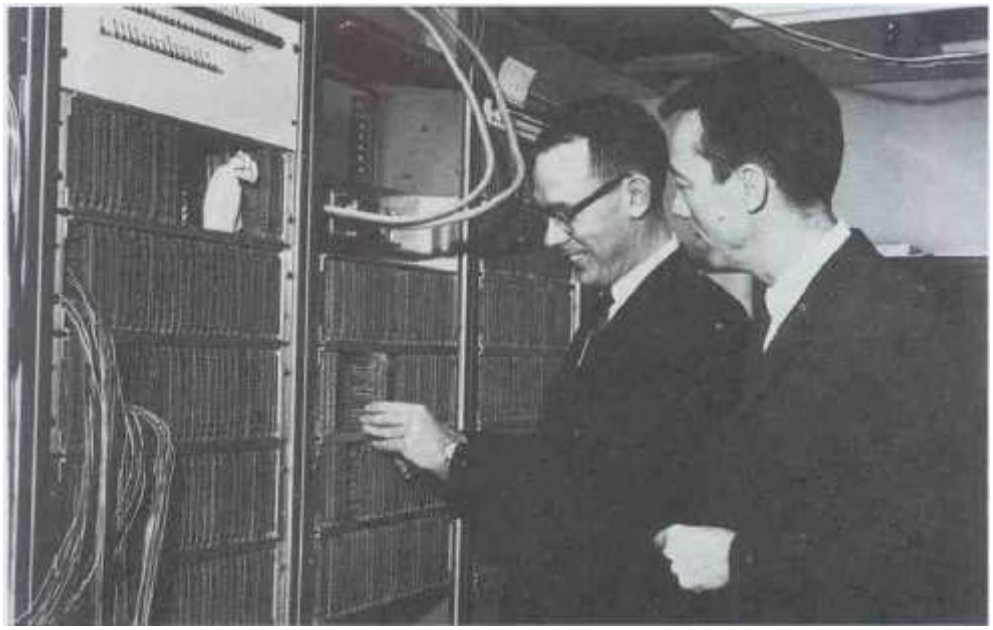
EVANS & SUTHERLAND NEWS

Special Issue

E&S Since 1968: The Early Years, Getting Established, Maintaining Industry Leadership

In 1968, two university professors-David C. Evans from the University of Utah and Ivan Sutherland tram Harvard-began a colfaboraUon that would shape the history of the computer industry. The risks were h;gh, but the dream, that oomputers could be used interactively as tools for a variety of tasks, was *compemng. And the dream came true. This article is a reprint of a three-part series of articles that appeared In Evans & Sutherland News, the company's internal newsletter, during 1989. Questions or comments about the article should be directed to (he E&S Hum n Resources Department, 6 0 Komas Drive, Salt Lake City, Utah, 84108.*



December 1969. [van Sutherland (left) and Dave Evans (right) with th:e LDS 1.

About the Founders

Dave Evans was director 0f engineering in Bendix Corporation's computer division fram 1953 to 1962. There, his group developed the first low-priced gerieral-purpose stored-program computer to be manufactured in quantity. D.uringthis tirne, Dave also develqped an interest in the Interaction be:tween people and computers, or the man-machine interface. He thought that computers should be used more effectively as tools and that people should be able to Interact With computers in an easier, more natural way than was possible at the tlme.

In 19s2, he began what turned out to be a five-year stint as visiting pmfessor at Berkeley, There, he pursued his interest in man-machine communicati0n a,nd found new interests, including the synthesis of pictures of objects described only in the memory of a computer and the application of co,rnp1:Jter graphics to many fields outs.ide computer science.

In 1966, Dave was recruited by the University of Utah to establish a computer science program there. Computer graphics became Ills primary research interest and the computer science program he established became one of the leading programs in the nation.

During this period, Ivan Sutherland's work was establishing him as a leading researcher in the computer science field. In 1960, he produced a motion picture called *Sketchpad: A Man-Machine Graphical Communication System* documenting his doctoral disse rtation. The dissertation has been described as a major contribution to computer graphics knowledge. because, up to that time, computer graphics had dealt exclusively with two-dimensional pictures of objects. Ivan' s dissertation dealt with the objects themselves and used **a** data structure that was based on the topology of a three-dimensional object and described the relationships between the parts of the object. Dave Evans saw *Sketchpad* while he was at Berkeley. "Everycomputer center in the country had a print of it," he remembers.

After receiving his Ph.D. from MIT, Ivan became director of informa-1lon processing at the Advanced Research Projects Agency, and subsequently became a professor at Harvard. There he developed a perspective divider, clipper, and matrix multlp i er. These developments were

integral parts of the first E&S products.

In 1967, Ivan was recruited by Dave Evans to join the computer science program at the University of Utah. This set the stage for the founding of E&S in 1968.

Concurrent with the work being done by Dave Evans and Ivan Sutherland, a group of engineers with General Electric in New York state were developing technology that would be merged with efforts at E&S in 1972. This group consisted of Rod Rmigelot, Bob Schumacker, and Ed Wild. Their efforts on two projects at GE-ANIP and JANAIR focused on developing technology to provide a "highway in the sky." The end result, however, turned out to be too large to be put into an airplane cockpit, but the group was excited about the technology and thought it might be used for pilot training.

A series of demonstrations across the country culminated in the sale of their first product, NASA 1, a two-dimensional plane surface texture generator. NASA subsequently became interested in generating three-dimensional images, and efforts for the project were moved to GE's Apollo support group in Daytona and out of the hands of the New York-based group.

Taking the Plunge

While they were at the University of Utah, Dave Evans and Ivan Sutherland were both sought after by large companies as consultants, but many of their ideas went unused by their clients. As Dave explains, "The things we really wanted to see done were not going to get done anytime in the near future unless we did them ourselves. In the long evenings after we finished our consulting work, we talked about the problems. One of the things we decided to do was start our own company."

The decision was not primarily to make a lot of money, but to develop the technology that would allow computers to be used as powerful tools. "Before the company was organized," says Dave, "most computers were used for well-understood routine tasks like utility billing, business files, extracting information from files, and sorting information. The jobs were time-consuming and the computer was the faithful slave. The vision that we were inspired by was that you could use computers as tools, much as you could use a pencil and paper as an aid in solving problems."

Developing graphics was only part of the dream.

But first, the founders had to create a market for those tools. As one engineer puts it, Ivan in particular went to the market and identified "needs that the market isn't even aware of. Then he goes back to the lab and designs something that fills that need." As Dave puts it, "You feel a little like a physician who's got a cure for an unknown malady, stopping people on the street saying, 'You're sick. I can cure you.'"

"The first product was Ivan's product," Dave recalls. "We decided that we *were* going to build his graphics system, a necessary ingredient considering the state of computer art at the time, to make the computer work with enough detail and a quick enough response to use it as an interactive design tool, rather than a batch design tool, where you give it a job, let it run, come by, and pick it up later."

Although E&S is hailed as a leader in computer graphics technology, Dave contends that developing graphics was "only part of the dream. In starting the company, we had a different idea: that computers were simulators. Simulators can replace real objects on occasions when a simulation can be built more cheaply than the physical model can be." The company began with graphics because "we thought they were an essential link between the human user and the simulation."

A Volkswagen Beetle becomes the subject of a 1970 simulation project. Ivan Sutherland (left) and assistants plot coordinates for digitizing the car.

Financial Backing

Founding the company in order to realize the dream would take money. And as the entrepreneurs established their business plan, they gathered friends who were willing to invest in the initial endeavors of the company. Eventually, Dave and Ivan met representatives of Venrock (an investment group and an arm of the Rockefeller family) that for 50 **years** had been funding the research and development of new technologies embodied in companies like Eastern Airlines and McDonnell Aircraft. Venrock agreed to back the E&S venture.

Initially there were three principal ownership groups: Venrock, a group of friends, and the families of founders and early employees. As Dave recalls, "in the early days, we were simply severely restricted on the amount of money and the number of people we had. We had to focus entirely on a single project. We had a bound notebook, and anybody who had a good idea was encouraged to write it in the book with the notion that when we got this first project done and paid for, we'd look back and see if we ought to do something about some of those ideas. It was a very expensive development. It was the first of its kind, the first dynamic real-time graphics system. Everybody knew everybody; we saw each employee as they came to work every day. There was a very tight communication and a very, very strong focus."

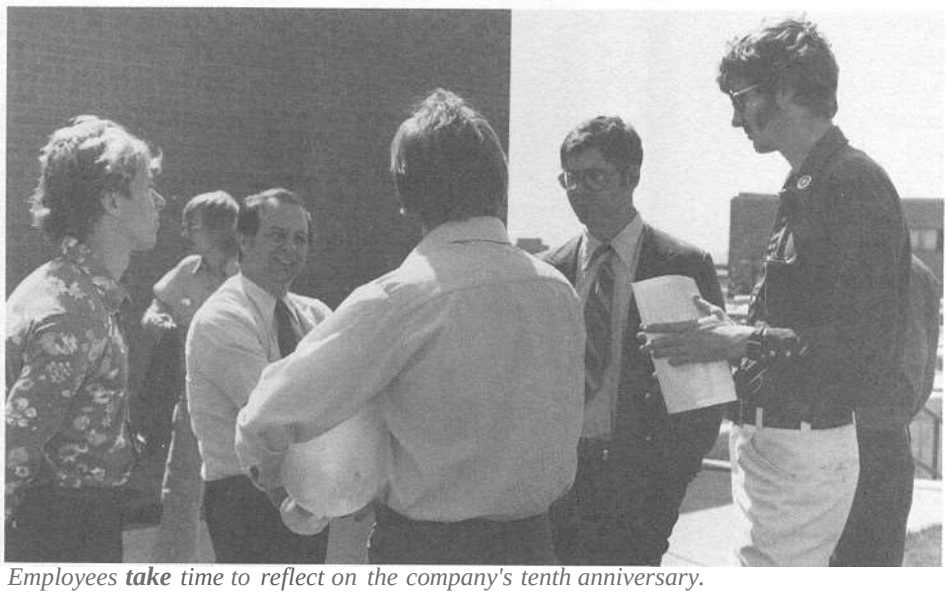
The work of creating new products, and thus a business, began in some army barracks on the University of Utah campus. These humble quarters enabled the company to retain close ties to Dave's colleagues and students at the school, and to minimize **expenses.**

Minimizing expenses was important; five years would pass before the company celebrated its first profit. Still, there was anair of excitement among the employees. Dave and Ivan carefully selected the first engineers; the technology was so new that very few universities even taught the basic principles. As a result, E&S attracted many of the best in the field, and in the early-to-mid 1970s, the Salt Lake Valley boasted the greatest concentration of computer graphics experts in the world.

The first products these experts developed were graphics subcomponents: a clipping divider and a matrix multiplier. The first system sale was the LDS 1 (line drawing system), which was contracted early in 1969 and shipped in July of 1969. "We all gathered around as they loaded it into the back of a manager's Datsun truckt recalls one early employee. "A few of the guys rode in the truck bed to hold it steady. We had all worked on it and it was exciting to see it go."

The LDS 1 "was really hot, which means we probably sold three or four of them."

The early products were sophisticated and expensive for their time; few people could use them, let alone afford them. According to one engineer, the LDS 1 "was really hot, which means we probably sold three or four of them."



*Employees **take** time to reflect on the company's tenth anniversary.*

In 1971, E&S shipped its second system product, the LDS 2, a general-purpose version of the LDS 1.

In 1972, E&S made its first attempt at a high-performance graphics system, the CT1 (continuous tone). Combining the LDS 2, the Watkins Box, and other innovations,it was designed for computer animation. It didn't generate any profits, but it did generate lots of new ideas.

The GE Contingent Joins E&S

About this time, a banking concern contacted the GE group (Rod Rougelot, Bob Schumacker, and Ed Wild) with queries about a method for creating computer-generatedcharts derived from computer data. The group conducted a market survey, formulated a business plan, and attempted to convince GE to create an independent group. As Rod Rougelot explains, the move was not well received. "We went to the manager of the department and said, 'We don't think that this (bank graphs) is a plan for GE,'" says Rod. "We asked if GE could contribute and get some equity and we would do the work and get some equity. We had sort of a spin-off in mind. But GE decidedto keep the business themselves."

The group decided to leave GE. Since they had met Dave Evans at conferences around the country and **knew** of his **work,** they gave him **a** call. "I said, 'How would you like to hire three guys from Syracuse?'" Rod recalls. "Dave replied, 'It depends on who they are.'" The group came to E&S in late 1972 and focused their efforts on the flight training market.

Financially, times were anythingbut easy for the new company. On Christmas eve in 1972, the future looked particularly bleak. "The company had around $700 left in the bank, had used up its lines of credit, and was running on personal loans taken out on the founders' homes," Dick Leahy E&S Secretary/ Treasurer remembers. "Everybody had gone home and we were saying we really ought to phone these people and tell them, 'Why don't you have a

Employees lined up on the lawn outside building 580...

real holiday and come back after the new year,'" says Dave. uBut we received a special delivery letter. We opened it and there was something in there that looked !ike a check for $500,000. I said, 'What do you think this is?' And Dick said,., think this looks like a check.' We decided we better take It to the bank and see If they thought it looked like a check." They later learned that after a great deal of hard work, Venrock representatives had found an overseas investment company that was willing to invest in the research going on at E&S. At Venrock's request, this company had sent the check.

Meeting Market Needs

By the mid-1970s, Evans & Sutherland was beginning to develop a broader range of products, each targeted *to* fill specific market needs. The NOVOVIEW series of visual systems was aimed at the commercial flight training market, the LOS (Line Drawing System) and PS (Picture System) product lines were geared toward the computer graphics and computer aided design Industry, and the CT (continuous tone) image generators found their niche first in the research and development arena, later in the engineering and training markets.

This range of products is one of the things that distinguished E&S from Its competitors. As Bob Schumacker notes, although NOVOVIEW was not the best visual system that technology could produce at the time, it was a successful product because "it met **a** market need at a much lower cost than high-performance systems. Providing the right capability at the right price made it **a** hit." Each product line was important to the company; technology developed for one product often contributed to the development of other products as well.

The Flight Simulator Market

In the early '70s. flight simulator visuals were created using model board technology in which a camera would "fly" over detailed physical models of cities and landscapes,projecting an image onto a screen in a simulator. CAE, Singer, and RSL (Rediffusion Simulation Limited) were purveyors of model board visual systems, a technology that had been in use for about ten years.

E&S engineers had been Interested in developing **a** product *for* the flight training market, but found the airline market unreceptive to the high-cost, high-performance computers they wanted to produce. Then In i 973, McDonnell Douglas introduced a product called VITAL, technologically less demanding than what the E&S engineers had in mind, but very *effective.* Instead of simulating the gamut ot real world scenery, it focused on night flight simulation.

Soon after vrrAL was introduced, CAE contacted E&S engineers about designing a prnduct to compete with VITAL. Although the company didn't win a contract with GAE, E&S engineers had the kernel of an idea for a new product line. In mid-1973, the Visual Systems group was formed at E&S with Rod Rougelot as manager.

...to celebraie the company's tenth year ir1 business.

ASL and E&S: The Collaboration Agreement

In 1972, representatives of E&S and RSL had briefly discussed the idea of using computer-generated visual systems in flight simulators, but RSL was not interested. RSL supplied

about 50 percent of the commercial simulator market, had a reputation for building very high quality simulators, and estimated that model board technology had about ten years of marketability left. However, when their customers began requesting computer-generated visual systems and refusing to buy model board visual systems, RSL representatives contacted E&S.

E&S and RSL entered into a working collaboration agreement in mid-1973 that would launch E&S into the flight training simulation business with the NOVOVIEW product line. E&S agreed to supply visual systems exclusively to RSL; RSL would market them exclusively to their customers. These were "embryonic times" for E&S and resources were tight. Pete Doenges, who joined the company in 1973, recalls that "the first **NOVOVIEW was** debugged in a trailer outside the corporate barracks." E&S and RSL later made a formal collaboration agreement, and the first NOVOVIEW system was delivered to the Dutch airline **KLM.**

The NOVOVIEW product line developed quickly, successfully competing with VITAL and bringing E&S its first profit in 1974. The entire simulator flight training industry grew very rapidly during this time as well. Fuel prices had soared during the Arab oil embargo of 1974, increasingthe cost of in-flight pilot training. The systems sold well, as Rod Rougelot explains, because if a company needed 5,000 training hours to meet FAA requirements, they could save $20 million per year by using a simulator. As a result, simulators became an economic necessity for pilot training.

TheHigherPerformance Products

While some E&S engineers were developing the NOVOVIEW product line for commercial airlines, others were working on the CT product line: higher-performance, higher cost image generators. CT1, developed in 1972, was sold to Case Western Reserve University, and was based on the Watkins architecture and work that had been done at the University of Utah. According to Rod, CT1 was not a true realtime system, "it was a hybrid between the Watkins Box and an LDS front end" that had to do very high-capacity, high-resolution pictures. It helped E&S win an important contract to produce a system for CAORF, a maritime research and training facility.

SP 3 was the first of the NOVOV!EWs certified by the FAA/or Phase II/ training.

The contract was awarded in 1972 and CT2 was delivered to CAORF in 1975. According to Pete Doenges, it was at this point that the CT line began diverging from LOS hardware. Following the success of the CAORF system, E&S won subsequent CT contracts: CT3 to **NASA** in 1976, and CT4 to Lufthansa in 1977.

In 1975, Ivan Sutherland left the company he co-founded to pursue other interests. The company was becoming established in the computer graphics industry at the time, and Ivan wanted to move on. As Pete recalls, people at E&S were "sad to see the intellectual giant leave," because he had contributed so much to the creative synergy. Even to this day "his influence lingers all over the map," Pete continues, "but there were enough capable people left behind to focus on product applications and business goals," that the company did fine after he left.

CT4 and CTS

The CT4 was the best computer image generation product on the market in 1977; the Visual Systems group brought in everyone they could think of to see it. **A** representative of the Naval Training Equipment Center saw a demonstration and decided to consider E&S with Singer and GE as potential contractors for the CH 46 helicopter system.

E&S engineers were faced with a dilemma. CT4 could do about 400 polygons; the training center wanted two or three thousand. To do it with CT4 technology would have required 60 cabinets; the customer could not have afforded a project of that scope, and even if it could, engineers weren't certain the system would have worked.

Shortly after the discussionswith training center personnel, Bob Schumacker, who had been considering ways to increase the capacity of the CT line, made a now legendary trip to Boston for a three-day conference. In his hotel room, he put together the outline for a radically new system architecture that would enable E&S to increase the CT's performance by approximately 1,000 percent. Rod recalls Bob's return. "When he got back, I asked him, 'How did your conference go?' He said, 'I didn't go to any of the presentations.' I said, 'Were you sick?' He said 'No,'" {he'd been thinking about the CH 46 program). "He pulled his notebook out and he had CT5. All of its characteristics were defined. We got real excited."

The Visual Systems group won the contract and developed the CT5,

August 1985. As the last MPS system shipped, employees seized the photoopportunity.

hoping that a couple of sales would recoup the millions of dollars that would have to be invested. As Rod puts it, "it was a whole lot more system than we'd ever done before." The CT systems had never been very successful during the '70s; they were specialized systems developed for specific customers and were, at best, break-even prospects. The CTS, delivered in 1981, had greater potential for success because it was the first large system capable of serving the needs of a variety of customers without extensive customization.

The Interactive Group

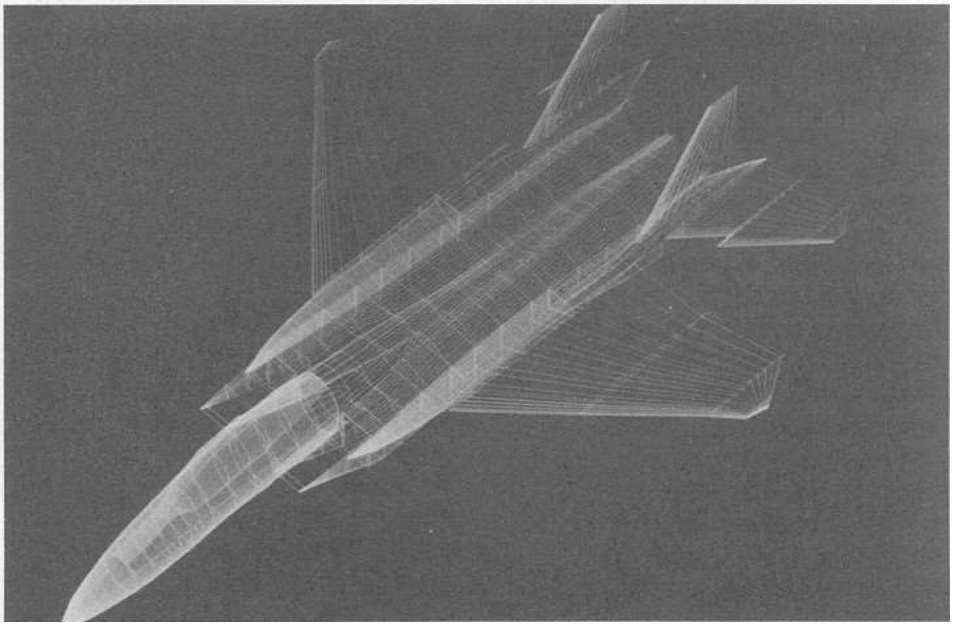
While the Visual Systems group was aiming products at the operator training market, engineers led by Dave Evans worked on the picture system series (PS 1, 1973; PS 2, 1975; MPS [multi picture system] 1975; and PS 300, 1981) targeting the graphics, CAD/CAM (computer-aided design/ computer-aided manufacturing) markets. The PS 1 could display complicated wire-frame models of objects or mathematical expressions that could be turned and viewed from all angles. Described by some as a more user-friendly machine than its predecessor, the PS 2 was the closest thing to a general-purpose graphics system on the market at the time. The MPS enhanced PS system technology, reducing dependence on the host computer and allowing for multiple simultaneous users. The PS 300, a major departure from the traditional graphics terminal, was a self-contained dynamic interactive system, less dependent on a host computer.

The **CAD/CAM** market also differed significantly from the visual systems market. Whereas E&S held a large share of the visual systems market through the collaborationagreement with ASL, the company **was a** relatively small fish in the large pond of computer graphics. And where Visual Systems products were high-performance or mid-range visual systems marketed by RSL, Interactive Systems products were off-the-shelf leading-edge graphics systems marketed by E&S sales teams.

Going Public

During its startup years, E&S had been financially supported by individuals and private venture capitalists; it had been a closely owned company. In 1978, the company went public. As Dick Leahy remembers, the success of the NOVOVIEW and SP products had brought E&S a reputation for earning money; a stable financial track record. "The Public market was receptive to high-tech companies at that time and we needed money," says Dick, so with the assistance of Hambrecht & Quist, a national investment banking firm, they submitted a securities filing to the SEC (Securities Exchange Commission). After receiving approval, they offered company stock on the public market.

At the same time, E&S and RSL announced an extension in the collaboration agreement. The SP 1, successor to NOVOVIEW, had been released in 1977 and, according to Rod, had become the most successful product in the company. It had been certified for FAA (Federal Aviation Administration) Phase II training and had more sales than all of the other simulation product lines combined. The product line continued to gain popularity and acceptance. In 1978,



A wire-frame model displayed on the PS 300.

SP 2 had full color and in 1980, SP 3 met FAA Phase Ill requirements by providing daylight capability, making it an even more appeallng visual system for flight training.

In 1981, however, dlfflcult economic conditions In the commercial aviation business and a dramatic increase In the military appetite for visual systems and simulators for training combined to shift the Visual Systems product emphasis to large military systems and systems for engineering.

*CEO and President, Dave Evans, looks back on the early days from **a** 1988 perspective .*

Shape Data

In 1980, E&S entered Into a working agreement with Shape Data Ltd., of Cambridge, England, to produce software. Shape Data was developing a CAE geometric modeling software package called ROMULUS. In 1981, E&S acquired Shape Data. Together, the Interactive Systems group and Shape Data personnel continued to develop software packages for molecular modeling, mechanical engineering, and pharmaceutical research.

The Military Marketplace

As E&S and RSL began seeking military contracts in the mid '70s, they entered a market that was radically different from the commercial market. As Bob Schumacker points out, in the commercial market, "you often work directly with the instructor pilot. You sit In the cockpit, flying with the flight Instructor, and he says, 'Let me tell you what we really need to see here.' You get *very* tight feedback." Engineers had been able to develop the **NOVOVIEW series rapidly partly** because ot this tight feedback. "With the mllitary," Bob continues, "you've got the user, you've got the agency that procures the system for the user, you've got one or two other layers or interpreters, then you've got your prime contractor, then us." Since there are more people involved, the development process tends to slow **down.**

"There's a lot of ritual, **a** lot of regulation, a lot of standards that are required of military contractors in terms of documentation, the security of certain kinds of Information, and the nature of the contracts," Dave Evans adds. Still, Dave contends that E&S has not become a typical military contractor. "The typical military contractor is not a risk taker. Your typical military contractor does research and development paid for by the government and produces intellectual property they don't own. E&S has always developed products at its own expense and offered those products for sale. That's part of our working pattern, our culture. We think it's the right way to do the work:

"E&S tends to be Informal and tries to be less hierarchical: adds Rod. "but much of the structure that we've had to establish is a result of dealing with the military."

Engineers began to manage what was in the scene, as opposed to worrying about how to generate it.

Consequences of Growth

Dealing with the military, however, is not the only factor that has Influenced the organizational structure of E&S. "When Bob Schumacker, Gary Watkins, and Ed Cheadle, Sr., went *off* and did the first NOVOVIEW, they were directly involved with the design work, working with the technicians, and conducting a lot of tests themselves," says Rod. Product development "was done in a very close, tight environment. The size of the company today is such that you're forced to have some structure just to operate. And that structure brings with it more difficult communication, and a separation of people who havein the past provided direct leadership.

"The best you can do." Rod continues, is "try to keep it as loose and unstructured as Is feasible so that you can get your work done."

"The communication was natural when [the company was] small," adds Bob. The challenge now is to "somehow establish communication paths that cross over organizational boundaries.·

In 1973, the company employed 88 people. In 1975, there were 144 employees. By 1983, the company employed 779 people, Rod Rougelot was appointed Executive Vice President and Chief Operating Officer, and Gary Meredith was appointed Vice President of Interactive Systems.

In 1984, the simulation group was reorganized. Bob Schumacker was appointed Director of Technology, Pete Doenges was given charge of New Business Development, and Ron Sutherland was named Manager of S[mulation Products.

Great strides had been made in the computer graphics field since the company started in 1968. As Bob recalls, "for a long time we concentrated on the image generator development. When the image generator could just generate a few things on the screen, you couldn't do anything very tricky or subtle. In the early 80s with the CT5 and CT5A, we could do a lot more;" engineers began to "manage what was in the scene as opposed to worrying about how to generate it. That was a real turning point.·

New Challenges

By 1986, the company employed 1072 people, had well-established product lines, and had earned a reputation for quality and stability in the volatile field of high technology computer simulation and computer graphics. In its 1B years, the company had survived a start-up period when resources were tight. had cultivated a

marketplace for graphics, and had established itself as a major supplier of image generation systems for vehicle operator training simulators.

In 1986 however, the company faced a new set of challenges. Although IAS had successful graphics products that were at the leading edge of technology, other companies had entered the graphics marketplace with engineering workstations that contained both graphics and computational capability in the same box at a price comparable to E&S graphics-only products. Following deregulation of the civil aviation market, E&S faced increasing challenges in the simulation industry as well. E&S needed to diversify. And E&S was no longer a small company. More thought had to be given to its organization.

Left to right: Dave Evans, Bob Driggs, Bob Schumacker, Ron Sutherland, and Rod Rougelot at the 1988 groundbreaking for building 770.

Divisionalization

In June of 1986, Dave Evans announced that there would be a formal divisionalization between the Simulation products group and the Interactive Systems group. A partial separation had existed since the formation of the Simulation group in 1973, but the two groups had worked closely together and had shared resources. It was thought that a formal divisional structure would allow each business to focus on specific needs and better respond to the unique challenges it faced.

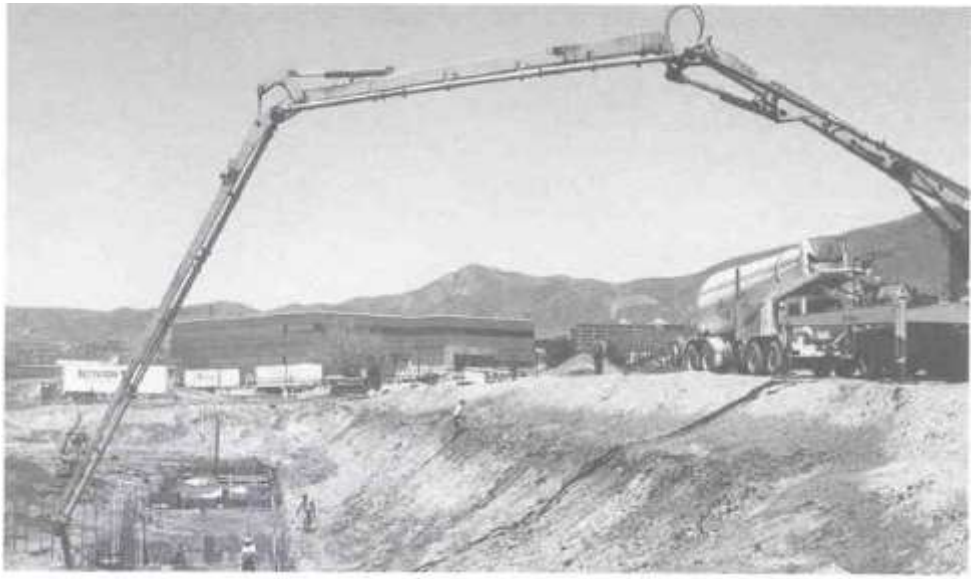
Upon divisionalization, it was announced that Simulation and Interactive Systems would share facilities, stockholders, and *many* other corporate functions; divisionalization was not intended to create differences, but to recognize them where they already existed. It meant restating part of the company philosophy. "We had said before, 'Whenever it is feasible, share the service and the facility,'" Dave explains. What was said at the time of divisionalization was, "Unless it really doesn't make sense, be independent."

It was hoped that divisionalization would get *away* from the functional organization in which employees were grouped according to the function they performed and return to a more project-oriented structure in which groups were formed in support of projects and customers. This would allow employees to become more involved with the company's products and be more responsive to customer needs. "Part of the divisionalization idea," says Dave, "was to create more opportunities for people to be decision makers, more opportunities for people to be managers, more than one environment in which a person could have his ideas considered, and of course, the opportunity to specialize." Dave emphasizes that the divisionalization was not intended to open the company to acquisition or takeover attempts; major defense mechanisms had been put into place to discourage such actions. Divisionalization would give each side of the house the power and flexibility necessary to compete in rapidly changing, increasingly competitive fields.

Employees got more than their feet wet during this 1988 summer picnic relay at Lagoon.

The Computer Division

In 1985, a European group lead by Jean-Yves Leclerc, with plans for developing a very high performance compute server, approached E&S for advice on getting started in the industry. After months of discussion, E&S brought the new group in as company employees. The announcement was made in 1986 in conjunction



Building 600 neared compleJion in the summer of 1988 as the foun dations were being poured for building 770, the Simulation Center.

with the divisionalization, and the group became known as the company's third division, the Computer Division. Because of its proximity to design tool suppliers, chip manufacturers, and a large high-tech labor force, Mountain View, California was chosen as the sae for the Computer Division.

As research and development progressed, It was decided that the new division should target the supercomputer market instead of following its original charter to produce a compute server. As Dave explains, realigning the Computer Division's product goals was a calculated maneuver, designed to combat the E&S tendency to be enamored of technology-to pursue technology but lose touch **with** market needs-or to generate more technology than was needed for the market or the product. "E&S has always had good technology but occasionally has not done enough business planning," says Dave. No such mistake would be made with the Computer Division product. "As we watched the market evolve·, Dave continues, "we moved the product from the mini-supercomputer market to the true supercomputer market. In evaluating the competition, the current state of the market, and what we know how to do, we believe that there is no directly competitive system on the market."

When the dust of divisionalization had settled, three divisions emerged: the Simulation Division, with President Rod Rougielot: the Interactive Systems Division, with President Gary Meredith; and the Computer Divisio n, with Presi - dent Jean-Yves Leclerc. Dave Evans retained his position as CEO and Chairman of the Board of Directors. Divisionallzation. it was thought, would allow the three groups to indep endently focus their energies on specific goals and products while retaining the strength of a common corporate base.

Rediffusion

E&S had an exclusi ve collaboration agreemen t with Rediffusion Simulation Limited (RSL), a British simulation company; and its U.S. subsidiary, Rediffusion Simulati on Incorporated (RSI), by which Reditfusion marketed E&S visual systems. The ten-year agreement, which began in 1973, had been mutually beneficial and when E&S went public In 1978, the two companies extended the commitment for an additiona l five years (ten years from 1978).

As the simulation market evolved, however, SO did each company's product goals; each found the pact increasingly restrlctive. Representatives from both companies began meeting to discuss their goals and possible modifications to the collaboration agreement. A few months after E&S's divisionallzation was announced in June of 1986, E&S and Rediffuslon announced that a new working agreement had been approved. Under the working agreement, joint ettorts on certain contracts would continue as before, and the compan ies would still work together to sell products Into the civil aviation market and the United Kingdom military market. Under the working agreement, the two companies could combine efforts on future projects if they so desired, but they were free to pursue other projects independently.

The exclusive nature of the agreement was relaxed. For E&S, this meant the company could begin marketing its visual systems products

They brought out the bczndfor the 1989 summer picnic at lagoon..

in a growing new arena that Rediffusion had been reluctant to enter: US military training.

E&S visual systems already had been introduced to the military market, but since they had been sold under the Rediffusion name, E&S was not widely known. The Simulation Division now had to begin marketing its products, showing its systems to military customers and attending trade shows on its own, without the expertise of Rediffusion. E&S also began to target the growing field of full-mission simulation in which the image generation system is used to train not only one, but all members of a crew performing a mission. In 1988, the Simulation Division renamed the CT and SP products with the ESIG (Evans & Sutherland Image Generator) prefix. CT6+ became ESIG-1000; the NOVOVIEW or SP line became ESIG-100, -200, -500, and -600.

Acquisitions, Joint Developments, and Investments

Over the years, E&S joined forces with a number of other companies to enhance products or share technology. In 1980, E&S made a financial investment in VLSI Technology Inc., (VTI). Through the investment, E&S was guaranteed a fabrication house for ICs and allowed non-exclusive use of the VLSI modeling tools VTI was producing. Using these tools, E&S developedseveral custom circuits including the custom chips that comprised Shadowfax technology. This technology was first used in the PS 390, introduced in 1986, to produce wire frame or shaded images that were anti-aliased (displayedwithout the jagged stair-step lines commonly used to depict non-horizontal or non-vertical lines). E&S also invested in Mosaic Systems, Inc., a company developing VLSI through the use of direct surface-mount silicon wafers. E&S tested prototypes of these wafers.

To broaden its product and technologybase, E&S also made acquisitions. The company wanted to develop mechanical modeling products, and Shape Data, with its ROMULUS product, was acquired in 1981. UNICAD, a company developing modeling and user interface tools, was also acquired in 1983. In 1987, E&S acquired Tripos Associates, a molecular modeling software developerin St. Louis, Missouri. These acquisitions were managed by the Interacitve Systems Division.

In 1987, IAS announced a joint development with Digital Equipment Corporation (DEC) to develop the VAXstation 8000. The joint effort combined E&S VLSI Shadowfax technology with DEC's workstaiton expertise to produce a very high quality graphics workstation.

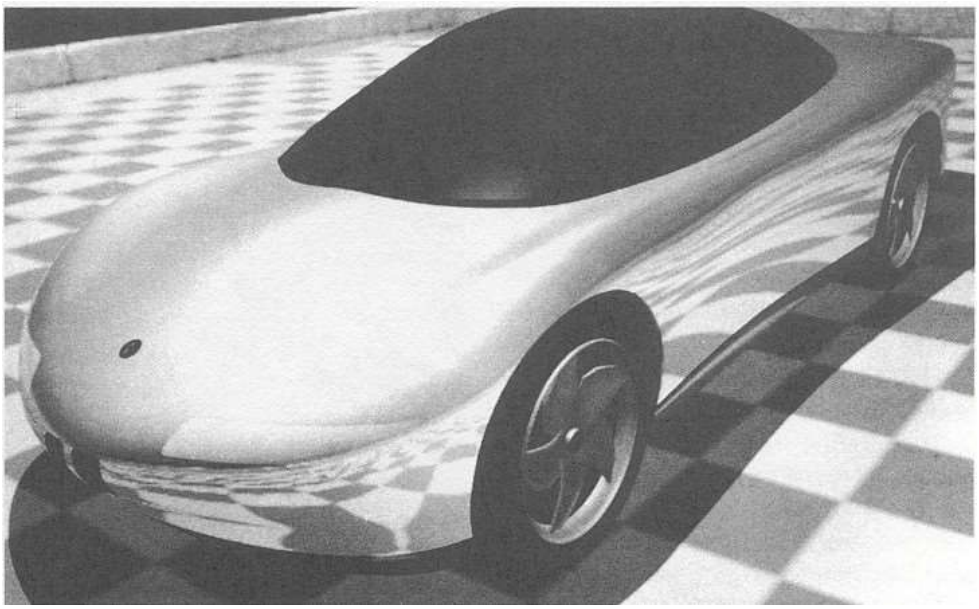
1987 Debenture Offering

In April of 1987,the company offered $56 million in convertible debentures. E&S had seen substantial growth in revenue and employee numbers since 1986,adding nearly 200 employees in the space of a year. In the CT line, advances in texture had improved scene realism. The company was winning military training and engineering contracts. SPX, the newest addition to the NOVOVIEW family of products, continued to do well in the civil aviation business as E&S and Rediffusion still maintained a large percentage of that market share. The Simulation division also had announced plans to develop and sell large scale custom projection systems, domes, and specialized screen materials to complementtheir visual systems.

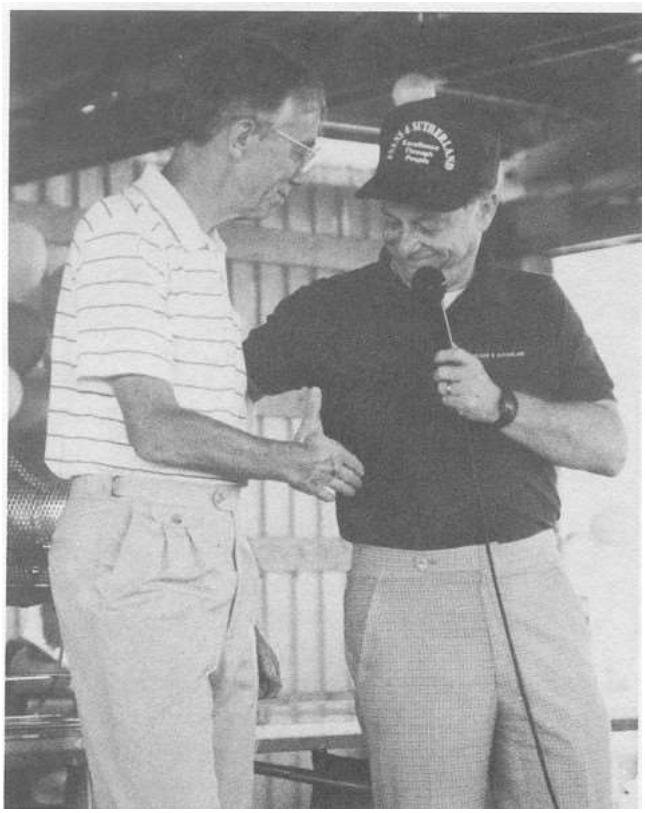
In **IAS,** there were high expectations for new products, including the Conceptual Design Rendering System (CDRS), a system being developed for the automobile design industry. In addition, the Computer Division had recently embarked on a two-yearresearch and developmentventure. As CFO Bob Driggs puts it, "there was a window of opportunity" in the spring of 1987; the market conditions were right, E&S was expanding, and working capital would be needed to proceed with plans for new products and facilities. To get that capital, the company decided to offer convertible debentures on the market. After the offering, E&S began construction of building 600 in the University of Utah's Research Park and plans got underway for building 770, a simulation center designed to accommodate the large dome projection systems being developed by the SimulationDivision.

Reorganization

By the time building 600 was finished,some problems in IAS had become critical. Many other companies had entered the graphics market with products that were winning customers over. IAS found its market share dwindling and needed to refocus its resources and realign its products



The Conceptual Design Rendering System (CDRS) was introduced in 1989.



Dave Evans and Rod Rougelot at the 1989 summer picnic.

to customer needs.

A series of events during 1987 and 1988, including the sale of UNICAD and Shape Data, and the cancellation of the VAXstation 8000 product, culminated in a major reorganization and redirection of IAS.

In August of 1988, the Interactive Systems Division was combined with the Computer Division under the leadership of Jean-Yves. The division goals were redefined, the skill base was re-evaluated, and resources were redirected. As Dave Evans puts it, "there was a mismatch of skills and people" in Interactive Systems, at the time. "The group was bigger than we thought was needed to do what we planned to do, and there were skills missing that we really needed." The reorganization was accompanied by a reduction in force. "A lot of things happened," Dave continues, "some new people were hired, a number of people were transferred to the Simulation Division, and there were people-who were good people-for whom we just didn't have jobs." The business and market had changed and corresponding changes had to be made within the division.

Four distinct Computer Division product groups emerged after the August 1988 reorganization: the California group's supercomputer product, graphics workstations and terminals, industrial design products, and software products for the computational chemistry/molecular modeling industry. The latter would be produced by Tripos Associates in St. Louis, Missouri. The changes in IAS were painful, but were deemed necessary to increase the company's ability to compete in the computer graphics industry.

In May of 1989, Chairmano f the E&S Board of Directors, Dave Evans, announced that Rod Rougelot had been elected President and Chief Executive Officer of Evans & Sutherland. Dave maintained his position as Chairman of the Board and Bob Schumacker was subsequently appointed President of the Simulation Division.

In November of 1989, E&S announced that it intended to sell the supercomputer development project because of technical problems and developments in the marketplace that called into question the product's competitive edge. After 60 days, however, a buyer had not been found and the Board of Directors decided to terminate the project.

In a press release announcing the decision, Rod Rougelot stressed that the traditional business would not be adversely affected by the closure. "We continue to be the leading supplier of visual systems in the civil pilot training market, with a strong position in other rapidly growing simulation markets," he stated. "Our Graphics group and Tripos software subsidiary provide hardware and software products of very high quality and performance. We have decided to focus our efforts on the market areas which we have historically served with proven capabilities."

The Salt Lake City branch of the Computer Division, formerly known as IAS, was renamed the Design Systems Division under the leadership of President Gary Hodgman.

A Forward Vision

In reviewing the company's history, Rod observes that E&S has always been an innovator and that its products and technology have been at the leading edge of computer graphics and image generation. "I believe there's occasion for great pride among all the employees of the company for what we've done over the years," says Rod. But he emphasizes that we should take care not to overstate our accomplishments or become complacent, believing that our products are very far ahead of the competition and thereby jeopardizing our competitive edge.

To avoid complacency, we need to be technological risk takers as we develop new products and new opportunities. As Rod defines it, what we need is "goal-directed, calculated risk taking that lets us achieve things we couldn't have achieved any other way. If we don't take risks like that, if we only take on projects where return is guaranteed, then five or ten years from now we won't be around, because other companies will have taken those risks."

Dave Evans echoes these sentiments. As he puts it, there are businesses in which you can survive without taking many risks and where products change slowly, but the computer industry isn't one of them. "It's a dynamic, changing world," he says, "the rules change when the technology changes and when the market changes."

In our industry, we see changes happen every day. But with these changes come opportunities to make the future of our company as unique and as successful as its past has been. It's up to all of us to look toward that future and make it **happen.**