelbart's words about his philosophy, we've also included his memories of episodes in his life that shed light on his philosophy. And—in keeping with Engelbart's commitment to dialog—we have included chapters from people who have been in conversation with him for many years, as well as chapters from scholars who have studied his work and applied it in their own. You will find many ideas and events mentioned multiple times, in different ways—reflecting various perspectives.

About Us

Valerie is a multimedia pioneer, professor, and inventor. Eileen is a journalist, visual communicator and organizational consultant. We've used every tool at our disposal—video, graphics, and many, many iterations of the book with Doug's inputs and corrections. In the end, what best served the goal of conveying Doug's philosophy was a trusted partnership among three people determined to use a linear medium to write about a non-linear, recursive, multi-layered framework based on multiple views of information, hyperlinking and collective dialog. The project was fraught with internal contradictions and constraints. So, this is by no means the final word; it is a step in furthering the dialog in the hope that Engelbart's much-needed philosophy will reach the mainstream.

—Valerie and Eileen

"Just a Dreamer"

"Someone once called me 'just a dreamer,'" Engelbart recalled. "That offended me, the 'just' part; being a real dreamer is hard work. It really gets hard when you start believing in your dreams."

Engelbart's curiosity and inventiveness flourished in a childhood surrounded by Nature with freedom to experiment and explore. Later, as a WWII veteran and young engineer, Engelbart wasn't interested in solving simple problems with simple solutions. He dreamed of a better way.

"Every problem facing humanity on a global scale is complex, and so, the solutions to those problems are also complex. Solutions themselves often bring on new unforeseen problems," he hypothesized. "Models for problem-solving do not address the needed complexity. The solutions are too big for any one individual or any one discipline."

Engelbart created a multidisciplinary philosophical framework—integrating social-cultural strategies with new technology to create a way to portray information. The goal was to include, view, and aggregate as much information as possible in order to enable humans to act strategically to solve global, complex problems.

In the following sections, Engelbart describes his early years.

Engelbart on His Childhood

I grew up in and near Portland, Oregon. I was the middle of three children, with an older sister and a brother some 14 months younger. The two of us, my brother and I, were quite close. My early years, ages four to 15, were during the Depression and my father died right in the middle of that, when I was nine. We moved to a rural area outside of Portland, in the woods with a creek. We had a lot of freedom and nature all around. I didn't get involved in city activities, nor did I have much interaction with people outside my family. I had quite a bit of reflective time. I read a lot and roamed the woods with my brother.

I had to generate my own picture of the world. There wasn't anything to drag me into reality except the things I tried to make or build that wouldn't work. I didn't develop the assumptions that many others did. I didn't know what I couldn't do. So, it didn't seem to dismay me much if I failed. I had to try. Because my father was dead and it was the Depression, socio-economic status didn't mean much. Our school district didn't have its own high school. We had to commute into Portland five miles away. We'd hitchhike, get rides with neighbors, or walk. We lived on a one-acre plot. Our garden was important and we had a cow. I'd get up at 5:30 in the morning and milk the cow and light the fires for cooking and heating. We used wood stoves, but that was nothing unusual in those days. I'd been up some two or three hours by the time school started. I didn't feel any terrible hardship. It was just the way things were.

My mother was very cheerful and supportive and our family was very close. We didn't experience any great dark, gloomy periods. It was just a way of life. My mother was always positive about things, and never negative. The only demand she made on me was to do the chores correctly. I had a sense of freedom and also a sense that I really wasn't like the other kids in school. I assumed they always knew what was going on all the time and I didn't. I was very shy, even at 12, 13 years old. I can remember walking pathways to the country store and somebody coming along who knew our family very well, but I would be too shy to meet their eyes so I would look down at the path as they walked by. Girls frightened me terribly.

I had a dream once of making a balloon with a framework underneath so that I could mount bicycle-like pedals, and drive with a propeller to move around the sky. I actually tried to decide how I'd build it and how I'd get the hydrogen. I remember reading someplace that you could pass steam over red-hot iron and the interaction would create hydrogen. It would oxidize the iron and leave the hydrogen free. So I built a huge fire and put an iron pipe across it to generate steam. Those were all things that seemed possible. I had a proclivity to dream the picture and then say, "let's go." I also assumed that somehow I wasn't like other people; I didn't understand their clubs or the way they operated socially and I didn't feel I had to try. It didn't bother me if I was different. That's still one of my characteristics and problems. It doesn't bother me to think about something that I can not see any direct way to get to. If it is possible, why not think about it? That has been an underlying problem for decades now.

I often say, "Well, it's just over on the other side of that canyon. So all we have to do is go." It is always surprising to me that other people would expect me to tell them how we're going to get there directly. That it is not enough to say, "Well, it would be important to get there and there is probably a way. Let's go." Years later, when I had to manage budgets, other people would come to me with ideas they would want to implement and I'd say, "My God, where's this guy coming from?" And then I'd realize, "Boy, that's just the way I often sound."

When I was in the service I had time to think through a lot of things. I generated a sort of algorithm: the rate at which a person can mature is directly proportional to how much embarrassment he can tolerate. And I realized that embarrassment didn't seem to bother me very much, because of my upbringing and the perspective I had about the world. Something Benjamin Franklin wrote was so beautiful, "You wouldn't worry half so much about what other people thought about you if you realized how seldom they did," and I'd say, "Oh, that's right."

I seem to have a lot of intuitive capability. I just don't mind at all not being able to explain to people how I reached something. It doesn't bother me. Intuition is important to me and I have a pretty logical head, etc., but I'm not very good at budgets and figures and explicit plans. They get in the way. I always needed other people to come along. Then I'd say, "just on the other side of that canyon." Then usually somebody would start a plan for some roads and get it together. I've always depended on that. Until they show up, there I am, floundering around, and pointing across the canyon.

I bought an old car I found in a barn when I was 13. It had a brass radiator and was 10 years older than I was, a 1916 Model T Ford. The parking lights were kerosene lamps and it had a brass radiator. The first-year cars had electricity and a generator. The headlights were a couple of big bulbs tied to knobs, so the faster the motor ran, the brighter your lights were. The seat was way up high. There were no starters in those days. You had to crank it. I just loved that thing. It took me seven years to get it running. I'd ride my bicycle all over to find parts, spend a quarter here and a quarter there. But the car ran. The guy that ran the local garage about a mile away let me borrow a tool. I'd ride up there on my bike and borrow the tool I needed. And as soon as I finished, I took it back to him until I needed it again or needed another tool. That was the only way that I could possibly get that engine apart.

Engelbart on Personal Influences

The war had just ended. I was in the Navy and was shipped to a little island in the Philippines. I was put in a camp that they called the "Receiving Ship," even though it was on land. During that time, I found a funny little Red Cross library, in a Filipino hut. It was up on stilts. There was nobody there, just all these books and magazines. I spent a lot of time in that hut. I found that Atlantic magazine article, *As We May Think,* by Vannevar Bush. I can remember being very intrigued by that article. But my goal didn't surface until quite a bit later, after I'd already made the commitment to augment humans. Then, suddenly I realized how the concepts in that article fit in with the things I was going to do with computers.

I read a lot—fiction and some biographies. I was interested in how things worked and why things happen. I read an interesting book of William James' writings when I was overseas, just after the war. He wrote that humans actually employ only a small proportion of their mental capability. That stuck with me. There was a book that was a layperson's approach to making the most of your life. I was at a stage where I read and reread books and articles that said, "If you want to go someplace, take the first step." I remember putting that idea to work quite often saying, "Well, what would be the next thing one would do if one wanted to get across the canyon? Well, all right, step off the edge."

Engelbart recalls his Epiphany: "Bingo: It Just Occurred to Me"

One Monday in December 1950, I was driving to work. I had just gotten engaged on Saturday night. I had a job working for the NACA, that's the forerunner of NASA, at Ames Laboratory down here in Mountain View. It was a good job, as an electrical engineer with nice people and a pleasant environment. As I was driving to work, I just looked ahead. In front of me appeared an uneventful tunnel, full of nice people and nice things, but I was struggling with this image. By the time I got to work, I realized, "I have no specific goals." And it really shocked me. I was going to get married and live happily ever after!—goal number one, and I had a nice steady job—that's goal number two.

For a Depression kid, that's about as high as you'd reach for. It just seemed so strange to me that, at 25 going on 26, I had no more mature goals than that. It kind of embarrassed me. My fiancée lived far enough away that we could only see each other on weekends. I had all these evenings free and, after I'd write daily letters to her, I set to work to try to figure out what should I have as a goal for professional work.

That was an interesting two or three months. I looked at all the crusades people could join, to find out how I could retrain myself as an economist or a teacher. What did the world need? I realized that the crusades were very complex and hard to manage. Slowly it dawned on me, this business of complexity. It's a complex problem to pick a goal for your meaningful crusade. It's a complex problem to organize, finance, and run it. It's a complex problem to guard against the secondary effects that could be negative if you don't anticipate them when you formulate your goal.

Then one day, it just dawned on me—BOOM—that complexity was the fundamental thing. Solving any significant problem would also be a complex thing. And it just went "click." If in some way, you could contribute significantly to the way humans could handle complexity and urgency, that would be universally helpful. I put together, very quickly, the possibilities presented by the very immature computer world that was just emerging at the time. But since I had been an electrical engineer and had worked with radar during the war, I could easily extrapolate. Bingo! I could help people work, and not just with numbers, but with the kind of thinking symbology that we employ now. I could picture people sitting in front of big cathode-ray tube screens with the computer. We could make symbolic arrays to develop new information forms in order to portray for ourselves the thinking that we were doing. And other people could be sitting at similar complexes associated in the same computer center collaborating.

I said, "Wow, tremendous possibilities! Okay, I'm going to go after that." That was in the early spring of 1950. If a computer could punch cards or print on paper, I just knew it could draw or write on a screen, so we could be interacting with the computer and actually do interactive work. You could engage in collaborative work, with other people at work stations tied to the same computer systems. We could be working independently or collaboratively. I had intuitive certainty that this would work.

Engelbart on his Dream for Humanity

Many years ago, I dreamed that people were talking seriously about the potential of harnessing a technological and social nervous system to improve the collective IQ of our various organizations. What if, suddenly, in an evolutionary sense, we evolved a super new nervous system to upgrade our collective social organisms? Then I dreamed that we got strategic and began to form cooperative alliances of organizations, employing advanced networked computer tools and methods to develop and apply new collective knowledge. I called these alliances Networked Improvement Communities (NICs).

The new technologies could enable more effective distributed collaboration, and the potential for shared risk and multiplied benefits seemed promising. In the dream, the solution involves giving high priority to the collective capability for a distributed community or organization to develop, integrate, and apply new knowledge. We already had this capability—organizations handle new collective problems all the time. But, in the dream, we become much more effective. I called this collaborative capability CoDIAK, for Concurrent Development, Integration, and Application of Knowledge.

Engelbart on U.C. Berkeley to SRI

In 1951, I wanted to learn about computers. There were not many computers in those days. You'd have to go clear to Boston or Baltimore to find a working computer. I think there were only about seven computers in the world. The University of California at Berkeley had a Navy research project to build a computer with vacuum tubes. The memory was on a rotating magnetic drum. It was scattered on racks around a room. I applied to U.C. Berkeley, where I eventually earned my Ph.D.

By the time I could do thesis research, people made it clear to me that any talk of using a computer interactively or to process logic, rather than numbers, was too far out. I had to settle for doing something else as a thesis and I happened to dream up some gaseous discharge phenomena to make computers work. It took a couple of years of work to make the tubes work and complete the Ph.D. By that time, we had three children. Little tiny twins came along after our first child. We weren't very mobile.

My colleagues made it clear to me that the computer ideas I was talking about sounded crazy. People said, "You will never be anything but an acting assistant professor at the University if you keep talking like this. The only way you're going to stay here is to teach and to develop a laboratory and publish things that are peer reviewed." At that time, the salary for an acting assistant professor was less than what you would earn with a bachelor's degree in engineering. I stayed and taught for a year, but I was getting very restless.

I thought I could capitalize upon the patentable devices. A patent attorney said, "Gee, why don't we form a corporation and then we'll see if we can sell the corporation and share the profits." We set up a company and found backers. They said, "Why don't you build these things." So pretty soon we set up a laboratory in the basement of a house we rented in North Oakland. The four of us were trying to build these devices in the basement while my wife, Ballard, and the three little girls were in the upstairs apartment. It was strenuous. The rapid emergence of semiconductor technology, just one year later, made it clear that what we were doing was not in line with the solid-state computer world.

My partners were still enthusiastic about going ahead anyway. They wanted to get a company established. After a few months, I still could not find a way to relate this work to my dream of augmenting the world. I finally called up my partners one Sunday and said, "I'm sorry, I have to go a different route." They didn't want to go ahead without me, and the whole thing collapsed. After a few months of negotiation, I was hired at SRI, then called Stanford Research Institute.

The first person I interviewed with was someone I'd known at Berkeley, and I told him what I really wanted to do with computers as communication devices. He listened.

Then he said, "Have you talked to anybody else here yet?" I said, "No, you're the first person." He said, "well, I'll tell you, I think if you want to get hired, you better not tell people this. It's just too crazy." "Oh," I said.

I got the job and started being a good boy. Pretty soon, I had some more patents and was in good standing with the emergent community of high-tech solid-state circuit people around the country. Then I started saying, "But here's what I really want to do." And finally they sort of said, "Well, you can have part-time to do that." It was very strange that, almost immediately, the feedback for the things I wrote went from "Oh, great, great!" to puzzled looks.

My boss gave me quite a lecture one day. He said, "Look, here's eight pages you've gone through to describe this thing you want to do and it's still all faint. Bill has just written this proposal, on one page, very concise, clear, describing exactly what he wants to do with his research." The model proposal was very detailed in an intellectual domain that was already all thoroughly beaten out. What he was proposing was a very narrow research question pursuing a tiny sub-domain.

I tried to explain to my boss that I was interested in opening up an entirely new approach for which there is no vocabulary. Later, people used the term "paradigm shift" to describe a fundamental change in assumptions and thinking. If you're really dealing with something in a different paradigm, the vocabulary of almost everything you're trying to say is different. You have to somehow establish the terms as stepping-stones to arrive at what you're trying to say.

And people aren't used to it taking that long for you to get the picture to them. That has been the basic problem ever since, when trying to describe the framework Augmentation System and the Bootstrap Strategy.

Engelbart on The Road to the Augment System

In 1961, I wrote a proposal to Harold Wooster, the Director of Information Sciences of the U.S. Air Force Office of Scientific Research to develop a comprehensive framework for augmenting human intellect. To my surprise, the key administrators were highly imaginative, and open to new and controversial ideas. The assistant, Rowena Swanson, put in a strong vote to fund the project. Wooster, Rowena Swanson's boss, would put proposals he liked on one side of his desk. The proposals he was dubious about he put on the other side. Swanson would come into the office after he'd gone and move my proposal into the other pile: the favored pile.

The project to articulate a framework for augmenting human intellect was funded by both The Air Force Office of Scientific Research and SRI. The little bit of money from the Air Force let me finally sit down and start writing a description of a new paradigm and form the Augmentation framework. We wrote a proposal about how to start bootstrapping and building a system to help us develop our own thinking and support our own projects. Eventually, it became the first Hypertext system and the first collaborative support system.

The title of the paper was, "Augmenting the Human Intellect: A Conceptual Framework." It was an attempt to create systems that provide intellectual support. Through the generations, humans have invented all kinds of tools and methods to support intellectual work. We have entire augmentation systems already. Improving the systems we have for supporting intellectual work really deserves explicit cultivation. I tried to outline the ways the new computer system could help us augment our natural abilities. Imagine how important it would be. I see it as analogous to the way a shovel augments small digging projects, while the bulldozer really augments our ability for big projects.

I attempted to explain that you could learn to use computer-supported tools to help develop and improve existing computer tools. I wrote an initial summary report of a project taking a new and systematic approach to improving the intellectual effectiveness of the individual human being. A detailed conceptual framework explores the nature of the system. The system is composed of the individual, and the tools, concepts, and methods that match his basic capabilities to solve problems. One of the tools that shows the greatest immediate promise is the computer, when it can be harnessed for direct on-line assistance, integrated with new concepts and methods.

I published the paper in 1962 when J. C. R. Licklider came to the Information Processing Technologies Office of ARPA [Advance Research Projects Agency]. I was, figuratively speaking, standing at the door of ARPA with the Conceptual Framework report and a proposal. How could he in reasonable consistency turn this down, even if it was way out there in Menlo Park? In those days, many in Washington believed there were no decent programmers in the Palo Alto area.

My colleagues at SRI thought I was crazy. To them, hearing about people using computers to communicate through a network to collaborate was crazy talk. They laughed at me when I talked about word processing. "Using computers for writing. Ha! Why would we need that? We have secretaries that do our typing for us."

They put someone else in charge and gave my team very little access to the equipment SRI bought with the grant. When Licklider finally came for a site visit, two years later, he continued with some funding and made sure we had more access to the computer equipment. But the support level he could offer wasn't enough to pay for both a small research staff and interactive computer support.

What saved my program from extinction was the arrival of an out-of-the-blue support offer from Bob Taylor, who, at that time, was a psychologist working at NASA Headquarters, then in Washington D.C. Later, Taylor moved to ARPA and became a significant factor in launching the ARPANet. I visited him months before, leaving copies of the Framework report and our proposal. The combined ARPA and NASA support enabled us to equip ourselves and begin developing Version 1 of what evolved into the NLS[1] and AUGMENT systems. We were

1 NLS stands for oNLine System, the computer system built by Engelbart and his team, that later was call the Augment System.

able to get the system robust enough for its debut at the 1968 demo. Then, the following year, we could demo even more features as a new member of the ARPANet. The ARPANet later became the Internet.

Engelbart on The Beginning of Networking

The computer in my lab received the first message on the ARPA network. The computer at UCLA sent a message to my lab at SRI. They were trying to send a message for us to log in. But all that got through were the letters "lo," and then the computer crashed. That was the first ARPANet connection. That was 1969. The network grew and other networks emerged. Now the Internet is huge with millions of computers. Back then, number two was ours. I was one of the 12 or 13 principal investigators that each had a timesharing computer and was doing work on ARPA projects.

Because I was continually interested in the future of human organizations, I volunteered to run the Network Information Center to help other groups. Then ARPA said, "Well, we want to start learning about computer networks, so for the first example we're going to connect all you researchers together."

Engelbart on The Mouse and Keyset

I believe that the complexity of the problems facing mankind is growing faster than our ability to solve them. Finding ways to augment our intellect is both a necessary and a desirable goal. The mouse was just a tiny piece of a much larger project aimed at augmenting human intellect.

It was 1964 and I was working at SRI. I envisioned problem-solvers using computer-aided workstations to augment their efforts. They required the ability to interact with information displays using some sort of device to move around the screen. We were looking for the best and most effective device to point to and select the information displayed.

By the time I invented the mouse, I had already spent a dozen years exploring ways for people to increase their capability to solve complex problems. In the early 1960s, several devices were in use: the light pen, joysticks, and others. We analyzed the various characteristics of other pointing/input devices before the invention of the mouse. We made a grid, similar to the Periodic Table of the Elements. We laid out the grid in rows and columns with the characteristics that define each group of devices. And just as the periodic table's rules have led to the discovery of certain previously unknown elements, this grid ultimately defined the desirable characteristics of a device that didn't yet exist.[2] That device was the mouse.

We approached NASA in the early 1960s[3] and said, "Let's do a study to determine, once and for all, what is the most effective selecting and pointing device." With NASA funding, we developed a set of simple tasks and timed a group of volunteers to complete the tasks with the various devices. For example, the computer generated an object in a random position on the screen and a cursor somewhere else. We timed how long it took each user to move the cursor to the object. It quickly became clear that the mouse outperformed all the others.

The light pen required the user to pick up the pointer and reach across the screen. After several tests, it became evident that it was very tiresome. We also developed a knee-based pointing device.[4]

A fellow named Bill English built the world's first mouse. Bill was an extremely effective guy. I had sketched out the idea fairly quickly in a little notebook and I gave it to Bill to build. He went home and carved a piece of

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2 Bill English recalls, "The mouse development was one of the very early engineering projects. I don't remember anything about the 'grid' that defined the characteristics of pointing devices. We simply looked around at all of the display pointing devices that were in use, and conducted the experiment."

3 "It was 1962 when we proposed the NASA experiments, and the final report was issued in July, 1963." Bill English recalls.

4 According to Bill English, "The foot has very poor fine control, and the foot control was the poorest of any we tried.

mahogany and built the world's first mouse.[5] I couldn't have done it without Bill. But the patent attorney at SRI did not agree that Bill English should share the patent. The original mouse had the cord in front, but we quickly moved it to the back end to get it out of the way. It was a simple mechanical device with two perpendicularly mounted discs on the bottom. You could tilt or rock the mouse to draw perfectly straight horizontal or vertical lines. Or you could give the mouse a push and lift it off the desk, and watch the cursor continue moving while the disc was spinning.

No one can remember who coined the term, "the mouse." It just looked like a mouse with a tail, and we all called it that in the lab. I thought it would be called a "servo-control unit" or something like that. But the name "mouse" just took.

We also developed a chording keyset to work in an orchestrated way with the mouse and keyboard to get maximum flexibility and efficiency. The keyset allows users to type the entire alphabet and numbers, as well as key commands, in conjunction with the three-button mouse. The concurrent use of mouse and keyset also provides considerable gains in speed and flexibility for modifying document structure. For example, if the author perceives

5 Bill English commented, "I did not carve the box. I did the engineering work necessary to take Doug's sketch to a working device that held the orthogonal wheels and the potentiometers to transmit position to a computer. After the device was built by the SRI machine shop, a box to hold it was carved, by a draftsman who worked near our project. The original mouse had the cord in front and only one button, but we quickly moved the cord to the back to get it out of the way, and realized that the was space for more buttons that could greatly increase the functionality of the mouse."

that Statement 2b really belongs in Section 3, following Statement 3c, she/he can execute the necessary move command in a very quick, deft manner. In order to move an entire section, which I called a "Branch," using the keyset, the user strikes "m" and then "b" for "Move Branch."

Meanwhile, the mouse hand is positioning the cursor anywhere in the text line of Statement 2b. So in order to move an entire section or branch, it only takes two chord strokes.

> The chording system of typing is similar to playing notes and chords on an instrument. Each finger is assigned a number, so when you press a combination of fingers simultaneously, the numbers are added together. Letters are also given numbes, so, for example, 1=A and 2=B, so pressing those simultaneously results in a "C."

Professor Bill Buxton conducted and researched a serious study of text input devices in 2002. He concluded his study with the following: "Based on the literature and personal experience, I believe that chording keyboards have an important role to play in human-computer interaction … Major improvements in methods for keyed input will only be achieved through a radical change from current practice.

This is true for both novices and experts. The use of chord keyboards as an alternative means for keyed input is still underdeveloped. This is, I feel, due to the range and complexity of the issues affecting their performance. To change this situation, research must investigate appropriate applications as much as technical issues. In my mind, the issue is not if chord keyboards can be effective, but where and how?"

Engelbart on Scalability

Finding an evolution process is key to preventing an organization from becoming extinct. In order to create a process for the evolution of our social and organizational structures, you can learn to sensibly integrate different elements and co-evolve all of them in order to allow for a rapid change in scale without creating such an imbalance that the whole thing falls apart. What if we look ahead to see all the new capabilities that we probably will develop in the future? It would be very important to develop, early on, your improved capability to evolve.

The notion of the rapid change in unprecedented scale is a cornerstone of the Augmentation framework. The nature of change and rapid scalability has a profound impact on the high-tech industry. The idea of "dimensional scaling" stemmed from my first job at Ames Laboratory in the early 1950s. I noted to one of the Air Force officers, "I see you've got a little wind foil in a little wind tunnel, but it's only one fiftieth of the size of the wing. How can you take the data here and say what it will do to the wing?" The officer said there is a special science called, "Dimensional Analysis."

Years later, at SRI, I remembered that conversation. I conducted a study and wrote a paper on dimensional analysis, studying what happens if you make things smaller and smaller. When you make things smaller and smaller, it causes everything to function faster and faster. But there is also a different phenomenon at work. As you get smaller, some things will shift with the length, some will shift with the area, some will shift with the volume. There will be new phenomena you can explore. I gave a talk at a conference about that. After I finished, someone in the audience named Gordon Moore was eager to learn more. He developed a formula, known as Moore's Law.

> In 1965, Gordon Moore predicted that the number of transistors on a chip would double about every two years.

I like to give visitors a little test to see if they understand the concept of scalability. What if all of us, and everything in this room, were to become 10 times larger? Would you still be able to do what you are doing now?" Visitors think about themselves sitting on a chair, standing up and down, and most of them figure that if everything grows at the same rate, things would look and behave the same way in relation to one another. The answer is "no." Actually, a person would weigh 1,000 times more, but would only be 100 times stronger. You could no longer support your own weight to move the body. The chair would break and a host of other unexpected changes would take place.

The appropriate design for a five-foot creature is not that much different from that for a six-foot creature. But the design for either of these would be totally inappropriate for a one-inch creature, or for a thirty-foot creature. A mosquito, as big as a human, could not stand, fly, or breathe. A human the size of a mosquito would be badly equipped for basic mobility, and, for instance, would not be able to drink from a puddle without struggling to break the surface tension, and then if his face were wetted, would very likely get pulled under and be unable to escape drowning. When thinking about human aspects of collaboration and the technology involved, you have to think about the effects of increased and decreased scaling effects.

I became aware of an important general principle: if the scale is changed for critical parameters within a complex system, the effects will at first appear as quantitative changes in general appearance, but after a certain point, further scale changes in these parameters will yield evermore striking qualitative changes in the system.

Bootstrapping applies this concept to problem-solving. Each time a change is made, or a problem is solved, it leads to a completely new state of the situation. What is needed is a strategy that allows for continual reevaluation of the problem at every stage, so that a new strategy can be created. This applies to both human systems [social relationships, culture, politics] and tool systems [technologies]. As a result of issues of scale, it is imperative that human and tool systems must co-evolve.

Engelbart on Capability Infrastructure

The capability of a society is determined by the complexity of its infrastructure. All societies have an infrastructure that is made up of tools. Some of the tools are culture based: language, tradition, protocols, organizations, educational institutions, economic structures, etc. Each society also has physical artifacts, utensils, buildings, transportation systems, weapons, communication systems, etc. Complex activities require larger and more complex underlying infrastructure.

It is, in fact, the infrastructure that defines what that society is capable of. Each of us is born with a unique set of perceptual motor and mental abilities (vision, hearing, verbal, smell, touch, taste, motion, sensing). We build upon those through our learning new skills and knowledge. We become socialized through culture: language, methods of doing things, customs, organizational behavior, and belief systems. In addition, we learn to use tools and have developed communication systems. The capability infrastructure is the way all of those innate abilities, acquired skills, cultural assumptions, and tools work together.

Change in one tool or custom can have unintended consequences in other tools, customs or, indeed, effect the entire structure. In order to create powerful tools to augment human thinking, we have to change many aspects of the infrastructure, and examine how the tools will be used. The potential for change with the introduction of augmentation technology can create fundamental shifts in the world. While we continue to spend millions of dollars researching newer, faster tools, little research is being done on the most strategic investments that will provide the highest payoffs for augmenting human thinking.

During the 1960s and early 1970s, ample funding by the U.S. Department of Defense promoted research for networked computing. The result was the creation of the infrastructure for the Internet. The investment in the Internet infrastructure made substantial global changes in our collective capabilities.

Engelbart on Measuring Collective IQ

Strategic planning to boost the Collective Intelligence Quotient of a large-scale community or organization is a long-term goal. When you are talking about computers, many people dive right into the computer system. What often happens is that tactical rather than strategic plans are implemented.

Consider a community's "Collective Intelligence Quotient" as the scaling of individual Intelligence Quotient. Imagine the benefit if an entire group's perception, thinking, and ideas about how to take action could be immediately available when needed to understand a problem. What if groups of people could access their collective knowledge quickly when faced with a decision, sorting through all other "noise," and keying in on the most relevant information? It would vastly improve our ability to deal with complex, urgent problems—to get the best possible understanding of the situation, including the best possible solutions.

My interest in interactive computing, even before we knew what that might mean, arose from this conviction that we would be able to solve difficult problems using computers to extend the capability of people to collect information, create knowledge, manipulate and share it, and then put that knowledge to work. Organizations that respond to disasters are tremendous examples of organizations that must learn to adapt and use new information quickly. Disasters are, by their nature, unplanned and surprising. Responding requires rapid access to other information, geographical and mapping information—information about local resources, local communications, the availability of outside resources and organizations—sometimes even about the location of buried mines and unexploded munitions.

It turns out that it is difficult to share information across systems—where "sharing" means both the ability to find the right information, when it is needed, and the ability to use it across systems. Even harder is the ability to use computer networks to monitor and reflect a complete picture of any given situation. Anyone who regularly uses e-mail can readily imagine how the chaotic flow of messages between the different people and organizations during a disaster falls far short of creating the information framework that is required for an effectively coordinated response. It is striking how the capabilities of today's personal productivity and publishing systems are mismatched to the needs of these organizations as they work to coordinate effective response flexibly and quickly.

These problems are due to structural factors. We have the opportunity to change our thinking and basic assumptions about the development of computing technologies. The emphasis on enhancing security and protecting turf often impedes our ability to solve problems collectively. If we can re-examine those assumptions and chart a different course, we can harness all the wonderful capability of the systems that we have today. People often ask me how I would improve the current systems, but my response is that we first need to look at our underlying paradigms—because we need to co-evolve the new systems, and that requires new ways of thinking. It's not just a matter of "doing things differently," but thinking differently about how to approach the complexity of problem-solving today.

Networked computing has the potential to increase the human's capability to share and manipulate ideas leading to phenomenal change for knowledge work. But market forces driven by an invisible hand, as described by Adam Smith,[6] are unlikely to invest in strategies that evolve new ways of working, managing work, and knowledge. Organizations must strategically change their approach to harness the power of this new medium rather than adapt the medium to mimic other media. A community's collective IQ represents the community's capability for dealing with complex, urgent problems. Some of the capabilities include the ability to:

- adequately understand problems;
- unearth the best candidate solutions;
- assess resources and operational capabilities and select appropriate solution commitments;
- effectively organize and execute the selected approach;
- monitor the progress and be able to adjust rapidly and appropriately to unforeseen complications.

I contend that a strategy for "facilitating the evolution"

6 Adam Smith wrote a book, An Inquiry into the *Nature and Causes of the Wealth of Nations,* published in 1776, describing the "invisible hand" as one of the underlying forces driving supply and demand in the free market."

of our organizations' collective IQs will be the optimum approach. The measurement of a society's capability to problem-solve is based on the infrastructure that supports it. The culture, training, organizations, tools, artifacts and physical infrastructure all determine the capability of any individual or group to perform. If we don't improve our infrastructure, it is unlikely there will be significant progress. Let's say you could build a measurement of how well a company interacts with its external environment. Suppose you start getting measures of things like:

- How sensitive was the company to what was happening in that environment—opportunities or threats?
- How quick and effective was the company about making a plan for taking advantage of an opportunity or avoiding a threat?
- How directly and quickly and effectively did the company go about marshaling?
- How well was the company able to watch what is going on in their arena?
- How rapidly could the company readjust its plans and resource allocations to take advantage of new opportunities?

There is some measure in there that you could call the collective IQ. Research with the explicit intent of collectively solving complex and urgent problems merits serious investment.

Engelbart on Concurrently Developing, Integrating and Applying Knowledge

Concurrently Developing, Integrating and Applying Knowledge (CoDIAK) is a strategy for building improvement into the process of improving the group's collective IQ. Their collective IQ is measured by their ability to gather information, analyze it, and develop the best possible understanding to create action plans.

The Concurrently Developing Integrating and Applying Knowledge (CoDIAK) process is recursive. Teams continuously incorporate and analyze the intelligence they are collectively gathering, such as research, dialogs, and best practices. The data are cataloged with metadata so they can easily be incorporated and reviewed by all team members in a Dynamic Knowledge Repository, allowing team members to reflect on what they are doing, and at the same time examining how they are doing it.

The CoDIAK process provides the key capabilities for their steering, navigating and self-repair by categorizing and continually analyzing information such as lessons learned, new information, and dialogs among the group.

The information is then integrated into the knowledge products throughout the life cycle of the project. As participants tag and categorize their dialogs and information gathering, they will develop skills and adopt practices that increase the value they derive from the practice of analyzing this data, which will also make their contributions more valuable.

People are surprised by how much value is derived from this practice, by the ways the value is derived, and by how natural and easy the practices and tools will seem after they have become well-established (even though they may initially be viewed as unnatural and may be hard to learn).

There was a feedback system that was a powerful mechanism. (It hasn't really been picked up by the rest of the world in any systematic way, that I can see. So that is one of the areas that I think deserves a lot more attention.)

Everybody in my group used the system to do almost all their work. As people add to a structured knowledge base, they reflect on their current practices, assumptions, and strategies and could respond and adapt to the new information and analysis. As those people add their new ideas, others build upon them. Each person or group makes a small contribution that builds upon the contributions of others.

So the whole thing became a very integrated whole. By using the CoDIAK process, it effected:

- how people worked
- how the technology turned out
- and how the group behaved.

Charles Irby was the Information Architect at the ARC lab at SRI for seven years. At Engelbart's 80th birthday party, he described what it was like using the Bootstrap framework and the CoDIAK process.

> "I think a lot of the things that he [Engelbart] was doing had to do with the combination of developing a technology and, at the same time, developing the human side—ways of dealing with that technology and incorporating that technology into the way you get things done…He was using this notion of bootstrap where you could basically use the technology to influence how the group behaved and use the technology to invent another revolution of the technology."

Engelbart on The "Networked Improvement Community"

Networked Improvement Communities (NICs) form to share information and to analyze and improve upon their current practices and processes. With better tools, an improved infrastructure, and a recursive approach, groups can raise their collective IQ. "Improvement communities" have existed for centuries. Improvement communities (trade organizations, guilds, professional associations, communities of practice) get together to exchange ideas in order to improve their processes. In a "Networked Improvement Community," members also evaluate how well their system of idea-exchange is working by using Dynamic Knowledge Repositories to record their exchanges.

Network Improvement Communities also focus on improving their improvement process. These NICs are an important part of the evolutionary improvement infrastructure that is a central part of the bootstrapping strategy. Since the scale and complexity of the world's problems are changing, we need to also be constantly improving our processes. As we improve one thing, it causes a problem somewhere else and we need to adjust the system. We need to build improvement of the process directly into the design process.

Curtis Carlson, President of SRI, said to a group of industry leaders at Engelbart's Unfinished Revolution Symposium at Stanford University in 1998:

> "It is often said that point of view is worth eighty IQ points. The objective of the NIC is to collect as many plus eighty IQ points as you can. That is collective intelligence. We are a lot smarter as a group or as the magnitude than we are individually. It is recursive, it builds on itself. That is the bootstrapping idea. Doug is recursive in his model in every way that you can imagine. It really is a very thorough analysis of how many recursive ways you can build value to make an improvement community."

Engelbart on Dynamic Knowledge Repositories

Dynamic Knowledge Repositories (DKR) offer a snapshot at any given moment of the state of the knowledge related to a specific subject. The DKR can serve as a metric of how well the process of gathering, categorizing and analysis of information is working. The DKR is an integrated knowledge domain, providing the current state of the frontier [leading edge ideas and practices] for that domain, via dynamic integration of any new data observations, questions, proposals, and challenges that reflect the current state of the frontier.

A DKR should also be a viewing mechanism for portraying multiple views of the information, from multiple viewpoints, from multiple people who are stewarding that DKR. DKRs could be structured so they integrate with other DKRs to integrate interdisciplinary Dynamic Knowledge Repositories. Standards and protocols allow people to tag phrases, paragraphs, or citations in order to embed and link to other systems in different knowledge domains, similar to standardized library systems. Discernible argument structure with linked citations to the specific passages that are components of the structure help to determine whether or not to accept an assertion made. Data can be tagged to show a particular classification.

A few examples of data types include:

- Fact
- Argument
- Hypothesis
- Evidence
- Research
- Observation
- Discussion
- Question

Dynamic Knowledge Repositories not only store and link data, but include tools that allow users to integrate, manipulate, and edit that data in unique and powerful ways. In order to create Dynamic Knowledge Repositories, groups of people record their communications, work processes, and research, and continually reflect on not only WHAT they were working on but HOW they were working. My hypothesis is that evermore effective Dynamic Knowledge Repositories will be central to improving a community's collective IQ—essentially the capability—in dealing with a complex problem, for providing the best, up-to-date understanding of the current state of both the problem and its solution efforts. DKR updates might change the direction, future thinking, decisions, etc., for a project.

Engelbart on Measuring the Effectiveness of a DKR

A DKR could serve as a measure of how well a large group understands a complex situation, and how well the group understands the possible solutions and the complications each solution engenders. Groups could use the DKR to help understand what resources each solution might require and anticipate that each will have snafus and complications. The DKR could show how each solution will engender new, unforeseen complications and opportunities.

Networked Improvement Communities can use the DKR to strategically plan stages of development and to create metrics to determine the effectiveness of their plans. Key questions for decision-making might include:

- What are the resources each solution requires?
- Are the snafus and possible complications understood?
- Is there a space for us to say, "Oops, we didn't anticipate this"?

The DKR has to be dynamic. The dynamics of a DKR are central to its effectiveness. Key questions to study the dynamic aspects of a DKR might include:

- Are we able to analyze with coherence and sensitivity both the current situation and the changing and evolving state?
- How can we measure the collective IQ?

Engelbart on Future Mapping and Facilitated Co-Evolution

I think it would be useful to have a new category of knowledge workers I call "outposters".[7] The outposters conduct research and analysis about possible future scenarios and create "future maps" to help others make informed decisions. These future maps will facilitate directed co-evolution to help groups find a strategic path rather than let evolution take its normal course.

"Facilitated co-evolution" is a term I used for creating planned strategies based on information rather than the haphazard trial-and-error way tools are adopted in the marketplace. I would like to see the people who create the tools also using their tools, analyzing how to improve them, and then modifying the tools. I would like to see knowledge workers examine how their work process might have to change to leverage the possibilities. I would like to see experimentation with new ways of working with new sets of social relations based on information and reflection.

As we pursue significant capability improvement, we need to appreciate that we are trying to affect the evolution of a very large and complex system that has a life and evolutionary dynamic of its own. We should move toward pursuing improvement as a multi-element co-evolution

7 The idea of 'outposters' became popular among think tanks and futurists in the 1990s.

process. In particular, we need to give explicit attention to the co-evolution of what I call "tool systems" and "human systems," which are cultural practices, organizational structures, reward systems, etc. If we co-evolve these systems as we develop new tools, and reflect on how we can improve the infrastructure, together we can increase our capability. If we then add a systematic approach to sharing knowledge, we can also improve our ability to solve problems and boost our collective IQ.

Engelbart on The New Role of "Logician"

Specially trained teams will be involved to ingest the ongoing dialog. They will assist in adapting to the relevant ontological shifts, help monitor and solidify the "argument structures" involved in seeking coherence and plausibility, etc. They will also help facilitate associated "views" of the knowledge structure to facilitate learning. This might entail creating different viewing alternatives for different categories of learners. A new class of knowledge workers, Certified Public Logicians, may be required.

The Certified Public Logician's job would require a variety of skill sets. Some of the Certified Public Logician tasks would be akin to Certified Public Accountants. The Certified Public Logicians will create sound accounting systems, but instead of accounting for money, they track and categorize data sources. Their job may also be likened to a librarian making sure the information is cataloged and placed effectively so users can easily find what they are searching for.

The Certified Public Logicians will ensure that the Dynamic Knowledge Repository represents the most complete, accurate and current picture of the domain. The Logician provides a detailed structure for integrating new data as well as accountability structures and standards for data. Just as accounting records allow for tracking of the financial state of an organization, the Dynamic Knowledge Repositories should provide the most complete and current information about a particular domain with traceable pointers to when, where, why, and who deposited the data and into what section.

Logicians may also help create multiple viewing options of relevant information. They help categorize information with multiple meta-tags so it can be assimilated into structured argumentation and fact-finding within Dynamic Knowledge Repositories (DKRs). They should be able to tag data with standardized codes that will make information in one DKR compatible and easy to integrate with other DKRs.

Engelbart on Structured Arguments

An argument is not a serial affair. It is sequential because some statements have to follow others. But this doesn't imply that its nature is necessarily serial. We usually string Statement B after Statement A, with Statements C, D, E, F, and so on following in that order: This is a serial structuring of our symbols. Perhaps each statement logically followed from all those which preceded it on the serial list, and if so, then the conceptual structuring would also be serial in nature, and it would be nicely matched for us by the symbol structuring. But a more typical case might find A is an independent statement, B dependent upon A, C and D, E depending upon D and B, and F dependent upon A, D, and E. The statements are sequential but not serial.

They form a conceptual network but not a conceptual chain. The old paper and pencil methods of manipulating symbols just weren't very adaptable to making and using symbol structures to match the ways we make and use conceptual structures. With the new nonlinear symbol-manipulating methods, we have terrific flexibility.

Structured arguments are key to being able to see a variety of views on any given topic.

Example of Augmentation Tools:

- Create Symbols for Parts of an Argument
  Each part of an argument can be coded with its own symbol to help the reader determine fact from opinion, research, analysis, etc. New symbols may

be created to define parts of an argument such as research, premises, findings, opinion, hypothesis, or other categories.

- Color Code Parts of Speech
  By color coding parts of speech people will be able to increase their speed for finding and comprehending key points. The parts of speech can be color coded so users can read through large amounts of information quickly. For example: verbs are one color, nouns another, adjectives a third.
- New Color Codes or Symbols for Hyperlinks
  Hyperlinks can be identified by category to make finding information easier. New symbols for links might include:
    - Links to dictionaries, taxonomies or other references
    - Links that refer to previous research or supporting information, including footnotes
    - Links to information that contradicts the prevailing opinion
    - Links to online discussions (discussion boards, blogs, and emails)
- MetaData Taxonomies and Ontologies
  Every document or section within a document can be tagged with metadata [data about the data] so it can be easily searched and integrated with taxonomies and ontologies.[8]

8 An example of a taxonomy currently in use in the medical community is the Medical Subject Headings (MeSH). MeSH is the National Library of Medicine's controlled vocabulary thesaurus. It consists of sets of terms naming descriptors in a hierarchical structure that permits searching at various levels of specificity.

Engelbart Explains the ABCs of Improvement Infrastructure

(Excepts from Engelbart's keynote address to the World Library Summit in Singapore 2002)

The key to developing an effective improvement infrastructure is the realization that, within any organization, there is a division of attention between the part of the organization that is concerned with the organization's primary activity – I will call this the "A" activity – and the part of the organization concerned with improving the capability to perform this A-level function. I refer to these improvement efforts as "B" activities

The investment made in B activities is recaptured, along with an aggressive internal rate of return, through improved productivity in the A activity. If investments in Research and Development, Information Technology infrastructure, and other dimensions of the B activity are effective, the rate of return for a dollar invested in the B activity will be higher than for a dollar invested in the A activity.

Clearly, there are limits to how far a company can pursue an investment and growth strategy based on type B activities – at some point the marginal returns for new investment begin to fall off. This leads to a question: How can we maximize the return from investment in B activities, maximizing the improvement that they enable?

Put another way, we are asking how we improve our ability to improve. This question suggests that we really need to think in terms of yet another level of activity—I call it the "C" activity—that focuses specifically on the matter of accelerating the rate of improvement.

Clearly, investment in type C activities is potentially highly leveraged. The right investments here will be multiplied in returns in increased B level productivity—in the ability to improve—which will be multiplied again in returns in productivity in the organization's primary activity. It is a way of getting a kind of compound return on investment in innovation.

The highly leveraged nature of investment in type C activities makes this kind of investment in innovation particularly appropriate for governments, public service institutions such as libraries, and broad consortia of different companies and agencies across an entire industry. The reason for this is not only that a small investment here can make a big difference—though that certainly is an important consideration—but also because the investment in C activities is typically pre-competitive. It is investment that can be shared even among competitors in an industry because it is, essentially, investment in creating a better playing field. Perhaps the classic recent example of such investment in the U.S. is the relatively small investment that the Department of Defense made in what eventually became the Internet.

Investing wisely in improvement

Let's keep our bigger goal in mind: we want to correct the current bias, emerging from over-reliance on market forces and the related obsession with ease of use that get in the way of developing better computing tools. We want to do this so that we can use computers to augment the capabilities of entire groups of people as they share knowledge and work together on truly difficult problems.

The proposal that I am placing on the table is to correct that bias by making relatively small, but highly leveraged investments in efforts to improve our ability to improve—in what I have called type C activities.

The proposal is attractive not only for quantitative reasons—because it can produce a lot of change with a relatively small investment – but also for qualitative reasons: This kind of investment is best able to support disruptive innovation—the kind of innovation that is necessary to embrace a new, knowledge-centered society.

The acceleration in movement away from economic systems based on manufacturing and toward systems based on knowledge needs to be reflected in accelerated change in our ways of working with each other. This is the kind of change that we can embrace by focusing on type C activity and on improvement of our ability to improve.

If the organizations want to support and stimulate this kind of investment, where do they begin?

The answer to such questions has two different, but complementary dimensions.

- The first dimension has to do with process: How do you operate and set expectations in a way that is consistent with productive type C activity?

- The second dimension has to do with actual tools and techniques.

Process considerations

At the C level we are trying to understand how improvement really happens, so that we can improve our ability to improve. This means having different groups exploring different paths to the same goal.

As they explore, they constantly exchange information about what they are learning. The goal is to maximize overall progress by exchanging important information as the different groups proceed. What this means, in practice, is that the dialog between the people working toward pursuit of the goal is often just as important as the end result of the research. Often, it is what the team learns in the course of the exploration that ultimately opens up breakthrough results.

At the C level, context is tremendously important.

We are not trying to solve a specific problem, but, instead, are reaching for insight into a broad class of activities and opportunities for improvement.

That means attending to external information as well as to the specifics of the particular work at hand. In fact, in my own work, I have routinely found that when I seem to reach a dead end in my pursuit of a problem, the key is usually to move up a level of abstraction, to look at the more general case.

Note that this is directly counter to the typical approach to solving focused, B-level problems, where you typically keep narrowing the problem in order to make it more tractable. In our work on improving improvement, the breakthroughs come from the other direction—from taking on an even bigger problem.

So, the teams working at the C-level are working in parallel, sharing information with each other, and also tying what they find to external factors and bigger problems. Put more simply, C-level work requires investment integration—a concerted effort to tie the pieces together.

That is, by the way, the reason that the teams that I was leading at SRI were developing ways to connect information with hyperlinks, and doing this more than two decades before it was happening on the web.

At the C-level, then, the approach focuses on:

- Concurrent development (See Engelbart on CoDIAK)
- Integration across the different concurrent activities though continuous dialog and through constant cross checking with external information·
- Application of the knowledge that is gained, as a way of not only testing it, but also as a way to understand its nature and its ability to support improvement.

As a mnemonic device to help pull together these key features of the C-level process, you can take "Concurrent Development," "Integration," and "Application of Knowledge" and put them together in the term "CoDIAK."

For me, this invented word has become my shorthand for the most important characteristics of the C-level discovery activity.

We need to become better at being humans. Learning to use symbols and knowledge in new ways, across groups, across cultures, is a powerful, valuable, and very human goal. And it is also one that is obtainable, if we only begin to open our minds to full, complete use of computers to augment our most human of capabilities.

monday afternoon

december 9

3:45 p.m. / arena

Chairman:

DR. D. C. ENGELBART

Stanford Research Institute

Menlo Park, California

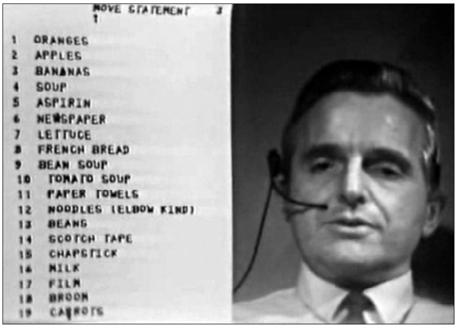
a research center for augmenting human intellect

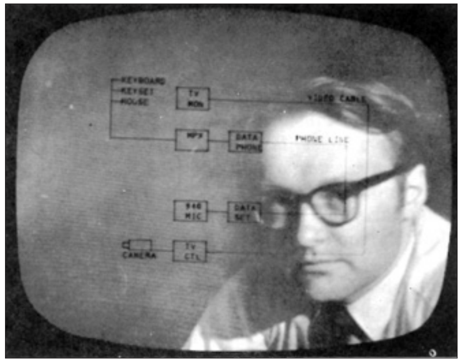
This session is entirely devoted to a presentation by Dr. Engelbart on a computer-based, interactive, multiconsole display system which is being developed at Stanford Research Institute under the sponsorship of ARPA, NASA and RADC. The system is being used as an experimental laboratory for investigating principles by which interactive computer aids can augment intellectual capability. The techniques which are being described will, themselves, be used to augment the presentation.

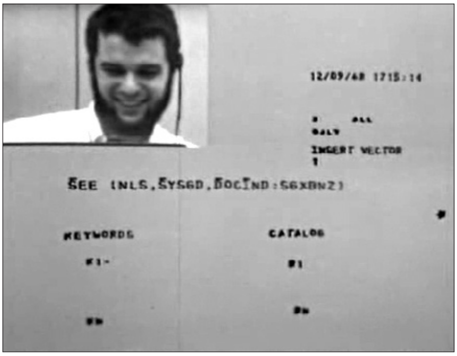
The session will use an on-line, closed circuit television hook-up to the SRI computing system in Menlo Park.

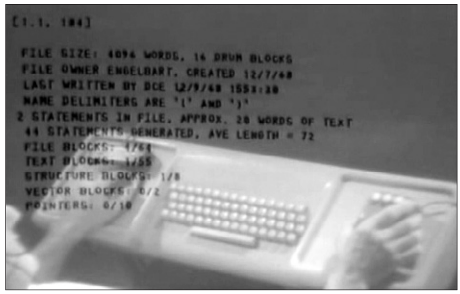
Following the presentation remote terminals to the system, in operation, may be viewed during the remainder of the conference in a special room set aside for that purpose.

Program for the "1968 Demo"



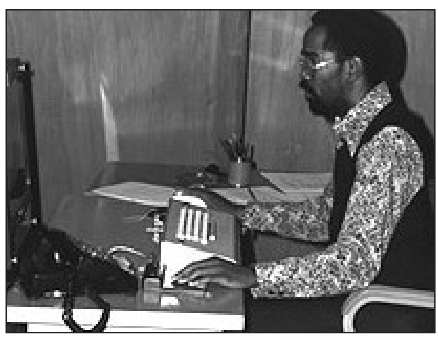






Photos from the "1968 Demo" (Above)

ARC Lab team using the mouse and keyset.



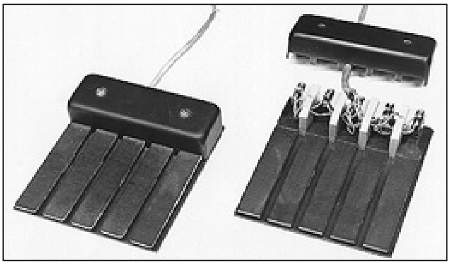
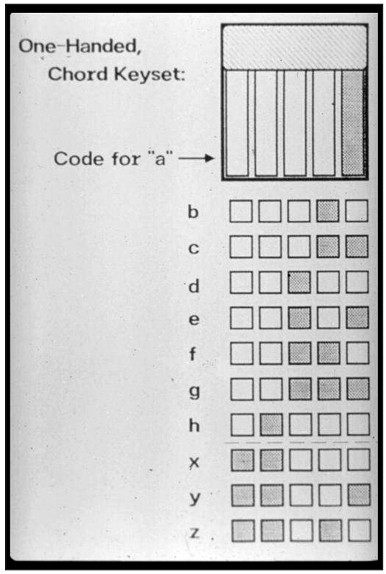
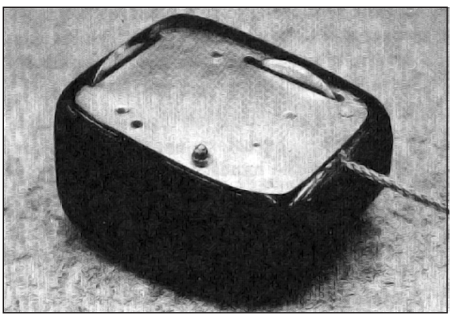
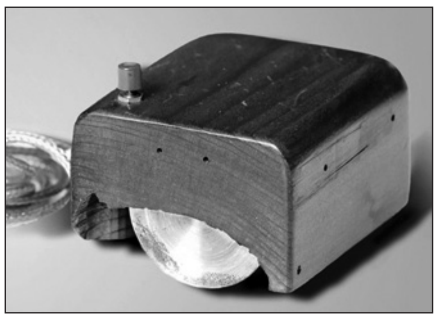


Photo of Doug Engelbart using the chording keyset taken by Evan Schaffer in 2008

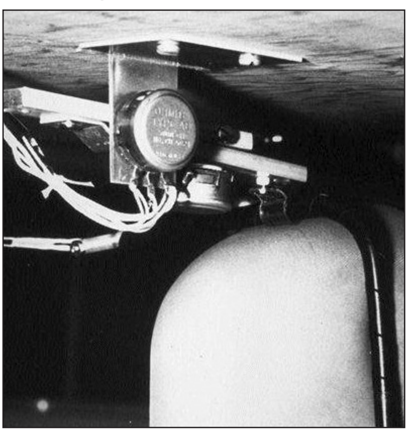


"Cheat Sheet" for the chording code for the keyset





The original mouse carved out of wood



Knee pointing device, which did not perform as well as the mouse.

Engelbart showing Tim O'Reilly the original mouse.
Photo by Bill Daul 2007

Professor Landau and Douglas Engelbart
-Photo by Bill Daul, directed by CSUMB student Matt Lussier

President Clinton and Doug Engelbart receiving the National Medal of Technology

Introduction to the "Mother of All Demos"

"I don't know what Silicon Valley will do when it runs out of Doug's ideas."
—Alan Kay

On December 9, 1968, Dr. Douglas C. Engelbart and his research team unveiled the most robustly featured networked computer system in history—a system they designed to solve the complex and urgent problems facing humanity. An amazed crowd at the Fall Joint Computer Conference in San Francisco watched in disbelief. Engelbart and his team demonstrated a new way to work: interactive collaborative personal computing. The "demo" laid the foundation for many of the computer innovations of the 20th century.

Engelbart sat in the front of the packed hall, while his larger-than-life image was projected on a giant screen. He addressed the live crowd and remotely addressed the team at the Augmentation Research Center some 30 miles away in Menlo Park. As the lights dimmed, Engelbart began his presentation. "What if, in your office, you as an intellectual worker were supplied with a computer display backed up by a computer that was alive for you all day and was instantly responsive? How much value could you derive from that?"

Engelbart and collaborated with team members at the lab in Menlo Park, each participant added and changed text, manipulated graphics, and even providing live audio and video in multiple windows that they expanded, closed and opened with ease. Engelbart created a text document, drawing lines, shapes, and moving text from print view to outline views, as well as cutting, pasting and transposing text. He and his team collaboratively created a map, and edited the text and graphics, using the mouse in combination with the keyset.

All the while, they were chatting live, via video conferencing, with multiple colleagues back at the ARC lab.[9] They showed elements of virtually every tool we use today. They may not have had these names at the time, but this is what they became:

- The computer mouse
- Visual display of text and graphics
- Multiple windows
- The concept of online publishing in pre-World-Wide-Web-like journals as well as blog and wiki-style collaboration
- Searching and finding information
- An integrated and flexible messaging system
- Video conferencing
- User help system
- Online glossary

9 Bill English explains, "Images of the screen and other video images were transmitted by a one-way video link from SRI. Keystrokes and mouse movements were transmitted by a one-way data link to SRI... Multiple windows were created on the video console at the rear of the room and were not part of the system. There was no two-way video to SRI. All communication was by a telephone link."

- Hyperlinking
- The ability to create customized views
- Linking of multiple files
- Collaborative annotation of documents
- Shared-screen teleconferencing
- Formatting of text

In addition, Engelbart integrated the mouse with the chording keyset and QWERTY keyboard.

In the most ambitious technical demo in history, Engelbart and his team laid the foundation for personal computing. The audience of an estimated 1000 people stood up and applauded and some rushed to the stage in excitement. Engelbart couldn't believe they pulled off this feat without a glitch. After the demo, the team anticipated a flood of questions and offers to participate. Instead, what Engelbart remembers was that a young professor accused the team of perpetuating a hoax. He recalls how his team invited the professor to the ARC lab and spent two days demonstrating to him that it was all live, all real – just unbelievable.

Tim Berners-Lee (inventor of the World Wide Web) describes his reactions to the video of the 1968 demo, "... when I saw that [demo] the first time, I was amazed. ... Doug's stuff is unbelievable. You have best to see the video of him demonstrating it."

Paul Spinrad wrote in UC Berkeley School of Engineering's Forefront Magazine about Engelbart, "He named his group the Augmentation Research Center

(ARC), referring to the use of technology to augment human intelligence, or 'raise the collective IQ'... Engelbart was describing something that did not exist, which is what delusional people do.[10] But fortunately, J.C.R. Licklider at the U.S. Department of Defense Advanced Research Projects Agency shared enough of his vision to fund the formation of the ARC and start implementing Engelbart's ideas. Five years later, the innovations developed by the 12-person group were ready for prime time. And the rest is history."

10 Bill English noted, "Engelbart's original name for the group was "The Augmented Human Intellect Research Center" (AHIRC.) It was changed to Augmentation Research Center (ARC) in early 1970."

ABC Level Activities and the Bootstrapping Framework

In those early years of creating the first graphic user interface, keyboard and mouse, the team at Engelbart's ARC was following the Bootstrap Strategy precisely. As they were developing the tools, they were improving them and reflecting on the process and improving it.

As part of reflecting on their own processes, the group challenged traditional assumptions about the workplace and knowledge work. They researched new infrastructure (desks, chairs, offices) and attire. They tested new protocols, new cultural paradigms, and new approaches to engineering and knowledge work. While most engineers wore starched white shirts and ties, there was no dress code at the ARC lab. (Many team members had long hair, and wore jeans and T-shirts.)

They designed experimental work-stations. They created workplace PODs and lined the walls of the lab with paper, and kept copious notes of their work process. Some team members used open space, some used semi-private space, and others sat cross-legged with pillows on the floor. They routinely invited psychologist and sociologists to comment on their work process. They were the vanguard of collaborative activity that others are carrying forward.

An essential part of Engelbart's "Bootstrapping Framework" is what he calls the ABC process for improving capability. Engelbart believed that at any given time there can be three levels of improvement activity working in parallel. The first level of improvement is done by a Networked Improvement Community (NIC), reflecting on improving its own capability. This A level activity is typically performed by people who are engaged in the actual task. The second level of activity, B, examines how the infrastructure, process and procedures can be changed so that the A level activity can be more effective. This task might be done by trade associations, communities of practice or other such groups. The third level of NIC (the NIC of NICs or meta-NIC) improves the process by which we improve the process of improving the process. The latter is a more scholarly process, and rarely accomplished within businesses.

Reflections by Fellow Pioneers of the Computer Age

Alan Kay was a graduate student at the University of Utah when he attended the demo. It changed the course of his studies and career. Kay became a computer visionary and pioneer in his own right. While Engelbart is often referred to as the Father of Personal Computing, Alan Kay and Steve Wozniak are the fathers of the personal computer.

"Doug was like a biblical prophet," recalls Kay. "His talks were not for information, but to show a promised land that needed to be found and the seas and rivers we needed to cross to get there...He always had a powerful physical presence, and his demos with the projector reminded me of Moses, as played by Charlton Heston, parting the Red Sea in 'The Ten Commandments.'"

"It was the romance of humanity thinking its way out of its genetic structure," Kay said at the Stanford event commemorating the 30th anniversary of the Mother of All Demos. As he recounted the impact of the 1968 demo, his voice broke with emotion. "That's the great thing about this industry. Technology is one thing, but you meet the most fantastic human beings."

"He named his group the Augmentation Research Center (ARC), referring to the use of technology to augment human intelligence, or "raise the collective IQ'... Engelbart was describing something that did not exist, In his book “Weaving the Web,” Tim Berners-Lee identified Engelbart as a visionary. “Doug was too far ahead of his time. The personal computer revolution, which would make Engelbart’s mouse as familiar as the pencil, would not come along for another fifteen years…”

Colleagues on The Engelbart Diaspora: Impact on the Future

> "Your thinking about how this is all going to turn out is correct but it's still yet to happen."
> —Alan Kay in conversation with Engelbart

The "Engelbart Diaspora" is the relationship of Engelbart's ARC lab to the community of technology developers that created computer tools over the last 40 years.

The term "diaspora" is a Greek term meaning the scattering of seeds. The July, 2006 the Wiktionary defines diaspora as: "A dispersion of a group of people from their native land, commonly used in reference to the Jews." The study of diasporas examines how the ideas and tradition traveled with a group of people as they migrate. They influence those around them and in turn are influenced by their new environment.

People who worked with Engelbart carried their experience with them as they moved into leadership positions across Silicon Valley. Like a potent bushel of seeds, Engelbart's ideas were planted and cross-pollinated across the high tech industry to create new products and methodologies stemming from Engelbart's seminal work and approach to development.

The team from the Augmentation Research Center went on to influence their colleagues at other companies.

The mass exodus from Engelbart's lab to Xerox PARC (13 key team members) and then the adoption of many of the PARC features in the Apple Macintosh lead some historians to inaccurately credit PARC and Apple for many of Engelbart's innovations such as the mouse and the Graphical User Interface (GUI). Several people who worked at PARC went on to become major industry players, founding companies (including Adobe Systems and 3Com) or joining companies such as Apple and Sun Microsystems.

Bob Metcalfe, founder of 3COM, wrote in a 1997 Wired Magazine article, *The Visionary Thing,* "Hey, it's not easy being a proto-prophet…Engelbart got left behind because he embodied his visions in the time-shared computers of his day and missed the detour we all took into stand-alone personal computers. With the emergence of the Web, though, he'll be back."

At Engelbart's 80th birthday in 2005, people who worked in Engelbart's lab in the 1960s and 1970s gathered at SRI with those who were carrying his vision forward. Bill Daul, who worked with Engelbart in the 1970s remarked,

> "Doug had such an incredible vision and every one who worked with Doug was touched by his vision."[11]

11Bill Daul heads the NextNow Network, a global social network of people who are interested in Engelbart's vision.

Applying the A,B,C Principles

By Darla Hewett

Through my encounters with Engelbart's work, the seeds were planted that grew into a lifelong career and passion for creating my interpretation of Dynamic Knowledge Repositories (DKR) to raise collective IQ, with surprising successes.

I have interpreted Engelbart's "ABC" as follows:

The "A" level activity is carrying out the work. The workers add to the DKR by documenting what they are doing and how they are doing it.

The "B" level activity is improving the human and tool systems. In my case, creating models of the work flow and the production process.

The "C" level activity is improving the improvement process. It is the meta-level—improving the process for how the "B" level activities are carried out.

I helped a small manufacturing group demonstrate what I call, "Actionable Engelbart." The CEO of a very people-oriented business wasn't happy with one of the big-name content management systems. He wanted a more flexible and adaptable system for product design, manufacturing, sales and customer service.

I listened to the various teams describe how they wanted the computer system to be designed. Next, I built a tool so the team could build models of the systems they described; including the ordering process, customer profiles, manufacturing processes, shipping and pricing, and the layout of the factory floor. We also made models of the team workflows. I made sure that modifying the models or building new models was easy. The new models became part of the DKR, which drove the business and facilitated the raising of the collective capability.

If a worker added a new model or modified an old one, it resulted in higher productivity. Additionally, other team members could investigate all details of the new model, which leveraged not only the model, but the acquired knowledge about the model. This created an improved capability for the entire team.

This created a new paradigm. The employees could design and modify their own tools and processes to make them better. They were able to represent what a product should look like, changes in the factory floor, how a work order could be set up, etc. The employees felt empowered. They didn't have to use a system designed by someone else – it was THEIR system.

Interestingly, more aspects of the computer system benefited from flexibility than we initially hypothesized. For example, the customer profile forms were modeled on a standard industry practice. It turned out the customer service representatives pushed for more flexibility in their systems. A wonderful woman named "Kim" said that each customer was an individual and she needed a variety of approaches on how to input and access each profile.

We asked her to design a model for the customer profile application. She knew just what to do. We removed the standard industry code and based customer service on Kim's models. The entire company, and particularly the sales department, were able to increase their capability and sales. When we made certain procedures fixed, based on best practices in the industry, the employees began saying, "No, no! We want to be able to improve this." The company augmented the best practices to create their own internal, flexible models for almost every aspect of the business.

The changes in the system evolved as a result of the changes in the way people worked. And their customer relations improved as the tools improved. For example, people answering the phones were the first point of contact with the customer. As they found new ways to improve their connections with customers, they made changes to their interactions, and that affected the whole system of the company.

Before we began writing code to implement a process, we asked, "Does this task or system benefit from flexibility in the design?" Some tasks and systems don't need to be flexible. For example, their accounting system, which followed structured tax standards and guidelines, would not benefit from a flexible model. However, allowing workers in customer interaction, product design, production and delivery to create their own tools increased their capability. We allowed all employees to create and modify the models at every level. So the workers, who mostly engaged in

"A" level activity—such as sales, product design, facilities maintenance, production, shipping, and pricing—were engaging in the "B" level activities as well. They were, in fact, improving their processes.

So, we were successful at creating a system for the "A" level activity, the programs the employees used everyday. Then we were able to get the "B" level working well, allowing employees to create and modify models to improve the current "A" processes. It was the third level of abstraction—creating a model of all the "B" levels, or, in other words, a "model of models"—that was tricky.

The manufacturing company achieved unexpected efficiencies and financial success. The business went from 31st to 3rd in sales within a couple of years; they had that much more capability with the same number of people. Their teams were generating a better customer experience than a company 10 times larger. It was not only because the workers were more efficient, but, more importantly, the employees became more capable. They supported each other as the tools supported them. They were supercharged. It was a beautiful thing to see—it changed my life and I vowed I would do whatever I could to help this happen on a larger scale.

By creating models of a team's process, constraints and big obstacles become apparent and can be eliminated, empowering the group and the individuals to move forward. In order to improve, human processes and tools need to evolve to meet the goals of the organization. If either the tools or the processes are rigid, the collective cannot improve. If you identify the constraint and it cannot be fixed, then the collective is locked into the current level of capability. Of course, sometimes there are people who refuse to change and this can be obstructionist. The bigger problem, in my mind, is when a process or tool cannot change. Most tools do not adapt well to the collective. Unfortunately, the collective is forced to adapt to the tools.

Later, I tested a similar "A," "B," and "C" process with a city bus maintenance and repair company. We augmented their systems. Once we created models of what they were doing, the constraints of the systems became apparent. They then created new models and figured out how to improve their own workflow. As a result of the process, they improved their capability so much that workers had free time at the end of the day. In order to avoid layoffs, they began a new service. They bought old scrap buses and refurbished them. So they expanded their business without adding additional personnel. The old buses are still on the road as "retro buses."

Again, we were able to support a collective to be creators of their co-evolved human and tool systems. It has been so exciting to apply these ideas and see the results.

When employees have the capability to change their own processes and procedures and inter-link their own systems with tool systems to make them flexible and easy to manipulate, then the tools can adapt. With these improved tools people's capabilities improve in each of "ABC" bootstrap levels.

When one or more people assemble into a group (Engelbart's collective), there is a baseline capability of that group. The group becomes a unique entity with the capability to receive input, add value, and produce meaningful results. For example, this could be sales, production, or services. When you increase the capability of the group, it can receive more input, add more value and produce more meaningful results.

Today, leadership usually extends a group's capability by recruiting more members. Engelbart had a different idea. The group's capability can be improved by improving the improvement process. There are times when it is necessary to extend the capability of a group by bringing in additional members. However, there is an enormous amount of latent capability in any group that can be realized by following Engelbart's ABCs.

I am now involved in a project to help build what Engelbart has asked for a "DKRs of DKRs," helping individuals who have studied and applied the framework to share their insights with one another through co-evolution, improving organizations and tools. I am confident that we will see the realization of Engelbart's dream of raising our collective intelligence so we can solve the urgent, complex global problems that threaten humanity.

Darla is CIO of Hewett Research with a passion to build flexible, adaptable systems based on the collective intelligence of the people in the enterprise. These systems are self-generating/self-correcting and can instantly adapt to any change or innovation in the business or supply chain. She is also a core member of Program for the Future.

Behind the Technology: A Vision for Problem-Solving Communities

By Charles House

I first met Doug a couple of years before the '68 Demo and immediately saw the power of his inventions: You could be a one-man band and corral all the information in the world at your fingertips. At the time, I was project leader at Hewlett-Packard, where I was working to develop innovative information displays to support better decision-making. Doug's inventions inspired me, along with a whole generation of computer designers, about the "personal power" that the networked computer tools could provide. His 1968 Demo provided a glimpse of "the future" in a bold way that had no precedent, and unleashed a torrent of creativity that has changed the capability of people for individual and group activity everywhere on the planet in nearly unimaginable terms.

Behind the technology, Doug's philosophy for collaboration also has created transformation in a more subtle way within organizations, including in my work with Hewlett-Packard. We brought Doug into HP for several key sessions in 1983, and put his "ABC" Model into action. The power of the ABC lies in the nested levels of community, and the definition of respective roles for improving process as well the actual work. This offers incredible power for improving infrastructure.

I wound up licensing Doug's Dialog system, and we built a very ambitious HP 'Internet', with e-mail system, computer conferencing system, and videoconferencing system, influenced by his input. Then we constructed a significant NIC community for HP, comprised of Productivity Managers in ninety divisions, to complement the Corporate Engineering group that I had built in Palo Alto.

In terms of the A,B,C model: Corporate Engineering was the C group, the Productivity teams were the B group, supporting the A teams at the divisions. We did this extremely well at HP in the mid-eighties, and I am a total believer. It earned me the first annual "Chuck House Award for Productivity" from the company, the first award given in the company named for a living employee. The ABC idea works.

Engelbart has a vision for large-scale "Networked Improvement Communities" for solving complex, global problems, but the links between the A community, the B community, and the C community have to be solid, and trusted, and that has almost never been understood or accomplished. It is very hard to do, in my view.

It is telling that Doug's efforts to create NICs have never resulted (to my knowledge) in any lasting NIC that changed much. This is more than just a pity; it is perhaps reflective of the difficulty of building a sustaining Improvement Model.

Are there positive examples? Yes, I believe that there are: President John F. Kennedy accomplished some of this with the Peace Corps, and FDR did it with the Civilian Conservation Corps. I am hopeful that President Barack Obama can harness this idea for America's "tomorrow."

In support for Doug and his vision, I served on the board of his original nonprofit organization, Bootstrap Alliance, and nominated him for the Lemelson-MIT award, which he received in 1997.

Charles "Chuck" House, is the author of *The HP Phenomenon* (to be released October, 2009 by Stanford University Press), the definitive book on the transformation of Hewlett-Packard, where he worked for 29 years. He was involved in the development of many technologies, including the first commercial CRT graphics display, the first Logic State Analyzers, Motif and VUE GUI's, and the first desktop publishing program, PageMaker.

Previously director of Intel Corporation's Virtual Collaboratory, Chuck was senior VP of multimedia communication research for Dialogic, and President of Spectron Microsystems. Chuck was part of the IPO executive team at Veritas Software, and SVP of R&D at Informix Software. An IEEE Fellow and ACM Fellow for Logic Analysis technology, he also was President of ACM, the world's largest Computer Science society. Currently, he is executive director and senior researcher for Media X, Stanford University's Industry Affiliate research program on media and technology. His research focuses on technology-enabled communications, collaboration, and community.

Co-Evolving an Information Ecology

By Vint Cerf

I think of Doug's work as having many dimensions. The mouse is among the enduring incontrovertible successes, but I am sure that Doug would not think of the mouse as his most important contribution. Rather, it was a convenient way of interacting with the oNLine System (NLS.) The oNLine System (NLS) made its public debut at the "1968 Demo." As important as the tools he demonstrated was the philosophical view behind them: The idea that people could co-produce, engage with, manipulate and interact with information—and with each other—in a very direct way. The mouse enabled people to use physical gestures to manipulate data, so that people could have a "shorthand" conversation with a computer.

Doug espoused the belief that people should use these technologies to communicate and collaborate more effectively to solve problems. At the Augmentation Research Center, people used the breakthrough technologies as they developed them. They also had a systematic approach to collaboration in their physical interactions, including workstations facing one another and a projection system that allowed everyone to see a shared display of their collaborative work.

One might look at our present capabilities and ask about the implications of Doug's philosophy for future collaboration. The "Demo" marked the beginning of a remarkable information ecology that has co-evolved in the decades since.

We have moved beyond textual documents and have the ability to design, build and interact with relational databases and other complex digital objects. Scientists are sharing information in enormous quantities: DNA sequencing, the large Hadron Collider, and the Hubble telescope are all sources of vast quantities of scientific measurements. Today, hundreds of millions of people have access to tools enabling them to contribute, interact, manipulate and share data through the "co-evolution" that Doug envisioned more than 40 years ago.

There are aspects of Doug's ideas that were not fully understood at the time that could have impact if they were invoked in the context of today's information ecology. For example, Doug saw people interacting with information in a structured way. He invented a vocabulary for editing and presentation that enabled people to abstract the information content of documents with very little effort. It represented a sophisticated way to manipulate information that could apply to today's more elaborate digital content.

His ideas could further stimulate our thinking today about ways to convey to computers our intent and to interact with information in a variety of ways, with tools that could enable us to obtain context along with the information. For example, if you are interested in the age and make-up of the stars in our galaxy, you might interact directly with a three-dimensional star map to obtain detailed data associated with each star or galaxy in the image.

Through the use of touch sensitive displays, we have more ways to use natural gestures to navigate through detailed visual representations of information, enabling people to comprehend increasingly complex information spaces. These capabilities, together with audio and video conferencing, offer unlimited possibilities for people to collaborate remotely, resembling a portion of Doug Engelbart's vision of 40 years ago.

Vinton G. Cerf is vice president and Chief Internet Evangelist for Google. Widely known as a "Father of the Internet," Vint is the co-designer, with Robert Kahn, of TCP/IP protocols and basic architecture of the Internet. In 1997, President Clinton bestowed them with the U.S. National Medal of Technology. In 2005, Vint and Bob received the highest civilian honor in the U.S., the Presidential Medal of Freedom.

Vint has received numerous awards and commendations in connection with his work on the Internet, including the Marconi Fellowship, Charles Stark Draper award of the National Academy of Engineering, the Prince of Asturias award for science and technology, the Alexander Graham Bell Award, presented by the Alexander Graham Bell Association for the Deaf, the A.M. Turing Award from the Association for Computer Machinery, the Silver Medal of the International Telecommunications Union, and the IEEE Alexander Graham Bell Medal, among many others. He holds a Ph.D. in Computer Science from UCLA and more than a dozen honorary degrees.

Hyperlinking and Media

By Kristina Woolsey

In 1986 we hosted a conference titled *Interactive Multimedia* at Apple Computer (where I was then a Senior Engineer in the Education Research Group and the Human Interface Group). We established a collaboration with the National Geographic Society and Lucasfilm to explore how multimedia capabilities might bring image and sound-rich experiences to education. This conference brought together a small number of innovators from publishing, television and education to establish the basis for new and continuing collaborations around the development of interactive multimedia learning products and concepts.

I worked closely with Doug in writing a chapter, "The Augmentation System Framework," for the book *Interactive Multimedia: Visions of Multimedia for Developers, Educators and Information Providers* [1988 with Sueann Ambron and Hooper (Editors)] that documented the conference. In our discussions, I came to understand the depth of Doug's commitment to "augmenting the human intellect" and "evolving collective intelligence." I learned about "community handbooks" and "bootstrapping between human and tool systems." And I described these concepts and Doug's examples in a chapter that was distributed widely, documenting ideas that were, at that time, rather obscure to most, except for those close to Doug's work.

Looking back, I recall Doug's being so far ahead of his time. (Remember, in 1986 the mouse was still an object of much scorn, the Macintosh computer was still considered a curiosity, Microsoft had not yet adopted the desktop interface, the World Wide Web as we know it was not yet developed, and Doug was working on his own out of an obscure office at McDonnell Douglas.)

In 1987, Apple introduced HyperCard to the world, created by Bill Atkinson. It was a new kind of computer application that was very difficult to explain to people who were looking for the next "killer app," the next "VizaCalc" that would compel people to buy computers. (Again, remember that, in 1987, techies dominated the world of computer users; they were not yet integrated into the social fabric in ways that both Apple or Doug were predicting.) Of course, Doug (and Ted Nelson) had envisioned hyperlinking years before HyperCard was released. They were pioneers in understanding the power of this networked topology to create a rich fabric of both information display and personal experience.

HyperCard provided a tool for linking content elements. It also let one connect to videodiscs—analog devices that let you randomly access movies. And, it provided an accessible tool (arguably more powerful than any tool available today, though the media were primitive) where users could create their own interlinked content—combinations of text and images and sounds, not formulas and programs.

Many educators were enthralled with this new product. It gave them the ability to create new kinds of materials for their students. And it provided students with direct hands-on experience in the creation of media-rich interlinked compositions. However, most people were completely uninterested and confused. Why would you ever want to link things randomly? Why deal with non-linear narratives? Why move films from entertainment venues into education or business or other serious communications domains? Why should individuals create their own content online when publishers could do this?

The digital revolution was right in front of people's eyes, in a product that was available for free on a personal computer. And yet HyperCard was not taken seriously. It was not solid technology. It did not fit into the business models of the computer industry or the publishing industry. It was a curiosity. A toy. A passing fancy.

Doug had also been very clear that media was an important part of the general communication and community framework for online experiences; his classic 1968 demonstration of video conferencing with shared screens made quite clear that live dynamic visual displays could play a very important role in everyday exchanges. Doug's analyses and visions then became a very important framework which we could ground our HyperCard activities within, and which we could use in articulating our visions of hyperlinked media in the support of a wide range of learners, many of whom were not co-located.

My conversations with Doug, which were frequent in those days, became a constant source of inspiration. They provided the activities with both a solid grounding in past research, and a vector to consider the future of digital technologies, which were rapidly evolving to support the kinds of collaborative learning environments that just might prepare youth and adults to organize their collective knowledge to address the world's problems. For, as Doug noted in his earliest writings, and as many are becoming aware of today, these problems are too complex and interrelated to be solved by local, provincial, isolated analysis that might have worked in the past.

The "augmentation of the human intellect" continues to be the major challenge of the era; Doug has left a trail of devices, like mice and user experiences including hyperlinked media-rich elements. The challenge for all of us is to continue to keep our eye on the major conceptual challenges, even as each of these devices and capabilities try to capture our complete attention. Doug has not been tempted to shift his glance from the biggest of problems. We can all benefit from this focus of his.

Kristina Woolsey is a cognitive scientist who focuses on the intersection of real and virtual learning spaces. She has been on the faculties at University of California at Santa Cruz and Massachusetts Institute of Technology. She directed both the Atari Research Lab and the Apple Multimedia Lab, and was a Distinguished Scientist at Apple Computer. She is currently leading a major learning space design project at the San Francisco Exploratorium.

21st Century Universities as Networked Improvement Communities

By Lev Gonick

For many of us who have spent our professional lives inside academe, there has always been a kind of genetic flaw between:

- the ideal-type of the university as a generative ecosystem that might be driven through its DNA to advance collective intelligence, and
- the lived realities of our personal and group experiences working and participating in one of the most enduring and amazing institutional organizational structures ever designed by humans.

Twenty-first century universities, located at the intersection of a globalized world undergirded by advanced communication technology challenged to advance knowledge and answers to incredibly difficult and complex challenges of our times, could gain much from framing their mission in terms of Engelbart's Networked Improvement Communities.

Even in the highly structured and parsed engineering-speak of his 1962 bible known as "Augmenting Human Intellect: A Conceptual Framework," there is no mistaking Engelbart's core personal value system. Engelbart believes in science and engineering serving as powerful and transformational agents in the service of the common good.

I have always felt that our common challenges are of a scale and complexity such that only an engaged set of university communities can marshal the problem-solving skills and innovation required to frame and begin to solve them in concert with other social forces connected to, and aligned with, the same set of values.

A prodigious generator of engineering and scientific knowledge, Doug never viewed the university as an organization with a sufficiently coherent social purpose. A new view would have universities as Networked Improvement Communities leveraging the pursuit of collective intelligence methodologies as a means to both reaffirm our relevance to cities and regions we live in, and to position ourselves for consequence in the key policy debates of the 21st century. This seems an entirely appropriate legacy and challenge that draws inspiration from Doug Engelbart.

Lev Gonick is the Vice President and CIO at Case Western Reserve University in Cleveland, Ohio. Among his local, national, and international activity to leverage technology to advance education and community capacity building is the pioneering work now known as OneCommunity. He blogs regularly at http://blog.case.edu/lev.gonick

Case Study: Reflections on an Educational Networked Improvement Community (EdNIC)

By Valerie Landau

> "This vision is incredible, even just trying to make it happen it brings incredible things."
> — Rueben Lustman

In the fall of 2003, Dr. Engelbart invited a small group of college professors and technologists to his home for three days to plan the formation of an Educational Networked Improvement Community (EdNIC) to apply Engelbart's philosophy in formal educational settings. What followed were three years of innovative, collaborative educational experiments. I was Assistant Professor of Multimedia Design at California State University, Monterey Bay (CSUMB) and Professor Mary Angie Cooksey taught philosophy courses at Indian University East (IUE). (Cooksey coined the term "The Engelbart Hypothesis" in a paper she published in 2003.)

Cooksey framed Engelbart as an Information Age philosopher. My work focused on Interactive Media Design and Development. As each student or group of students mastered a body of knowledge, they presented a summary of their understanding to their peers at the other institution via a biweekly video conference.

The students also used discussion boards and blogs to dialog with each other. The students at CSUMB became teachers to the students at IUE, and visa-versa. Professor Cooksey and I acted as facilitators of the students' learning.

I structured my class as a combination of classic constructivist principles and Engelbart's idea of the CoDIAK process. Students were continually analyzing their work and work process and improving both their designs and their design process.

Dr. Jamie Dinkelacker (a the time a professor at Carnege Mellon University, now Engineering Manager at Google) joined the experiment and brought a wealth of knowledge about Engelbart, communications, and the high tech industry. Field trips, informational interviews, and group work were key elements. Each student acted as a member of our EdNIC.

Student Reflections on the Collaboration

The exchange between students and universities effected the students on many levels. Students voiced three main themes in their reflections on the experience:

- The inter-university exchange made them feel like their work was part of a historical movement.
- Engelbart's ideas on Bootstrapping knowledge across disciplines and within the class is highly effective
- Exposure to different perspectives through a variety of media (videoconference, blog, wiki, paper) was "mind expanding."

"We all felt a part of something much bigger than ourselves, a part of something that also made us bigger...By bringing the disciplines together, students get more breadth of knowledge. The current matrix is learning in an isolated environment, in the EdNIC learning takes place in a multicultural world."
—Denise Gant

"By reading the philosophy students' posts, we are exposed to alternative ways of thinking and ultimately it affects the direction of my work in media."

—Chuck Spidell

Student Kathleen Bierksteker later reflected upon her experience in this new form of collaborative learning in a letter to the President of the University:

> Our projects would not be as impressive as they are without the contribution of each individual. As a result, team members are thinking together and tapping into the collective IQ to augment individual performance, and the whole of our group is much greater than the sum of its parts.
>
> It is an exhilarating and rewarding experience. There were two main class requirements. One, was to collaborate with classmates and second, was to design and develop a hypermedia prototype that incorporated Engelbart's ideas, including multiple views of the same information, creating modular, scalable, and linkable objects within a project that was open source.

Paradigm Shift

When we began collaborating with the IUE philosophy students we saw:

- the real power of interdisciplinary learning
- how much we needed a DKR to track our exchanges, our in class discussions, our papers, and presentations.

The students soaked up each others' presentations, discussions and papers. What became almost unmanageable was how to track all the exchange of information the two courses generated. We needed a DKR to organize, share, and parse or tag all the video, online discussions, class discussions, wiki entries and weekly blogs—as well as multimedia presentations, formal papers, field trip photo essays, and project assets. We came to realize how powerful Engelbart's ideas could be in transforming teaching and learning.

Unintended Consequences

What came out of the class was far beyond our expectations. Based on student testimony, the results were that students:

• Developed a passion for Engelbart's ideas and creative problem-solving that continued well beyond the course

• Became filled with hope

• Changed perspectives

• Increased critical thinking

• Worked collaboratively

- Felt part of something bigger
- Developed projects beyond the scope of the class
- Engaged in holistic and meta-learning techniques

Several Engelbart scholars and members of his nonprofit Bootstrap Alliance board attended our final class presentation. The Bootstrap Alliance made a $12,000 donation to CSUMB to support the project in the Spring 2005.

Scaling Up

Moved by the student progress at their final presentations in the Fall 2004, Engelbart asked me to include a broader number of universities in the experiment. Eight Engelbart scholars from around the world participated in a series of recorded online dialogs to define and discuss Dynamic Knowledge Repositories and Networked Improvement Communities.

The scholars included:

- Professor James Whitehead, University of California, Santa Cruz
- Dr. Jaime Dinkelacker, Carnegie Mellon University, West
- Erik Duval, ARIADNE Belgium
- Professor Brian Fisher, University of British Columbia
- Dr. Robert Stephenson, Wayne State University
- Eileen Clegg participated and drew murals of the dialogs.

The practice of articulating thought, engaging in dialog, and reflecting on the dialog, deepened everyone's understanding of Engelbart's writings and inspired other groups to begin their own dialogs about Engelbart's ideas. All eight of the scholars agreed the bi-weekly dialogs challenged us in unexpected ways and deepened our thinking about interdisciplinary global collaboration.

Valerie Landau is an interactive media producer and designer with Round World Media. She began her career as Regional Director of the Literacy Campaign in Nicaragua. She then worked in public television on award-winning documentary programs including *Silicon Valley* (on permanent exhibit at the Smithsonian Institution). She also worked for *60 Minutes* with investigative reporters Lowell Bergman and Harry Reasoner and for legendary singer Paul McCartney. She is author of the seminal book *Developing an Effective Online Course* (1999) and implemented Engelbart's ideas as Assistant Professor at California State University, Monterey Bay. She attended the Harvard Graduate School of Education.

Engelbart: Tools for Community Problem-Solving

By Howard Rheingold

In the 1970s, I thought the interesting story was not about young Bill Gates or young Steve Jobs, but this guy who invented it all and was still around. So I looked him up and I still think almost every day about the day I met him. I was very energized by the meeting, wrote about him, and we've been friends ever since. Like so many others, my writing and work has been inspired by Doug. My book is called *Tools for Thought* and it's been on the Internet ever since you could put books on the Internet because I thought that people ought to know about that story.

I first met him in the early 1980s, and he had this little warren in the corner of an office at Tymeshare and I found my way there. Doug told his story with that look on his face of looking out into the future just like still does with everybody he meets. It's sort of like John the Baptist, or that guy in the Coleridge poem. He just transfixes you and tells you his story.

So I became a convert to his vision. I'm not an engineer—I'm not the person who creates those things—but certainly have lived in the world that Doug has created and thought about. In my own humble way, I have tried to bring some of that vision to fruition. Because, as Doug never tires of saying, people concentrate on the mouse and the Personal Computer, but he had a larger vision of humans using language, artifacts, methodology and training to increase our ability to solve complex problems together.

Well, I've created virtual communities which, of course, wouldn't have been possible unless Doug, and Bob Taylor, the person who turned me on to Doug, had recognized that these engineers, who were spending their time sending each other messages about their favorite science fiction book, were actually pioneering a new medium. And I think they deserve a lot of credit for that. Bob Taylor and ARPA deserve a lot of credit for realizing these things were more important than engineers sharing data over computer lines. Of course, twenty years later, it was much more sophisticated, and people who weren't engineers, like myself, got online and started doing the social things that Doug had envisioned that we would do.

One of the exciting things about being able to play with these toys to this day is that really a small group of people, who were quite out of the mainstream, had a vision that you could amplify your mind and build communities from people who shared interests, even though they were all around the world. And that vision—as science fictiony and distanced from reality as it was in 1968 when Doug made the famous "Demo" or 1962—is still unfolding.

Doug is a person who believes that people and tools can make things better, and I'm certainly with him there. Everybody will tell you what a nice, warm human he is. Two things about Doug: He has this obsession and he's nice.

Howard Rheingold is an author, futurist and seminal thinker about technology and community. Among his books are: *Tools for Thought, The Virtual Community, Virtual Reality: Exploring the Brave New Technologies of Artificial Experience* and *Interactive Worlds from Cyberspace to Teledildonics,* and *Smart Mobs*. He teaches courses at U.C. Berkeley and Stanford University and is a research director with Institute for the Future in Palo Alto.

Scaling Human Capabilities for Solving Problems that Threaten Our Survival

By Sam Hahn

I've been committed to Doug's ideas since I attended his week-long seminar in March of 1992, at Stanford University, and subsequently brought him in to consult with our small team developing analytical and visualization tools for a branch of government intelligence analysts. I was inspired by his comprehensive and innovative approach to boosting the collective intelligence of people and teams. Since that first exposure, I have sought to apply his ideas in every professional (and even non-professional) role I've had. In the early 1990's, I was honored to serve as chairman of his Bootstrap Alliance, and today, am working with my Program for the Future associates to further disseminate Doug's vision for enabling teams (and all of humanity) to solve complex problems.

Doug is well-known for his amazing technology innovations, but even Doug doesn't call himself a technologist. His focus is how technology can be leveraged for problem-solving. He has warned that if we do not evolve our ability to apply technology more effectively at a rate that keeps pace with the evolution of technology itself, the end result will likely be detrimental to our intentions. I share

Doug's concern that humanity is running out of time to effectively counter those threats we've created for ourselves.

Engelbart's conceptual framework encompasses a multi-layered approach to boosting the collective intelligence of people—using technology to improve human capabilities, and then using tool-augmented behavior and habits to influence the further refinement of the tools, in a continual "co-evolution."

Engelbart has an appreciation for the complexity of organizational processes that take place within and among teams. His focus is on how tools and practices can make human beings and teams collaborate, and how to integrate our work across disciplines. These processes can then scale up, so that ever-increasing groups of people can work together to address impending phenomena that threaten our existence.

Unfortunately, often people fail to increase their own capacity. We fail into the "ease of use" trap and don't choose to evolve our behaviors and practices.

Engelbart illustrates this concept with a simple question, "Would you rather go across town on a tricycle or a bicycle?" A tricycle is obviously easier to learn to ride, but clearly nowhere near as efficient as a bicycle. There's a learning curve from tricycle to bicycle. There's a learning curve moving away from tried and true traditional methods, to new practices and ways of thinking that will enable us to become more highly functional beings and teams capable of collaboration.

Engelbart devoted his life to a paradigm shift to move us away from our current dysfunctional political and organizational models. Right now, we have no solution to urgent and complex global problems: disparity between poor and rich, environmental problems, evermore dangerous diseases, religious strife—those can kill the human race. (In one extreme perspective, we have proven we are the world's most destructive virus.)

Engelbart's framework proposes a new way of thinking about problems—changing the competitive, power-based models and focusing on how to integrate our ideas toward a greater whole.

Engelbart does not offer a formula to follow. The framework necessitates that you start somewhere and build your collective capabilities by learning as you go—improving your tools and practices, reflecting, and using your insight to develop better tools and practices. Do this often, and do this quickly.

That's the essence of bootstrapping and the co-evolution of human and tool systems. (By the way, some call it "agile" these days.) But it has to be done on a massive scale. If we have a lot of uncoordinated small efforts, or working at cross-purposes, we likely won't accelerate our achievement of human survival.

As a professional tool builder, I've seen too much emphasis placed on the tools and not enough on the human systems. According to Moore's Law (which even Gordon Moore has acknowledged was inspired by Doug, as reported in the *New York Times* by John Markoff), we've grown multiple orders of magnitude in our computing capacity. Our collaboration skills have seen little improvement—namely, our ability to align, to detect miscommunications early, and to be clear about our objectives.

We are still working off of Robert's Rules of Order and Quarterly Reports. The ways we measure and manage ourselves is shortsighted. Westerners are surprised to learn that in China, it's common practice to make 50-year plans. In our society, we don't sincerely reward people for thinking much beyond the next fiscal quarter or year. Our systems are organized around short-term achievement, rather than in terms of scalability, stainability and strategic objectives—at the highest levels. It's sobering to think that our federal administrations think in four-to eight year time frames.

Ironically, Doug's own teams over the years have not sustained themselves to perform continuing, directed, coherent activity around his vision. Some say Doug is hard to work with. Others say the problem is people do not have the patience for Doug's long-term vision, so they take a small subset of his ideas and go off to make their fortunes. A third hypothesis is that visionaries like Doug are not skilled in leading groups to deliver. For whatever reason, there has not been a critical mass of people organized around his principles for solving complex, global problems.

Though Doug's ideas are immortal—and have changed the world in terms of personal computing—Doug is human and has suffered from not being able to carry his big ideas forward. That leaves it to the rest of us, who believe in collective IQ, to figure it out.

I hope we're not too late.

My dream is to build a community around Doug and his vision for humanity that can rebalance the views, and explore and push the capacity of teams so we can catch up and keep pace with our tools and technological capacity. I'd like to see this applied toward the threats to humanity and our habitat. I'm interested in the modern day rules of engagement. I want to understand what limits teams, and explore ways to counter those dynamics.

I want to understand and bring to light the barriers to scalable collaboration, and am working with others to evolve the means to counter these obstacles. The barriers often seem traceable to miscommunications, misunderstanding, misalignment, fears, and hidden mixed agendas—egos protecting themselves versus the greater good. Self-protectionism keeps people from fully committing to teams. There is a fear their needs will be jeopardized if they commit to the team. All too often, team problems come down to personal fears and the need to "hang onto what you have," which prevents people from reaching to the higher plane where over-arching goals are aligned.

If we could each put our fears and agendas on the table, and develop effective ways to counter them, then we could unleash our aligned energy toward a higher purpose. We could then begin working together to accelerate toward positive results that, in uncoordinated fashion, would take too long to achieve. Perhaps with conscious massive cooperation, this accelerated ability to solve complex problems could happen in our lifetimes. That would be worth any effort we can imagine.

Doug devoted his life to a beautiful vision, one that we must realize if we are to survive as a race, and as a healthy ecosystem. Doug deserves a vibrant, aligned, collaborative, inspired, dynamic, effective community to carry forth his ideas and his vision. Humanity deserves a chance to see what might be possible. It is also great fun to be a part of such a program: a program for the future.

Sam is VP of Engineering at eGain Communications, and as an associate of Sand Hill Angels, advises entrepreneurs in startup strategies and companies on effective application of Chasm and Agile thinking and practices. As a founding member of Program for the Future (www.programforthefuture.com), Sam is part of an initiative to bring a spectrum of innovative pioneers together to systematically reformulate our approaches to collaborative problem-solving.

The Program for the Future Challenge

By Robert Stephenson

In a sense, I spent many years practicing Engelbart without a license. In the 1990s, I began The Harvey Project to create and disseminate effective physiology curriculum and pedagogy among physiology teachers—using online tools and a networked community of practice. Later, I realized these were part of Engebart's philosophy.

One Engelbart insight that proved to be a powerful revelation to me: "It's possible to be effective and reflective at the same time." As chief cook and bottle-washer for a small web-based collaborative repository and networked community, I saw the need for continual improvement of the process of collaborative work, as well as the improvement of the online tools. Community members began to co-evolve the rules as the technology changed, and the tools had to evolve as community members changed their practices. Eventually, it evolved as a collaborative platform where people could edit their own pages, participate in discussions and work on interactive media applications collaboratively.

Currently, I am curator for The Tech Museum in San José, which is sponsoring the Program for the Future together with the MIT Museum in Cambridge. The Program for the Future is a collaborative challenge inspired by Engelbart's vision of using technology to improve our collective intelligence for the betterment of humanity. The goals of this conference, design challenge, and exhibition are to:

- identify new tools that can improve collective intelligence, and thereby:
    - improve the quality of important decisions,
    - solve pressing global problems and
    - inspire others to do the same.

People often ask me: What is a collective intelligence tool? Intelligence is defined by the capability to create an accurate picture of a situation or problem in order to find an effective solution. It includes abilities to:

- gather information
- create a mental model
- and draw inferences from the model.

> Collective Intelligence: the whole group arrives at a more intelligent outcome than any part could.
>
> **Collective Intelligence Tool**
> A collective intelligence tool (in the broadest sense: hardware, software, process, methods or system) to augment collective intelligence; leading to solving important problems, making better decisions and planning more effectively.

The Program for the Future Design Challenge is a search for the Engelbarts of the 21st century. We are looking to future generations and are especially excited about involving young people whose ideas may go well beyond anything we can imagine now. We invite everyone to join in the grand challenge.[12]

Robert Stephenson is a neuroscientist, e-learning designer and architect of virtual open source and open content collaborations He is a curator at The Tech Museum in San Jose, California and is a member of Program for the Future core team. He holds an A.B in physiscs from Princeton University, M.S. in physics from MIT and a Ph.D. in physics from MIT.

12Join the Program for the Future Challenge
http://thetechvirtual.org/projects/program-for-the-future/

What sort of projects might result from the design challenge? Existing projects can provide an idea:

Groupspace.org

An asynchronous environment for civic groups to meet, discuss, and come to decisions. http://www.groupspace.org

MIT Deliberatorium: A forum for structured argumentation where amateurs and experts can pose questions or contribute and rate ideas.
http://www.youtube.com/watch?v=k2w2WBCn7ug

Institute for the Future: Superstruct: An interactive, multiplayer, future scenario-building game. http://www.iftf.org/node/2098
http://www.superstructgame.org

Innocentive: A market for solutions that matches problems with problem solvers. http://www.innocentive.com/

Condorcet Voting Method: a strategy for choosing the most satisfactory candidate in instant-runoff voting (proposed 225 years too soon for this design challenge). http://en.wikipedia.org/wiki/Condorcetmethod

Processed Humanism: Douglas Engelbart's Personal Philosophy

By Thierry Bardini

Rebirth

December 11, 1950. Alone in his car on his way to work, blinded by the sudden light, this thought dawned on him: "My life is pretty much over." An abstract death if you will, this nagging feeling when you are 25 years old. Over, done. All that he could have done, and more, was done. A sudden feeling, and its aftermath, leaving him empty like a drying puddle after a rain. Over, done. And then?

All that he could have hoped for, and more, was accomplished. Surviving a depression, the Great Depression, surviving a war, the Second World War. Getting a job, finding love, getting engaged. 25 years old, going downhill, comfortably, toward retirement. What else?

Answer: "I ought to do something (else) with my life." The rest is sheer stubbornness.

Anybody else, I guess, would have come back to his senses—on with the comfortable life or would have just shrugged—and shaken away the moment. Douglas Carl Engelbart, instead, clung to it. That morning, on the freeway, he embarked on his life-long "crusade."

Trained as a RADAR technician, he sailed toward the Pacific theater of operations, passing under the Golden

Gate… on V-Day! He spent the rest of his time in uniform reading on a beach. He did not question it. Anyway, here he had landed, on a beach in the Philippines, reading. Learning.

That, he liked. He was not much of a talker, to this day still isn't. Too abstract, too dense. Too obsessed and rigorous, maybe. Uncompromising.

After so much destruction, death, and despair, the whole world, not only he was recovering. It was time to rebuild. It was the time of the Marshall Plan and the Point IV program.

Listening to him tell his story (and/or reconstructing it), you can feel his drive, and its paradoxical innocence. Never again! And the pragmatism of the engineer: how to make sure it does not happen again? How to build a safeguard for it never to happen again? The death and despair, the war and destruction.

He did not get metaphysical or political; he did not wonder about a contemporary theodicy. He did not ask why so much evil and pain. In his usual, matter-of-fact, engineering pragmatism, he abstracted a ratio, like the efficiency of an engine.

Except the engine was the world, and it was pretty much out of control. To him, it boiled down to two notions (admire the minimalism): urgency and complexity. The world was facing, he intuited, increasingly urgent and complex problems. And Man was showing his limits; yes, Man was in over his head. The world's problems had grown complex like a cybernetic system—another invention of the period—full of feedback loops gone astray, circular causalities and side effects. You could simply not declare peace, growth, and happiness for all. The time of wishful thinking was gone, blown up in ashes. He had seen the mushroom clouds, witnessed the effect of out-of-control chain-reactions.

Later, he would refine his diagnosis: a crucial, perilous, disastrous, lack of intelligence. Man's means to react to ever increasingly complex and urgent problems, was, quite simply, wearing too thin given the complexity and urgency of the world's problems.

It was high time to do something about it. It had come pretty close to be too late, the last time around. The euphoria was already gone, a Third World War (a still cold) was cooking. You could feel pressure building, and, this time, it might prove to be too much. So, what to do about it? And again, pragmatically, "what to do with my life?" also meant, "what to do with the current state of the world?" Remember: he was recovering; he was, after all, strangely, still alive, awkwardly, temporarily out of danger.

So another ratio came to his mind equating the ratio of his still young and aspiring life to the ratio of the world. Provided he and his family were okay, the question became: "how to maximize the good he could do."

The Computer as Midwife

The flash went on and reflected on the screen. Here it was: the screen and the script. The book and the RADAR.

Tools for thought, still in the making. Again, it dawned on him: a vision of thought reflected on a screen; an engineer's dream, with levers, knobs and all, to put the world back into working order. He knew for a fact "that wasn't what the world's dominant needs were; more engineering, right then…"

After all the latest science and engineering wonder, the A-bomb, was both (at best) the problem and part of the solution. The year before, the reds had successfully tested their own version of the monster. But hell, he was an engineer. However, he did not think about the computer in engineering terms.

He knew the computer was at first an engine, a difference engine. Years later, in his SRI lab, the time sharing computing system was set in a room dubbed "the engine room." He also knew that the computer was more than an engine—an engine of change—a connected set of differences that make a difference.

He saw a means to meet the intelligence challenge. At that time, he actually did not know much about computers, almost nobody did. Back then, a computer was still a middle-aged lady with a hand calculator. Because of his readings and the RADAR training, he knew of the other computer, the universal machine that would replace the middle-aged ladies (among others, alas).

The computer, in his mind, was more than a calculator: something like a universal translator, a mind-prosthesis, a means to augment the human intellect.

This machine could become the midwife of a rebirth, the rebirth of Man, this intellectually challenged form of life. Yes, strangely enough, when he thought about the computer, on that morning in December 1950, he imagined symbolic logic, the incorporation of script at a whole new level, reconnecting mind, hand and sight by new, extremely powerful means.

His thoughts about the computer became the center of his conceptual and practical articulation of his very own idiosyncratic version of processed humanism. A unique combination of mid-century USA cybernetics, phenomenology, and materialist dialectics that suddenly crystallized in a personal philosophy he would never question.

Thierry Bardini is an Associate Professor at the Université de Montréal. He is the author of *Bootstrapping: Douglas Engelbart, Coevolution, and the Origins of Personal Computing,* He is currently writing a new book *Junkware. The coming of Homo nexus.*

Engelbart's Vision: A Global Perspective

By Gopika Kannan

Knowledge is dynamic and constantly evolving, and knowledge grows through sharing. Engelbart's vision embodies both principles effectively, providing a superior framework to other theories of intellectual capital management or organizational collective intelligence. I had the rare honor of meeting and working with Doug Engelbart in 2006 and this meeting reinforced these principles and gave me an appreciation of the potential to scale them.

I will attempt to describe my understanding of this vision through practical examples of current day strategy and process applications, in organizations and in national policy.

Let me begin by comparing Doug's theory of collective intelligence with a management theory that has gained acceptance in both the corporate environment and in national policy. The 1990's and the early 21st century saw a movement towards understanding how an organization can identify, measure, manage, leverage and act upon its collective intelligence towards the pursuit of sustainable innovation. This school is widely referred to as the Intellectual Capital Management (ICM). I was influenced by the intellectual capital movement and the effort to measure intangible assets. Intellectual Capital Management is the third big idea in management thought in the late 20th century (after Business Process Re-engineering (BPR) and Total Quality Management (TQM)), according to Thomas Stewart, editor, Harvard Business Review.

The ICM framework defines an organization's intellectual capital as being a sum of its market capital (relationship with suppliers, customers, and brand value), structural capital (internal structure, computer systems, patents, etc.) and its human capital (educational experience of people in organizations).

Many ICM measurements have been successfully adapted in organizations.

Yet, none of them has been successful in improving collective innovation or utilizing collective intelligence to solve complex problems. The Engelbart theory manages to do that because it recognizes knowledge as being dynamic and constantly evolving.

The traditional ICM frameworks are static. They assign a value to education, to the years of experience of the employees. They fail to measure: What kind of knowledge is being transferred? Is it tacit to explicit? Or tacit to tacit? How much is being learned? How quickly? By whom? And how is it being applied? Are there new innovations in the applications of that knowledge?

The traditional ICM frameworks fail to factor the dynamic nature of knowledge and its growth due to constant interaction between individuals. The Dynamic Knowledge

Repository (DKR), as envisioned by Engelbart, is a more accurate measure of collective intelligence.

The traditional ICM school of thought does not account for the formal and informal networks. Networks are another component of Engelbart's model. Networks can help overcome the barriers to change. Social networks exist in every organization and are used to find information and solve problems. Organizations have been formalizing these groups and providing the web-based connectivity in order to leverage collective knowledge since the 1980's. Doug Engelbart envisioned the Network Improvement Communities (NICs) in the 1960's. NICs are networked communities of practice (CoPs) that maintain protocols and practices with the goal of sharing information in order to improve processes. Studies show that these trial NICs rapidly reduce the learning curve of new employees and generate new ideas.

The ICM framework does not account for the organization's adaptive capacity and response time. How an organization responds to threats and opportunities is another element of the Engelbart model. Absorptive capacity is the external capital, and is probably a far more accurate measure of its success in responding to complex and urgent problems than its brand equity.

I was able to create a robust strategy and measurement model by incorporating Engelbart's system with frameworks for managing intangible assets. My first implementation was with India's National Knowledge Commission (NKC). The

National Knowledge Commission was a high-level advisory body to the Prime Minister of India, with the objective of transforming India into a knowledge society. It included a broad spectrum of partners from education to e-governance. The commission's objectives included:

- easy access to knowledge
- creation and preservation of knowledge systems
- dissemination of knowledge and better knowledge services

The NKC worked with Doug Engelbart on understanding the value of high speed research and education networks. Based upon the recommendations of the NKC, the government of India has created a National Knowledge Network. The network has a capacity covering 1000 nodes with gigabit capacity scalable to 10,000 nodes/ institutions.

Other key aspects of Engelbart's vision include the dynamic knowledge repository and networked improvement communities. The DKR is essentially an easily accessed decision support system. It is a continuously growing repository of collective knowledge that provides information to solve complex and urgent problems. An example of this would be at Daimler AG, where it was used to correct a materials error problem almost instantaneously. Daimler AG was one of the early adopters of communities of practice and used a web-based DKR-like tool. When the materials problem occurred, one of the engineers in a plant in Germany came up with a "quick-check" solution and shared it with his peer group through the EBoK. This method was applied in all plants globally and resulted in large savings for the firm. The adopted method also became standard practice on future projects.

Another example of applications of the DKR and NICs is a project to improve the requirements elicitation process in a client organization. fifty percent of defects can be traced back to errors in requirements. Thus, getting the requirements elicitation process right is critical for project success. Requirements are constantly evolving and a single business analyst rarely understands all the impacts of a proposed change. Hence, it was important to make the collective knowledge of the analyst, operational and systems teams available to the all members.

This knowledge had to be codified and stored in a central repository. It also needed to be easily accessible and to be dynamic. Every change or modification to the system, every new learning and innovation, could change the current state of the system and impact the requirements accuracy. My team created a dynamic knowledge repository that is supported and maintained by a NIC that meets regularly to discuss and review requirements. Members of the NIC take stock of changes and re-evaluate a requirement.

We incorporated the principle of bootstrapping and acknowledged that each time a change is made or a problem is solved, it leads to a completely new situation. A good strategy requires continual reevaluation of the problem. The result was an integrated knowledge-based dynamic process similar to Engelbart's CoDIAK.

I have used knowledge mapping as a tool for post-merger integration strategy in organizations for over nine years. I've realized that most of my methods are akin to Doug's theory of future mapping and facilitated co-evolution.

Knowledge-based integration is a very effective method, especially in the context of highly diverse cultural differences between the merging organizations. A three-company merger can be especially challenging when the three organizations represent three nationalities and three varied approaches to knowledge management.

The British view knowledge as being managed by rules, the French share through a social network (who knows whom) and the Germans like to convert all tacit knowledge to explicit form. The best way of getting these three teams to work together is to map and understand the various components of the knowledge required to meet the new organization's goals and the direct benefits that they provide to each other.

These form the motivators for sharing and reevaluating the old processes to develop new ways to share knowledge and improve the organization's collective IQ. We build our processes around knowledge needs and flows, and develop tools and technology to facilitate these processes.

Collaboration is a key to overcoming any complexity or solving problems effectively, whether it is in a firm or in society. There is now a lot of interest in collaboration and collective intelligence. Engelbart's vision and methods give us a tool to start collaborating both technologically and strategically. However, there is still a need for measurement, to demonstrate the value of collaboration and knowledge sharing. This is especially true in a globally competitive world, where knowledge is power and people may be motivated to hold on to their knowledge in order to hold on to their jobs. The very same technology that facilitates collaboration and globalization could also impede it. It is now time to implement the strategic aspects of Engelbart's vision in order to ensure successful collaboration.

Gopika Kannan is a consultant, researcher and author specializing in knowledge and collaboration-based post merger integration strategy. She has worked with large aerospace, automotive, research and development, information technology, and insurance corporations in Europe, North America and South East Asia, developing and implementing her own unique methodologies and strategies.

She also worked with the India knowledge commission on national knowledge strategy and valuation of research and education networks. She has designed innovation and knowledge reuse tools that have been widely adopted in corporations. Gopika has published in several peer reviewed journals, conference proceedings and edited volumes on knowledge management. She is a reviewer on the editorial board of the *Management Decision Journal.*

Capturing the Dialogues with Doug and Valerie

By Eileen Clegg

Doug Engelbart believes in "improving the improvement process," and that's what we did in our quest to help Doug express his vision in language for a mainstream audience. This edition does not pretend to be the final word, but rather the best picture we have at the present time. Doug liked the idea of publishing iterations of our dialogs, as an invitation to more dialog. From the beginning of his work, Doug has sought dialog to help find the right words and narratives to illuminate the Augmentation Framework and his highly conceptual thinking: capability infrastructure, dynamic knowledge repositories, collective intelligence, the ABC process and bootstrapping.

Our years of writing, drawing, rewriting, redrawing, and interviewing enabled us to hone the language and clarify the concepts. Our first version was an online-book presented as an experimental wiki-book.[13] We also published various hard copy versions for different events, including a slim volume for the India National Knowledge Commission's meeting in Long Beach in June, 2006, and a softcover book called "Evolving Collective Intelligence" for the

13 http://opencourse.org/Collaboratories/eh/eh-wiki/ThisExperiment/view.

40th anniversary of "The Mother of All Demos" in 2008. We relied on a recursive process to develop our writings. We had to continually improve our "human systems" (the inner workings of our quirky team of three) and our "tool systems," not just the online docs, blogs, wikis, and word docs, but also video, audio and paper and pastels.

But before describing more about our five-year experiment, let me tell a little about Valerie and me, and how we got together with Doug.

Valerie and I met in 2002 through NextNow Collaboratory[14], a community organized around learning and technology. Valerie is our in-house radical, having grown up in San Francisco in the 1960s near the Haight Ashbury district of San Francisco, in a home that was a meeting center of artists and activists, including Bob Dylan, Jane Fonda, Mario Savio and Angela Davis. As a young adult, she carried on the family tradition after college, spending two years in Nicaragua as director of the National Literacy Campaign for Northern Managua. She'd just finished a documentary chronicling the tours of musicians (including Joan Baez and Pete Seeger) opposing the Contra War the US was waging against the Sandanistas in Nicaragua, when she became associate producer for a documentary series about the history of Silicon Valley in 1985. During her

14NextNow is both a purposeful social network (NextNow Network facilitated by Bill Daul) and a collaboration laboratory (NextNow Collaboratory lead by Claudia Welss). The social network intends to accelerate the identification of synergies in the web of relationships it represents, and began in January of 2003. In September 2006, the collaboratory was established to help tap those synergies for social benefit—to help keep them "on-purpose."

research, she met Stanford librarian Henry Lowood, who convinced her to watch a film of Doug's '68 Demo.

Valerie saw Doug's story not through filter of business and technology—the areas where Doug had been working—but through the eyes of a radical: Engelbart wasn't just an inventor, he was a man with a vision for solving global problems. The vision involved a paradigm-shift in thinking, and Doug explained how new concepts defy old language. Valerie became an Engelbart scholar and was inspired to a career in educational multimedia design, returning to Harvard for an advanced degree, then teaching university students at a new technology-focused California State University, Monterey Bay. Engelbart's ideas were central to her work so, when we met, she filled me in quickly.

I wanted to read more about Doug's philosophy, but Valerie told me that he had not written a book. There was this little problem with translating his vision into common language. I was surprised. I'd heard Doug speak at several events and considered him the Einstein of modern technology, and clearly many around the world felt the same way. As a longtime journalist, this seemed like a lifetime opportunity. We talked to Doug about writing a book together, and he said yes! Later, I'd find out that many had tried before, and we would be challenged to the limit to help him find words to tell his story and explain his ideas in terms that the mainstream public could understand. He wanted dialog and we pledged to engage in as many as possible.

Valerie already had a test-bed with her classes at CSU Monterey Bay. Here were these young people who were not bound by previous ideas of "what's possible." They jumped in to experiment with various ways of explaining and practicing Engelbart's ideas. One highlight was a student project interviewing Doug's colleagues and friends at his 80th birthday in 2005.[15]

We began meeting with Doug in many venues. He joined Valerie with the students in Monterey, we visited with him at his then-office at Logitech, we joined him at meetings and talks (including a landmark session with the National Knowledge Commission of India) and we stayed for extended periods at his Atherton home, filming and interviewing him about his ideas, looking for gems that would capture the essence of his ideas.

We came to understand the true challenges of language for new ideas. For example, Doug in his papers had written about the role of "facilitator." To us, the term "facilitator" meant the person running a meeting, or the person getting a team to talk or accomplish. But after many hours of conversation of many years, one day we had an "aha." We asked Doug, "What does a facilitator do?" He looked at us like the answer was obvious. "A facilitator creates maps of the future," he answered. His facilitator was a new role that

15 The video archive is on the web http://www.roundworldmedia.com/ednic/cst595/sheranian_capstone/timeline/timeline5_18_5.swf"

had only emerged in the latter 20th century.[16]

People ask us why writing about Doug's vision demanded so much dialog over so many years. One insight came when Doug took an online test about cognitive styles created by Michael Sturm, and he scored way off the charts as a conceptual thinker, which often leads to difficulty being understood—especially when his topics are concepts for the future. Doug was talking about global teams working together to solve complex issues facing humanity using computers and 3D views in 1951, when there were only a handful of computers existing in the world. Today we are still struggling with global teams; many of the things that Doug foreshadowed have come about, but many have not, and he's still trying to explain those concepts. Many of his writings are obtuse and difficult for even fellow Ph.Ds to understand. Doug wants people to reflect back to him what he is saying, so he can improve the articulation of his own vision.

This brings us to another way we improved our process. Over the years working with Doug, I frequently created visual murals about his ideas. They were a hit with Doug and with others because these murals are ephemeral "snapshots"—not the final word. I created many murals during Doug's various talks and interviews, including a memorable one with Alan Kay. Before explaining how

16Engelbart's boss at SRI, Roy Amara, went on to head The Institute for the Future, now know for their Future Mapping. Researchers used paper on the walls to map cross-disciplinary information to see the "landscape" of future scenarios.

the mural innovation process works, let me give some background about the medium. The idea is to gather specific facts, quotes, events and theories in a literal "big picture." Instead of connecting information together with a verbal narrative, pictures provide the context. Unlike words, images are ambiguous and open to interpretation. A picture helps people share a frame of reference without imposing meaning or premature conclusions. We began using the visual tools more and more during the writing process.

Writing about Engelbart's vision is difficult because his vision is holistic, multilayered and fundamentally nonlinear. It is also challenging to separate the concepts from the historical and social context, and the constant need to either separate or integrate the "human systems" and the "tool systems." Doug talks about the need to create new tools to facilitate the manipulation of ideas. He argues that the current word processing and old print models just won't do. We really needed to use the tools he was trying to describe to describe what he was thinking. And they do not yet exist in an integrated way that would enable the kind of massive online, structured dialog Doug envisioned, with flexible tools that would enable everyone to adapt the medium. We could benefit from another five years of dialog, both written, illustrated, and verbal—and look forward to migrating our videos, audio tapes, murals and various media into a comprehensive Dynamic Knowledge Repository.

So we innovated our process. As the 40th anniversary of the 1968 demo approached, we had some questions we couldn't get a handle on: How did the demo impact history? What aspects of Doug's vision had diffused? What aspects had yet to come to fruition? How was Doug's philosophy a product of his time? How was the demo connected to previous technologies? We felt we could facilitate those conversations by creating a landscape of his life and times. We created a series of these. The first mural was 4 by 8 feet and included facts and information about significant technology events, starting with the year of Engelbart's birth in 1925.

We placed those innovations in a historical context, adding global political events, big shifts in thinking about business and organizations. We realized we were illustrating Engelbart's "capability infrastructure"—the culture, tools, and landscape of human experience in which co-evolution occurs. The first mural went to Foo Camp, an annual retreat of technology leaders hosted by O'Reilly Media. Most of the feedback we received was in the technology arena. But, there was also input about ideas of deep meaning to humanity, including the Anne Frank quote, "Despite everything, I believe that people are really good at heart."

We researched and filled in more historical facts, ideas, and trends. In dialog with Doug, we refined the illustrations of his vision. We posted our findings and asked colleagues to add information online, then carried it to different groups who engaged in exercises. We added the collective insights to each successive mural. When we created the latest mural, the big "wave" appeared with the rise of technology innovations around the Demo, just after the "big sun" of ideas that inspired this sea change in our history.

This mural has traveled from small meetings with Doug, friends, and family, and to large venues with hundreds of attendees. We even sat with people who normally argue about ideas and found that they didn't argue with the mural, or one another, when they all had a chance to work together and share ideas. There was real dialog and collaborative constructive interaction that generated excitement.

Immersing ourselves in the mural process helped facilitate the writing of the 2008 version of the book. Engelbart jumps from the abstract to concrete in mid-sentence—he's talking at the meta-level and at the concrete level. We began to actually SEE how these two come together and where we could separate them.

Before the Program for the Future event, celebrating the 40th anniversary of "The Mother of All Demos," Valerie searched through our tomes of material to select the most salient passages. Doug reviewed the draft and made comments for revision. We asked some of his close colleagues to contribute chapters.

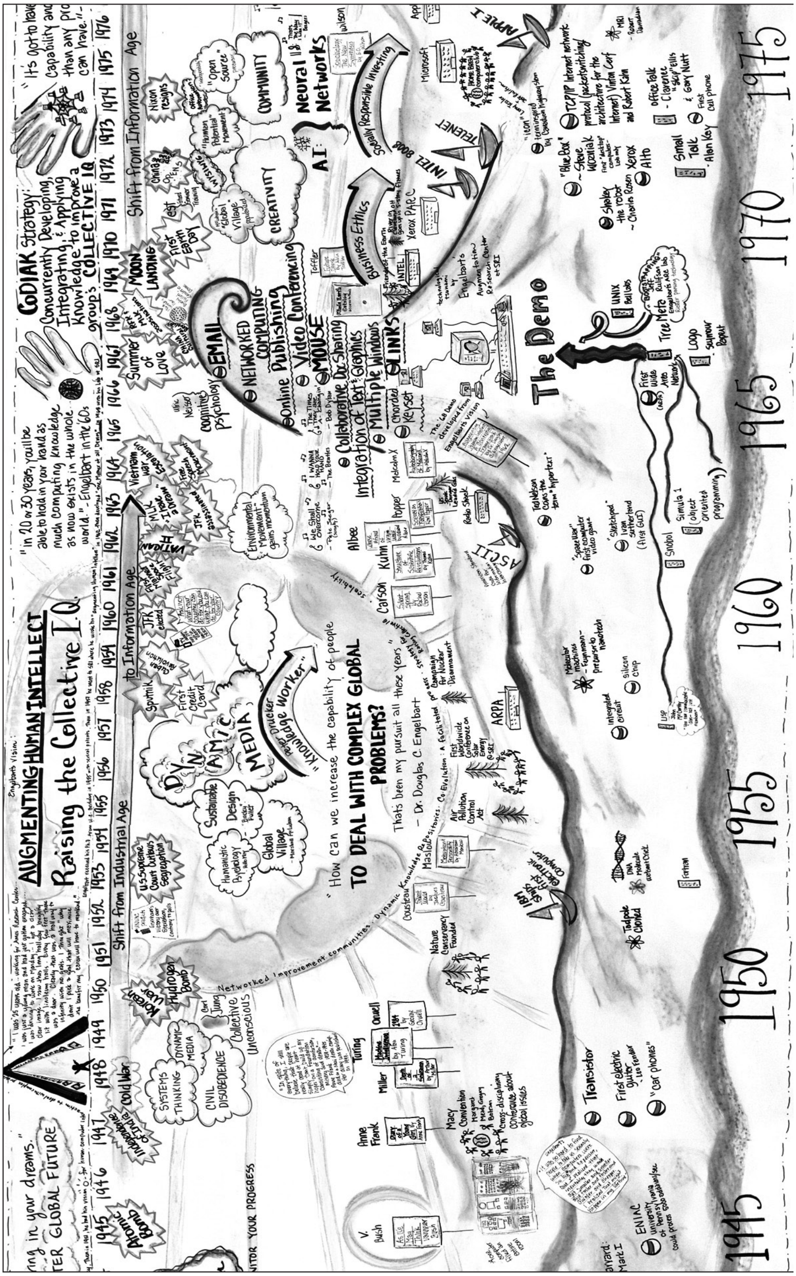
When the book was published, Doug opened the book, read several pages, and then had to stop to put his hand over his face, and he cried. He didn't want the women standing there in his office to see him cry. "I've been trying to do this for so many years," he said. Then he sat down and wrote an inscription to Mary, his secretary for 20 years, and gave it to her. It was one more step in the Engelbart dialogs.

The 2008 version brought a flood of feedback, excitement, controversy and debate. People had different memories about events we related, and different interpretations of Doug's ideas. Doug was excited about the dialog, and we were a bit overwhelmed. We created an online blog for public debate, and had several offline rounds of off-line discussion. As we were creating a line-by-line response to criticisms, we wished for that Dynamic Knowledge Repository, so we could structure the debate, show where ideas converged and diverged, as we developed the next version.

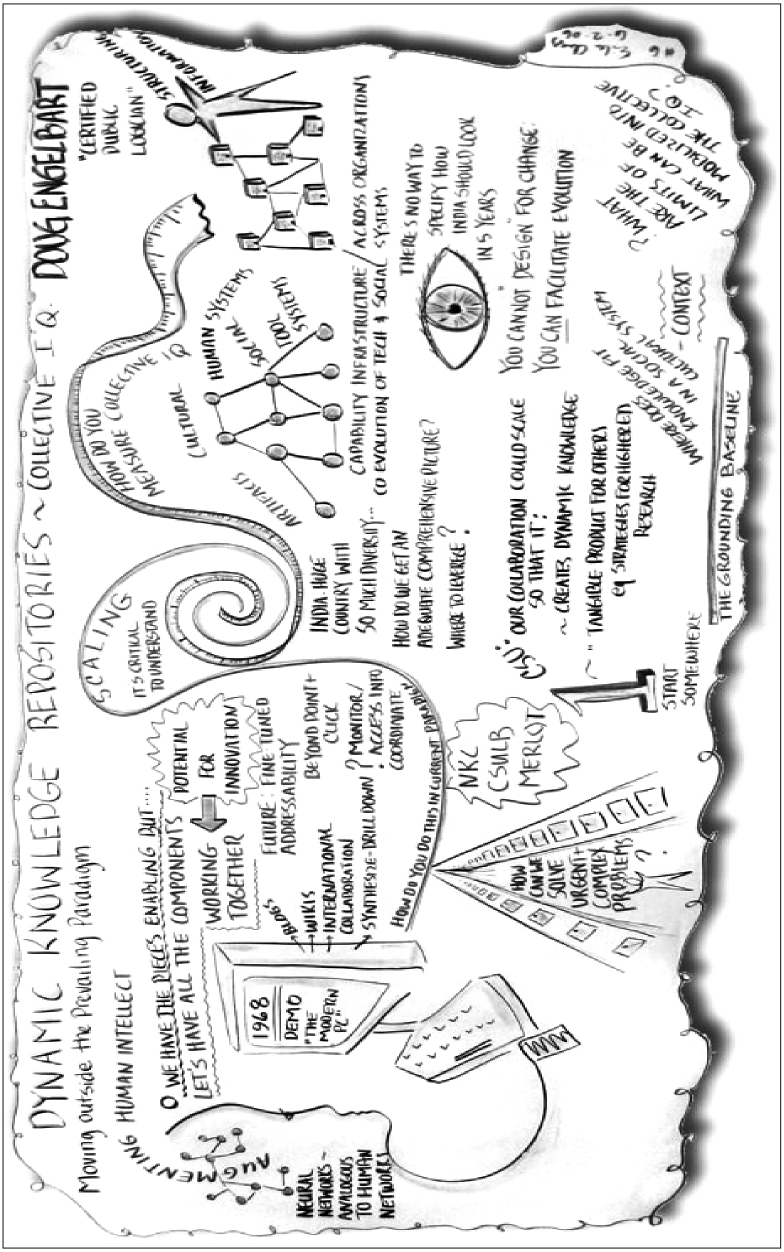
For this publication, we returned to the title we were using back in 2005, and brought in some new voices and perspectives. Claudia Welss, executive director of the NextNow, had launched the NextNow NextPress to enable the publication of this kind of philosophy that might not fit into the mainstream publishing paradigm.

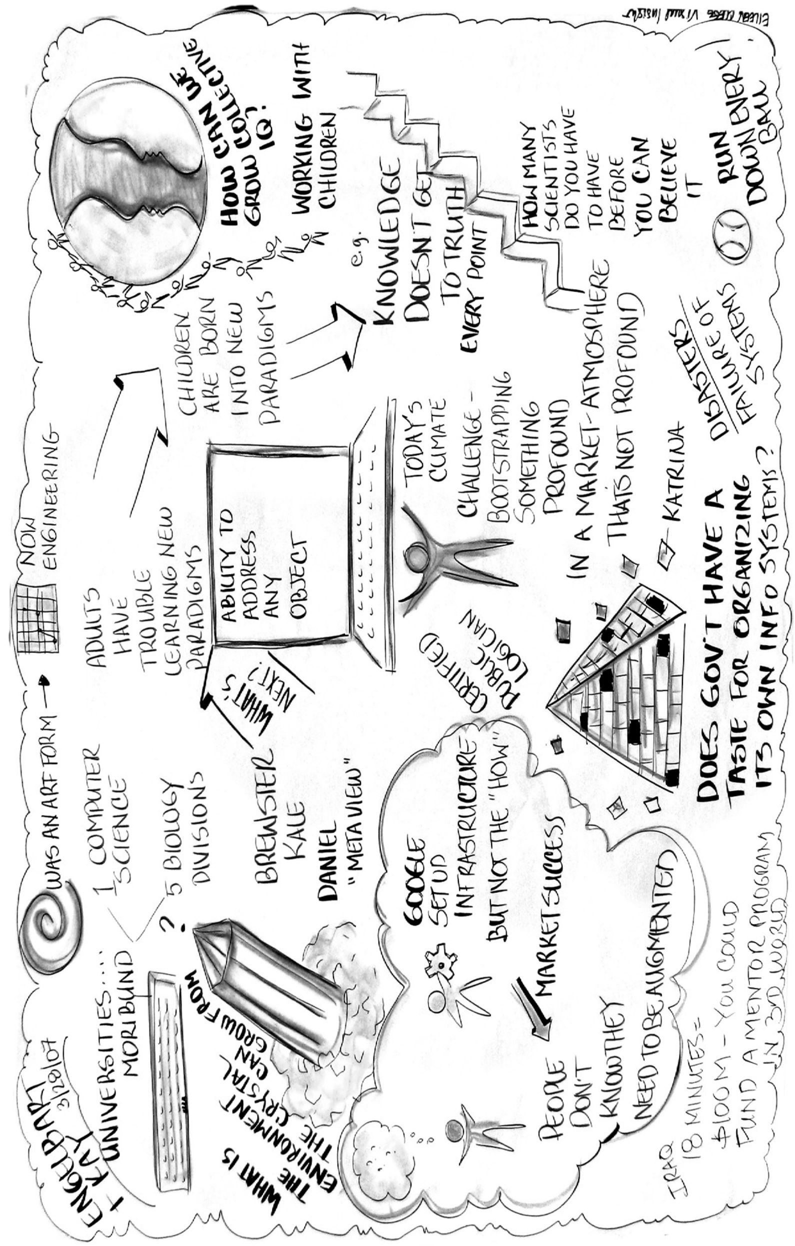
As we go to press with this version, we are pulling together our archive and looking forward to sharing the story behind the story in a better forum. For now, we are grateful to have taken another step in the dialog. We encourage you to help us keep expanding and refining so we can improve our collective intelligence—remembering Doug's vision that, ultimately, we will find ourselves motivated and equipped to solve the complex, urgent problems facing humanity.

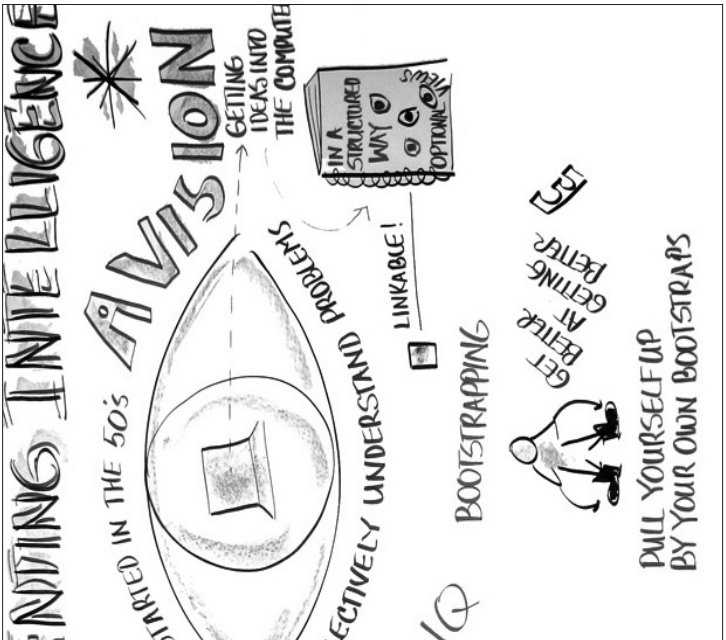
Eileen Clegg is a journalist, book author, visual communicator and founder of the company Visual Insight, creating large-scale, real-time murals to facilitate leadership of Fortune 100 corporations and non-profit organizations. Her work with Engelbart began when she was a research affiliate for Institute for the Future, in Palo Alto, California, creating future scenarios about learning and technology.

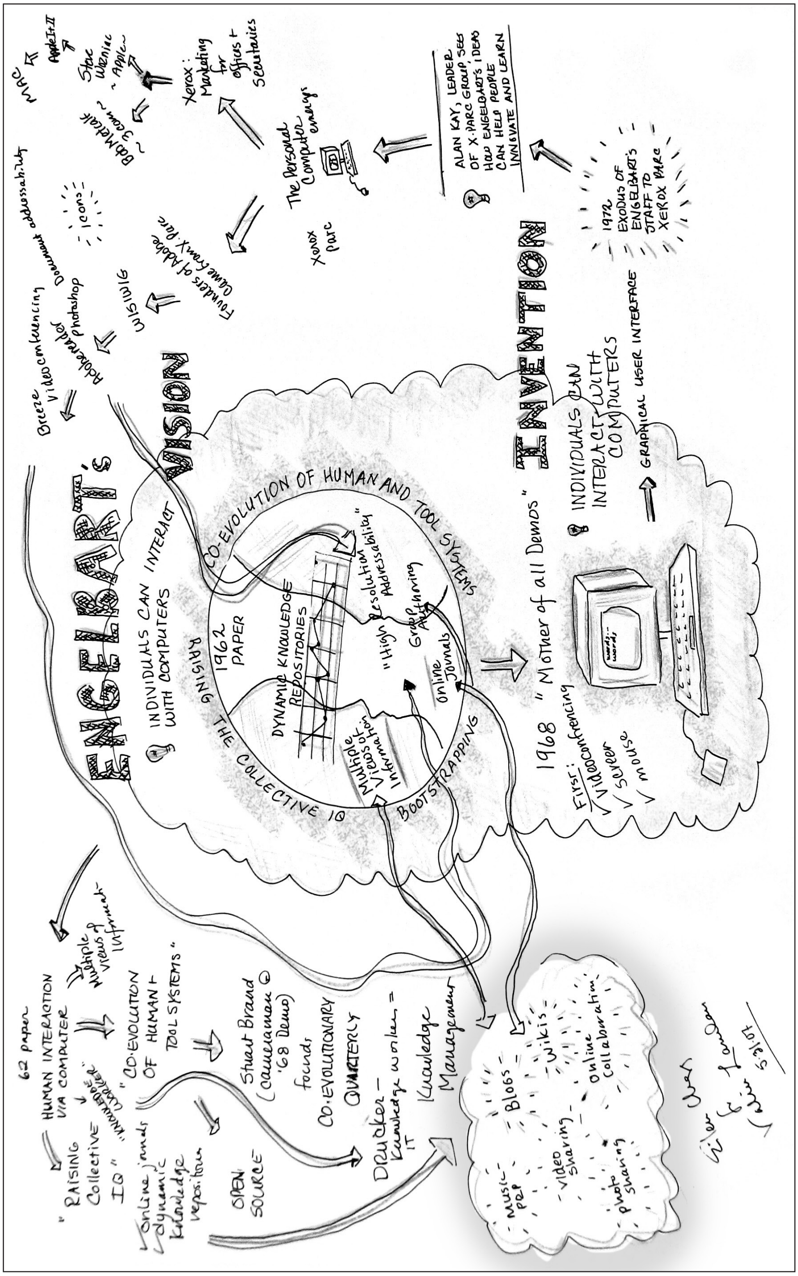


www.engelbartmural.com


DYNAMIC KNOWLEDGE REPOSITORIES ~ COLLECTIVE I.Q.
DOUG ENGELBART
Moving outside the Prevailing Paradigm
AUGMENTING HUMAN INTELLECT
NEURAL NETWORKS - ANALOGOUS TO HUMAN NETWORKS
O WE HAVE THE PIECES ENABLING BUT....
LET'S HAVE ALL THE COMPONENTS
WORKING TOGETHER
POTENTIAL FOR INNOVATION
1968 DEMO "THE MODERN PC"
BLOGS
WIKIS
INTERNATIONAL COLLABORATION
SYNTHESIZE - DRILL DOWN
FUTURE: FINE TUNED ADDRESSABILITY
BEYOND POINT + CLICK
? MONITOR / ACCESS INFO COORDINATE
HOW DO YOU DO THIS IN CURRENT PARADIGM
HOW CAN WE SOLVE URGENT + COMPLEX PROBLEMS ?
NKC CSULB MERLOT
SCALING
IT'S CRITICAL TO UNDERSTAND
HOW DO YOU MEASURE COLLECTIVE IQ
CULTURAL
ARTIFACTS
HUMAN SYSTEMS
SOCIAL
TOOL SYSTEMS
"CERTIFIED PUBLIC LOGICIAN"
STRUCTURING INFORMATION
INDIA: HUGE COUNTRY WITH SO MUCH DIVERSITY...
CAPABILITY INFRASTRUCTURE / ACROSS ORGANIZATIONS
CO EVOLUTION OF TECH & SOCIAL SYSTEMS
HOW DO WE GET AN ADEQUATE COMPREHENSIVE PICTURE?
WHERE TO LEVERAGE ?
THERE'S NO WAY TO SPECIFY HOW INDIA SHOULD LOOK IN 5 YEARS
YOU CANNOT "DESIGN" FOR CHANGE:
YOU CAN FACILITATE EVOLUTION
CSU: OUR COLLABORATION COULD SCALE SO THAT IT:
~ CREATES DYNAMIC KNOWLEDGE
~ "TANGIBLE PRODUCT FOR OTHERS eg STRATEGIES FOR HIGHER ED RESEARCH
1 START SOMEWHERE
WHERE DOES KNOWLEDGE FIT IN A SOCIAL CULTURAL SYSTEM
- CONTEXT
? WHAT ARE THE LIMITS OF WHAT CAN BE MOBILIZED INTO THE COLLECTIVE IQ ?
THE GROUNDING BASELINE
#6


ENGELBART + KAY 3/28/07
UNIVERSITIES.... MORIBUND
WAS AN ART FORM
NOW ENGINEERING
1 COMPUTER SCIENCE
5 BIOLOGY DIVISIONS
?
WHAT IS THE ENVIRONMENT THE CRYSTAL CAN GROW FROM
ADULTS HAVE TROUBLE LEARNING NEW PARADIGMS
CHILDREN ARE BORN INTO NEW PARADIGMS
HOW CAN WE GROW COLLECTIVE IQ?
WORKING WITH CHILDREN
BREWSTER KALE
DANIEL "META VIEW"
WHAT'S NEXT?
ABILITY TO ADDRESS ANY OBJECT
e.g. KNOWLEDGE DOESN'T GET TO TRUTH EVERY POINT
GOOGLE SET UP INFRASTRUCTURE BUT NOT THE "HOW"
CERTIFIED PUBLIC LOGICIAN
TODAY'S CLIMATE CHALLENGE - BOOTSTRAPPING SOMETHING PROFOUND
IN A MARKET-ATMOSPHERE THAT'S NOT PROFOUND
HOW MANY SCIENTISTS DO YOU HAVE TO HAVE BEFORE YOU CAN BELIEVE IT
MARKET SUCCESS
PEOPLE DON'T KNOW THEY NEED TO BE AUGMENTED
KATRINA
IRAQ 18 MINUTES = $100M - YOU COULD FUND A MENTOR PROGRAM IN 3D WORLD
DOES GOV'T HAVE A TASTE FOR ORGANIZING ITS OWN INFO SYSTEMS?
DISASTERS FAILURE OF SYSTEMS
RUN DOWN EVERY BALL!
EILEEN CLEGG Visual Insight


AUGMENTING INTELLIGENCE
Doug Engelbart
A CALL TO ACTION
TO MAKE THE WORLD A BETTER PLACE
GOAL
IT STARTED IN THE 50's
A VISION
GETTING IDEAS INTO THE COMPUTER
IN A STRUCTURED WAY
OPTIONAL VIEWS
LINKABLE!
COLLECTIVELY UNDERSTAND PROBLEMS
COLLECTIVE IQ
FOCUS ON CAPABILITY
BOOTSTRAPPING
GET BETTER AT GETTING BETTER
PULL YOURSELF UP BY YOUR OWN BOOTSTRAPS
AT GOOGLE



ENGELBART'S
VISION
INVENTION
INDIVIDUALS CAN INTERACT WITH COMPUTERS
CO-EVOLUTION OF HUMAN AND TOOL SYSTEMS
RAISING THE COLLECTIVE IQ
BOOTSTRAPPING
1962 PAPER
DYNAMIC KNOWLEDGE REPOSITORIES
Multiple Views of Information
"High Resolution Addressability"
Group Authoring
Online Journals
1968 "Mother of all Demos"
First: videoconferencing
screen
mouse
INDIVIDUALS CAN INTERACT WITH COMPUTERS
GRAPHICAL USER INTERFACE
1972 EXODUS OF ENGELBART'S STAFF TO XEROX PARC
ALAN KAY, LEADER OF X. PARC GROUP, SEES HOW ENGELBART'S IDEAS CAN HELP PEOPLE INNOVATE AND LEARN
The Personal Computer emerges
Xerox Parc
Xerox: Marketing for offices + secretaries
Steve Wozniak ~ Apple ~
Apple I + II
MAC
WYSIWYG
icons
Founders of Adobe came from X. Parc
Breeze videoconferencing
Photoshop
Document addressability
"RAISING Collective IQ"
62 paper
HUMAN INTERACTION VIA COMPUTER
Multiple views of information
"CO-EVOLUTION OF HUMAN + TOOL SYSTEMS"
Stuart Brand (cameraman @ '68 Demo) founds CO-EVOLUTIONARY QUARTERLY
Online journals dynamic knowledge repositories
OPEN SOURCE
DRUCKER — knowledge workers = IT
Knowledge Management
music P2P
Blogs
wikis
video sharing
online collaboration
photo sharing
5.31.07

Engelbart's Reasons for Action

Our world is a complex place with urgent problems of a global scale. The rate, scale, and complex nature of change is unprecedented and beyond the capability of any one person, organization, or even nation to comprehend and respond to.

Challenges of an exponential scale require an evolutionary coping strategy on a commensurate scale at a cooperative, cross-disciplinary, international, cross-cultural level.

We need a new, co-evolutionary environment capable of handling simultaneous complex social, technical, and economic changes at an appropriate rate and scale.

The grand challenge is to boost the collective IQ of organizations and of society. A successful effort brings about an improved capacity for addressing any other grand challenge. The improvements gained and applied in their own pursuit will accelerate the improvement of collective IQ. This is a bootstrapping strategy.

Those organizations, communities, institutions, and nations that successfully bootstrap their collective IQ will achieve the highest levels of performance and success.

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