Douglas C. Engelbart

A Profile of His Work and Vision:
Past, Present and Future

Prepared by Logitech
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Douglas C. Engelbart is known by most people as the inventor of the computer mouse. But that's akin to defining Michelangelo as "a sculptor" or calling John Lennon "a singer." The mouse, developed with a small team at Stanford Research Institute (SRI), represented only one aspect of a much larger vision.

In the 1950s, Engelbart conjured the revolutionary idea that computers – then massive stand-alone machines dedicated to number crunching – could be used as tools for knowledge workers to collect, share, and advance ideas and research. In the 1960s, Engelbart led a team of SRI researchers who developed technologies and capabilities that would help to spawn the personal computing industry as we know it. The center's breakthroughs included on-screen text editing, the interactive user interface, the remote computer network, hyperlinking, and of course, the mouse.

Though he is not a well-known figure in popular culture, Engelbart has achieved legendary status among the pioneering giants in the PC industry. In 2000, he received the National Medal of Technology, the nation's highest award for technology innovation, presented by then President Bill Clinton. And in 2005, he was inducted into the Hall of Fellows in the Computer History Museum, located in Mountain View, Calif.

Today, Engelbart continues to champion ideas and develop technologies that he believes will help societies to record and grow their collective intelligence. A self-described dreamer, Engelbart maintains a persistent, almost stubborn, dedication to a life course he set for himself more than a half-century ago.

The Hallway to Infinity

Engelbart's lifelong motivation is derived from a single vision he had in a single moment of time. It was a Monday morning in 1950. Engelbart was 25 years old, and he had just asked his future wife to marry him. He was driving to Moffett Field, where he worked as an electrical engineer. "It's still so vivid," he says. "All of a sudden, this clear image came to my mind." The image, he describes in great detail, is of a hallway, brightly lit, with windows on the left and closed doors on the right. The hallway, with a shiny linoleum floor, extends as far as he can see – "to infinity," he says.

At the time, Engelbart felt he had already accomplished many of his career goals. He grew up during the Great Depression on a small farm near Portland, Oregon. He received a degree in electrical engineering from Oregon State University. His undergraduate studies were divided by his two years spent with

At the age of 25, Engelbart was motivated by a sudden vision:

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the Navy, working as a radar technician in the Philippines immediately following the end of World War II. After he finished his degree in 1948, he took a job at Ames Research Center, at Moffett Field, with the National Advisory Committee for Aeronautics (NACA), which later evolved into NASA. Not bad for a farm-boy from Oregon.

But Engelbart's vision begged the question: What next? "I thought, 'Why don't I set a goal for my profession that will maximize the benefit my career will have to mankind?'"

His new goal took a matter of minutes to figure, but determining the specific course of his career would take a few years. Engelbart came to the realization that on a global level, "our problems were getting so complex, but our ability to deal with them collectively wasn't getting any better." He pondered issues such as disease in third-world countries, where an outbreak of malaria might kill thousands of people. Governments may fund scientists, who in turn might develop antidotes for such diseases, but that solution may ultimately create a new problem: overpopulation that would drain a region's finite resources. "I knew we had to find a way to collectively gain a better understanding of problem areas," he says.

Troubled by his revelation, Engelbart turned knowledge attained through three experiences into an idea.

While he was in the Navy, Engelbart picked up a magazine at a Red Cross library, which included an article written by Vannevar Bush, titled "As We May Think." The article, originally published in the *Atlantic Monthly* in July of 1945, articulated the need to create a system of information archival that provides researchers the tools to efficiently find relevant studies that they can then build upon. Bush wrote: "The summation of human experience is now being expanded at a prodigious rate, and the means we use for threading through the consequent maze to the momentarily important item is the same as was used in the days of square-rigged ships."

Later, Engelbart read a book, *Giant Brains, or Machines That Think (*1949, written by Edmund C. Berkeley), about computers that could, at the time, efficiently calculate mathematical problems. Intuitively, Engelbart knew the computer was capable of much more.

Last, Engelbart drew upon his experience as a Navy radar operator, when he used a light pen to interact with the radar's cathode ray tube (CRT) screen. By using some kind of device to interact with a monitor, attached to a computer, and connected to a network, Engelbart believed ideas and information could freely be exchanged.

Engelbart, a former Navy radar operator, conceived the idea that a computer, used in combination with a CRT (as shown above), could be the foundation for an interactive workstation:

'… if radar attached to a CRT could respond to operators, then people could also interact with a computer that had a CRT.'

The idea for an interactive computer network was born.

"I knew implicitly, and with surety, that if a computer could punch cards, that it could also electronically display text and draw on a CRT," Engelbart says. "And if radar attached to a CRT could respond to operators, then people could also interact with a computer that had a CRT. I could see electronically, that if other people were connected to the same computer complex, we could be collaborating.

"And I knew that was something I could do."

And it was the computer, Engelbart believed, that could be the foundation for a new way of solving the world's increasingly complicated problems. He believed it would allow ideas and knowledge to grow and advance, efficiently, serving as a mechanism to pool a society's collective intelligence.

Although he had a degree in electrical engineering, Engelbart knew that to further develop his ideas on computing, he would have to return to college.

Engelbart enrolled in an electrical engineering Ph.D. program at University of California in Berkeley, in part because Cal had recently accepted a project to build an experimental computer. "I was there for six years, but in all that time, they never did get the computer working." During his six years at Cal, he and his wife Ballard had three children within 18 months, including twins. While he was finishing his studies, Engelbart also began teaching engineering courses as an acting assistant professor at Cal, hoping that while establishing himself in academia, he could slowly build support for and ultimately start to develop his computer system. That never happened.

Fighting Widespread Skepticism

In the 1950s and '60s, the idea of using a computer or workstation for interaction was outlandish. The computer was viewed simply as a tool to do heavy calculations or handle basic administrative tasks such as payroll and accounting – it was never perceived as a device that could be used by knowledge workers to collect, share and build upon ideas and information. Engelbart was destined for a frustratingly long battle against that prevailing paradigm. "Back then, the idea of interacting with computers would be like someone today saying that everyone is going to fly his own private helicopter," he says.

While in the Ph.D. program, Engelbart shared his vision with a fellow professor – the reaction wasn't exactly one of intrigue. The professor looked at him with skepticism, asked how many people on the university staff Engelbart had told of his ideas, then offered some advice. "He told me, 'Do you know how promotion is handled here? It's called peer review. … I can tell you right now that if you keep talking like this, you will be an acting assistant professor forever.'"

The university wasn't the only place his ideas were frowned upon. Engelbart interviewed at Hewlett-Packard for a position as a research engineer, before the company entered the computer business. Engelbart was offered a job the day he interviewed. On his way home, he stopped to call the head of research, almost as an afterthought, and said, "This may sound silly, but I'm assuming that you guys are going to get into computers soon, because I've committed myself and that's what I'm going to do." The response was a surprise: "Oh, no Doug. Sorry, not a chance." Engelbart declined the job offer.

He also sent a letter to Stanford, pitching the idea of teaching a computer class – and was turned down. The official line, as Engelbart recalls: "Stanford is a small university that has to stay focused on highly academic special domains. Computers are only a service activity, and we don't contemplate ever having courses in their design."

In 1957, Engelbart interviewed for a position as a researcher at SRI. They had a computer project funded by Bank of America to build a system that could help the growing banking giant handle its accounts more efficiently. The project was called ERMA (Electronic Recording Method of Accounting). Engelbart saw it as an opportunity to get involved in computers, and eventually expand the role of the computer into an interactive workstation. One of his future colleagues, whom he knew from Cal, advised him before the job interview: "He told me, 'Don't tell them about (your idea for computers) because you will probably be hired if you don't, and then you can wait and see once you get in.'"

Engelbart received the job offer, accepted the position and bided his time.

Slowly Gaining Support

During the early days of his 21 years at SRI, Engelbart worked in the same laboratory with other people involved in ERMA, though he was not directly involved. He earned several patents for his work on breakthrough technologies including scaling and magnetic computer components, which helped him build enough credibility within the lab to pursue funding for his desired course.

Engelbart, shown conducting a workshop at SRI in the 1960s, had to fight the perception that computers were simply tools to perform administrative mathematical tasks, such as accounting.

'You have to keep in mind that back then the idea of interacting with computers would be like someone today saying that everyone is going to fly their own private helicopter.'

In 1959, he received a grant from the Air Force Office of Scientific Research, a grant that led to his landmark 1962 paper, "Augmenting the Human Intellect: A conceptual framework." The paper represented his personal mission statement.

For the first time, Engelbart formally documented his high-level thinking about the increasing complexities of the world, and detailed his vision of the computer-based augmentation solution. He defined the concept of augmentation as "increasing the capability of a man to approach a complex problem situation, to gain comprehension to suit his particular needs, and to derive solutions to problems. … by 'complex situations' we include the professional problems of diplomats, executives, social scientists, life scientists, physical scientists, attorneys, designers – whether the problem situation exists for twenty minutes or twenty years."

In the 134-page document, Engelbart details a tangible mechanism, the computer, which could help increase "human intellectual effectiveness:"

> "We see the quickest gains emerging from (1) giving the human the minute-by-minute services of a digital computer equipped with computer-driven cathode-ray-tube display, and (2) developing the new methods of thinking and working that allow the human to capitalize upon the computer's help."

Remarkably, Engelbart wrote in great detail and with striking accuracy about how an architect might use such a workstation in the future:

> "He sits at a working station that has a visual display screen some three feet on a side; this is his working surface, and is controlled by a computer (his 'clerk') with which he can communicate by means of a small keyboard and various other devices. He is designing a building. He has already dreamed up several basic layouts and structural forms, and is trying them out on the screen. The surveying data for the layout he is working on now have already been entered, and he has just coaxed the 'clerk' to show him a perspective view of the steep hillside building site with the roadway above. … Gradually, the screen begins to show the work he is doing – a neat excavation appears on the hillside, revises itself slightly, and revises it again. After a moment, the architect changes the screen to an overhead plan view of the site, still showing the excavation."

Engelbart's landmark 1962 paper defined the concept of a computer system augmenting human intellect by:

'increasing the capability of a man to approach a complex problem situation, to gain comprehension to suit his particular needs, and to derive solutions to problems … whether the problem situation exists for twenty minutes or twenty years…'

The paper was well received by several agencies – particularly the Defense Department's Advanced Research Projects Agency (ARPA), which provided Engelbart adequate funding to found his own lab within SRI, the Augmentation Research Center (ARC), dedicated to his vision.

Enter: The Computer Mouse

In the 1962 paper, Engelbart refers to a "pointer" that allows the knowledge worker the ability to navigate items on screen. Engelbart originally conceived of a computer mouse while at a conference, the year before he wrote his paper, and sketched out drawings of the device in a notebook. When, in 1963, NASA announced it would fund a project to identify a screen selection device, Engelbart dug out his notebook. He passed his notes to one of his engineers in the lab, Bill English. It was English who built the world's first mouse – a wooden box-like device with two steel rollers coming from the base, aligned to track horizontal and vertical movement. With a single red button at the top and a cord coming out the back, someone in Engelbart's lab said it looked like a mouse. The name stuck. To this day, no one recalls who dubbed it the mouse.

The world's first mouse featured two steel rollers coming from the base, aligned to track horizontal and vertical movement, a single red button at the top and a cord that extended from its base. No one recalls who, but someone in Engelbart's lab said the pointing device looked like a mouse.

"We all assumed that later, it would have an official, more dignified name when it got out to the world," Engelbart said.

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The device won all of the NASA tests for usability and became a key element of ARC's work in collaborative computing.

Going Online

In 1965, Engelbart and his team developed and implemented the oN-Line System (NLS), a system of sharing and navigating content through a shared, centralized digital archive. It was the first system to use hypertext – providing the ability to jump between documents, reports, software code, etc – and it linked the lab's growing mass of electronic intelligence. Engelbart's ARC was the also the second location to host the budding government network called ARPANet (founded by the Advanced Research Projects Agency), which later evolved into the Internet. This network provided the opportunity for Engelbart and his team to extend the collaborative properties of NLS beyond the realm of ARC's network.

The 'Mother of All Demos'

While the 1962 paper was the first articulation of Engelbart's vision, the 1968 Fall Joint Computer Conference was the first public demonstration of it. Engelbart's team found out in March about the FJCC show, which was to take place in December.

After a rigorous nine months of planning and technical execution, Engelbart and his team wowed the crowd of an estimated 1,000 attendees at Brooks Hall in San Francisco. In the course of 90 minutes, they displayed a remote network, shared-screen collaboration, video conferencing, hypertext, interactive text editing, and the computer mouse.

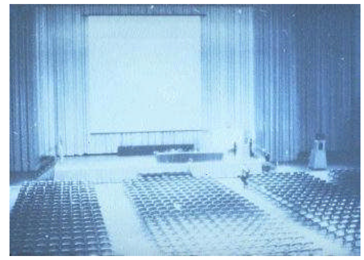
In his opening line for the conference, Engelbart began, “If in your office, you as an intellectual worker were supplied with a computer display backed up by a computer that was alive for you all day and was instantly responsive, how much value could you derive from that?” Engelbart then demonstrated working interactively with text on the screen – a hypothetical to-do list – using a mouse, a keyboard and his chording keyset. He also spoke through a headset to two engineers on his team, located miles away at the SRI office in Palo Alto. Dramatically, their images appeared on a large projected screen as they participated in what is believed to be the first public video conferencing demo.

In technology circles, the demonstration has come to be known as the “Mother of All Demos.” Most believe the event set in motion an era of innovation around personal computing and inspired a generation of technology innovators. For Engelbart, the demo represented a paradigm shift: For the first time, the world perceived that the computer could be used as more than simply an administrative tool.

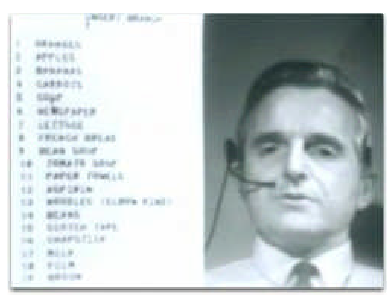
John Markoff, a technology reporter for the *New York Times*, described the event as “the demonstration that changed the course of the computer world,” in his 2005 book, *What the Dormouse Said*. Markoff wrote that “computing had made the leap from number crunching to become a communications and information-retrieval tool. Second, the machine was being used interactively with all its resources appearing to be devoted to a single individual! It was the first time that truly personal computing had been seen.”

The Next 30 Years – The ‘Personal Computer’

The 1968 event spurred immediate development around the computer, but it didn’t spawn the level of innovation around knowledge networks that Engelbart originally envisioned. As computers became known as “personal” computers in the 1970s and 1980s, manufacturers focused on expanding what single computers could offer individual users rather than how a network of machines could perform in a collaborative environment. At the same time, industry focused on delivering PCs that were easy to use. Engelbart felt that these trends detracted from development of systems and networks with fundamentally greater capability.



Known as the ‘Mother of All Demos,’ Engelbart and team wowed an estimated crowd of 1,000 at San Francisco’s Brooks Hall (above) by showing a remote network, video conferencing, hypertext and the computer mouse. Engelbart and SRI colleagues connected remotely and collaborated to edit a shopping list (below).



"There was this flat declaration that the computer had to be easy to learn," Engelbart said. "Well, I always felt we should be looking at computer-supported capability first."

Engelbart continued to champion the idea that society needed a system to help capture and grow collective intelligence in order to solve the world's increasingly complex problems. He extended the capabilities of NLS, which later evolved into a second-generation network he called "Augment." SRI, however, shut down ARC in 1978 because of lack of funding.

In the 1980s, Engelbart briefly consulted with McDonnell Douglas Corporation on information system architecture projects. In 1989, he launched his own Bootstrap Institute, founded on the notion that ideas or systems can start simply and slowly become more sophisticated and powerful over time as more and more people contribute. "The better we get at getting better, the better and faster we'll get better," Engelbart says.

In the 1990s, Engelbart further evolved Augment by tying it to the World Wide Web in a project he calls "HyperScope." The project was the first step toward establishing an open hyperdocument system, which, if broadly implemented, could provide people a fast, efficient way of navigating ideas, reports, and other materials that are widely dispersed across networks. HyperScope links portions of documents together by using html addressability, much like hyperlinks. A paragraph in one report could be tied to a portion of another document, allowing people to establish a virtual evolution of ideas and structured arguments, instead of simply an archive of documents.

The HyperScope name is predicated on the idea that individual users could specify their own unique view, or scope, of relationships between ideas and topical content. An intermediary file is created using XML when a document or passage is opened, allowing the user to define how relationships between different information is viewed without changing the source document. For example, during the course of research, a scientist might link key thoughts or ideas within five generations of studies on a particular topic as he prepares his own related study. Other subsequent researchers could follow the path of this researcher, and see the complete evolution of an idea. Over time, new ideas are added and new relationships are established, resulting in the growth of what Engelbart refers to as "collective IQ" – that is, a society or organization's "capability for coping with complex, urgent, large-scale problems."

Much like his initial ideas revolving around the interactive, networked computer, Engelbart's open hyperdocument system was largely ignored for the better part of a decade.

Engelbart founded the Bootstrap Institute in 1989. It was created with the idea that ideas or systems can start simply and slowly become more sophisticated and powerful over time as more and more people contribute. The BootStrap Institute was recently renamed the Doug Engelbart Institute.

'The better we get at getting better, the better and faster we'll get better.'

Renewed Attention

In the new millennium, Engelbart is experiencing a resurgence of attention, in part because of Markoff's book. In fact, a promotional event for the book – and a concurrent celebration of the 25th anniversary of the Homebrew Computer Club – unexpectedly turned into a celebration of Engelbart's accomplishments.

"Dozens of computer pioneers stood up," wrote Tom Foremski in his *SiliconValleyWatcher.com* blog, "to acknowledge his much larger role, as one of the most profound and influential thinkers of their time. The tributes to Mr. Engelbart went on and on, long after the allotted time for the event, with many stories told publicly for the first time. … The event was not billed as a love-fest for Mr. Engelbart, but that's what it became, and you could not sit there and hear these people – many of them A-list names in their own right – and not walk away with a profound admiration for Mr. Engelbart and his ability to change the lives of the super-smart elite of the early Silicon Valley."

And just a few years ago, Engelbart surreptitiously crossed paths with an official from the National Science Foundation (NSF) while at a Silicon Valley gathering. Engelbart is hoping that NSF or another entity might work on the development of an open hyperdocument system. The first step of such a project would be to develop browser-like software that can effectively link a series of documents and other content sources – reports, recorded dialog, software code, etc. The software would be applied within what Engelbart refers to as a Dynamic Knowledge Repository (DKR). These information centers would evolve as more people add original content and create their own links to other knowledge within the DKR. Over the course of time, the organization using the DKR experiences an information evolution, and ultimately an improvement in their collective IQ. Concurrently, these knowledge centers can become linked to one another, and society's collective intelligence can experience a large-scale improvement.

One of the basic principles of such a flexible, open system, Engelbart says, is that it allows for a "co-evolution." As human skills and human factors evolve, a society's or an organization's information system should also evolve – rather than an organization needing to frequently redesign its knowledge system to accommodate constantly changing environments.

Work Left to Do

Engelbart has never been motivated by economic opportunity. In fact, since he launched Bootstrap, he's mostly been working off of his personal savings. He's never wavered from his personal

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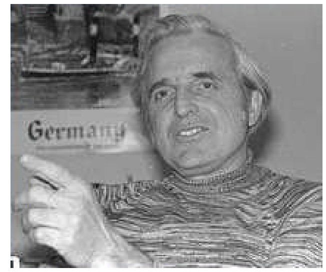
mission to "maximize the benefit my career will have to mankind."

Put most people in Engelbart's shoes and it would be easy for them to take a step back, acknowledge their achievements, and enjoy retirement. But Engelbart says that "the likelihood of things getting to the point where I will say, 'I'm satisfied,' is not very high. I've just become so totally convinced that there is a significant amount of improvement we can make in our collective capability on a global level. I feel with conviction that if we don't strive to really improve that capability, there's an ever increasing probability of our society collapsing."

Peer into Engelbart's eyes and you get a sense that he's always thinking about two decades ahead of everyone else, still dreaming of a hyper-connected world that's as sophisticated as the problems it faces.

"People have told me that I'm just a dreamer," Engelbart says. "The 'just' part offends me. Being a dreamer is hard work."



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Photos courtesy of SRI

The Augmentation Research Center's Pioneering 'Firsts'

Engelbart and his team at the Augmentation Research Center use an early collaborative computing system during the late 1960s.

- The mouse
- Two-dimensional display editing
- In-file object addressing, linking
- Hypermedia
- Outline processing
- Flexible view control
- Multiple windows
- Cross-file editing
- Integrated hypermedia e-mail
- Hypermedia publishing
- Document version control
- Shared-screen teleconferencing
- Computer-aided meetings
- Formatting directives
- Context-sensitive help
- Distributed client-server architecture
- Uniform command syntax
- Universal "user interface" front-end module
- multi-tool integration
- grammar-driven command language interpreter
- protocols for virtual terminals
- remote procedure call protocols
- compilable "Command Meta Language"

(SOURCE: The Doug Engelbart Institute)

Achievements/Honors

- Authored over 25 publications
- Earned more than 20 patents
- Industry awards include:
  - IEEE Computer Pioneer Award (1992)
  - The Lemelson-MIT Prize (1997)
  - The National Medal of Technology (2000)
  - Computer History Museum Hall of Fellows (2005)

(**SOURCE**: Computer History Museum)

In 2000, President Clinton presented Engelbart with the prestigious National Medal of Technology.