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PLATO: From Computer-Based Education to Corporate Social Responsibility

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Abstract: This article will analyze Control Data Corporation co-founder William C. Norris' vision for the PLATO system of computer-based education (CBE). It will begin by relating the history of PLATO prior to Norris' arrival on the educational scene. The second part will discuss how Norris promoted PLATO from 1976 onward. On the basis of Norris' public lectures during this time, it will be argued that PLATO was expected to become not just CDC's most profitable investment, but also a valued corporate solution to a set of urgent social problems. More specifically, we will see how in Norris' vision PLATO changed from being a straightforward application in CBE to becoming the cornerstone of CDC's policy of "corporate social responsibility."

Keywords: Control Data Corporation, PLATO (Programmed Logic for Automatic Teaching Operation), computer-based education, corporate social responsibility, Control Systems Laboratory (University of Illinois)

What would be the 'next big thing after the mainframe computer?' Today, with the benefit of hindsight, we would say 'the personal computer,' and then 'the Internet.' But William C. Norris, co-founder, president, and CEO of Control Data Corporation (CDC)—one of the leading mainframe manufacturers—had a different answer: Between 1976 and 1986 the future seemed to be governed by PLATO (Programmed Logic for Automatic Teaching Operation).

This article will analyze Norris' vision for the PLATO system of computer-based education (CBE). It will start out by relating the history of PLATO prior to Norris' arrival on the educational scene. The idea of computer-based education first emerged in the late 1950s. In the 1960s, Donald L. Bitzer originated the PLATO system. Not until 1976 did Norris and CDC gain full commercial control over the production and sales of PLATO.

The second part of this paper will discuss how Norris promoted PLATO from 1976 onward. On the basis of Norris' public lectures during this time, it will be argued that PLATO was expected to become not just CDC's most profitable investment, but also a valued corporate solution to a set of urgent social problems. More specifically, we will see how in Norris' vision, PLATO changed from being a straightforward application in CBE, to becoming the cornerstone of CDC's policy of "corporate social responsibility."[1] Yet, it was precisely this social vision for PLATO that many journalists, investors, and human rights activists would not let go uncriticized.

The Emergence of Computer-Based Education

In the late 1950s, a variety of factors facilitated the birth of research into computer-based education in the United States.[2] Due to increasing enrollment figures, educational institutions faced financial pressures to explore alternative means of education. Between 1950 and 1975, enrollments doubled from about 31 million to 60 million students, with the costs of their education growing exponentially from $9 million to over $100 million.[3] Early developers of computer-based education (CBE) referred to these kinds of figures in order to convince administrators that computers would save costs, lift the pressure of finding additional qualified teachers, and provide better education.[4]

Computer-based education was also a product of the political climate of the 1950s. Within the military, different projects had explored the possibility of "automatic teaching" of personnel since the early 1950s. This research received a big boost when in 1957 the Soviet Union surprised the world with the successful launching of the *Sputnik I* satellite into space. President Eisenhower reacted to this Cold War challenge by making the teaching of science and mathematics instrumental to regaining American leadership.[5] Thus, in the mid-1960s, National Science Foundation funds were assigned to further the cause of computer-based education.[6] The first conference was held at the University of Pennsylvania in 1958, sponsored by the Air Force Office of Scientific Research (OSR). This conference was also the first occasion at which IBM publicly presented its experiments with computer-based education.[7]

PLATO's Origins

It was against this background that in 1959 Chalmers Sherwin, a physicist and Associate Director of the Control Systems Laboratory at the University of Illinois, suggested to William Everett, Dean of the College of Engineering, the possibility of using computers for teaching.[8] Everett recommended that Daniel Alpert, also a physicist and head of the Control Systems Laboratory, put together a group of engineers, educators, mathematicians, and psychologists to examine this matter further. This select group debated the matter for several weeks, but failed to reach common ground. Dan Alpert was about to inform Everett of the fruitless outcome, when he decided at the last minute to mention the problem to Donald L. Bitzer, a

young assistant in the lab.[9] Bitzer had obtained a Ph.D. in electrical engineering at the University of Illinois towards the end of the Korean War while working in the Control Systems Lab on military radar technology.[10] When Alpert approached him, Bitzer claimed he had already been "thinking about ways to use old radar equipment as part of an interface for teaching with a computer."[11]

In 1960, it was Bitzer who completed the first version of PLATO.[12] This was the first computer system designed especially for general educational use. In designing its teaching logic, Bitzer had cooperated closely with his colleague, mathematician Peter Braunfeld. They decided to go against the grain in popular teaching methodology.[13] Rather than following Skinner's approach (which divided up information into elementary bits for easy retention), Bitzer and Braunfeld adopted a system first explored by Norman A. Crowder of the Air Force Personnel Training and Research Center, favoring a branch programming methodology over "drill and practice."[14] This meant that PLATO incorporated course material into larger interrelated conceptual packages.[15] If a student found the material easy or familiar, she could "leapfrog" through a course in a minimum of lessons. Students who needed more time and explanations found themselves directed back and forth through the total sequence of lessons until the concept was mastered.

The Bitzer team rapidly created increasingly sophisticated versions of this general idea. PLATO I, developed in 1960, accommodated only one student, and ran on the University's ILLIAC computer. It connected a TV display, a specially designed key-set, a storage device and a slide selector to the computer.[16] PLATO II, developed in 1961, was the first time-sharing version and could accommodate two students. PLATO III, developed between 1963 and 1966, became the first computer-based education system to serve a substantial community—now handling twenty individual terminals.[17]

Compared with earlier versions, PLATO III also made gains in educational flexibility. This was achieved with the new TUTOR language. The brainchild of Paul Tenczar, TUTOR made it possible for regular teachers to write their own courses. [18] Thanks to TUTOR the range of classes that PLATO incorporated increased. PLATO III offered algebra, anatomy, psychology, pharmacology, languages, and life sciences.[19] With all these features in place, PLATO III became the first version to be used in a classroom setting. Connections were set up for PLATO III to serve not only the University of Illinois, but also a local nursing school, a community college, and an elementary school.[20] By 1970, 720 hours of course software had been developed for PLATO III covering all these different levels of education.[21]

PLATO III ran on a refurbished CDC 1604 computer. William Norris had given this computer to Bitzer and his colleagues in 1963 for use rent-free. As head of Control Data Corporation, Norris had been kept informed of the pioneering developments in computer-based education at Illinois through his sales agent

Harold Brooke.[22] (Brooke had visited the campus of Illinois regularly since 1960, the year in which he had sold the Control Science Laboratory its first CDC 1604). [23] The donation of this later CDC 1604 specifically to the group working on PLATO marked the beginning of Norris' personal involvement with CBE.[24]

In 1967, the University of Illinois set Bitzer's team up in a separate laboratory, the Computer-based Education Research Laboratory (CERL), to continue PLATO research that was funded by a National Science Foundation grant.[25] Until 1966, PLATO I, II, and III had been financed out of the general support that the Coordinated Science laboratory received from the Army, Navy, and Air Force.[26] But for the development of PLATO IV, Bitzer received his own NSF funding. This allowed Bitzer to set up CERL for the development of a PLATO system that, according to the NSF's stipulations, was to accommodate at least 300 terminals.[27]

In line with these requirements, the new PLATO IV was ready to be put into operation by 1972.[28] It subsequently became the first version to have an impact beyond the immediate Illinois environment. In 1975 PLATO IV served 146 locations from the University of Illinois (26 on campus), 10 elementary schools, 3 high schools, 6 community colleges, 22 government-related installations, 31 medical sites, 32 colleges and universities and 16 at other off campus locations.[29] Besides running on increasingly powerful computers, including the CDC 6000 and the CYBER series, PLATO IV made use of a new invention, the plasma display panel. This flat, gas-filled panel housed transparent electrodes, onto which images could be projected.[30] The plasma panel also made possible a touch screen option; PLATO could receive information over regular telephone lines, and it had an inherent storage capacity for both computer and student generated images and text.[31]

With these new technological features in place, the developers of PLATO claimed that they had achieved an educational system that was cost-effective, and that in many ways outperformed learning in a classical classroom setting. Bitzer and his colleagues presented PLATO to the press as offering "individualized instruction in a wide array of courses or subject-material areas."[32] PLATO could accommodate graphics, animation, simulation, and text-based instruction. Furthermore, behind her individual terminal, every student had the PLATO 'teacher' all to herself. Bitzer and his colleagues claimed that PLATO was infinitely patient, gave the student immediate feedback, and let her go through a course at her own pace. Moreover, the system kept traces of all the student's interactions and answers. Bitzer therefore argued that PLATO offered the teacher the ability to gain detailed insight into each student's progress. Finally, PLATO was unique in that it allowed student and teacher, indeed anybody on the PLATO network, to communicate online. This gave students the opportunity to discuss any issue with their peers or their teachers immediately while working in PLATO.[33]

Control Data's Involvement in PLATO Development

With PLATO reaching the final stages of development, its relationship to Control Data Corporation was also about to take a new turn in the 1970s. In the 1960s, Norris had provided Bitzer's research group with CDC hardware, but over time his company became increasingly involved with preparing PLATO for the commercial market.[34] In 1971, the company began writing and modifying PLATO "courseware" in a newly established CDC Educational Department.[35] In 1974, the company set up an independent PLATO IV system on its own premises.[36] In 1976 Norris' Control Data officially acquired the rights to *all* aspects of the PLATO system from the University of Illinois.[37] CDC then immediately put the system out on the market, offering customers the option of purchasing a CDC mainframe with PLATO courseware in full, of acquiring only a set of terminals with which to connect to the company's main computer, or of paying for only a single PLATO course at one of the many Control Data Institutes and CCC Learning Centers that the company, prior to PLATO, had built around the country and abroad.[38]

Moreover, at the official press conference organized to announce the acquisition, the company informed the world that "by 1985 PLATO-related revenue could account for 50 percent of CDC's business."[39] CDC, a firm that had started out as a mainframe producer in the late 1950s specializing in developing powerful computers for scientific markets, by the late 1960s had diversified its activities quite substantially. In 1968, it took over Commercial Credit Company (CCC). This acquisition brought CDC into data services and the individual customer and small business market (offering among others accounts receivable, insurance, finance, leasing, credit card, and repatriation services).[40] CDC had also already built its reputation for risk-taking behavior and fluctuating profit levels (including some losses), and had set out on a path of "corporate social responsibility."[41] For example, the same year that CDC acquired CCC, the company built its first production site in a designated "poverty area" in its hometown of Minneapolis. However, through its acquisition of PLATO, CDC took its risk-taking, socially interested, corporate strategy to a much more serious level. And of course, computer-based education in itself was an entirely new field for CDC to become involved in.

Indeed, I would argue that CDC's acquisition of PLATO had at least three important consequences for the company. First, it meant that, in the 1970s, Control Data would become a main player in the drive to 'computerize education.' The company put enormous effort, and especially investment capital, into the development of PLATO courseware. CDC also launched important advertisement campaigns, and allowed ingenuous financing constructions to put PLATO at strategic places in the market. Secondly, over the course of Norris' reign, Control Data itself would also become thoroughly "PLATO-ized."[42] All new employees were trained with PLATO to prepare them for their jobs, and current employees were strongly encouraged to continue using PLATO courseware to increase their 'human capital.'[43] Even investors, in particular small

private stockholders, were encouraged to use PLATO to keep themselves informed of business policy and performance. Thirdly, PLATO became the new linchpin of the company's strategy of "corporate social responsibility." Just as PLATO was targeted to meet "the need" for better education, new PLATO-type applications were developed especially with an eye towards fulfilling a perceived "social need."

Norris' Public Lectures on PLATO

Each of these aspects of PLATO becomes apparent when we take a critical look at a series of lectures published by CDC between 1977-1981. In these lectures, William C. Norris set out in detail his vision for the future. It was a future in which American business in general, and CDC in particular, solved society's "most pressing problems."[44] Norris discussed his company's solutions not just for education, but also for tackling unemployment, rural development, problems faced by the poor and disabled and many other issues. The basic idea behind Norris' solutions was that society's ills could best be solved by the company's computer application systems. The PLATO computer-based education system was the main—though not the only—component in Norris' corporate solution for society.

Speaking on June 27, 1979, at the Annual Meeting of the Minnesota Society of Certified Public Accountants in Bloomington Minnesota, Norris presented what was at stake:

> What we need is a fundamental change in which business takes the initiative and provides the leadership for planning and managing the implementation of solutions—in cooperation with government, labor unions, universities, churches, and all other major segments of society. The major problems of our society are massive, and massive resources are required for their solution. The best approach is to view them with the strategy that they can be profitable business opportunities with an appropriate sharing of cost between business and government. Where the resources for solving problems are beyond those of a single company, as most are, they should be pooled through cooperative projects or joint venture companies.
>
> Control Data adopted such a strategy almost 12 years ago. It has been pursued vigorously and has proven sound. Examples will be given later, in which profitability is proving to be as good or better than with traditional strategies. Unfortunately, most companies are not yet following a similar approach. Too many businessmen, economists, security analysts and institutional and individual investors believe that the business is to maximize short-term profit for stockholders, and that consideration of social problems detracts from this and is therefore the government's job.[45]

On an earlier occasion, Norris pointed out in this respect that:

> Most big business don't want to rock the boat; instead they prefer to keep doing more of the same—make the cars two inches shorter or two inches longer; put

> more fake walnut on the TV set or put new stripes on tennis shoes. Big business is not disposed to share its technology and cooperate with small business.[46]

Control Data, Norris made clear to his various audiences, was not that kind of big business. It had put a lot of money into PLATO—$600 million by 1980[47]—and it was doing so because it believed in its long-term social utility and economic success. The following words delivered to an audience at the Society for Applied Learning Technology in Washington, D.C., in July 1976, indicate how committed Norris was to computer-based education and, secondly, how computer-based education fit into Control Data's corporate strategy:

> The steady, steep rise in the cost of education—to the point of bankrupting one school administration after another—has received only fragmented efforts at solution. Indeed fragmentation is at the very root of the cost problem in education, and can be blamed for the mounting quality complaints as well.
>
> One manifestation is the horrendous duplication of effort, as each teacher continually reinvents the wheel in his or her own classroom. The prerogative of each teacher to decide what is best has resulted in only isolated applications of advanced technology in education. . . . Teachers are not solely to blame, because college presidents, boards of trustees, public school boards, and even communities all maintain their educational prerogatives and their outdated labor-intensive ways.
>
> But I believe it is increasingly evident that there is one segment in our society that can cut across these narrow, autocratic domains: private competitive enterprise. Corporations must be, and I believe want to be, more concerned with meeting the needs of society; and the number one need, after jobs, is higher-quality, more readily available education— at lower costs.
>
> The most direct and effective way to get it is for private companies to provide the appropriate technologies, management, marketing, and leadership to glue together enough governmental and institutional support to provide a better alternative. The primary technological alternative is computer-based education, in a learning center network.[48]

In 1981, Norris claimed that PLATO had already "proven" to be both cost and educationally effective in teaching even young children the most basic academic skills:

> PLATO has been proven to be cost-effective in many fields including vocational training and teaching basic skills—areas of critical importance to developing countries and the disadvantaged in our own country. Basic skills courses cover the range from grades 3 to 8 and courses are under development for 0-3 grades. Present basic skills courses have proven to be very effective. On the average, individuals have advanced an extra grade level in reading in about twenty-one hours and two grade levels in mathematics in twenty-five hours of work at the terminal. Vocational training courses are equally effective and courses in many subjects are available. Secondary education and adult continuing education are also beginning to benefit from computer-based education.[49]

A year later Control Data ran an advertisement campaign on radio and in print media that promoted this message.[50] The theme of the first part of this campaign was "Control Data's PLATO is Changing How the World Learns." One of the ads showed a photo of a happy little girl beneath the slogan: "A few months ago Jane could hardly read: Look at her now!"

CDC's local newspaper, *The Minneapolis Tribune*, took issue with this claim.[51] Upon contacting CDC, the paper was told that the advertisement was not based on a genuine little girl. Spokespeople from CDC admitted that Jane was merely a profile "based on hundreds of case studies." When journalists further asked where the report that PLATO successfully taught basic skills could be found, CDC informed them that their results were based on the experiences at Knox Elementary School near San Antonio, Texas. However, their report was not open for publication. The newspaper, subsequently, undertook its own investigation at the school where PLATO was used as a remedial tool. Children at Knox Elementary School who had fallen behind in basic reading and math used PLATO. All children who used PLATO really enjoyed it and felt they had made progress, but the newspaper reported that PLATO provided "no lasting benefits."[52] When the principal of Knox was informed of the results she was disappointed and answered:

> 'Regardless of the findings,' she added, 'I still feel PLATO does help the kids. Maybe it's because I've been in there with the kids. It seems they're getting more from the computer—more than we could help them along with. I would still keep PLATO.'[53]

Later that year, a new report came out drawn up by the San Antonio School District. Although this report corroborated the findings of the *Minneapolis Tribune*, the reporters found that students who had taken mathematics on PLATO "gained twice as much [on achievement tests] as in the past."[54] What happened to these children's grades after they had stopped using PLATO was not investigated in this new report.[55]

These findings appear to be typical for PLATO. The first official evaluation of the PLATO system produced by Educational Testing Services (ETS) in 1977 already concluded that children, students and educators enjoyed working with PLATO. ETS' study of the use of PLATO in community colleges found that PLATO, "had a favorable impact on student and faculty attitudes," while its study of PLATO in elementary schools found that "the users were quite positive about PLATO as were the evaluators."[56] ETS was much more modest in its conclusion regarding the instructional achievements of PLATO. In a community college setting it concluded that "PLATO had no effect on student attrition and no significant impact on student achievement." In the elementary schools where PLATO was used for mathematics and reading, ETS found the system to be "no more effective than the corresponding curriculum."[57] In other words, in these early reports PLATO was judged an able teacher, but not necessarily better than a human one.

In the face of such ambiguous results, convincing a non-business audience to invest in education or computer applications remained a recurring problem —not just for CDC but for all companies in the field. By 1984, CDC had changed its campaign style and ran an advertisement series that did focus on real people. In May of that year, *Fortune*, *Forbes* and the *Wall Street Journal* ran a CDC ad featuring, for example, University of Georgia student Carolyn Christian who used PLATO to learn music theory.[58] Incidentally, in 2002, Apple-Macintosh developed a very successful advertisement campaign in which real people, clearly identified by name and occupation, related their motivation to "switch" from the PC to the Apple platform.[59] In reaction to this campaign, however, Microsoft committed a marketing mistake much resembling CDC's in the early 1980s. In 2002, Microsoft's web site carried a letter allegedly written by a "free-lance writer" who after eight years of using Apple had "switched over" to the Windows platform. The woman's name was not given, only her photo, and the fact that she was "married" and had "once rented a Lexus."[60] It soon turned out that the mystery woman was actually an employee at a public relations company hired by Microsoft. After the full truth had been discovered, Microsoft quickly pulled down the ad.

Beyond advertisement campaigns, CDC also developed rather ingenious financing structures to try and boost the sale of PLATO. In 1982, for instance, CDC offered the University of Maryland a CDC Cyber 170/720 with the PLATO system, using Servico Leasing Inc. as an intermediary.[61] Maryland was to pay this leasing company $600,000 a year for seven years for the computer. The University of Maryland also received CDC licensing rights for all 11,000 hours of PLATO courseware for free. Under the deal, the university would resell PLATO services for less than the regular price to surrounding institutions. With the income, the university was expected to face no problems meeting yearly payments to Servico to become the owner of the system. Yet by 1988, the University of Maryland had to close down its PLATO center, finding it not to be cost-effective.[62]

Following the logic of corporate social responsibility, CDC also developed several new PLATO applications that targeted market segments outside of the regular educational domain. During many of his lectures between 1976 and 1981, Norris discussed, for example, the respective benefits of AGSERV and TECHNOTEC to small farmers, and FAIR BREAK for inner city youths:

> The agribusiness sector needs a massive dose of technology and information supplied unlike this country had ever provided before. This need grows ever more urgent. . . . Computer technology has advanced to the point where it can meet these information and technology transfer needs. Control Data's AGSERV, TECHNOTEC, and PLATO computer-based education services are specifically responding to them today. AGSERV is a more accurate and timely service for crop information that is being developed….
>
> TECHNOTEC is a worldwide computer-based communication information and technology transfer system. . . . PLATO CBE is for training and education. . . .

> There are not yet enough computer-based education courses available to warrant home ownership of a PLATO terminal, so that delivery of education is best achieved now by PLATO terminals in cooperative offices, chamber of commerce offices, extension offices, and privately operated learning centers.
>
> Control Data is implementing a program of achieving nationwide delivery of TECHNOTEC and PLATO computer-based education via those places. However, as soon as enough courseware is available, it will be in the economic interest of the average American farm family to own a PLATO terminal, both for education as well as for rapid access to information and technology. The courseware can be written within the next three or four years.[63]
>
> PLATO computer-based education is [also] central to Fair Break. A Control Data inner city program to prepare young, disadvantaged unemployed persons to get and keep a job and to make jobs more available to them. Our first Fair Break center is now operating in St. Paul and delivering innovative training and employment to inner city youths.[64]

Moreover, Control Data's own corporate constituents were also 'PLATO-ized.' For its employees, Norris developed the "Fair Exchange:"

> "Fair Exchange: A Partnership For Excellence"— …*is* a partnership, a shared commitment that Control Data will help each employee achieve personal goals at the same time the employee strives to help Control Data achieve corporate goals.
>
> The premise is that we all perform best in an environment of caring where there is a sincere effort to use available resources in an equitable, consistent and humanistic manner, as among employees, company and other constituencies. […] While there is more work ahead of us, substantial progress has been made, so much so that what we are doing is seen as a new culture building within Control Data— a culture that is distinct from that of other organizations following more traditional practices.[65]

In addition, some CDC stockholders received PLATO terminals in their own homes to allow them to communicate with management and aid the company to overcome social resistance to its products and services. As Norris put it:

> By utilizing PLATO computer-based education, shareholders or other corporate constituents can learn about issues of importance to them, ask questions and tell us what they think. In addition to financial and product data, information is stored in the computer regarding Control Data's position on current issues, such as trading with communist countries, doing business in South Africa, and hostile takeovers. Incidentally, our position on corporate governance is being prepared for entry into PLATO.
>
> The main points about the PLATO approach are that a constituent can access information that he or she is interested in, ask questions and comment. In other words, they have an opportunity for some ready dialogue with corporate management […] [66]

PLATO, Profitability, and Social Responsibility

The point of all CDC's investments, Norris stressed in his lectures, was "to make a profit." Control Data was not doing it for altruistic or corporate philanthropic reasons. Norris stressed that he expected the sale of all the various social applications, especially all the different systems making use of PLATO to become very profitable for CDC. In the meantime, Norris believed, the implementation of PLATO within the company itself, and in nontraditional segments of the market would also boost Control Data's image:

> Such programs as these produce highly positive results for business within the local communities in which they are performed. Neither the number nor the accomplished results are yet great enough to achieve widespread awareness, but they are an important part of the overall approach that will greatly enhance the business image.[67]

However, both the morality and the economic rationale of Control Data's investments were often contested. With respect to offering the Homework project for sale, Norris argued that

> the last thing that a disabled person or non-disabled person wants is charity. All want and deserve to be a part of mainstream America, which is an entrepreneurial society. . . . No one objects to a reasonable profit for a can of beans. Why should there be objections to making a profit on meeting special needs of disabled persons?[68]

This time the *Minneapolis Star* actually received the Homework project favorably.[69] The newspaper reported on two participants, Olson and Guy, who had become paralyzed from the chest down through accidents. The two had signed up for an (especially adapted) PLATO course in programming basics at the local Courage Center. Olson successfully completed the course and then went on to take the regular programming course for CDC employees on an adapted PLATO terminal. After graduation, CDC had promised to hire him to work as a part-time programmer. Guy, who was still in training, said of his new career path:

> I don't care about machines because they haven't done anything to help blacks . . . Computerization has helped worsen black unemployment. . . . Machines have nothing to do with the spirit and quality of life. . . . [But] I've got to eat. If I don't learn something about technology, I might be out of a job in three or four years.[70]

The biggest controversy over CDC's notion of corporate governance broke out, though, over its PLATO sales to South Africa in 1980—only three years after the Soweto riots, and during a period in which the regime had declared a "total war on security." Church groups in the United States chastised the company repeatedly for its South African business.[71] In 1985, a report appeared by the Africa Research & Publications Project, Inc., New Jersey, in which CDC was accused of giving the South-African government the tools to keep apartheid in place:

> What Control Data Corporation claims to be an educational solution to black inequality in South Africa seems, in fact, to be a solution to the regime's present shortage of skilled labor, its conflict with increasingly politicized students and educators, and its self-preservatory [sic] need to centralize and augment security information. In a country where black teachers seldom have more than an eighth grade education and black students struggle to buy textbooks and supplies it is ironic that [$900 million] are being spent on computer equipment for schools. Having no cure for a national uprising, the South African government is resorting to computer surveillance and control for its prevention.[72]

Of course CDC was hardly the only American computer company to trade with South Africa throughout the 1970s and 1980s. By far the largest player in this field was IBM. Its annual sales were $180 million by 1985. CDC was only ninth on the list of American computer sales to the African country, with a total of $27 million in 1985.[73] In contrast to even fairly recent accusations, CDC's computers were never used to administer the notorious "passbook system."[74] The passbook was an extensive form of ID that all black South Africans had to carry with them at all times. It allowed the government to strictly control their movements beyond their assigned "homeland." This pillar of apartheid rule was processed on British International Computers Limited (ICL) mainframes. It was IBM that had made an unsuccessful bid for the passbook system for black South Africans in 1965. In the 1970s, IBM obtained the contract for the computers that registered the "book of life" mandatory for colored and Indian South Africans.[75] The international embargo was not installed until 1977, however, and all trade that CDC and other American companies were engaged in after that year, even when morally questionable, was at least technically legal.[76]

According to new stipulations made by President Reagan in 1985, all computer sales to "the South African military, the police, the prison administration, the national security agencies, to apartheid enforcing agencies and to the South African weapons manufacturer Armscor" were banned.[77] Trade with the South African Council for Scientific and Industrial Research (CSIR) was permitted, however, if the material was intended for non-military use. CDC had lobbied hard for this exception, as CSIR was one of its biggest trade partners. Of course, as anti-Apartheid activists in the 1980s pointed out, the problem was that it was quite impossible to check whether CSIR was using any of its systems in the 300 terminal network for military related communications or not.[78]

Throughout his lectures, Norris maintained however that CDC was simply helping black South Africans get access to higher education for the first time. "It's the black church and community leaders in South Africa who are most enthusiastic about PLATO's potential," Norris said at a press conference for Micro-PLATO in 1980.[79] In general, Norris believed:

> Fretting about executive 'perks' or pointing fingers at overseas payments makes spicy reading, but accomplishes little else. All of the church and student attention devoted to questioning the morality of doing business in South Africa

> is not only unproductive but hypocritical, when we remember that 35% of the disadvantaged youth in our society are denied the basic rights of a decent job.[80]

The End of Plato?

Norris' published lecture series ended in 1981, a year after Micro-PLATO had been officially introduced into the world. CDC's stand-alone version ran PLATO courseware from a floppy disc rather than via a dialup network. It was expected to be the definitive step in the realization of that long-announced event: the moment when the PLATO division would become more profitable than CDC's mainframe division.

At the official introduction of Micro-PLATO, Norris reaffirmed his initial conviction "that educational computing will become the largest contributor to CDC profits sometime after 1983."[81] The newspapers soon picked up on this story:

> After 20 years of research and development and investing $900 million in cash, Control Data Corp. has yet to make any significant profits on PLATO, its computer-based education system. . . .Yet, vice president for education Miller and William Norris expect . . . big money from it, too, beginning by 1984 and accounting for more than half the giant company's profits in 10 to 15 years.[82]

Yet the anticipated success of Micro-PLATO did not materialize. In 1986, William Norris retired from CDC. In 1989, his successor Lawrence Perlman sold the entire PLATO division:

> [July 18] the financially struggling company [CDC] announced that it was divesting itself of PLATO and the associated remains of its training and education business. It will turn them over to a new company to be run by a Chicago employee-training firm. Control Data will keep a 20 percent interest in the company.[83]

Currently, PLATO software and technology is owned by PLATO Inc., based in Minneapolis.

The sale of PLATO was part of Perlman's overall strategy to dramatically scale down CDC's activities. Over the course of the 1980s, as microcomputers increased in popularity, profits in CDC's mainframe and super computer divisions had continued to decrease.[84] Yet, despite all Norris' predictions, PLATO did not take over the lead. As a result, CDC reconsidered its commitment to PLATO and its strategy of corporate social responsibility. The company could no longer afford to direct 'long term' investments toward a 'future social and economic success' of PLATO.

Conclusion

Why did PLATO fail commercially, or did it? In the eyes of William Norris, despite all the extensive criticism and challenges of PLATO, the system never lost its allure:

> At the press conference in January 1986 where he announced his decision to retire as chairman and chief executive, [Norris] was asked what he considered his proudest accomplishment. His unhesitating answer: PLATO.[85]

As we have seen, in the 1970s, PLATO was one of the most technologically advanced CBE systems available. Thanks to Bitzer and his team, especially PLATO's display and online communication features were quite unsurpassed. The system also already had substantial backing in the educational world, with CERL serving a variety of communities.

It was not that CDC neglected to invest in the PLATO system, after taking commercial control over the product in 1976. Quite the contrary, Norris made sure CDC set aside hundreds of millions of dollars for the long-term development of the system. As demonstrated in this article, Norris defended these investments by portraying PLATO not just as an excellent CBE system, but as an efficient solution to pressing social problems. Yet it was precisely this social outlook that drew a lot of criticism from journalists, investors, and human rights activists alike. From this perspective, PLATO not only failed to become profitable as a product, but Norris' strategy of corporate social responsibility also failed to have the intended marketing effect.

In 1988, Donald Bitzer was asked to explain CDC's failure to commercialize PLATO successfully. He put most of the blame on CDC's decision, in 1976, to go "into competition with [University of Illinois] authors over courseware."[86] Although CDC had the rights to all the original courseware written for Bitzer's group in the 1960s, the company chose to write its own.[87] Moreover, CDC paid its authors considerably more for a single course than CERL ever had (sometimes as much as $300,000). Consequently, to render a profit a CDC course would need a great many more paying users. As Bitzer put it:

> In my opinion, they produced an inferior program at a very high cost because they had an organization that needed the work. [88]

Looking back in 1986, Norris himself believed that CDC had lost valuable time and money in their switch-over to Micro-PLATO.[89] Indeed, Norris' experiences seem to run counter to the common notion that PLATO 'had always been ahead of its time' and should naturally have benefited from the PC revolution. In general, the PC played of course a crucial role in rendering CBE affordable to a much larger segment of the educational market. However, some of the strongest and most characteristic features of PLATO initially seem to have had little place in a PC world, especially before the widespread use of the Internet. Norris related

how CDC initially contracted Texas Instruments (TI) and begun rewriting all PLATO courseware for use on their PCs in 1981. A year later, however, TI decided it would permanently withdraw from the PC market. CDC subsequently had to re-rewrite its courseware for use on Apple or IBM. Then, by 1983, Norris realized that the idea of selling PLATO courseware as a simple set of floppy disks was fundamentally flawed in itself.[90] There was hardly a profit margin on courseware diskettes, and a stand-alone Micro-PLATO did not offer a customer any online support, control or communication services. And the latter, Norris believed, were precisely among PLATO's most appealing features.

By the mid-1980s CDC therefore settled for a Micro-PLATO system in which courseware was downloaded from the mainframe center onto a PC. The user then could go through the lesson in a 'stand alone manner,' thereby keeping long distance phone outlays to the minimum. At the end of the lesson, courseware results were to be sent back to the center for comparison and processing. CDC would so remain, Norris pointed out, a center for the "delivery of educational services" rather than "the sale of educational products."[91] However, by the mid-1980s, CDC was hardly in a position to 'wait for' PLATO much longer. In the midst of the "computer wars," the company needed capital, and fast.[92]

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[1] Mark A. Heuer, "Control Data Corporation/Commercial Credit Company, Case B: PLATO," A Case prepared at the Center for Business and Public Policy, University of Maryland, College Park (1984), 1. See also note 40.

[2] Both critics and defenders of computer-based education alike see the military as the decisive factor in pushing the development of this technology. Compare Douglas D. Noble, *The Classroom Arsenal: Military Research, Information Technology and Public Education* (London and New York: The Falmer Press, 1991) with Theodore M. Shlechter, "Promises, Promises: History and Foundations of Computer-Based Training," in Theodore M. Shlechter (ed.), *Problems and Promises of Computer-Based Training* (Norwood, New Jersey: Ablex Publishing Corporation, 1991): 1-21.

[3] T.D. Snyder, *Digest of Education Statistics 1987* (Washington: Office of Educational Research and Improvement, U.S. Department of Education).

[4] See for example D. Alpert and D.L. Bitzer, "Advances in Computer-Based Education," *Science* (Volume 167, 1970): 1582-1590, and the critique and final response that followed in Robert J. Seidel, Felix F. Kopstein, Ronald J. Swallow, Daniel Alpert and Donald L. Bitzer, "CAI: Technological Misconceptions," *Science* (Volume 168, 1970): 1397-1398, 1400. Another author who was critical of the achievements realized in computer-based education thus far, but at the same time pressed for further educational reform was Anthony G. Oettinger, *Run Computer Run* (Cambridge: Harvard University Press, 1969).

[5] On the importance of Sputnik for computer-based education (via the adoption of the National Defense Education Act) see: Shlechter, "Promises, Promises," 2 and Noble, *The Classroom Arsenal*, 14, 19 and 20.
[6] On the role of NSF see: Shlechter, 5 and Noble, 20.
[7] Noble, 51.
[8] Indicating the success of Bitzer's group, the Control Systems laboratory was renamed in 1961 into the Coordinated Science Laboratory, and in 1967 he received his own Computer-based Education Laboratory. See: *Interview with Donald Bitzer conducted by M. Price*, 17 August 1982 (CBI: OH 283): 2 and 5.
[9]OH 283: 5-7.
[10]OH 283, 2.
[11] James C. Worthy, *William C. Norris: Portrait of a Maverick* (Cambridge, MA: Ballinger Publishing Company, 1987), 84/5.
[12] *The PLATO System* (Computer-based Education Research Laboratory, 1979).
[13] During the Korean War, Braunfeld had been one of the principle programmers of the Cornfield Radar system at the Control Systems Laboratory. R.A. Kingery, R.D. Berg, E.H. Schillinger, *Men and Ideas in Engineering: Twelve Histories from Illinois* (Urbana: University of Illinois Press, 1967).
[14] Ibid.
[15] Ibid.; "Computer Sciences Men-of-the-Year," *Data Management* (June, 1975): 19-26.
[16] D. Bitzer, P. Braunfeld, W. Lichtenberger, *PLATO: An Automatic Teaching Device* (Urbana, Illinois: University of Illinois, Coordinated Science Laboratory, 1961).
[17] D. Bitzer, E.R. Lyman & J.A. Easley, Jr., *The Uses of PLATO: A Computer-Controlled Teaching System* (Urbana, Illinois: University of Illinois, Coordinated Science Laboratory, 1965): 1.
[18] Paul Tenczar was a biologist who took the initiative to develop a more "general purpose" language for PLATO at CERL around 1967. See OH 283, 39 and D.L Bitzer, "The Wide World of Computer-Based Education," *Advances in Computers* (Volume 15, 1976): 269.
[19] Alpert and Bitzer, "Advances in Computer-Based Education," 1583.
[20] Donald L. Bitzer, *PLATO: An Adventure in Learning with Computer-Based Education*, 8.
[21] *The PLATO system.*
[22] Norris talks about events leading up to his founding of Control Data in: *Oral History Interview with William C. Norris conducted by Arthur L. Norberg*, 28 July and 1 October 1986 (CBI: OH 116) and also in *An Interview with William C. Norris conducted by Carol Pine*, January 28 1982 (CBI: OH 270): especially 8-18.
[23] Worthy, *William C. Norris*, 83; OH 283: 17, 23, and *An Interview with Donald L. Bitzer conducted by Sheldon Hochheise*r, 19 February 1988 (CBI: OH 141): 1-3.
[24] OH 283: 24-25. Bitzer recalled how he, Harold Brooke, and a third person had visited William Norris in Minneapolis to talk matters over. Bitzer believed that

Norris was at this point interested in putting a low-risk stake in PLATO research, knowing that its competitor IBM had been spending "millions" on their own research without it "going anywhere."

Around 1968, CDC stepped up its involvement with PLATO IV, when it sold the Computer-Based Education Laboratory a CDC 64-6500. For this second contract, Bitzer made a new trip to CDC to state his case (this time accompanied by Dan Alpert). Norris agreed to a contract where CERL would pay nothing the first year, followed by increasing installments in subsequent years (when presumably more money would have come in from government grants and new PLATO contractors). But because of CDC's decentralized corporate structure, each of the vice-presidents had to give CERL their individual permission for the deal as well. This second contract would be followed by at least two more over the 1970s and 1980s. OH 283: 28 and OH 141: 5-8

[25] Lyman, *PLATO Highlights*, 5.

[26] OH 283: 21-22. More specifically, between 1957-1965, the laboratory received funds from Army Signal Corps and Ordnance Corps, the Office of the Naval Research, and the Air Force Office of Scientific Research. Nobel, *The Classroom Arsenal*, 101.

[27] OH 283: 26, 29 and OH 141: 5. Around the same time PLATO received its first funding from NSF, the latter also put a large amount of money in TICCIT a computer-based education system under development at the MITRE Corporation. Shlechter, "Promises, Promises," 5. NSF's involvement with PLATO ended in 1977. "Financial Supporters of the PLATO Project."

[28] Lyman, *PLATO Highlights*, 5.

[29] *The PLATO System*.

[30] D. Alpert, and D. L. Bitzer, "Advances in Computer-Based Education."

[31] Ibid., 1588.

[32] Ibid., 1585.

[33] Ibid., 1585. In fact, on the basis of these communicative network features, PLATO could now arguably claim priority for having invented "instant messaging," "emoticons," etc. This apparently is the goal of a forthcoming book by Brian Dear. See www.plato.com.

[34] It should be noted that by 1974, CERL's interest in assigning PLATO-rights to CDC was as genuine as CDC's desire to commercialize. Bitzer explained how it had always been difficult to obtain funding for hardware (relative to labor costs). And he also believed that it would get increasingly difficult to obtain additional federal funding for the PLATO project. Yet CERL was in need of Extended Core Storage and wanted to keep up with the pace of mainframe improvements. If CDC was willing to continue its hardware support as part of an agreement on courseware and other PLATO essentials the two could make ideal partners. This was also the explanation the University of Illinois gave to NSF regarding their CDC deal. UI officials mentioned that it had taken CDC's competitors into consideration (particularly Xerox, IBM, Raytheon, Magnavox, Eastman Kodak, Texas Instruments, and Owens-Illinois) but found each of these lacking in their

financial and commercial commitment to PLATO. See: Memorandum from James F. Hogg to David Barnes, on August 1, 1974, regarding CDC-PLATO-Courseware License Agreement; Letter from George A. Russell, Vice Chancellor for Research, UI, to Leonard A. Redecke, Contracting Officer, NSF, September 22, 1976;

[35] Angeline Pantages, "Control Data's Education Offering: 'Plato would have enjoyed PLATO,'" *Datamation* (May 1976): 183, 186-7.

[36] *The PLATO System*.

[37] CDC and UI established separate agreements on courseware, software, patent licenses, plasma display licenses, and Control Data equipment, products and related services.
To facilitate the transfer of PLATO knowledge, several CERL researchers were sent to CDC to train their staff. According to Bitzer, several members of this CERL group then stayed on at CDC permanently. OH 283: 52.

[38] Pantages, 183.

It may also be noted that the contract between the University of Illinois and Control Data Corporation did not end Bitzer's involvement with PLATO. Rather, the two partners had agreed to exchange all patents, hardware technology and even software. So that, after 1976, there were, in a sense, two parallel PLATO tracks. CERL was entitled to attract and serve new PLATO customers for up to four terminals apiece. Bitzer also undertook various promotional activities on behalf of CDC. Potential CDC customers could visit the CERL lab, and see PLATO used in a classroom setting. Bitzer even did some lectures in South Africa, Australia, Russia, Germany, and Venezuela for CDC. However, by the late 1970s, due to CDC's refusal to use much of the original PLATO courseware, the two partners were in a state of "benign neglect." It was not until 1983, with the adaptation of PLATO for the microcomputer that Bitzer sought contact with CDC again. OH 141: 9-10, 15 and 20.

[39] Ibid., 183.

[40] Heuer, Control Data Corporation/Commercial Credit Company, 2.

[41] Ibid. The precise meaning of corporate social responsibility continues to evolve—both in conceptual and in empirical terms. In the 1920s, corporate philanthropy gained much visibility as a form of socially inspired behavior through Carnegie, Vanderbilt and Rockefeller. The early 20th century also brought a divers group of pioneers in welfare capitalism to the foreground including Endicott Johnson, Hershey, US Steel, the Filene Department Store, and Henry Ford. But where corporate philanthropy tends to address the larger community, while welfare capitalism is aimed at one's own employees, the concept of "corporate social responsibility" (CSR) has taken on a much broader meaning. It starts from the fundamental idea that a public enterprise has a public responsibility (and arguably an intrinsic self-interest) beyond immediate profit making. Business historians have traced the term back to a 1957 publication by Howard R. Bowen entitled *Social Responsibilities of the Businessman*. But the CSR concept really began to proliferate in the late 1960s-early 1970s. By that

time "the military-industrial complex" was well established, while at the same time television, cheaper airfare, and a dense high-way network had rendered the average citizen much better informed and also much more critical of the formers growth in power. The civil rights movement of the 1960s and the environmental movement of the 1970s also factored into the growing public resentment towards the perceived goals of Big Business.

William Norris' embrace of CSR therefore came exactly at this challenging period in corporate history. Although on the one hand, as we have just seen above, CDC and PLATO were themselves off-springs of the 'military-industrial complex,' William Norris did his best (perhaps even for that reason) to make his company a trendsetter in the CSR movement. As we will see below, Norris' implementation of CSR via PLATO and PLATO-based applications brought a commitment to innovative projects which addressed social needs, and were often seen (by investors) as carrying relatively high risks, because they only were expected to render a profit after a long and costly gestation period.

For historical perspectives on corporate social responsibility and related concepts see for example: Edward Berkowitz and Kim McQuaid, "Businessman and Bureaucrat: The evolution of the American social welfare system, 1900-1940," *The Journal of Economic History* (March, 1978): 120-142; Stuart D. Brandes, *American Welfare Capitalism, 1880-1940* (Chicago: University of Chicago Press, 1976); Archie B. Carroll, "Corporate Social Responsibility: Evolution of a Definitional Construct," *Business and Society* (September, 1999): 268-295; Morell Heald, "Business Thought in the Twenties: Social Responsibility," *American Quarterly* (Volume 13, 1961): 126-139; Edwin M. Epstein, "Business Ethics and Corporate Social Policy," *Business and Society* (March, 1998): 7-40; Mark Sharfman, "Changing Institutional Roles: The Evolution of Corporate Philanthropy, 1883-1953," *Business and Society* (December 1994): 236-270; Gerald Zahavi, *Workers, Managers, And Welfare Capitalism: The Shoemakers and Tanners of Endicott Johnson, 1890-1950* (Urbana: University of Illinois, 1988).

[42] For a perhaps more limited use of this term see: James C. Worthy, *William C. Norris*, 89

[43] See also the chapter on Worker Performance and Productivity in: James C. Worthy, *New Frontiers for Business Leadership* (Minneapolis: Dorn Books).

[44] Control Data named the lecture series "perspectives on employing technology to solve the pressing problems of society." (There are 19 lectures in this series.)

[45] Norris, *Technology and Corporate Governance* (Volume 13, December, 1979): 2.

[46] Norris, *Technological Cooperation for Survival* (Volume 1, February, 1977): 11.

[47] See for example, "CDC Introduces Stand-Alone PLATO," *Electronic News* (October 20, 1980).

[48] Norris, *Via Technology to a New Era in Education* (Volume 2, June 1977): 1.

[49] Norris, *Technology and the Humanities* (Volume 14, March, 1980): 3/4.
[50] "Control Data Intros PLATO", *Adweek/Midwest Advertising News* (May 31, 1982), Gregor W. Pinney, "Studies Don't Confirm Claims for PLATO's Teaching Success," *Minneapolis Tribune* (August 22, 1982).
[51] Gregor W. Pinney, "Studies Don't Confirm Claims"; Gregor W. Pinney, "How PLATO Teaching System Works," *Minneapolis Tribune* (August 22, 1982); Pinney, "Texas Students Show Mixed Results Using PLATO, Report Says," *Minneapolis Tribune* (December 20, 1982).
[52] Pinney, "How PLATO Teaching System Works."
[53] Pinney, ibid., op cit.
[54] Pinney, "Texas Students Show Mixed Results."
[55] Ibid.
[56] Francis D. Driscoll, *The PLATO System: A Study in the Diffusion of an Innovation* (Ph.D. thesis for the University of Massachusetts, 1987): 116-118, op cit.
[57] Ibid.
[58] See "PLATO ad-vantages publicized," *The University of Georgia Faculty Staff News* (May 7, 1984).
[59] See "Microsoft pulls phony Switch Ad," http://www.wired.com/news/business/o,1367,55785,00.html, Oct. 15, 2002.
[60] Ibid.
[61] Thomas W. Lippman, "Unusual Deal Cuts Computer Learning Costs," *Washington Post* (June 21, 1982).
[62] OH 141: 17.
[63] Norris, *Back to the Countryside Via Technology* (Volume 5, January, 1978): 8/9.
[64] Norris, *Technology for the Inner City-Experience & Promise* (Volume, 8, 1978): 6.
[65] Norris, *Technology for Company-Employee Partnership to Improve Productivity* (Volume 17, June 1981): 5. See also NH 299: 10.
[66] Norris, *Technology and Corporate Governance*, 8/9.
[67] Norris, *Technology for Improving the Image of Business* (Volume 7, July, 1978): 4.
[68] Norris, *Technology and the Handicapped* (Volume 12, August, 1979):12.
[69] Derek Reveron, "Technical Training for the Disabled: These Computers Programmed for Hope" (*Minneapolis Star*, Monday October 27, 1980).
[70] Ibid.
[71] Connie Winkler, "At Introduction of Micro PLATO: Norris Attacks Churches' Criticism of CDC," *Computer World* (October 27, 1980): 81.
[72] Thomas G. Bartholomay, *Control Data's PLATO Computer and South Africa's Apartheid Education System* (New Jersey: Africa Research & Publications Project, Inc., 1985): 41
[73] Richard Knight, *U.S. Computers in South Africa* (New York: The Africa Fund, 1986): i.

[74] In 1997 an editorial in the *Los Angeles Times*—as far as I can judge falsely—stated that PLATO had been used "by the South African Security Forces to manage the hated passbook system, the basic documentary enforcement of apartheid." See Gary Chapman, "China Represents Ethical Quagmire in High-Tech Age," *Los Angeles Times* (January 27, 1997).
[75] Knight, *U.S. Computers*, 9.
[76] I have found reference to only one case where CDC was indirectly connected to illegal trade with South Africa. In 1982, ICL was fined $15,000 for having sold nine mainframes to the South African Police. Inside those mainframes were 9780 CDC disk storage units. CDC had sold those to its own subsidiary in Britain, which in turn passed them on to ICL. CDC claimed however to have explicitly warned ICL that "US regulations prohibited the use of US- made subunits in equipment intended for the South African police, and that its sales to ICL were in compliance with US law." NARMIC/American Friends Service Committee, *Automating Apartheid: US Computer Exports to South Africa and the Arms Embargo* (Philadelphia, 1982): 29-30.
[77]Gert Slob, *Computerizing Apartheid: Export of Computer Hardware to South Africa* (Amsterdam: Komitee Zuidelijk Afrika, 1990): 48.
[78] Knight, *US Computers in South Africa*, 7.
[79] Winkler, "At Introduction of Micro PLATO," 81.
[80] Norris, *Technology and Corporate Governance* (Volume 13, December, 1979): 3.
[81] Geoff Lewis, "CDC Introduces Stand-Alone PLATO" Electronic News (October 20, 1980).
[82] Many newspapers ran this article in March 1982. See for example John Cunniff, "PLATO still not selling smartly for CDC," *The Minneapolis Star* (March 11, 1982).
[83] Joe Blade, "CDC will sell PLATO education system," *Star Tribune* (July 19, 1989).
[84] Ibid. In an effort to turn the financial tide, CDC had already taken "a $490 million writeoff to close its ailing ETA super computer business, streamline its main frame computer segment and further streamline its headquarters operations." In addition, CDC had sold "its Imprimis disk drive subsidiary to Seagate Technology of California for $ 450 million in cash and securities."
[85] Worthy, *William C. Norris*, 106.
[86] Ibid., 18.
[87] It remains unclear why CDC decided not to rely more extensively on UI courseware very much. One factor may well have been the reluctance with which UI authors and particularly the NSF had given their consent to transfer their courses to CDC in the first place. According to an internal CDC memo the transfer of courseware from UI to CDC was delayed for several reasons. First of all, the UI was unsure who held responsibility within its administration to release UI courseware. Secondly, some UI authors did not want their courseware to be commercialized on principle, or because they felt it was outdated, or because CDC did not remunerate them sufficiently. Thirdly, the NSF maintained initially

that it held “rights in all courseware since it had paid for some of the system courseware.” And the NSF felt that CDC should not become the sole vendor of the courseware, but that all of material should remain available for additional proprietors. See: CDC Memorandum, from T.T. Spengler, to R.D. Conner et al, April 26, 1976; Letter from George A. Russell, Vice Chancellor for Research at UI to Leonard A. Redecke, Contracting Officer at NSF, September 21, 1976.

[88] OH 141: 18/9.

[89] Worthy, *William C. Norris*, 96-100.

[90] Ibid., 98

[91] Ibid.

[92] OH141: 23.