The Computers Nobody Wanted
My Years with Xerox

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Paul A. Strassmann

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Prelude

While I was waiting for my year-end bonus at General Foods in 1964 I received a call from a managing partner of Arthur Andersen. Would I consider talking to the Chief Financial Officer of the National Dairy Products Corporation in New York who was looking for a corporate systems director? Working for some sort of a dairy company was certainly not my idea how to advance my career until I looked up information about the NDPC. It was larger than General Foods! NDPC was a holding company that owned well-known brands such as Kraft and Sealtest. The firm had been consistently profitable.

I went for the interview with Mr. Kenneth B. Fishpaw, who in my view could be typecast as person who looked and acted as an ideal CFO who was completely trustworthy. He talked in reasoned, carefully phrased clear sentences as if his words would require audit certification. I took an immediate liking to this man of grace and old-fashioned courtesy. Ken explained that the NDPC was not an operating company but provided headquarters oversight over widely diversified global operations. Though the firm included more employees than General Foods the entire headquarters operation was squeezed into modestly furnished small quarters located a walking distance from the New York Grand Central station. The headquarters, smaller than one hundred people, consisted of auditors, accountants, lawyers and investor relation executives. My job would be to organize a corporate staff that would guide the various units of NDPC on an accelerated migration to pervasive computerization. The firm already operated over fifty small computers and was now facing, as a major investment, the soon to be announced IBM 360 series.

The scope of my job would be to oversee spending that would be a multiple of what I proposed for General Foods. I was particularly im-

pressed with Mr. Fishpaw's recitation of the logistic challenges. The NDPC operating units produced and distributed perishable products where mistakes or delays, such as in the distribution of ice cream, could not be tolerated. The firm was vertically integrated, which included the ownership of delivery trucks that brought products directly to stores. The truck drivers also placed the goods directly on the shelves or into the freezers. Out-of-date merchandise would be lifted for return to the company's warehouse. Accounting for the deliveries and the issuing of credit for return merchandise would be the driver's responsibility. As Fishpaw described the NDPC operations he presented what I would consider a textbook case of how one must deploy a rapid-response logistics value-chain. It appears he must have been coached about my work on COPT at General Foods and about the sort of centralization vs. decentralization conflicts I had to address. It dawned on me that IBM must have had a hand in setting up the interview. After rather perfunctory greetings from the CEO, the head counsel and the treasurer I was offered the position as the corporate Director of Information Systems. Later I found out that there were no other candidates interviewed for the job.

The IBM 360 Promises

Early in 1964, while Kraft as well as Sealtest would be studying the restructuring of their computer set-ups, all planning was suspended by the news from the IBM sales force that a new computer series, the IBM 360, would radically change ways how one should think about computerization. By consolidating its increasingly disjointed and incompatible lines of computers, IBM promised to increase the technology life of their hardware from four to at least seven years. With a longer technology life, the purchase instead of leasing of added capacity would become more attractive. IBM also claimed that software applications would be portable regardless of the size or configuration of the hardware. All of this turned out to be false claims even though it persisted as a part of IBM's promotional advertising. A time- sharing operating system would make it feasible to set up telecommunications links with terminals. This promise turned out to be wrong because the IBM time-sharing system never worked properly.

Processing power, memory and magnetic storage would be infinitely scalable but that was true only in a very limited sense.

Software firms would now have an incentive to offer standard applications for IBM computing, thus reducing the costs of innovation. Most importantly, all applications now running on IBM equipment, which had its 1400 series installed throughout NDPC, would be able to run and migrate upwards on the new equipment without any change in code or without loss in performance. That was not true at all because all that IBM offered was a degraded capability named "emulation." High-level languages, such as COBOL, would make it possible for companies to use simpler and more reliable instruction codes. In other words, comes April of 1964, IBM would offer a nirvana in the computing heaven, where everything that used to be difficult would now become easy to do. Behind much of the hoopla and misrepresentation were the IBM marketing machine that promoted capabilities that the IBM technologists could not deliver immediately, and some cases only a decade later.

Starting in January, IBM salesmen visited major customers with blank order forms for machines with unknown specifications, unknown performance and unknown prices. Customers were told that there would be limitations on the production capacity would constrain the ability of IBM to fulfill orders. Therefore, IBM was introducing a priority system. Blank orders, with only a brief description, stated which version of the equipment would be placed on order. The orders would be time-stamped. Orders would then receive a sequential position in an order queue. After the equipment specifications would be released customers would have an opportunity to modify or cancel their orders. This was salesmanship the likes I have not seen since my starvation days in the summer of 1944 when city folks gave to peasants deposits for parts of a pig that would be slaughtered after Christmas. Without exception, everybody ordered more processing capacity than they could possibly use. Corporate purses would be loosened to promote innovation that would be able to take advantage of IBM's extravagant claims.

By the time I gathered all of the information, I found out that NDPC divisions placed worldwide over fifty orders for IBM 360s. Despite jubilant anticipations and priority placement on the waiting line, I did not

share the optimistic outlook with my peers in other corporations or within NDPC divisions. The news I was getting from the Air Force testers was that emulation was hard to do, error prone and unlikely to work across a broad spectrum of computers that were running frequently patched Autocoder programs or versions of RPG (Report Planning Generator).

Shortly after the IBM series was announced I was able to add up the bill for the NDPC equipment that was on order. Although the new computers offered a theoretically attainable quadrupling in processing capacity the cash cost of rentals and maintenance would double. Purchasing options, if amortized over seven years, would made the computers more affordable. However, based on my understanding of the rapidly changing technologies seven-year amortization of computer capital looked to me like a far-fetched horizon. I was not going to endorse any purchases until such time that performance tests would give us an indication about actual capacity of the new equipment running in emulation. Meanwhile, the probable consolidation of computer operations within NDPC left me without the ability to plan what computers would be needed and where.

The Honeywell Installation

The most worrisome aspect of the IBM 360 computers concerned the portability the existing code from the in-place IBM 1401s and IBM 1460s to the IBM 360/30, 360/40 and 360/50 machines. The emulation capabilities remained shrouded in pithy bulletins from IBM. Without an efficient emulation capability the new equipment would be useless. Compounding the problem were the alarms I received from two Sealtest Divisions. While waiting for the IBM 360 they held back on any upgrades. They were now flat out of processing capacity. Their operations started experiencing delays. Upgrading the now obsolete IBM computers did not make sense and IBM discouraged that.

I tried to placate the divisional managers by passing on to them whatever scraps of hope I could garner from IBM. We pleaded to be allowed at least to observe an "alpha" (working prototype) to gain confidence. That would not be possible. How about letting us in a "beta" testing? When that would be feasible was unknown. Bill Reedy, the IBM major account

representative to Kraft who scooped up most of the NDPC orders and was already paid hefty sales commissions, did his best to encourage patience because IBM would surely deliver the emulation capabilities soon. Besides, other than ordering upgrades to the existing equipment, which would be a retrogressive step, there were no easy alternative options. The IBM representative offered to install a totally incompatible IBM 7010 computer at a substantial discount but at an insanely expensive conversion cost.

Meanwhile we marked time and I met with other senior computer executives at the American Management Association to find out what they were doing. The bad news was slowly seeping in. IBM would not or could not deliver on its promises not only on emulation but also on the ease of portability from the old to the new.

After waiting for about four months, I received a phone call from Art Messerschmitt, the Sealtest controller in Schenectady, New York. Would I consider forgetting, for the time being, about IBM promises and consider the installation of a Honeywell 200 Liberator? Art had in his office a Honeywell salesperson. Art was offered to install Honeywell equipment at no cost. Honeywell would run it in parallel with the Sealtest IBM 1401 until such time that auditors could certify 100% compatibility for both machines. There was sufficient space in the computer room to house both computers, side by side. If the 200 could run as expected and provide the much needed extra capacity the monthly rental payments to Honeywell would be pegged at 50% of whatever IBM would have charged for a comparable IBM 360.

It just happened that a week before I saw an Air Force briefing commenting favorably on Honeywell equipment they would be installing to support worldwide communications for their strategic strike force. I told Art to proceed with the Honeywell, which could be delivered the following week. When it was installed I would show up in Schenectady for a reality check.

After I hung up the phone I walked into Ken Fishpaw's office. We were going to have a storm on our hands as soon as the news leaks out that we would be testing out the Liberator. Ken's only question was whether Art was out of processing capacity. Would there be any damage to operations during a conversion? After Art confirmed that he would be account-

able for any problems, he got an OK to proceed. I do not think it took more than two hours after that to receive a call from the IBM national account manager. Was I canceling NDPC orders for the IBM 360s? No, we were not canceling any orders, just waiting for IBM to demonstrate the conversion to whatever 360s we ordered and then to pass a test that the emulation features would perform as advertised. The IBM salesman was unhappy and I was sincerely sorry for him because he was an exceptionally pleasant person. He then recited, apparently from a prepared legal text, that under the existing consent agreement with the Justice Department he had to cease further conversations about the prospective installation of a Honeywell computer in Schenectady. He invoked the so called unhooking clause from an anti-trust settlement which prohibited IBM from engaging in any sales efforts after a customer had placed an order with a competitor. In the following days I received visits, carefully pre-announced as social get-acquainted occasions, from the District, Regional and Eastern Area IBM executives. Based on the titles on their business cards I could figure out the latest organization chart for IBM marketing. During each visit Schenectady was never mentioned.

The following week, Honeywell people broke their back and installed a fully operational Honeywell 200 one day ahead of schedule. It performed better than expected and the IBM 1401 was removed a month later. The story did not end there. Suddenly, all the other regional managers wanted to get a similar deal. Negotiations with Honeywell started and were consummated in one more case, but as the time passed, the IBM marketing machine managed to strengthen its position by enhancing emulation capabilities, at an increased cost that was not sufficient for anyone to secede from IBM.

All that changed when another brash controller, Alec Moon, in Kraft-UK decided to ask for Honeywell to bid on upgrading his computing facilities because his ICL 1301 could not keep up with his workload and was completely incompatible with the rest of Kraft. The Australians, always trying to best the Brits, followed shortly after that with a similar request to Honeywell. The game would now shift to the international scene where the comparative costs of IBM equipment were at a disadvantage and different legal rules applied.

The IBM Counter-Attack

Just when I thought that the IBM 360 situation, which consumed much of my time, would pass into oblivion I got a call from the Gordon Edwards, the NDPC CEO. Gordon never called before. He said that he just received an invitation from a Joseph B. Flavin, the executive vice president and chief financial officer of IBM World Trade. Would I have any idea why Flavin would wish to meet? I summarized the situation in Schenectady that Gordon already knew and ventured a guess that the antitrust provisions against unhooking would not apply to IBM World Trade, a corporation that operated outside of the US. Gordon, who found the IBM 360 unhooking efforts amusing, took the call from Flavin. It was an invitation to join him for a game of golf.

What happened during the golf outing was subject of entertainment at the next bi-weekly lunch of NDPC executives. Gordon, who loved to tell and enjoy his own tales, described how they played the obligatory twelve holes, with Flavin — obviously a low par player — making sure Gordon was winning all the way. It was only afterwards, in the club house, that Flavin asked whether Gordon was not concerned about Strassmann's risk-taking in managing NDPC computers. In effect, Flavin was trying to get me fired which was a fairly common IBM practice of last resort whenever all the other approaches to keep an account failed or, when IBM believed that the information technology was mismanaged. Such a decapitation was always executed under informal circumstances. Any dismissals would be then discussed only in general terms. In this case, IBM was free to unhook because they could always claim that even the implied conversation concerned a situation outside of the US. Subsequently, my discreet legal advisor told me that IBM misjudged the situation when they paired Flavin with Edwards. The only valid way to dislodge me would be to dig up an incident where I did some damage. A generality, such as doubts about the wisdom of NDPC choosing somebody who would engage in unnecessary "risk-taking" would work at General Foods, but certainly not with a former milk delivery-man.

Gordon, properly briefed, asked Flavin whether NDPC had placed orders for IBM 360 computers. Were any of these orders ever cancelled? If

orders had been placed six month ago, why would IBM not proceed with the installations when NDPC divisions needed added capacity? Whether Flavin was informed as well as Edwards, I do not know. When they parted, Edwards announced that the NDPC was paying Strassmann to see to it that its computers were running properly, which meant that pick lists would show up on time on the loading docks for ice cream deliveries. As long as that was done Edwards would not mix into computer decisions he knew nothing about and did not wish to know anyway. The next morning my wife received, with compliments from the CEO of NDPC a bucket of freshly made Breyer's rum-raisin ice cream. It was at that time the best ice cream anywhere. Our kids did not get any of it because it was laced with Baccardi rum, specially mixed for executive consumption.

Computer Leasing

When the IBM 360 series was introduced, salesmen boasted about its much longer technological life than for any prior computers. This opened, as an unintended consequence, the possibility that leasing firms would find it attractive to purchase the computers outright and then release it to customers at a substantial discount for three to four year fixed term. If a leasing firm could repeat fixed term leases two or even three times it would reap enormous profits.

The IBM purchase/monthly lease ratio was set at less than sixty. All revenues over five years would be then pure profit to the leasing company since IBM would charge identical maintenance fee regardless whether the computer was purchased or rented. What was IBM top management's thinking in offering such a pricing deal is a mystery. An inducement for customers to insert a financially motivated intermediary into what used to be extremely close service relationships would surely corrode a long cultivated trust relationship between IBM and customers.

The new leasing companies were run by ex-Wall Street operators who were in effect were arbitrageurs between the valuations of computers, as conceived by Armonk pricing experts, and the worth as seen by the customers. There were additional angles to be considered in order to extract maximum advantages for a leasing firm. For instance, IBM assigned

a numerical delivery priority to customers who ordered 360 early. That was supposed to serve as an inducement to rush into placement of orders without any analysis. Leasing companies offered special inducements to firms, such as NDPC who were high up in the queue for deliveries of new equipment. A clever leasing company could induce a firm with a favorable shipping position to purchase a 360 computer through a leasing firm and then have it shipped to someone who would be willing to pay a premium price.

Harvey Goodman, CEO of one of the most aggressive leasing firms, showed up in my office one morning. He did his homework. He had a list of all NPDC IBM 360 computers on order. He offered us a 30% discount from IBM monthly rentals for non-cancelable but upgradeable machines. Our portfolio of machines would be leased from the Data Processing Financial & General company. They would permit us to relocate machines as we saw fit. In addition, Harvey would also finance the replacement of IBM's expensive tape drives by fully compatible Telex or Systems Dynamics Corporation drives for added savings. Effectively, Harvey offered us IBM equipment at prices that were equal to what Honeywell could charge for equipment with lesser capacity.

I found Goodman to be a sophisticated financier but with no knowledge or care about computerization. Behind him were private investors looking for extraordinary profits from what appeared to be an IBM error in the valuation of what they were selling. As I considered NDPC's penny-pinching habits I could not turn down an offer to cut costs. It took weeks of legal work and negotiations about every conceivable detail before we signed up with DPF&G.

The Deterioration of IBM

The entire leasing experience with DPF&G left me with a bad taste about IBM as well as about the prospects that what used to be revered icons of US industrial achievement. It looked to me that IBM was becoming an organizations that made decisions regardless how it affected customers. Although IBM had been consistently rated for years by *Fortune* magazine as the most respected corporation I saw in their actions an abdication from

a long history of keeping up trusted relationships with customers. Though the shift by IBM from monthly leases to selling computers outright can be traced back to the mid 1960s it did not take long before IBM's market position started to crumble. By the mid 1980s there were serious doubts about IBM surviving as it started shedding half of their employees while their stock market price plunged from a high of $578 to a low of $42. In many respect this deconstruction of a company was to be repeated years later by Xerox, when it started selling off its lease base and substitute purchase arrangements that alienated the sales force and the customers.

When IBM failed to deliver the IBM 360, as promised, this could be explained as a technological glitch. However, pricing a product line for the rapid generation of cash though outright sales made no sense. Surely, IBM's cost of capital would be less than Goodman's. IBM's ability to manage the technology risks were vastly superior to that of a leasing company consisting mostly of MBA's looking out for quick profits.

Computerization of the US was still in its nascent stages. Customers did not have sufficient experience to evaluate how much capacity they would need even six months ahead. Committing to purchases placed customers at a disadvantage, as compared with the prior practice of contracting with IBM for only monthly leases and then trusting the IBM organization to deliver rapidly whatever capacity or features were needed. The close and trusted partnership between the IBM organization, believed to hold the care of customers on top of all other priorities, would be now broken. The sales commissions from outright sales were much larger than the trickle realized from pay as you go monthly billings. The IBM support team would now have less of an incentive to provide ongoing support. The only way the entire schema made any sense if IBM's 360 would have a much shorter technology life than was promoted. In that case, IBM would be unloading in five years to second-hand users an obsolete technology, which only they could control.

In fact, the IBM 360 had a much longer life than was expected. That was not the result of rapidly falling prices of semiconductors, but the consequence of rising difficulties in the management of application software. The industry was changing from a focus on the costs of hardware to software development and maintenance. By shifting from rental to sales of

equipment IBM commenced a liquidation of their previously unassailable position. It was not computing capacity that mattered any more. The management of information technology was now wrapped up in the development and conservation of application software.

Gideon Gartner

It was during this period that I ran, during a MIT Sloan school alumni reunion into Gideon Gartner of IBM. He found out that I was controlling a pool of IBM 360 computers and wanted to know more about the risks a large corporation would be willing to take in buying instead of paying IBM monthly rentals. It turned out that while at IBM Gideon was one of the leading analysts in setting up an extremely complex price list for IBM equipment, which included purchase prices, rental prices and equipment maintenance prices. Whether a customer would find purchasing or renting advantageous turned out to be an arbitrage between cleverly over-complicated quoted prices, delivery terms and the short-term rental costs for probable equipment upgrades. My point to Gideon was that IBM equipment would have a very long life not because of increasingly lower costs of computers but because of the rapidly rising expense of application maintenance.

Shortly after meeting with Gideon he left IBM and set up a lucrative consulting firm advising clients how to exploit weaknesses in what were not readily discernible inconsistencies in IBM pricing. Theoretically, this would allow customers to selectively purchase some components of an IBM 360 computer, while leaving more risky peripherals on rentals. Gartner made a fortune from providing advice to equipment leasing firms as well as to their customers how to understand what turned to be a deliberately confusing price list. In this way the Gartner firm gained enormous influence because they were advising both the sellers as well as the buyers how to get around increasingly convoluted IBM pricing practices that started plaguing the computer business.

Subsequently, over the period of several years, Gideon and some of his executives approached me about the possibility of joining their firm located nearby from where I lived. The Gartner firm appeared to me much

more as a Wall Street brokerage firm that extracted data from computer vendors and then serve up this information in pre-digested form for a steep advisory fee. Though Gartner called that "research", it was nothing but astute re-packaging and re-editing of generally available information that the vendors would be pressured to channel through the Gartner firm as easy-to read summaries. The Gartner firm could justify its fees by showing that computer vendors were notorious in making claims that could be false. The Gartner did not need to spend money on expensive testing to check the veracity of vendors' claims. They cultivated the skills of skeptical journalism, which they could then offer in a stream of publications, reports and bulletins as unbiased opinions. Gartner prospered by selling diversified newsletters as advice for computer managers.

Meanwhile, at NDPC we passed on all of the risks to Goodman, though we were left with a conviction that the past total reliance on IBM would not be a good policy any more. Although IBM continued to grow and prosper for another twenty years, with diminishing profit margins, I believe that it was IBM itself and not a competitor who in 1965 started eroding IBM's position as the flagship of American industrial superiority. The competitor of IBM was IBM, not some intruder. Twenty-five years later IBM was financially, technologically and organizationally a sick enterprise even though when I worked for the National Dairy Products Corporation nobody would have believed that.

Amdahl Computer Systems

The most dramatic proof of the rising discontent with IBM became apparent in a by-invitation-only meeting held at the Mark Hopkins Hotel in San Francisco that took place I believe, early in 1969. I was one of the members of the information technology round table advisory group to the American Management Association. I decided to attend the semi-annual meeting because I also wished to spend some time with suppliers of IBM plug-compatible equipment that could be installed at a discount. Corporate information executives, with a large inventory of IBM equipment, were asked to meet privately with Gene Amdahl, who was known as one of the principal designers of IBM 360 hardware.

Gene, a no-nonsense engineer, explained that he planned to form a company that would compete head-to-head with IBM in the large-scale mainframe market. He described how that could be accomplished by showing, side-by side his own as well as IBM's circuit boards performing identical IBM 360 hardware functions. Amdahl's version was much smaller and had fewer components. To get funding from investors Gene needed from some of large potential buyers an expression of interest signifying the if the Amdahl equipment would be "plug compatible" and if it were to cost up to 40% less than IBM's 360/65 models, the dozen computer executives sitting around the table would make such purchases. Though most of us considered any attack on IBM to be suicidal, as was demonstrated by the exit from the computer business by well-funded corporations, the calm analytic description of IBM economics impressed everyone. The IBM marketing overhead far exceeded the manufacturing costs and we wished to pay only for reliable and cheap computing power and not for all the frills. Without incurring any obligation whatsoever a notepad was passed around the table asking for the names of the attendees and the estimated number of computers we would consider purchasing. I believe that passing the notepad around generated a pressure for each of us to demonstrate how important we were. When the pad made it around the table, Gene "sold" over one hundred computers worth well over half a billion dollars even though the machines were still only on paper. I understand that Gene took our names to the investors, which included Fujitsu who were eager to break into the global computer business. A few months later the Amdahl Corporation was formed. When the Amdahl machines were delivered on schedule they worked exactly as promised. They were installed to run existing customer applications efficiently and economically. It was Amdahl, an IBM insider, who demonstrated that the so far invincible IBM was indeed vulnerable to a well-conceived attack.

Being Recruited

It must have been sometime in the middle of April 1969, when I received a call from George Peck, one of best known executive recruiters. My resume had not circulated yet so the call came as a complete surprise. Would I be interested in coming for lunch at the Union League Club? I could not refuse such an invitation. Without expecting much, since Peck's firm was recruiting only CEO and COO level executives for *Fortune* 500 companies, I showed up. George must have hired somebody to check me out because he had a thick folder about my prior jobs, family and the price of the new house I was finishing in Chappaqua. He knew all the details about my recent dealings with IBM, Honeywell and leasing firms.

An Unexpected Offer

George got to the point before the soup was served. He had a client, whose identity he could not reveal, who was looking for a Chief Information Officer. They would expect the CIO to displace their entire installed base of IBM 360 computers and do that worldwide. I could not imagine who would wish to do something as foolish as that. After the initial troublesome years IBM recovered its position. The 360 series were finally performing well and reliably except for the absence of a competitively priced communicating computer model, such as could be used for time-sharing. Rental payments to IBM increased but so did the demands for new capabilities, such as in manufacturing. My leasing contracts kept the expenses for IBM computers at tolerable levels.

How many 360 computers did this client use? George said that nobody knew for sure, because this was a global firm, but the numbers were certainly greater than in NDPC. What equipment would be replacing the

360s? I needed to know in order to figure out if George was testing me with a fictional situation. Harvard Business School graduates were good in spinning hypothetical case studies as a way of extracting knowledge from others. He laughed and agreed that I was asking the right questions, but prematurely. Would I be interested to find out more? The prospective firm would double my current compensation whatever that was. He could arrange for a private jet to take me to Rochester, New York so I could obtain the facts. Of course, the prospective employer would be Kodak because the only other notable firm in Rochester was Xerox and they were too small and too confused to use that many computers. In order not to compromise my existing job I agreed to stop off in Rochester for an interview on the way for my next weekly meeting in Chicago. A private jet would take me very early in the morning to Rochester and then continue to Chicago so that I could adhere to my schedule.

A limousine was waiting at the airport in Rochester. The chauffeur would not tell me where he was going until he pulled into the garage of the just completed world headquarters of Xerox. On the top floor waiting for me was no other than the man from IBM who had been commissioned five years ago to get me fired from NDPC. It was Joseph B. Flavin, now executive vice president and global CFO of Xerox. After a good laugh about the fickle vagaries of fortune Joe informed me that the following week Xerox would be entering into the computer business to compete with IBM. That would be achieved by acquiring a prominent computer firm. The only business computer firm worth acquiring in those days was Burroughs reflecting their exceptionally competent software. No, it was not Burroughs. Because of the challenges I would be facing in case I take the job, Xerox would double my salary. They would also award a performance bounty of 5,000 options for Xerox shares, at current low prices, for each displaced IBM 360 computer. There were at least thirty-eight known IBM computer installations at Xerox. Every IBM computer would have to be phased out in the shortest time possible. I already carried in my head a plan how to consolidate NDPC computing facilities and therefore mashing together that many IBM computers into a consolidated data center should make any conversion easier. That is exactly what Flavin wished to hear.

Flavin had been looking for candidates from inside IBM for the assignment for getting rid of IBM computers. Based on what he knew about the backing I had received at NDPC, my experience in placing Honeywell computers, and his own possible conflicts with a prior employer he must have concluded that I was the right man for the job. Furthermore, after their computer acquisition was completed, Xerox global corporate staff would be moving to Greenwich, Connecticut right next to the White Plains airport, which would be less than fifteen minutes from my new house. I would be able to come home in time to have dinner with my four little children who were quickly growing up as curious, assertive and lively bunch that needed a father to show up in daylight. Rochester would become the HQ of the US copier business, with non-copier divisions housed elsewhere. It did not take me more than a few seconds to decide that this was an unbelievably attractive offer. I accepted the job offer and Joe shook my hand and that was that. I would start in Rochester May 1st and work there until the new quarters in Greenwich would be ready.

I think there is a moral lesson that can be learned from the rapid and unexpected offer from Xerox. I have always found that doing the right thing, such as installing Honeywell computers, instead of just following conventional thinking such as waiting for IBM 360s, may look like a losing proposition. Ultimately, what's right may end up working for you in ways one could never anticipate. Call it luck, call if fate or just rewards for integrity. I do not know which one it is except that I remain convinced that even if the opportunists seem to be winning often, the righteous ones — at least in America — survive longer and have a more satisfying life.

Moving to Xerox

When I told Mona of an opportunity to become rich on Xerox stock options for displacing at least forty IBM computers she was not impressed. My super-conservative wife counseled not to count on any such gains until they were deposited in the family savings account. However, I should definitely take the job if that is what it took to get me home for dinner on time.

The profits from the stock options never amounted to much as the Xerox stock rose like a rocket and fell like a meteor burning out all the way down to below option prices. With regard to the 5,000 share bonuses for eliminating IBM computers, that never happened. I kept increasing IBM processing capacity to meet business demands because the IBM computers hosted applications I could not displace. The corporation was grateful that I never abandoned IBM because that was the only way of getting work done.

Joining Xerox in the position as the Chief Computer Executive was supposed to enhance my family life. This expectation turned out to be mistaken. The back breaking travel and fire-fighting removed me, for all practical purposes, from seeing my family for most of the time, even on weekends, for more than five years. If I have any regrets about working for Xerox it is because of my absence from the new house at Stornowaye in Chappaqua. The only offset was in the form of an increasing prosperity of our household as well as a most exciting career. That was insufficient to compensate for the increased loneliness of my oldest child, Vera.

The Xerox Tower

When I reported a corner office was ready. The windows were lined with copper mesh to prevent electronic snooping. Flavin arranged for a staff meeting to meet the twenty people who would be now reporting to me. They were told that the staff would be split with the global team departing for Greenwich to fill corporate positions and the remainder staying in Rochester to support the copier division. The objective of the corporate staff was to organize a state of the art network global network that would be recognized for its leadership in managing information technology. Now, that we were also a computer company, we owed an information technology superiority to our shareholders.

Following introductions I asked the staff to describe the Xerox computer establishment. There was a Univac 1108, but that served copier marketing only. The Univac installation was valued because it offered Teletype terminal access to its marketing database. This giant machine was located on the stage of a former theater that had been condemned by the

local fire marshal as being too risky for housing electronic equipment. Next to the Univac were IBM computers supporting the accountants and operated by a crew that reported to headquarters finance. On the 13th floor was a computer off limits to the systems staff because it was reputed to run intelligence reports. In the factory in Webster there were two IBM 360/65 running manufacturing schedules. The research department in Webster had innumerable DEC machines. Each of the five sales regions had their own IBM computer installations, though a few sales branches had tabulating equipment or used service bureau facilities. Equipment reconditioning centers were running small IBM computers. There was an education division with a huge data center in Columbus, Ohio. There were other computers wherever recent acquisitions had taken place. Xerox Canada was known to have least three data centers but nobody knew for sure where. Xerox Latin America had computers in Mexico and tabulating equipment in Brazil. Then there was Rank-Xerox. It was a joint venture and operationally totally separate from the US. Uncoordinated computer installations were present in the UK (an ICL computer), Ireland, France (of course a Bull), Germany, Spain, Italy, Holland, Switzerland, Australia and New Zealand. A joint venture was also operating as Fuji-Xerox in Japan and in Singapore, but nobody had a clue what the Japanese were doing. Not included in any of that were computers in factories and in research centers in England, France, Holland, Brazil and Japan. Added to that were numerous computer installations at Scientific Data Systems, now renamed as Xerox Data Systems (XDS). The scuttlebutt picked up in Rochester was that XDS was hiding somewhere an IBM 1460 to perform business data processing tasks that XDS could not perform on their own machines. An IBM computer in El Segundo worried me because it would give me a clue how difficult it would be to run commercial applications in an XDS environment.

Altogether, I estimated that the total information technology spending was well over $150 million and growing rapidly as Xerox was expanding as fast as was physically possible. I was going to preside over undisciplined and uncoordinated operations that were improvised to meet local data processing requirement. My job was to put all of that into order so that Xerox computers could take over everywhere. This qualified my

job as a formidable and probably an impossible assignment. The fact that Xerox was highly profitable should somehow allow me to accomplish this task by applying money as a lubricant. Ample funds would be available to throw at the XDS conversion problems.

Visit from Joe Wilson

Early in the afternoon, on the first day in Xerox, a distinguished looking grey haired gentleman walked into my office, un-announced. "I am Joe Wilson, just call me Joe" he said. It was the great man himself. The founder and spiritual leader of the company was an unassuming and gentle person. He welcomed me to Xerox and wished me well. For some time he has been bothered about the problems the company had with billing for copies and he hoped that someone who had supervised the printing of millions of delivery tickets for Kraft would surely know how to get more than 100,000 copier machines accounted for every month. He also knew about my displacing IBM computers with Honeywell and wondered if switching to SDS computers was comparable. He was not sure whether making a scientific computer behave as if it were a business computer could be accomplished in a short time. It was apparent that Joe has checked me out before he walked in.

We engaged in a discussion about the future of computers that was in the context of what apparently bothered Joe. Apart from the technology of xerography, his significant innovation was to think about capital equipment as a service instead as capital goods. The Haloid Company, the predecessor of Xerox, would have never sold too many of the pioneering Xerox 914 machines had they been priced as was then customary, which was at manufacturing cost plus mark-up. Joe had faith in what he produced, which was a far more expensive piece of copying equipment than had been ever produced. When the xerographic technology was first offered to Kodak, then to RCA, IBM, 3M and Agfa, everybody turned it down because nobody could see how one could justify installing expensive equipment to make only a few copies. Joe solved this difficulty by offering the Xerox 914 machine with a counter device that tallied how many copies were made. At the end of the month the customer would record

what was on the meter, write it on a punched card and mail that to Rochester. This approach was unique and fantastically successful. Customers did not perceive that copying was expensive (at five cents per copy) when they could get instant quality results, without waiting for the usual wet copying process to dry. Office personnel lined up to make copies. Xerox salesmen only had to stand by with a form to take orders.

Success with metering created difficulties in getting in all of the metering cards. When I showed up less than 70% of the meter cards from the installed base got into the monthly billing system on time. There were difficulties about giving credits for bad copies when the machine malfunctioned. There was dishonesty in reporting. Joe now felt that the business model on which he built his firm was now failing. How could computerization solve this problem? I did not know the answer. I would have to study the problem and get back to Joe, though I commented that in due course all metering would be done automatically over telephone or power lines.

I was impressed with Joe Wilson. Here was a genuine, thoughtful, unassuming and unpretentious person who talked about real problems. He was pleased to hear that a new executive, who was supposed to be an expert, confessed that he did not have a ready answer. Apparently I passed the Wilson test that he used to apply to all newcomers.

Shortly afterwards Flavin called. The Spring Computer Conference was starting in Boston and XDS would have a large display on it. It would feature the brand new Sigma 7 computer, which was the machine I was supposed to start installing immediately to fulfill the promise the CEO of Xerox, Peter McColough, made a few days before at a meeting of financial analysts. Would I "hop on the airplane" and get to Boston to see the Sigma 7. The phase "hop on the airplane" would be repeated often in the months to come so that the prospect of having early dinners with my four little children in Chappaqua kept receding fast.

Scientific Data Systems

Scientific Data Systems, or SDS, was a computer company founded in September 1961 by Max Palevsky and a handful of computer scientists

who used to work mostly for the military. He leveraged a specialty computer firm into an aggressive scientific corporation with sales of about $100 million. SDS was an early adopter of integrated circuits and the first to employ silicon transistors because that was what the government asked for, regardless of cost. SDS was also a user of early versions of the UNIX operating system that was favored by defense firms. The company concentrated on processing scientific computations that were used in avionics, missile and space applications, including support of NASA where cash was hardly ever accounted for. Forty years later I ended up as the Chief Information Officer of NASA and was still trying to unscramble NASA's profligate habits.

SDS machines were fast and were optimized around real-time applications that took advantage of many innovative features such as the very fast random access disk (RAD) for virtual memory swapping. Leading time-share firms, Tymshare and Comshare, relied on SDS equipment. It was the RAD that made it possible for SDS to become the premier supplier of computing power to firms delivering real-time computing involving complex calculations. IBM could not match the performance of SDS equipment and certainly not the price. I was also aware that SDS supplied special versions of Sigma for the Minuteman ballistic missile launch sites.

My First Sigma Computer

When I showed up in the exhibition hall in Boston on May 1, 1969 as the newly minted Xerox CIO, the XDS booth was crowded with onlookers who tried to figure out how a Sigma 7 could function as a business computer because that was now the rationale why Xerox bought SDS. I was welcomed with an embrace by Lou Perillo, the SDS VP of marketing and their star salesperson. Lou had a salesperson smile and personality that could sell ice cream to a frost bitten Eskimo. He understood that I came to check out the workings of the Sigma 7. The one on the floor was a "cream puff" (a used car salesman's expression I never heard before) and fully configured to demonstrate its versatility. Why not save money for Xerox and instead of shipping it back to the plant in El Segundo, California how about packing it after the exhibition and trucking it directly to

Rochester so that I could start using it? Lou's suggestion was sensible and sincere. After I made a call to Rochester to determine if could make a $1.5 million dollar purchase on the second day on the payroll I signed for the machine on the exhibit floor before somebody else would get it.

A closer inspection of the Sigma showed that it had magnetic tapes that could be used only for telemetry recording (making archival records of sensor inputs) and certainly not for sorting business files. The attached disk files — another key to IBM's business excellence — were not worth a damn. The capability of the Sigma to sort and store records would be essential for it could compete with what IBM excelled in. No problem, said the gleaming Lou after he pocketed my order, we can always attach to it fast tapes from the Systems Dynamics Corporation. With regard to the disk files that could be easily fixed by attaching Memorex drives. Meanwhile the Sigma could function as a time-sharing machine and support over fifty Teletype terminals.

The Sigma came only with a slim catalogue of software utilities that would be essential for any application that was running on an IBM machine. Lou informed me that making the Sigma to behave like an IBM 360 was my job, as he understood it. He was told that McColough had set aside a large war chest for converting the scientifically superb Sigma computers to performing business data processing. It dawned on me then that I had on my hand a one pilot fighter plane that had to be somehow transformed into carrying passengers. My only immediate prospect would be to displace the Univac 1108 with its communicating terminals with a Sigma 7 time-sharing computer.

The Boston Sigma 7 did not make it to Rochester for another four months because it had to be detoured to the factory for a "retrofit." It took another year, and close to ten million dollars to mate the Sigma to commercially suitable tape and disk drives. Despite all such fixes the Sigma 7 class of computers remained only superior time-sharing machines. These computers were respected for their real time capabilities in support of multiple terminals and sensors, which was exactly what the national security agencies needed. At the time of the Xerox acquisition of SDS the IBM Corporation had no intention to match XDS in cost and performance because XDS equipment was seen as filling only a niche market that was unstable.

The IBM Divorce

In view of his close business as well as social relationships with IBM executives Flavin believed that a meeting with IBM executives was in order to clarify relationships now that Xerox had declared itself as a competitor. I think it was about three weeks after I reported to Xerox that such a meeting was arranged. Attending were a large contingent from IBM, headed by David Kearns, then a regional IBM executive and a well known Rochester citizen. Attending for the Xerox side was Flavin, the chief Xerox auditor Walter Marx, a lawyer and myself. I was coached to watch Kearns who was enjoying a stellar career at IBM and would be expected to rise in the IBM hierarchy. How Kearns would prevent the loss of one of his key accounts — and that is how IBM marketing people were evaluated — would unfold in that meeting.

For openers, Flavin made declared that it was McColough's policy that Xerox would replace all IBM computers and that would henceforth dictate all of our relationships. I then rattled of the relevant statistics about Xerox computing assets, pointing out that the entire firm, in the foreseeable future, would have to be depend on support from IBM to meet our payrolls, pay vendors and collect revenues. I also offered a realistic opinion about XDS equipment, as a superior time-sharing computer with performance that IBM could not match. Whatever we would propose to do would call for a close relationship with IBM while we would migrate Xerox into an on-line, interactive environment where the existing IBM 360 series was underperforming. Alluding to my prior tussle with IBM, I noted that Honeywell-like emulation was not a viable solution, since XDS was optimized around time-sharing, not batch processing. So far, everybody was smiling. Kearns, in a most personable manner announced that IBM would do everything possible to retain its position as a trusted partner of Xerox. They intended to earn their monthly leases to the last moment whenever we could proceed to do something else. He also congratulated Xerox about thinking about communications-based information systems.

So far, the meeting was a love fest until Flavin remarked that my own bonus was totally dependent on the number of IBM computers that would be displaced. I thought that this closing remark was unnecessar-

ily confrontational. After the meeting I told Flavin, that regardless of the pleasantries, IBM was merciless when it came to competing. We were totally dependent on a dedicated staff of about twenty IBM systems engineers plus a full time residential staff of maintenance people, plus local spare parts, to keep our billing and payroll system afloat. I predicted that IBM would pull off most of these people out of Rochester and let us suffer so that they could use this as a lesson to anyone who ever dared to confront the power of Armonk.

The usual arrangement with IBM was that each computer installation was worth a number of points. A point was a dollar's worth of monthly rental. The typical rental for a medium size mainframe, such as a 360/40, was $10,000 to $12,000 per month. That increased to well over $30,000 for the bigger commercial computers, such as the 360/65. As a rule, for every 10,000 points you could expect IBM to dedicate to your account an "SE" (Service Engineer). These were systems engineers who assisted with installing new software releases, debugging the operating system and doing the customer's technical work. Systems directors would be always asking IBM to place more SEs on their site. Safe accounts, which were totally committed to IBM and had ample computer capacity, usually received less support. So-called "target" accounts could obtain from IBM two to three times as many people as the average allowance.

Xerox ended up with a total staff of about seventy IBM people, costing us nothing, though they were doing work that was not always for our benefit. About half of the SEs would be doing pre-sales work and preinstallation preparations, because we were upgrading equipment all the time. About a quarter of the SEs did feasibility studies and proposals to benefit the IBM sales efforts. Another quarter of the SEs would be available to perform tasks that we didn't have the budget to do, such as exploratory technology work. IBM found such engagements profitable because it strengthened the relationships with my staff and accelerated the installation of computers that ultimately generated greater revenues.

I was completely wrong when I thought that Flavin's aggressive posturing would deprive us of the much needed support staffs from IBM. They doubled the number of systems engineers and support people! The responsiveness of their service was superb. A senior IBM executive was

assigned permanently as my liaison. I trusted this man to give me good advice in the difficult transition to XDS, which never happened. While I was responsible for ordering and installing all computing equipment in the US directly, and globally indirectly, IBM revenue from Xerox more than doubled.

Following my retirement from Xerox I was invited to address a large gathering of IBM marketing executives in San Antonio, Texas. This took place during the times when IBM started failing and its shares were plunging. I told the story about IBM redoubling its support for Xerox at times when any other organization would have cut its commitments. In a glowing tribute to the "old" IBM organization which always cared about making customers successful, I compared Kearns' action with the then prevailing IBM practice to focus on filling sales quotas selling equipment. A number of the older salespeople came to meet me afterwards and thanked me for a tribute to an ethics that had been lost in the intervening years.

Dislodging Computers

Unfortunately, even with superior capabilities the Sigma could not dislodge the Univac. The Univac had a large accumulation of software, scientific utilities and a proprietary database. That would block any attempts for an easy transfer of applications. In the absence of standards and with code-and-patch programming, what was running on the Univac was for all practical purposes firmly welded into it. To replace the Univac we would have to reprogram what was already running well with the assistance of several dedicated programmers. These custodians were continually fiddling with undocumented codes. Porting such applications to a Sigma was not feasible since the resident custodians of the Univac would depend on their careers on their identification with that vendor and not with a brand new comer to the Rochester computer community.

The problem was that Xerox top management sold Wall Street on buying SDS as a vehicle for growth for what was then seen as an unprecedented price of one billion dollars. The justification was that Xerox would enter into the data processing business to compete head-on with IBM. Xerox would prove that by demonstrating that it could get rid of all of its

IBM computers, in short order. Xerox had the man to do it, with prior experience of displacing IBM. My job would be in peril if I could not deliver on that promise. Meanwhile, recruiters fanned out from Rochester with orders to hire as many IBM marketing executives as they could entice to switch into key copier sales positions until such time when computers could be folded into the Xerox catalogue offerings.

I got to know many of the ex-IBM executives on airplane trips shuttling from the White Plain airport to Rochester, then to Los Angeles and then making rounds to regional offices of Xerox where the installed IBM computers were the targets for displacement. The IBM executives were bright, personable, well groomed and well spoken. They were superb sellers of hardware. Whenever there were technical issues, they could readily depend on deep echelons of IBM support personnel to answer questions. Hiring IBM executives to sell a technically sophisticated time-sharing computer, such as a Sigma, was a lost cause. IBMers never managed to sell advanced computer systems even while at IBM. Their skills were in building relationships with customers, not in technical competence. In the absence of a huge support staff at Xerox, which was never acquired, there was no earthly reason why the newly hired IBM executives could ever sell XDS computers while enjoying huge salaries at Xerox by marketing copiers.

It was perhaps preordained that the copier sales force and their newly acquired IBM transplants would never be tested how well they could sell XDS computers. In less than three months I learned a sufficient amount of intelligence about the capabilities of XDS equipment to inform Joe Flavin that it would take tens of millions of dollars and many years, including a major overhaul of the Sigma operating system, for these machines to take over a business accounting workload. Such news percolated to other headquarters staffs that were now putting brakes on any opportunity to start fail-safe testing of selected business applications. What really shocked everyone was the discovery, by one of my eager emissaries, that despite an impressive showplace data center at the XDS HQ in El Segundo, tucked away in the corner was still an IBM computer performing the most essential business XDS functions, such a commission accounting and materials management. In addition, XDS outsourced just about everything

they could to service bureaus that took care of applications that XDS could never hope to load on their own machines.

As the disappointments about the potentials of XDS, as the flag carrier in the wars against IBM, were rising the XDS revenues kept falling. I am convinced that the flamboyant claims, about XDS transforming itself into a business data processing company damaged its hitherto favorable reputation as a company that offered advanced real-time computing capabilities. When the engineers and the scientists, who were the primary decision-makers in the purchase of such machines, heard that the future of XDS would be in business data processing they started placing orders with the Digital Equipment Corporation. That was a pity, because there were a number of applications, such as in time-sharing and in telemetry, where XDS was superb.

Burt Tregub ran a turnkey delivery organization in Rockville, Maryland from where he was catering to the requirements from national security organizations. He explained to me how Sigma could compete both in terms of price and performance in real time applications that supported such needs. The limited functionality of the Sigma operating systems, a lack of software clutter and the open interfaces were advantages in cases where a client needed fast and raw computing power to serve one of a kind remotely located devices. Xerox top management paid no attention to that. They kept repeating and publicizing what Peter McColough promised when he paid out a billion dollars for a dream that had no chance of ever succeeding. Instead of making out of XDS a small but profitable specialized computer firm until such time when they could redirect its technologies, Xerox started shoveling money into another strategy that would not pay off for a long time. The problem was that Peter McColough wanted results immediately as well as very large profits. So far as I was concerned, the migration of XDS equipment as a way of displacing IBM machines was doomed from the start. I do not remember when I came to that conclusion, but it was early in 1972 that I wrote off any prospects of becoming a rich man from the promised 5,000 shares for each displaced IBM computer.

XDS Conversion

To proceed with the conversion of IBM equipment to the Sigma I proceeded to organize a dedicated staff that would be directly accountable for displacing IBM computers. It was necessary to structure such effort as totally separate activity from the other business computer operations that were already struggling to cope with rapidly increasing demands for services. The conversion operation was set up as a separate profit center so that it could charge its costs to corporate R&D and not to overhead. This was one of the many accounting tricks to disguise the full costs of the XDS acquisition. Setting up conversion as a business was a smart decision. As the costs of the conversion mounted this effort had to be abruptly aborted after three years of spending well over two hundred million dollars in addition to the cost of equipment at manufacturing prices.

To run IBM applications XDS needed a COBOL compiler as well as more powerful sort utilities and a batch processing operating system that would have to replace the SDS operating system optimized for time-sharing. Xerox did not have a staff to develop such capabilities. Late in 1969 Xerox contracted with the French firm CII, which was subsequently merged into the French firm Bull, to develop a Xerox operating system for commercial purposes — XOS (Xerox Operating System). The announcement of the XOS as a business operating system was featured late in 1969 on double-page spreads of *The Wall Street Journal*. It was slated for beta testing by the Xerox internal staff now under my control.

Starting in 1970, many of the commercial class peripherals which were necessary to run XOS, such as printers, tape drives and large capacity disk drives were devices I started purchasing for internal use to reduce IBM rental payments. These "plug-compatible" peripherals made it possible to retain the IBM processors, while cutting the cost of monthly rentals. I would have followed that course anyway regardless of conversion to XDS because the profit margins for the IBM brand peripherals were excessive. As one of the largest purchasers of plug compatible disk drives we gave a boost to the Memorex company and to the SDC (Systems Dynamics Corporation) firm coming out with high quality tape drives. To show a reduction in the number of IBM computers in Xerox I also pursued the policy

of data center consolidation. For instance, instead of six 360/40 computers we rented two very large 360/65 machines. Consolidations combined with upgrades gave us a reduction in the number of machines that needed fewer operators while yielding a four-fold improvement in price/performance.

Under a corporate contract with XDS some of these peripherals were shipped with newly configured Sigma 8 and Sigma 9 equipment that were labeled as commercial computers but could not be used as such. At the peak of the efforts to transform XDS into a vendor that could compete with IBM there were more than hundred people on corporate staff trying to boost the capabilities of Sigma computers inside Xerox while picking up applications to increase the placement of XDS equipment. Though some of these Sigma machines would be put to good use as time-sharing machines to process APL time-sharing they would never displace IBM equipment. The French XOS would not catch up with what IBM had to offer. CII itself, on whom Xerox relied to deliver the critical operating system, was a firm in disarray. CII, like SDS, was primarily a process automation company with sales to the military sector. It was heavily subsidized by the French government hoping that it would become a networking firm. XDS would rely on CII as a way of minimizing its own software costs. That did not work out. It was like the lame leading the blind, which is not the best way to race in a marathon.

My involvement with CII and the XOS got me engaged in negotiations with various French organizations that were seeking out cash-rich Xerox for a partnership. On my many trips to Paris I was deputized by Xerox management to engage in exploratory talk how Xerox could acquire a part of the French Minitel messaging service. I thought that the idea of buying into a government controlled European videotext system, that was wedded exclusively to the French Postal & Telegraph authorities, was an example of acquisition promiscuity in Xerox thinking. Other than sumptuous dinners and exquisite entertainment the entire exercise was a waste of time. When I finally reported to Stamford that I thought Minitel would be yet another train-wreck, nobody paid attention because the prospects of a French XOS had just faded away.

The Leningrad Caper

As Xerox top management kept emitting mixed signals about the destiny of XDS, loyal government customers accounting for less than 1% market share of the computer business even during its peak years, started looking for other sources of comparable machines. XDS R&D was also in disarray, as the newly minted millionaires cashed in their Xerox stock. Since the SDS stock was widely held by employees, who were now wealthy, they stayed on the payroll for a while to take advantage of Xerox benefits while waiting to form new ventures or to do whatever they pleased. Meanwhile they did not contribute much to Xerox although some of them received choice corporate staff positions in Stamford. None of the SDS transplants in Stamford stayed longer than six months. We also started importing Rochester copier manufacturing people to El Segundo to support operations, which did not work at all because they would be never accepted in a totally different culture that was tainted by a Hollywood outlook on life.

Max Palevsky, the SDS CEO was an entrepreneur always looking for big gains. After the acquisition was consummated he invested in the production of "unconventional" movies, which were even more profitable than the computer business. Lou Perillo retired and bought an avocado farm. Meanwhile, the revenue of XDS kept declining, which was further compounded by the discovery of discrepancies about the accounts receivables and bookings just prior to completion of the acquisition.

One morning the telephone rang and Flavin was on the wire. Would I "hop on the plane" immediately and go to the Department of Commerce in Washington to pry loose an export application that was stuck in some sort of a bureaucratic hassle? Apparently, a Sigma 6 computer was sitting fully crated on the dock in Southampton, England, waiting to be put on a Polish ship for delivery to Leningrad for a computer exhibition. The ship would be sailing in a few days to arrive just in time for the show. Flavin vaguely remembered that I had served on some sort of Commerce scientific committee. Perhaps I would know my way trough the labyrinth of Commerce offices on the 14th Street. On this trip our Washington legal counsel would accompany me.

When I arrived at Commerce, I was advised to seek out informally the man in charge of "munitions control" because high performance computers were then classified as munitions. The staff responsible for granting export licenses were hopping mad about the conduct of Xerox. I was not ready for the abusive blast I received, which was totally out of line with the usual circumspect conduct of senior civil servants. The regulations on export of computer equipment to the Soviet Union were strict and were administered by Commerce, acting on behalf of the State Department though in reality everything was controlled from Langley, Virginia and Ft. Meade, Maryland. The computer we applied for in order to ship to Leningrad matched the profile of computers now in our Minuteman ICBM missile silos.

We were accused of trying to pull a "fast one" to circumvent an absolute prohibition against any equipment that would be of value to Soviets in the missile race. The Sigma 6 had a peak data rate (PDR) of over 250 million bits per second, whereas the best Soviets could obtain from us legitimately were instruments with a capacity never exceeding a PDR of four. Xerox was just lucky that the Government would not invoke criminal provisions that would subject us to enormous penalties, a complete exclusion from doing further business with the government and confiscation of contraband property. My lawyer advised me to apologize profusely for a misunderstanding caused by our Rank-Xerox subsidiary, without corporate approval. We begged for an immediate withdrawal of the tainted application. In view of my prior services to the Assistant Secretary of Commerce for Science and Technology I was informally advised that it was the habit of Soviets to entice American companies to participate in exhibits from where technology would be either stolen, or taken apart and copied during nights.

Flavin would not accept my explanation that we were planning to smuggle military contraband to the Soviets. It appears that Lou Perillo, desperate for making up for dropping US sales, shifted his marketing efforts to international markets where a few firms would place orders for advanced model Sigma computers to copy our intellectual property. This is how Lou snatched some sales in France, in Algiers (in cooperation with the French) as well as an interest from the Soviets. The Soviets knew that

Xerox would never get an export license and therefore made arrangements for a huge platform, at the forthcoming Leningrad technology show, with "guarantees" that the equipment would be fully guarded at all times (by Soviet guards, of course). After the show it would be immediately repacked for return to England. For all of that, Lou paid a huge amount of dollars for the exhibit space. Without an export license, the space would be empty. It would reflect unfavorably because it would show that we were "not trusting the Soviets", according to the British Chairman of Rank-Xerox. All that rubbed Flavin the wrong way because Rank-Xerox (now reporting to Flavin) enjoyed an enormously profitable copier business with the Soviets. They threatened now to buy copiers from the Germans.

If the Department of Commerce would approve only display of a computer with a PDR below four, I proposed that we would now offer only that. Being well versed in Russian history I remembered the "Potemkin villages" where a visiting empress was shown prosperous and happy peasants greeting her entourage standing in front of houses that had only a painted fronts and nothing behind. The prime minister, a Count Potemkin, was then praised for managing the czarina's estates well.

Our "Potemkin" computer consisted of gray computer cabinets plus a printer. The inside circuitry was gutted, including the extraction of the high performance RAD (Random Access Device) that the Soviets coveted. Instead, two simple circuit boards were sealed inside the wiring cage. The cabinets were also screwed in with breakable fasteners. One circuit board would control the console lights, which would blink in random sequence when the power button was pressed. The other board would manage the printer that spewed out one of four listing on command from one of the many console switches. The amused Commerce Department munitions controllers approved the proposed set-up. It met all of the regulations in every respect. The Sigma 6 was loaded, with much fanfare, on the Polish freighter. On the exhibition floor the Sigma was unpacked and set up behind ropes that were guarded against any nosy onlookers by guards provided by the Soviets. The entire event was a considered a great success as a sign of close cooperation between American and Soviet technology interests. At a subsequent black-tie dinner in London the Chairman of

Rank-Xerox acknowledged my work for promoting improved customer relationships.

Dealing with the Soviets

The Soviets were upset. After they found out that there was no chance of ever acquiring useful XDS equipment, they started pressuring Xerox to license manufacturing rights so that they could start making copiers. That would never came to pass after we convinced them that much of what went into a copier was not manufactured by Xerox at all but was purchased from hundreds of suppliers. That was not the way the Soviets operated. A Minister in charge of copiers could meet the targets set by the Five-Year-Plan only if he could fully control the supply of every part. That would involve making electrical motors, drums, switches, belts, pulleys and hundreds of other components. The proposed copier factory was going to be placed in one of the Baltic countries where the workforce was not sufficiently demoralized to make precision components. When the Soviets insisted that we also provide them with the manufacturing drawings of what we bought from our suppliers the negotiations broke down and after many years they were dropped altogether. For a couple of years we had to dedicate one of our most experienced engineers, Merritt Chandler, to attend unending negotiating sessions and responding to increased Soviet demands. Meanwhile, Xerox was increasing the share of purchased components and subassemblies included in our equipment. The Soviets simply could not catch up with the rising sophistication of our logistics that shrank the company-originated value-added to less than 50% of the total manufacturing cost.

I mention this experience as a way of explaining what finally prevented the Soviets from make much headway with computers or with XDS. Although their RIAD series were a poor copy of the IBM 360 series, they would be kept lagging behind American progress because the Soviet planning mechanisms blocked the development of a standard parts and supplies business. When I gave a presentation on the management of computers to the Soviet Council of Ministers, near the Kremlin in 1983, their interest concentrated on how I could keep the national Xerox data center

running with 99% uptime, while relying on an elaborate "supply chain" to keep it functioning. They had great difficulties understanding this concept. To them a "supply chain" was circumscribed by the extent to which any one Minister could manage everything, preferably in the immediate proximity of a single site.

The next day after the presentation to the Council of Misters, I was asked to give a seminar to a group of senior Soviet plant managers. After hearing about their difficulties in managing production of even simple consumer items, such as television sets, refrigerators or washing machines economically I came away convinced that the Soviet regime would not be able to produce electromechanical goods in sufficient quantity and quality. They could certainly mass-produce weapons by creating completely integrated factories, at an enormous cost, that were devoted exclusively to spewing out tanks, rockets and Kalashnikovs. When the Soviet Union finally disintegrated six years later, I attributed its demise not to "Star Wars" but to their inherent inability to connect thousands of suppliers with hundreds of producers. A relatively small number of bureaucratically and politically managed huge industrial complexes ended up with excessive amounts of obsolete and unproductive capital assets, while the employees grew increasingly inefficient because the absence of any critical part would stop an entire assembly line.

Exploring Opportunities in Education

When I arrived in Xerox and became the chief responsible for all information technologies as well as the General Managers of the Xerox Information Services Division I became immediately diverted to participate in strategic planning committees and task forces that would be addressing the question whether the copier business would be sufficient to keep increasing Xerox profits. This had to be accomplished at rates that would justify the huge price/earnings multiple that the Company was enjoying on the stock market. Xerox stock, then with a price-to-earnings multiple of over sixty, would be placing an enormous burden on any business that could deliver improved financial results and pay off on the generous stock options now held by all executives. While xerography, at least temporarily,

could be priced at premium prices that would be unrealistic to continue forever. As a diversification, Xerox had to become engaged in other businesses as well.

The first task force that I became involved in 1970 was steered by Cliff Teem. He was a physicist who had been analyzing the potential of making acquisitions that could become a viable diversification vehicle for Xerox. In the late 1960s Teem's group concentrated on getting Xerox involved in then notoriously inefficient education processes. That was seen by Joe Wilson both as a business opportunity as well as a service to society. Cliff and his team looked at every conceivable transformation of xerography, included some very advanced concepts of on-demand publishing of textbooks, but none of these could pass a screen as a financial match for the copier business. A number of unrelated acquisitions were then made in the education sector, without any possibility of leveraging their diversity into then frequently used term of corporate synergy. The education acquisitions were Basic Systems in 1965 (renamed Xerox Learning Systems); American Education Publications also in 1965 (renamed Xerox Education Publications, including *My Weekly Reader*); Professional Library Services in 1966; Learning Materials, in 1966; R.R. Bowker, in 1967; Ginn textbook company in 1968. Grouped with the educational acquisitions were University Microfilm, in 1962 and Cheshire, in 1967. Despite efforts of able executives, such as David Culbertson, the educational subsidiaries would never contribute to Xerox hoped for growth. In due course every educational acquisition was sold off, at bargain prices. Again, the major beneficiaries of the educational shopping spree were the original owners. For instance, Wesleyan University, who had nursed the *Weekly Reader* magazine for many years as a barely subsisting educational service, suddenly acquired a large anount of Xerox stock. For that they could afford building a magnificent new university campus.

Cliff Teem then turned to start looking at unconventional opportunities that could be grouped into the category "Office of the Future" that would haunt Xerox for the next fifteen years, until its demise. It was during these sessions with the corporate planners that I became exposed to what was then the prevailing strategic planning wisdom at Xerox. Using astrology-like circles and unlabelled three-by-three matrixes (a Harvard

Business School favorite), the markets considered to be eligible for expansion by Xerox were tagged as to their potential. With Xerox revenues approaching $1 billion, "education" could be seen as a huge market, but only vaguely related to anything that could be served profitably by the copier marketing organization. It was only subsequent to making educational acquisition that the corporate planners finally removed education from the shopping list.

Looking for the next great leap forward the planners were ranking markets such as in telecommunications, computing, paper (yes, buying paper mills was examined every year and rejected), commercial leasing, printing, book publishing and magazines as to their potential. Having been exposed to techniques of strategic analysis that were adopted by the General Electric Corporation and that were now disseminated by Sid Schoeffler of the Strategic Planning Institute, I found that the Xerox approach was based more on arguments and wishes, than on facts. Every strategic choice was argued as if it were an MBA case study but with hardly any of the depth of insight that would demonstrably narrow the focus for attaining a leading market share position in whatever segment that came under examination.

Schoeffler's methods, subsequently imitated by the Boston Consulting Group, made it clear than only firms that could gain one of the top three ranking market share position in any competitive segment, could hope to reap superior profitability. That was not the way Xerox management treated strategic planning. Blindsided by the enormous success of xerography, the "Carlson jinx" encouraged plunging into new businesses without an already established customer base, without top executive's market experience and starting only with a clearly inferior market share. The going assumption was that Xerox stock could now buy a market position, marketing know-how, executive experience and whatever technologies that could overcome entrenched competitors.

Project Plato

As the last gasp in an education-based strategy the corporate planners started exploring the possibility that somehow synergy could be ex-

tracted by exploiting the recently acquired XDS time-sharing capabilities for computer-aided education. This involved an interest in buying "Project Plato" from the Control Data Corporation of Minneapolis. CDC was run by Bill Norris a pioneer in scientific high-performance computing. While IBM was concentrating on business computing, where just about all of the profits in the computer business could be found, there was still open a market niche for high performance scientific computing to be delivered as a service. Norris, an excellent engineer, formed a corporation that designed and supplied such computers. For a period of about fifteen years there were scientists, especially those who wished to keep their computing out of the hands of the IBM-oriented data processing organizations, who would be the purchasers of this equipment. CDC was also not bound by some of the IBM pricing practices and could successfully bid to supply computing power to government agencies. In many respects CDC was very much like XDS.

For most of the 1960s CDC built the fastest computers in the world only losing that superiority when Norris became diverted into other ventures, of which Plato was a favorite because it attempted to harness the power of supercomputers for delivery of computer-aided teaching of elementary school children. For that reason Plato was appealing to a number of Xerox corporate executives. If we could not buy CDC we could consider acquiring Plato as a way explaining why Xerox was in the education business. Plato offered superior technology in the form of plasma screen desktop displays. This system took advantage of CDC's competent time-sharing offering and offered pioneering innovations in instructional methods. Besides, Plato kept receiving rave notices from computer scientists and from computing magazines.

When Norris offered Plato for sale an acquisition team, including myself, was dispatched to Minneapolis to check what CDC had to sell. The product demonstrations were impressive and the technologies were ahead of anything anywhere. Plato certainly fitted the Xerox visions of bringing to the world a revolutionary new way of managing information and would have enormous public relations potential.

On the second day of the shopping tour we visited a second grade classroom and observed how children were engaged in the testing of their

arithmetic skills. I priced out the terminals sitting on the children's desks, followed the cabling into the communications room, interviewed the support staff and checked out the computing power that was pumping interactive screens into the classrooms. The total cost of ownership, per classroom seat (at manufacturing prices), was much greater than the total annual schooling budget for education of a child in Minnesota. There were no displaceable costs to offset such expenses because it would have acquired more teachers and an increased staff of curriculum developers to operate Plato. The Xerox team returned to corporate headquarters with glowing reports, recommending that Plato be licensed as a research investment despite my non-concurrence. With Xerox always on the lookout for a prestigious acquisition announcement the Plato deal was almost approved except that attention was now sidetracked to dealing with the rapidly tarnishing luster of Xerox Data Systems.

The Xerox 530

When the Xerox 530 computer was announced in January 1973 to replace the Sigma 3, I made a mistake that ruined my reputation as a cautious computer executive. Trying to please the corporate leadership that was eager to show that we could install a large number of XDS computers internally in support of US administrative operations, I ordered fifty-eight Xerox 530 computers to be installed in each branch office in support of the newly-developed COIN system. These machines would give administrative clerks on-line access to customer and equipment files and propel Xerox into a real-time environment that could deliver enormous improvements in the quality of service to customers. Conceptually as well as financially the migration of Xerox administrative systems from batch processing to on-line processing was a great idea. In practice, it violated every principle to which I always adhered: never to pursue more than one, or at most two, major systems revolutions simultaneously.

In this case we were going to install a state-of-the-art new computing environment, on an extremely short schedule, with unproven hardware, with as yet untested software, with newly hired managers, using personnel with only batch processing skills. Compounding all of the challenges

was the growing resistance from the regional financial bureaucracies who opposed yielding control over original data entries to branch office personnel. These were at least seven major sources of risk. Anyone of these taken more than one at a time could sink the project. When the risks were combined for rapid implementation the failure was inevitable.

So far my track record in Xerox was close to perfect. Despite good advice not to proceed I signed up for the Xerox 530's and to the vision to take Xerox administrative processes into a time-sharing environment. With Ray Hay now in the position as President of US operations, it was his insistence that pursuing the re-engineering of business processes for the copier business was mandatory as a defensive move against Japanese encroachments. If I over-ran budgets or schedules that would not matter in the long run. When XDS pulled out of the computer business and Ray Hay decided to quit, I was stuck with a very bad bet. The much needed reforms of the Xerox administrative systems were killed and never restarted. This contributed to what Xerox experienced years later by coming close to bankruptcy.

After cleaning up the mess after the COIN project was dismantled I expected to get fired. Then the unexpected happened. In 1975 I was promoted to a corporate staff job as Vice President with only 9-5 duties instead of the harrowing around the clock worries about malfunctioning hardware and software.

The End Game

In 1972 Archie McCardell became president of Xerox and Peter McColough moved up to became chairman. Archie McCardell was an ex-financial executive from Ford Motor Company and it was said that this represented an attempt by the Board of Directors to convert Xerox from an undisciplined, fast growth venture to a structured and orderly corporate enterprise. Archie's arrival coincided with the slow-down in revenue growth and the flattening of the upward trend in the price of Xerox stock.

Applying methods and logic applicable to the declining fortunes of Ford, the corporate finance staff now started an interrogation how and when XDS would be shipping the much delayed new computers. XOS, the

Xerox Operating System, a joint venture of CII, would be late and most probably not a breakthrough product. Meanwhile, the Digital Equipment Corporation and the Control Data Corporation were rapidly gaining market share. Financial controls were now getting installed in El Segundo. Problems with cash flow accounting and receivables irregularities were discovered. The generous sum available for conversion of internal Xerox computing based on IBM machines was throttled to subsistence levels as the prospects of displacing IBM now receded into an indefinite future. I was now quoted that SDS had misrepresented what they could do to deliver commercial data processing services.

Valiant attempts to involve XDS in joint marketing with national account copier sales representatives didn't get anywhere. Copy sales people were calling on office managers or the print shop supervisor, with purchasing authority for operating expenses. Computer representative were calling on Directors of Information Systems who would have to go trough a time-consuming review process prior to approving acquisition of large capital investments. Complicating this situation was the absence of commercial selling experience by XDS. Their marketing people never called on corporate chief information officers but mostly on scientists, heads of university data centers and government program managers. XDS got orders based on competitive bids for purchases. Xerox copier salespeople used charm, pricing arrangements and re-shuffling of equipment to talk about monthly rentals. A few IBM transplants could not compensate for such deficiencies.

The auditors discovered problems with plant management. In a shift to functional centralization the computer manufacturing facilities in El Segundo were precipitously brought under control of Don Lennox, the VP of manufacturing and an experienced automobile production executive. He started placing manufacturing staff from the copier factory in Webster, New York, to run the plant in El Segundo. The more they tried to run computer manufacturing — in Ford style — the worse it got because of the culture and totally different concept of operations. Sigma machines could not be serially mass-produced in quantity. They were hand-assembled as one of a kind configuration, in limited quantities. Sigma computers were completed to meet the customers' specifications with only a second-

ary consideration given to direct costs. Good manufacturing practices that would perhaps apply in Detroit to mass-produced automobiles (they did not, as was shown later) certainly did not work in El Segundo making custom computers. The Webster people then tried to improve labor utilization rates in the now mostly empty computer manufacturing facilities by transferring production from the East to the West. That made things only worse. A labor force and facilities suited for assembly of custom-made computers could not be turned around to make copiers at the rate of 300 a month.

As the losses mounted, the number of task forces looking for bold and quick solutions kept growing. I was a member of about more than half of them because there were now a large number of XDS machines installed or committed under my control. As information about XDS capabilities became better understood we concluded that the decision to go into the computer business was made with little forethought. Going into the computer business should have been made strategically, as long-term (10 year) commitment in a specialized market niche, instead of attacking a broad market which was what the various task forces were now analyzing on a quarter-by-quarter basis. While we were examining current bookings and order backlogs, the mismatch between public relations pronouncements and viable options how to fix the situation was increasing. After current sales dropped by 50% everybody's attention turned to an examination how to exit the computer business with minimum losses.

Winding Down XDS

As the financial health of XDS was shriveling the corporate conversion project started assuming some the development tasks should have been properly charged to XDS as a cost of entry into commercial data processing. The capable Jack Lewis, ultimately the CEO of Amdahl, now assumed the leadership of XDS. By 1974 Jack was ready to launch a commercially oriented computer, the Sigma 9 computer that would offer many of the desirable characteristics considered suitable for business transaction processing, especially in the manufacturing environment. When Jack was ready to present his case for corporate review, and with some of the

development money now booked as a corporate expense and not chargeable to XDS, the enthusiasm for becoming a computer firm had evaporated. The funding for an aggressive program to promote the Sigma 9 was not approved. An otherwise promising machine that would have gained a modest but profitable market niche was allowed to fade away.

Because XDS could not sell large commercial computers, they continued to develop successors to their Sigma 2 and Sigma 3 microcomputers. These products were well accepted in laboratories and as control devices for manipulating data transferred from scientific instrumentation. The new Xerox 530 was a scaled down version of large Sigma machines.

While it was a part of Xerox, XDS retained its own marketing organization and its own service organization, except towards the end its manufacturing came under Rochester control. That made no sense except to hide some of the rising unabsorbed overhead. Originally, SDS was totally autonomous at all times, including research. Their R&D declined immediately prior to the acquisition so that accounting profits could be temporarily increased. After the acquisition by Xerox R&D remained stagnant and ultimately vanished.

There was no sharing of resources between XDS and Xerox even though many meetings were held to explore ways for working together. The principal rationale for the acquisition price of a billion dollars was justified by the presumed synergies that never materialized. Unfortunately, there was no fit with anything one could find among Xerox products. There was no fit with copier marketing, even with the newly joined ex-IBM executives who knew how to manage sales but not computer technology.

Compounding the misfit between SDS and Xerox was the fact that XDS business was already in a slump as defense purchases suffered through it customary cyclical decline, starting late into 1968. XDS was going to make their profit plan for 1969 by shipping a substantial amount of equipment, booked at list prices, internally to Xerox. That is why I attracted much attention about all of the XDS equipment I was planning to deliver for intra-company information processing.

On a cost performance basis, if you disallow for excessive downtime and high maintenance charges, the Sigma 7 computer was for a moment the best real-time computer available because it was designed to

function with an operating system that relied on virtual memory swapping. We bought a number of such computers for the research center to be applied to on-line interactive calculations by the research staff.

Luckily there was a backlog of information processing needs on the analytic side, especially in financial simulations of pricing. Offering generous Sigma time-sharing capacity for on-line Teletype terminals was an effective way of getting the finance and research staffs off my back. Pricing and marketing analysts loved to invent all sorts of theoretical financial models how to optimize prices and sales commission plans. We had hundreds of such model builders looking for computing power to calculate hundreds of possible alternatives. The Univac 1108 became totally saturated and could not support such efforts and therefore workload was shifted to Sigma 7 computers, which allowed me to maintain the pretense that I was converting to XDS.

Xerox withdrew from the mainframe computer business on July 21, 1975 after only five years of pursuing completely unrealistic expectations while the overhead costs grew completely out of control. It gave up trying to salvage this diversification only three years after announcing to the world that it would carve out a major position in the computer business. We sold off the remaining inventory to Honeywell who continued to do a competent job maintaining the leftovers of a misconceived venture. I do not believe that anyone ever figured out the shareholder costs of the aborted efforts to enter the computer business. The losses were co-mingled with the firm's cash flows and were promptly forgotten.

In closing the computer business Xerox management missed an opportunity to convert its losses into a valuable gain how to avoid repeating the XDS experience again. That was not done at corporate headquarters, where I was member of a task force consisting of David Kearns, Don Pendery, Jim Campbell (of Xerox Computer Services) and myself that recommended why and how to finally close out XDS. My position was that a small and profitable time-sharing business could be salvaged under the leadership of Jack Lewis who meanwhile prepared a credible plan how to proceed assuming that all past costs were sunk anyway. Retaining XDS as a placeholder would have maintained support for the 140 XDS computers that I now operated and would provide options to grow the business even

though the expected spectacular profits would not materialize in the immediate future. The task force had marching orders from McCardell and O'Neill to take an extremely short-term view of the cash situation. Consequently the recommendation to proceed with an immediate shutdown, except for computer printing, was inevitable.

Exit from the computer business was never discussed again in the two follow-on executive seminars run by the Harvard Business School professors and which I attended. That was regrettable, as the next failed venture (into the office automation business) would demonstrate soon. Failures happen in business and in life. Failures can be valuable if they can be converted into learning how not to repeat them ever again. In the case of Xerox the collapse was going to be repeated except that in the case of the next round the costs would be higher and ultimately cripple the once most promising innovative venture in America.

Thoughts about XDS

In retrospect, the purchase of SDS as well as the later funding of PARC can be now understood as a romantic attempt to recreate what occurred when the Haloid bet on a prototype copier demonstrated by the Battelle Institute. Accordingly, SDS was offering a daring and bold new architecture that offered a capable communications-oriented computer. The SDS, through time-sharing, offered new ways how to deliver computing services. SDS had nurtured different systems architectures than IBM. It offered virtual memory capability, which they did not invent but adapted from the UCLA at Berkeley, a notoriously non-conformist place. Its top executives would be best described as brash and aggressive operators, who went to great lengths to demonstrate their unconventional behavior. The SDS headquarters had no elevators to encourage physical fitness. The CEO drove to work in a London taxi. IBM style white shirts and short haircuts were avoided and kinky life-style habits were emulated in public. SDS displayed all of the cocky characteristics of a team ready to subdue IBM with a business model aimed at destroying the corporate data center, which was IBM's stronghold. SDS sold Xerox top executives — none of them having hands-on experience in running a data center — on the idea that SDS

could become and instrument of destruction of IBM. As long as Xerox was ready to pay for that, SDS executives were eager participant in such a joyride.

Such claims, supported without evidence of a single case of ever displacing an IBM business data installation, were catering to the wishes for Xerox to participate in the rapidly expanding computer business. SDS top management and Arthur Rock, the venture capitalist controlling much of SDS shares, appealed to Xerox's quixotic dreams of gaining quick access to the future of the computer industry. While SDS had less than 1% of market share of the computer industry, and even then only in the narrow segment of a notoriously unstable government defense sector, the expectations of making rapid gains that could add to Xerox multi-billion dollar revenues were a dream except that such speculations became a rationalization for the exorbitant price paid for SDS. After the acquisition, leading SDS executives either retired or would be appointed to key corporate staff positions in the Stamford HQ while they kept their houses in California and quit Xerox when their stock options matured. Most of the XDS top executives were replaced by recent ex-IBM recruits from Rochester. The remaining XDS executives delighted in coming to staff meetings at Stamford in polyester blue suits with a florescent hue. Dan McGurk, now the XDS CEO once showed up with a tie with the picture of a giant green frog. Such anti-establishment accentuation of cultural differences were duly noted as demonstrations of increased alienation between a failing Xerox subsidiary and the HQ staff who would be soon receiving reduced bonuses.

For all practical purposes the ex-IBMers now transplanted to El Segundo were useless in redirecting the rapidly declining SDS fortunes. Much of that was a matter of life style. The mid-level executives from upstate New York were from the University of Rochester, University of Indiana and the Rensselaer Polytechnic Institute. They were committed to corporate careers and practiced mid-American values of family and church going. XDS was Berkeley, UCLA and anti-establishment both in beliefs and in the way they lived.

When Xerox tried to make XDS into something that looked like IBM that idea was doomed to failure. The technology of XDS would never fit what IBM was good at. IBM's only time-sharing computer, the

IBM360/67 was an overpriced and poorly performing machine that was not a product they sold to large organizations who were their principal customers. IBM's salespeople made money selling hardware, not services and therefore their culture did not line up with what was originally seen as an SDS advantage. By 1973 IBM gladly got rid of its Service Bureau Corporation as a part of an anti-trust agreement — something they had wished to do anyway because it did not fit their capital-intensive business model.

Corporate Information Systems

During my interview for the position as Director of Information Systems of the Xerox Corporation, I talked with Joe Flavin for an hour about my views how the management of information resources would be evolving and how providing information as a professionally managed service would in due course offer the best way how to organize corporate systems. Joe agreed with this vision as a concept leading to the creation within Xerox of an independent Information Services Division (ISD) that would operate as a profit center. ISD would be extracted from the budget of corporate finance and become a servant of anyone who could pay a quoted competitive price (market price less industry marketing expense) for services received. Although these were lofty goals, and were explained to everyone in such terms, the real reason for chartering ISD was a politically expedient way how to find one more place where to hide the cash hemorrhage from XDS. As is the case in major corporate reorganizations, there is always an official explanation as well as a political reason for everything.

When I became the Chief Information Systems Executive of Xerox there was already a large staff already in place. In the US there were over three hundred data processing people split among the various controller organizations. To stage the migration to XDS computers I started moving senior staff from reporting to divisional comptrollers and placed them under the direct corporate control within a specially chartered XDS conversion organization that would be affiliated with the Information Services Division I would be running. The local controllers would be then given generous headcount allowances for backfilling hires.

The Equipment Billing Situation

As a first priority I decided to concentrate on my prime job of fixing what needed to be done with Xerox's internal business operations. When I showed up fewer than 70% of the installed machines could be billed at the end of each month. All copiers had meters counting the copy volume. Invoicing depended on a customer returning a pre-punched card, recording the month-end meter reading. There were an exceptionally large number of disputes about the timing of meter readings and unsettled credits issued against copy counts. That happened whenever a Xerox service man tested a malfunctioning machine. Consequently there were copiers that could not be billed. Until disputes were resolved, usually by accommodating a customer's claims, the billing system held an account in suspense. Compounding this situation was perhaps the most complicated commission system ever invented for the Xerox sales force. Central marketing staff used frequent changes in the pricing plans and commission plans to steer the sales force to sell the right products and for the customers to order the correct equipment. The continuous fiddling with pricing and commissions was inherited from IBM except that in the case of Xerox the changes were more frequent along with reorganizations and with the constant shifting in salespersons' territories. When I arrived there were hundreds of pricing plans plus all sorts incentive deals and allowances, such as for group purchases. The commission plan was tied into the billing systems. Unbilled invoices became a target for entering arbitrary adjustments that fouled up the entire invoicing process. In the ensuing years the billing situation got progressively worse, especially when Xerox started offering equipment for outright purchase in addition to renting it out on a per copy basis.

Copier prices and commissions were subject to change by the financial analysts who were recently minted MBAs without selling experience. While Xerox enjoyed a quasi monopoly position in the copier business they could shape the revenue and profit expectations at will. Invoices would be understandable only to an audit expert. What originally was an offer of a simple per copy usage fee now become so complicated that competitors advertised that even though Xerox technology was superior the invoices were not acceptable. From the purely data processing standpoint,

the worst offender to this situation was the way the sales force got paid. Sales people received checks, under a complex calculation that included an allowance for the realization of potential future revenues. In cases that the revenue did not materialize, or in cases when a customer returned a copier that had generated premium commissions, the system was supposed to back-charge a salesperson's paycheck for any differences. Performing such manipulations was a nightmare.

The billing system and the commission system transactions were recorded on magnetic tapes. To retroactively rerun any adjustments required a looking-back analysis of prior invoices and of prior copy volumes. At month-end this required spinning data that existed on a huge bank of tape drives in an exact sequence, so that adjustments could be made to historical records. Naturally, errors would be made and sales people, each with a good smattering of systems know-how, developed a keen eye for any errors that did not favor them. This led to inquiries, audits and adjustments that were noted by the financial controllers as MIS (management information systems) errors. As long as computers reported to financial executives, the noise level of complaints was held to a minimum. Fat margins made it possible to reach settlements that were acceptable to the marketing people. Later, when computers would be run independently of the financial establishment, complaints about commission errors rose to highly audible levels.

As the company grew and the squeeze on Xerox profits increased, the manipulation of pricing plans, territory re-alignments and sales compensation plans intensified. While we were busy reprogramming the billing/sales commission systems — now exceeding 300 million lines of patched Auto code with a smattering of COBOL — the sales force got accustomed to spending a substantial amount of time figuring out how to take a clever advantage of the latest incentives. In a number of cases the new plans opened unintended loopholes. When that happened, orders to stop the reprogramming of the commission system were released and new guidelines were issued. Errors were now added to corrections. As the effective date of a new pricing plan approached, most selling slowed down and programmers had to postpone any fixes until the next software release.

From this experience grew my understanding of how disorder could be self-induced in what could be otherwise an orderly process.

The administrative burden of delivering invoices and payroll plus commission checks was overwhelming as Xerox was growing at a fast rate. When I showed up I was told that more than a quarter of invoices could not be sent out on account of discrepancies caught by a huge number of administrative clerks prior to the invoices getting stuffed into envelopes. I started concentrating on straightening out the billing and payment system instead of addressing the job I was hired to do, which was to get rid of IBM computers.

There was no way I could trust XDS equipment to replace IBM computers while I was fixing billing. Until it could prove itself, under controlled and audited conditions, XDS equipment would be restricted to deliver only scientific, time sharing and real-time processing services. Cash related applications such as accounts receivable, payroll and shareholder disbursement would be the last ones ever leaving IBM equipment. These applications were never converted to XDS. Because of a steady growth in the number of transactions, Xerox expenditures for IBM equipment actually increased, which escaped the attention of top management who preferred to be oblivious to such trends.

With major help from accounting, I accomplished the acceleration of the billing process in less than eight months. Instead of billing only 70% of the copiers, we increased that to slightly over 90%. Most of that was achieved not through computerization, but by changing the process how copier credits were accounted for. Long outstanding disputes were written off and all credits were settled instantly. Computerized billing, now unencumbered by suspended customers receivables could now turn around the billing cycle faster and more frequently.

General Manager of the Information Services Division

Shortly after I made major improvements in the billing cycle for Xerox copiers I was moved from reporting to Joe Flavin, the Staff EXVP and CFO to start working for Ray Hay, President of US operations. That was most gratifying because Ray had the curiosity as well as a quick intel-

lectual grasp of the importance of systems to the future of Xerox. Instead of holding a corporate staff position with a staff of 30 I was now the General Manager of a newly created Information Services Division, ultimately with a staff of over 2,000. We operated data centers, telecommunications, programming services, systems design and operations research in the US.

Reporting to the President instead of the Chief Financial Officer was a monumental step. Most chief computer executives have always reported to the CFO even as late as the mid 1980s. Placing information technology as one of the key functions at the top of the organizational hierarchy had far reaching implications. My advancement was duly noted and envied by my industry peers. This extricated IT from the possession of the CFO where it was always treated as a cost center for automation of clerical labor.

The opposition to the move came from the leading Regional General Manager, Irwin Engelman, who had his eyes set on the position of the corporate CFO. Our disagreements culminated in a Harvard Business School case study to debate the merits of IT reporting through finance vs. a position near the top of the organization chart. My winning argument was supported by an analysis of how IT spending was allocated according to corporate functions. The largest share of computer spending, per capita, was in support of the financial functions with annual costs of IT exceeding payroll costs of financial analysts. Customer service personnel who maintained equipment at the customers' premises were receiving less than $400 of computer services per capita per year. That was seen as an unbalanced allocation that would be rectified by setting up the data processing operations as a service function where response to paid for demand would steer the spending for computers.

My big promotion came in March of 1972, when I was shown on the top-level organization chart of the company. Reporting to Peter McColough, the CEO, was the COO Archie McCardell. Reporting to McCardell was Ray Hay, President of US Operations and Joseph Flavin, now President of International Operations. In the US I reported at the same level as Jim O'Neill (in charge of Technology) and David T. Kearns (in charge of Marketing). This was as high as I ever got in Xerox. It placed me on the senior executive roster where I was kept even after I retired in 1985.

It was clear that I was getting groomed for a position to manage an office automation business.

Organization of ISD

Perhaps the best summary of the principles for organizing the Information Services Division (ISD) can be found in an article I penned for the *Harvard Business Review*. It summarizes the economic principles that lead to variable pricing of computer services.[1] For the computer community I extended these ideas to pricing concepts that would relate IT to profitability.[2] The economic charter of ISD was an evolution of concepts that I started nursing at General Foods and then commenced to implement at National Dairy. Years later, at the Department of Defense in 1989, I dusted off my papers about service utilities by becoming one of the three executives who defined the roles and the structure of the Defense Information Services Agency, now a $10.3 billion/year organization. In retrospect I have been dealing with the identical challenges at every place of employment since 1963.

The ISD was organized into ten business units, each with its revenue, costs and implied profits. My purpose was to measure the efficiency of each business unit so that by the end of each quarter one could judge performance. The idea of an implied profit for an in-house captive (insourced) operation was completely strange to the financial community though Ray Hay understood it and supported it. The metrics were based on the principle that I would be allowed to charge prevailing market prices for each service minus a 20% allowance for marketing expenses I did not have to incur because I had captive customers. In due course my comptroller developed a detailed price list for each service. During the first year ISD showed a small loss because I was building a data center. In the subsequent years the Division showed a good profit which was pocketed into the corporate coffers.

1 "Managing the Costs of Information," *Harvard Business Review*, October 1976.

2 "The Future Direction of Information Services to Impact the Bottom Line," *Proceedings of the 8th Annual Conference of the Society for Management Information Systems*, September, 1976.

The largest unit in ISD were three data operations, each about half of an acre in size. In the first room were time-sharing operations as well as a showpiece for our XDS Sigma installations. We stocked a large inventory of spare parts for that purpose. In the second room were IBM360/65 computers each with a huge bank of tape drives to run the incredible sorts that were demanded by our complex applications. In the third room were smaller computers as well as a line-up of impact printers. The computer rooms were individually secure and isolated in case of fire and protected against intrusions. In close proximity was a very large output handling section where paper printouts were sorted out and staged for delivery. The data center did not have a keypunch printing operation because I decentralized that for close proximity to the points of origin of data. In the basement, deeply underground, was a huge vault for storing data tapes. The underground tapes were rotated to upstairs storage and then to an outside repository.

I set up entrepreneurial operations in small rooms at the data center to develop new technologies. This included a surprisingly innovative and lucrative microfilm production operation and a remote-print-delivery unit that would eliminate labor and transportation costs by distributing computer printout electronically.

My programming operations were decentralized to three locations in the Rochester area. Programming was organized to be near customers, with manufacturing in Webster, business processing downtown Rochester and the COIN project in its separate location.

A small but very active Operations Research staff was set up in the corporate building to be close to marketing and planning.

Perhaps the most successful unit of ISD were telecommunication operations that proceeded aggressively and with great speed to extract voice phones, telex, facsimile and computer terminals out of the hands of office services. Particularly impressive was one of the first computer-driven network switches — an XDS computer — that established data connections with Xerox worldwide subsidiaries.

Running ISD as a Division General Manager was a killer job. I lived in Chappaqua and commuted for three and half years to Rochester. In addition to that I was serving on a variety of corporate strategy committees

as well as the global Chief Staff Officer for all of IT. In retrospect, it was a job that was not doable. I still have deep regrets that from 1971 through 1974 my family did not see much of me. Mona, alone in Chappaqua with four little children carried her burden without complaint even when on weekends I retired to my office to catch up with paperwork.

The wear and tear was not only on myself but also on my underlings. They were pleased to be running their business units because I gave them ample freedom to allocate money and manpower as they saw it fit as long as they were making the quarterly numbers. It was only years later that I discovered that all three of my managers of data center operations had a divorce while they were working for me.

By the end of 1974 holding both the job as General Manager as well as global Chief Information Officer was too much for any person to carry. Also, my failure to execute the COIN project that was based on XDS minicomputers faltered and I lost support from the finance establishment that never liked me anyway. I divested myself of the ISD job by handing it over to an accountant who would continue running the Division as a custodial operation. My job as the Chief Information Officer was now augmented with additional staff responsibilities for global administration staffs, and I was able to come home more often.

The Corporate Data Center

The XDS conversion effort would now become an opportunity to accelerate the trend towards consolidation of computer operations, first in the US and ultimately globally. Flavin knew my bias in this regard and asked for a proposal how to accomplish that.

I had been nursing the concept of a computer utility since my General Foods days. I tried to apply that idea to the consolidations in Kraft, but it was not affordable because communication technologies were still too expensive if one had to reach to a widely distributed retail delivery system. With Xerox now making communications oriented computers and with the possibility of huge gains to be realized from an acceleration of all transactions, a network-based utility would make sense provided one could proceed with caution. Besides, Xerox marketing operations were al-

ready consolidated into five Regions, which reduced the need for a highly distributed network.

What finally swayed the decision to proceed with the chartering of the Information Services Division was the recognition that the existing computer facilities located in downtown Rochester were inadequate. Xerox computers were operating in a high-risk environment and were physically insecure. I proposed proceeding with the construction of a state-of-the-art data center on the campus of Webster manufacturing and R&D operations. The new building (Building 300) would be surrounded by a high security fence, build-in sensors to control the transportation of magnetic media, windows made of blast-proof Lexan, a bomb-proof subterranean vault for housing up to 100,000 reels of magnetic tape, an uninterrupted battery powered supply of electricity, two huge diesel generators and a weeks' supply of fuel. All power and communications wires would be buried underground and would be fed from two independent sources of electrical power. Monitors would record the movement in an out of three compartmented computer rooms that were equipped with a wide range of monitoring and fire-prevention gear. When I proposed the budget for Building 300 that would have met even stringent Department of Defense requirements it was approved without question. The building was constructed on time and on budget because any construction change orders had to be signed by myself and I did not sign any.

Manufacturing Systems

The big issue in 1970-1971 was installing a new requirements planning package so that we could schedule production planning for our plants in Webster. Manufacturing lead times had to be rolled out so we could see whether the incoming components were in synchronization with the fluctuations in the manufacturing schedules. We depended on the coordination of in-bound components and sub-assemblies from a large network of suppliers. Xerox was buying a large share of what parts were needed for copying machines such as electrical motors, switches and lenses. While we were making as many as 50 models of copying equipment in the factories at any time we had to order parts averaging 5,000 stock keeping units

per model per shift. All that required the computers to project a planning horizon, by shift, of 52 weeks into the future for every model component number.

The output to produce the desired results started running on a Thursday night. To do a weekly production run we assembled the inventory status in the factory and in the plant warehouses, plus anything that would be arriving on the shipping dock. We then forecast what the production yield would be for Thursday, Friday, and possibly for Saturday in case the factory was on overtime. We had to confirm all the in-bound materials that had come in during the week plus what was in the trucks would be delivering for the balance of the week. We also had to take into the master files all of the engineering changes that took place during the intervening week. Only after that could we start on a requirement run, late Thursday night. If all went well we could be finished Saturday afternoon. If there was a problem during the computer run, we had to use Sunday as a buffer.

The component and schedule projections were enormous computer runs and involved twenty tape sorts. The entire system was considered to be a state of the art application. All the records were on magnetic tapes because disk drives arrived only later on. We had to make sure that there was limited delay between written input to tape drives and the final outcome. Only an IBM 360/65 had the capacity to do such work because the more powerful communications-oriented IBM360/67 computers could not process our workload.

The IBM computers supported only a handful of terminals. Because we had lots of COBOL sequential code we had to modify the IBM operating system so that the huge sorts could be executed in the time we had available. It was customary in those days for large computer installations to modify the manufacturer's operating system, especially if you needed a teleprocessing monitor to keep track of what was getting done. IBM did much of that work. They used that experience to feed back to their organization what needed fixing for the next software release. All of this involved a continuous and complex interaction between Xerox programmers and the IBM staff. Without such close coordination the systems would have failed. What mattered was the fact that the parts pick-lists for

the production starting Monday morning had to be available by 5AM on Monday. There was no way how we could cause a halt in the production as workers were arriving for the first shift. Tickets had to be ready to be put into baskets so that parts could be picked for every copier scheduled into production.

Manufacturing scheduling in a production environment to run a plant was a mammoth undertaking in the early 1970s involving thousands of tasks. The computer system supported a manufacturing sequence that had to be timed by means of time-motion studies to set the pace for the assembly. We had to examine all bottlenecks to find which piece you could be automated by making sub-assemblies. Without reliable IBM equipment and without the IBM systems engineering support delivering what was needed would have not been feasible.

European Regional Centers

The pressure to offer XDS equipment to our Rank-Xerox subsidiaries coincided with an enormous expansion in the copier business in Europe. Whatever computing and tabulating equipment was performing invoicing functions was quickly reaching their capacity. I now received the added mission to visit England, Germany, France, Holland, Italy, Spain and Sweden to explore the possibility of creating regional data centers that could support local operations. This effort was complicated further by an offer from the French government to give to Rank-Xerox a substantial subsidy in case we would be interested in creating a European data center in Sophia Antipolis near Nice. The French have already attracted IBM as well as an airline reservation center to become tenants in what was proposed to be a brand new science community dedicated to the creation of an information society. As was usually the case with similar French projects the complex near the Riviera was a highly promoted but badly disguised attempt to create a competitor to the Silicon Valley in the US.

In 1971 I must have made at least fifteen trips to Europe to participate in negotiations how to structure both the installation of XDS equipment as well as the opportunities for consolidation of data processing services. I still remember one occasion when it was necessary for me to get a

decision from Joe Flavin who would be available only at the Hotel de Crillon at Place de la Concorde in Paris. Incidentally, Crillon was by far one of the most expensive hotels in the world (it was occupied by the German High Command during the war). Living there attested to the high style in which Xerox executives became accustomed to live. I left JFK airport in New York on the last flight at 9:30 PM, arriving in Paris at 8:30AM, just in time to meet Flavin for a 10AM meeting. I returned on the 1:30PM flight from Orly to prove that one could go to Europe and return in less than 24 hours.

The idea of creating a European data center was quickly thrown out because none of the available communication links could support such consolidation. The European communication costs due to monopoly control by their Post Offices, were excessive beyond belief. After much negotiation we finally settled on a data center for the UK and Ireland near Bletchley Park of World War crypto analysis fame. The French insisted to house their regional computer in Paris because their employees would not move. An agreement was reached that they would support Italy from Paris but that arrangement was quickly broken and the Italian operated successfully an XDS machine in Milan. German operations set up a well organized, amply funded data center in Frankfurt and somehow managed to support Scandinavian operations from there. The Dutch had a large factory in Venray. After much hassle whether to import manufacturing requirement software from Webster they decided to continue with their unique solutions and to support Holland and Belgian business operations as well. Rank-Xerox in Spain would not be willing to discuss either XDS or any consolidation with anyone especially if that would be to France. They retained their IBM computer and managed their unique software. Ultimately, the Spaniards turned out to be the most successful and least expensive computer set-up in Europe.

Fuji-Xerox

It was with anticipation that I got on the airplane to visit Fuji-Xerox, which theoretically fell under my global responsibility. I was warned that this operation was unlike any other and that local privileges were a

carefully but very politely guarded possession. In Tokyo, after many preliminary visits and with much formal courtesy I was introduced to Michio Miyake, the F-X CIO. Out of this connection grew a lasting and most cordial relationship that still continues to this day when Michio is not well but still tries to translate some of my writings.

I found Fuji-Xerox fascinating, because their IT costs were low, their billing operations were simple and the entire staff — operators and programmers — were sitting together in one large undivided space. It took me a few more visits to Tokyo before I discovered the secret of their operations. Each sales district had a small office. The center of the office was a large table surrounded by open files shelves. Around the table were sitting young, pretty and under-paid girls waiting to get married. The sales people were men and they were always out of the office often doubling as copier maintenance personnel. When a customer called they reached a girl that was assigned to them. She reached behind her shoulder, retrieved from the shelf the customer's file and answered just about any question concerning billing, delivery or service. Fuji-Xerox did not require computers to perform complex work. All of the key files were on paper with detailed records kept up with great care to always reflect real-time conditions.

Over the years I found Fuji-Xerox a delight to visit because the operation was simple, straightforward and always associated with the utmost courtesy,

The APL Computer Language

The APL (A Programming Language) came to our rescue when all of our programming resources were tied up just keeping up with the rapid growth of Xerox while we were also burdened to substitute XDS equipment for IBM. Just by happenstance, Ian Sharp in Toronto developed a good version of APL for the XDS Sigma equipment. Analysts loved APL as a way of constructing their models. The problem was that APL code could not be deciphered by anyone without going through the same steps as if you were writing it. Even if you wrote your own APL model you had a hard time figuring out the logic you recorded after a lapse of time working on another project. APL became the analyst's preferred tool because

each individual could boast about a unique solution. I called it "write once, read never" programming which made each programmer indispensable. To satisfy the rapidly rising demand we licensed from Sharp APL processing software to be ultimately installed on our own equipment in Rochester with the proviso that after two years we would receive an unrestricted license to their APL software.

Setting up our own APL capacity would have made it very costly to absorb the full initial expense for setting up time-sharing operations and then gradually grow the workload. Sharp's pricing was based on a discounted marginal cost. When time came to move all processing back to Xerox, Sharp's marginal costs have declined sufficiently so that an in-house option would never become economical. This experience taught me an important lesson about the difference between average and marginal costs for the pricing of information services. It would bias me in favor of the acquisition of all software innovation from suppliers who had already paid for entry costs and taken all of the risks of failing. Such suppliers were now under pressure to build volume through marginal cost pricing which they would base on a cumulative experience curve. The trick in information services was to build revenue-creating volume faster than any competitor. Using pricing technique as a competitive weapon a competitor who tried to imitate a gaining innovator could never catch up except by launching another market entry on a brand new experience curve.

The highly subsidized APL offering, plus a surplus of MBAs who demanded computing power for analyzing every conceivable marketing plan made Xerox perhaps the largest user of APL time-sharing in the world for a period of one or two years. That was advantageous because it generated orders for XDS equipment that we could classify as "commercial" and not as "scientific." It allowed corporate management to say that we were installing XDS equipment at a rapid rate for internal use. The proliferation of APL was attractive because it got the financial staffs diverted from bothering my programmers. In fact we converted financial analysts to programmers without having to show that on our headcount which would be exploding otherwise. Whatever backlog may have existed was swept away because the customers now started doing their own coding as twenty-four hour, seven days a week services became available. Once

computer terminals became available and unlimited computer processing power became accessible that gave rise to quite a few spectacularly inefficient and irrelevant applications. With everyone tied up in meetings the waste of resources and time was not visible. On the positive side, customers were pleased. Much of the dissatisfaction that I observed by forcing reliance on batch processing was now eliminated. Conflicts were resolved by dispersing thousands of terminals throughout Xerox. As result we built one of the largest local data communications networks in the country.

There were additional advantages. Customers who do their own programming took off the pressure from my operations because now they could only blame themselves when job requests were rejected. I immediately launched a campaign to shift key punching from a huge central keypunch department that was always blamed for errors to on line key entry from teletypes and communicating typewriters. After the new data center was completed the massive report printing and report distribution department was materially reduced by shifting printing directly to each customer location using remote printers. We cut central headcount, where it was visible, and moved report distribution responsibilities to local administrative support that was classified as secretaries and administrative staff. A large share of the clerical workforce were now in a position to place their experience in "data processing" on their resumes while qualifying for a higher job grade. I could now redefine my job from concentration on what was in most corporations "computer management" to "information management." While my erstwhile peers were concentrating on the latest hardware technology available from vendors I was moving away to deal with a much broader definition of what constitutes office work in the era of office automation, which was administrative expense and not computer costs.

DanRay Telecommunications

When MCI received permission to use its microwave technology to compete with AT&T that was understood to be an attack on its long distance telephone service monopoly. MCI located an engineering division to be near two of the only companies that were brave enough to supply MCI

despite AT&T's virulent opposition. The two companies were DanRay and Collins Radio of Richardson, Texas. Meanwhile, the court-ordered break-up of AT&T opened opportunities to new service providers who needed suppliers who would not be tied to AT&T.

It was sometime in 1974 that Xerox purchased DanRay as an initial entry into telecommunications. Abe Zarem made this acquisition as a venture investment. These ventures were only remotely connected with any existing businesses except that Abe was a confidant of Peter McColough and his directions were set independently of whatever was going on in Xerox.

Abe called me up and suggested that I have a look at DanRay for possible use of this equipment in the Xerox intra-company network. By that time I had already hired from GE their top telecommunications expert, Bernard Overeynder, who turned out to be the single most valuable systems appointment I have ever made whether in Xerox or anywhere else. Bernard was a nationally recognized authority on telecommunications. I hired him just after his proposal for a private GE network was cancelled because of opposition from AT&T.

Bernard came back from a review of DanRay with an unqualified enthusiasm. DanRay was ready to supply us with nine switches that could manage the entire Xerox US network at a fraction of the existing cost, while providing advance features that would allow us to reap major reduction in labor that supported customer calls. Since nobody at Xerox HQ knew anything about DanRay I gave Bernard a free hand to come up with a proposal how Xerox could detach itself from AT&T excessive charges.

The proposal delivered by Bernard showed spectacular savings and provided for a cautious approach to installation, starting with parallel prototype testing. At this point I had to go to see my new boss, Jim O'Neill, now head of corporate staff. Jim was impressed with the expected savings but was not sure whether we would not alienate our largest customer for copying equipment, AT&T. As a way of sidetracking our proposal I was instructed to seek out AT&T management and solicit their agreement for proceeding with the installation of a private network. We would retain AT&T circuits and only install improved switching with advanced features they did not offer.

The proposal by Xerox to set up its own private network hit AT&T management worse than what I could have imagined. Except for some Department of Defense networks AT&T has always managed to prevent any corporation from launching their own networks. Since AT&T controlled all switching through equipment provided by their Western Electric subsidiary nobody has ever managed to organize the complex interactions between local, long distance and switching technologies. Bernard was proposing to do exactly that by using equipment now owned by Xerox and used by AT&T's nemesis, Bill McGowan of MCI. From a legal standpoint there was nothing AT&T could do to stop us.

Bernard and I were invited to come to AT&T Long Lines offices in New York and to explain what we were proposing to do. They were going to examine the viability of our plans, since in all prior cases corporations backed off from setting up networks because of the incredible complexity (deliberately arranged by AT&T and Bell Companies) how to do that. At the appointed time Bernard and I were ushered into a giant room, maybe 100 ft long and 30 ft wide, with a giant table around which sat over fifty AT&T experts. Sitting in chairs next to the wall were another eighty staffers representing various branches of AT&T, Bell Laboratories and Bell Companies. The whole set up reminded me of hostile Congressional hearings that I suffered years later.

Bernard, of Dutch extraction, gave a brilliant presentation in accented but measured technical terms. My accent also did not help. Here were a bunch of European refugees setting up a scheme how to deprive AT&T of its monopoly profits! None of the follow on questions would be relevant or material. The Bell Laboratories staffers were shocked by the details of our presentation that demonstrated that we had checked out every possible regulatory objection to our schema.

A few days later I received a phone call from Archie McGill, now a key senior VP at AT&T HQ in Basking Ridge, N.J. His hiring from IBM had been widely commented in the press as a sign that AT&T was trying to reform itself. Could I meet with him and the number three in the AT&T hierarchy, Ken Whalen — the ExVP for Marketing — for lunch to discuss the DanRay proposal? I readily consented to a meeting that would be held in Paterson, N.J. in an Italian inn that reminded me of a movie setting for

a Mafia get together. I was expected to come without Bernard. There were only Archie, Ken and I hunched around a table in a dimly lit booth.

Whalen did not mince any words. They recognized the quality of our proposal and our capability to execute it. AT&T was in no position to compete with the prices or the features that we proposed because the government was blocking their efforts to market discounted services to major corporations. Would we consent to their using the proposed Xerox communications design as a wedge for obtaining a special tariff that would classify our needs as requiring special regulatory "adjustments"? McGill explained that AT&T had been working on a similar proposal for some time but did not have a "pony to run for them."

In due course, AT&T filed for a new tariff and offered to Xerox material discounts. Most importantly, they threw dozens of people into support teams to install the necessary connectivity, which made us perhaps the first corporation that had a global directory for desk-to-desk dialing of phone calls. This network made it possible to shift the workload of our service dispatch operators who were distributed geographically, thus achieving very large clerical savings. After three years we saved closed to $70 million per year in our telephone management, mostly in the form of labor costs.

Meanwhile, DanRay worked with MCI to support their growth into a major communication carrier. Private networks were really not their strength. Within three years Xerox sold off DanRay to Nortel. That was another example how Xerox acquisitions came into disfavor if they did not produce enormous profits instantly.

I should note that when Jim O'Neill sidetracked me to talk with AT&T, I already had on order for a small DanRay digital switch to do some testing. Without giving it much thought Jim instructed me to install it at corporate HQ in Stamford. I must have been feeble-minded that morning when I consented to do so. Technically, the switch worked perfectly, but nobody in the executive row was willing to change habits that were necessary for using a feature-rich digital phone. After giving it only ten days, the DanRay switch was removed. From this experience I learned never to try first anything new that involves executives. There was no way how

we could teach them to use numbers instead of buttons to select phone features.

It was during this period that I discovered that our executives could not even remove a paper jam from a copier (which happened often). The dozen executives who occupied a separate section of the building were, as a group, technology-illiterate as well as dyslexic because they could not depend on reading to obtain operating or technical instructions.

Brazilian Computer

In 1976 our Brazilian subsidiary finally received a permit to import an IBM360/40 computer. This was a big deal because the military government of Brazil had a policy of stimulating the domestic computer industry and imports were under tight control. I was involved in securing of the requisite permit while visiting Brazil — Xerox's largest international subsidiary — several times before.

Elaborate festivities were arranged to celebrate the unveiling of the computer. A Jesuit priest presided over the entire affair including the sprinkling of the main computer console with holy water. I was moved by the events and on the spot composed a haiku that conveyed the idea that the computer machine would herald the introduction of a new cultural phase in the history of mankind. I pointed out that the computer was the machine of the future that will make through transportable thinking the sharing of knowledge for creating a global togetherness.

In the evening I was picked up in an armored Cadillac with a bodyguard and taken to a district where all the streets had high walls and no visibility of homes. We arrived at a steel gate, with TV cameras checking us out. The car drove into an enclosure that was blocked by another set of gates. Armed men showed up, checked us out and opened the second gates after the first set of gates closed. We drove into what looked like a park, with tennis courts and two swimming pools. It was the compound of the Governor of Rio de Janeiro with a house that was an imitation of a French chateau. In due course about 100 visitors showed up. They were all little squat men with double-breasted pinstriped suits accompanied by flashy young women. I gave a talk about the future of computers. It was re-

ceived in complete silence and there were no questions. Afterwards everyone paid attention to socializing, with the obligatory embraces and kisses.

In the following years I was well received in Brazil where I now appeared often. The largest publishing house in Brazil organized the translation of my *Information Payoff* book that sold in several editions. When the Brazilian Senate debated the restrictions and custom duties on import of computers I appeared before a committee, together with Charles Jonscher from Harvard, that favored the easing of import restrictions. During the meetings I met the proponent of Brazilian independence from the Americans, the chief of Brazilian intelligence who controlled all computerization. All matters related to computers reported directly to the office of the President of Brazil though a national security directorate. The restrictions on computer imports prevailed for another seven years during which Brazil succeeded in copying microcomputers but never managed to create a viable computer mainframe industry.

COIN: An Attempt to Change the System

My make-or-break venture as the Chief Information Officers of Xerox was the COIN (Computer-Aided Information Network) project. Ultimately it broke me though only after three years of trying. The opposition to this project from start — from the regional financial comptrollers — was that they wanted no part of it because it would centralize administrative processes. Consolidation of data files into a central database would interfere with their flexibility to enter local adjustments and corrections to billing and to commissions for a creaky system. The political support for COIN from the sales department, who would be the greatest beneficiaries, evaporated after my executive level sponsor — Ray Hay — precipitously left the company. Initially, the Manager of Customer Billing Operations, Sy Zivan, was a strong proponent of the entire effort. However, as the political support for the project crumbled he found it prudent to detach from the overhaul of the administrative system and settle for small crumbs that remained after the project was shut down. After that everybody preferred to leave the order entry, equipment management and maintenance services without a material change. Reorganizing the administrative workflows

was just too much trouble and would take another two years. That was well beyond the planning horizon of the administrators.

The demise of the COIN project is an interesting example of how ambitious efforts get killed. The COIN development budget was running at more than five million dollars per year plus capital expenses for Xerox equipment for which prices were not as yet settled. During the 1975 budget preparation season the company needed to cut expenses. A sum of about $750,000 was removed from COIN by eliminating programming expense as the project was entering into a programming-intensive test phase. By removing programmers at this stage the entire project would have to slide for at least one year while the fixed installation expenses were going to continue. Tom Winter, now the CFO of sales operations must have known that the surgical removal of the heart of a project would kill the entire venture. After re-allocating additional funds from COIN to maintenance of existing regional computers the short term ROI of COIN disappeared and the project was disbanded. There was no review of what would be the long-term consequences of decentralizing of the administrative processes of Xerox into the hands of the branch offices. By killing COIN Xerox was left with a system where branch offices would be left with little or no autonomy to manage equipment, sales and billing. It is noteworthy that when Xerox brought in a new CEO (Richard Thoman) in 1998 he proceeded to reorganize sales operations. With a rigid administrative system (now run by EDS) the reorganization failed, invoicing stopped and sales commissions were unpaid. Shortly thereafter Thoman was fired — first Xerox CEO ever to be dismissed. Meanwhile, Fuji-Xerox flourished and survived tough competition by relying on their low-cost and decentralized approach for handling of customer problems.

Unwinding ISD

The Information Services Division was my creation. I kept track of its wellbeing, especially as former employees called me for a reference when they were seeking jobs elsewhere. A number of my former associates rose to senior IT executive rank in other companies.

As Xerox's stock plunged starting in 2000 the search for easy savings was on. It was only a matter of time before most of the Xerox's elite IT organization would be tagged as being dispensable and outside the firm's core competencies. In 1994, Xerox entered into an outsourcing agreement with Electronic Data Systems. Initially, it transferred to EDS the entire ISD with about 2,000 people who were running demonstrably efficient operations, keeping only a staff of fewer than 400, mostly planners. The CIO, Patricia Wallington, hailed the deal, saying, "Xerox didn't outsource to replace a failing IT department or simply to save money. The $3.2 billion deal with EDS enables IT to focus on new systems and strategies." Thus, Xerox handed over to EDS the responsibility for running mainframe systems, legacy software (such as critical billing and sales-commission systems) and telecommunications and for supporting PCs.

It was a bad deal for Xerox. Trusted talent, necessary to innovate amid rapidly changing competitive conditions, left the company. EDS now owned the talent farm that had always nurtured star performers. The allocation of the remaining staff to innovation projects never happened. The culture of the conservative and highly regulated EDS people conflicted with the liberal and improvising Xeroids who were pushed to reduce overhead and improvise savings through workarounds that bypassed EDS.

It was also a bad deal for EDS. Taking over operations where there was little fat didn't leave much room for profit gains. To deliver attractive financial results, EDS had to rely on standardization of technology and greater uniformity of services that fit the EDS environment. To attain economies of scale, EDS adopted a more rigid fixed-cost model to extract profits. The goal was to grow volume at little extra expense to produce superior profit margins. That didn't happen. The Xeroids were adept at taking over the most lucrative sources of added profit for EDS. The stage was then set for the drama that was then reported as a technical and organizational snafu instead of a managerial failure.

In late 1998, Xerox stopped honoring bills from EDS. EDS had to write off $200 million — almost half of its 1998 corporate profits — attributing it largely to billing disputes with Xerox. EDS then filed a multihundred million lawsuit against Xerox. When Xerox reorganized its sales and marketing operations the billing system fell apart and the sales force's

efforts were diverted to administrative chores instead of selling at a time when Xerox market share was dropping precipitously. The EDS billing and commission system could not adapt to a major reorganization proposed by a new Xerox President, Richard Thoman.

Copier Troubles

While the various strategy task forces, which now included myself, were deliberating priorities for the computer business, the US government concluded — after extended investigations — that Xerox was monopolizing the copier trade and held a restrictive market share. Perhaps the least significant competitor, Smith-Corona who was manufacturing an inferior copier, launched an anti-trust suit against Xerox for restraint of trade. They were asking for penalties that could possibly amount to half a billion dollars. Xerox top executives now got bogged down in litigation as well as in a potential anti-trust suit. Xerox top management was subpoenaed and spent much of their time in legal depositions. Finally, Xerox caved in and entered into a consent agreement to license its patents to all comers and to offer its copiers not only for rent, but also for sale.

As results of all of such diversions, the executives' attention became drawn to countering the potential entry of both IBM as well as Kodak into the copying business. Suddenly XDS became a second, then a third, and finally a fourth order of priority before dropping out altogether. Top management started addressing what countermeasures were needed against the potential entry of Kodak and IBM into the copier business.

When IBM finally offered a copier, after many delays, their entry offered undifferentiated equipment that did not compete well with Xerox. IBM suffered from an exact reverse of Xerox's own struggles. IBM marketers could earn much better commissions selling impact printers spitting out digitally controlled marks on paper in high volumes. Despite all of the apprehensions about IBM as a competitor in the copying business, it was a threat than never materialized. While watching IBM, the Japanese manufacturers were slowly creeping into the US market without much opposition. It was the enemy that everybody was watching who proved to be

harmless. It was the adversary who advanced with stealth, who turned out to the mortal threat.

Kodak came up with a respectable entry into the copier business but had to divert its attention to the rapidly rising competition from Fuji photo that was devastating their premium priced photographic product. The Kodak threat did not damage Xerox in a material way except for putting pressure on our pricing.

While paying attention to IBM and Kodak, little attention was paid to low copy-volume copiers that Japanese firms started landing on the West Coast as marketing probes. I was present during one of the presentations to the executive committee when a program manager from Webster engineering gave a report about the inferiority of the Japanese offerings. Their cheap photoreceptors could not match the precision-machined Xerox selenium drums. Besides, Xerox profits were concentrated not at the low end but at the higher throughput machines. The market research findings indicated a strong preference of existing Xerox customers for Xerox quality copies, though nobody bothered to find out why small businesses were satisfied with crummy copies. Only Jim O'Neill, now the corporate CFO and always the analyst with the sharpest pencil, kept wondering why the Japanese could be selling copiers outright at retail prices for less than Xerox could offer on an eighteen-month rental. Jim observed that even if Xerox had zero manufacturing cost the Japanese could still undersell Xerox. I think that only Ray Hay, now the President of US copier operations, understood the full impact of what Jim was saying. On the way out of the boardroom Ray, in his usual caustic manner, remarked loudly that Archie should be running scared because Xerox was getting attacked where it had no defenses.

Xerox financial analysts used average manufacturing costs plus an overhead multiplier to come up with product pricing. That worked while Xerox maintained a dominant market share in copiers and duplicators. When marginal cost pricing, a method in which the Japanese excelled, was applied to copiers and duplicators the rapid erosion in profitability was inevitable. Years later the shifting of costs from average manufacturing costs to overhead accounts produced grotesque overhead multipliers. At that point the economics of the entire copier and duplicator product line

was headed for a wreck. When the Japanese could finally deliver copiers to customers at prices that were lower than Xerox manufacturing costs the collapse of Xerox would be approaching.

To counter the anticipated inroads from IBM and Kodak who were expected to launch mid-range equipment, Xerox decided to deal with such threats by funding a horrendously expensive program to build high volume duplicators based on belt photoreceptors where copy volumes would generate the highest profits. Xerox would now devote most of its capital as well as engineering resources to discourage competitors from a high-volume copier entry. Using reasoning dating from the days of Alfred P. Sloan at General Motors, Xerox was going to outspend IBM and Kodak while these firms were fighting encroachments from Japanese manufacturers. As these confrontations eventually played out, neither IBM nor Kodak were ever ready to extend their offerings to high volume duplications while they were struggling to enter into the copier business. While Xerox was shadow boxing with IBM and Kodak, we neglected to defend our low-end product entry offerings. Calculations based on Ford-vintage Return-on-Asset (ROA) ratios convinced Archie McCardell and Jim O'Neill that there was no profit in defending the low ROA soft underbelly of Xerox that the Japanese started shredding. Besides, Xerox executive bonuses were always based on ROA numbers. Nobody would favor offering ROA-depressing products.

Selling Copiers

The consent agreement with the government to offer copiers for purchase in addition to rental plans was not seen originally as a threat to Xerox. In fact, the bonus-earning executives saw in it an opportunity to unload some of their older and less profitable copying machines as a sure-fire way of boosting ROA. With the help of some accounting artistry the outright sale of the un-depreciated portion of a copier could be now booked as revenue, thus boosting the profit return number in the ROA ratio. Simultaneously, taking the un-depreciated worth of a copier off the corporate balance sheet would also lower the asset number of the ROA ratio. If you gave to the sales force the appropriate pricing and com-

mission compensation incentives, the Xerox financial analysts could come up with whatever profit and whatever ROA number they would need to meet Wall Street expectations. By jiggling the numbers, executive bonuses could be managed as predictable outcomes. In 1973 Xerox had sufficient fat to afford such manipulations. Twenty years later the habit of managing reported earnings backfired and resulted in what is still alleged to be irregular book keeping that violated government rules.[3]

Selling already installed copiers produced unintended consequences, as is often the case with well-intentioned decisions. To steer the sales force to do what's right for Xerox we provided each salesperson with a listing showing the inventory of a customer's equipment, a history of the copy volume produced by each machine, revenues by machine, depreciated book value and the list sale price. It was a matter of simple arithmetic to calculate which machines were extremely profitable because they were generating revenue far in excess of costs. Some of the most experienced Xerox salesmen used this information to enrich themselves by locating leasing companies that would finance the purchase of the most profitable copiers. A Xerox salesman could quit the company and return to a former customers with a proposition to lease the equipment on materially more favorable terms than continuing to pay to Xerox monthly copying charges. Xerox profitability now became eroded even though the most profitable machines were taken off the list as producing assets and showed up instead as short terms profit gains.

The consequences of the shift from renting to sales were devastating. Customers, for the first time, found out that Xerox would be keeping at their site copiers that could have been replaced by more economical machines. What used to be a trusted relationship between customers and the sales force to offer the most cost/effective solution was now compromised as Xerox financial management pressured the sales force to keep the larg-

3 In 2002, the Securities and Exchange Commission filed a complaint against Xerox. The complaint alleged Xerox deceived the public between 1997 and 2000 by employing several "accounting maneuvers," the most significant of which was a change in when Xerox recorded revenue from copy machine leases — recognizing a "sale" in the period a lease contract was signed, instead of recognizing revenue over the entire length of the contract.

est profit producers in place regardless of efficiency. However, the greatest damage came from the demoralization of the sales force when they saw that a small, but boastful number of their erstwhile associates, enriching themselves by setting up independent dealerships in lease-financed equipment. The new dealers were skimming off exceptional profits both from Xerox as well as from potential gains in commissions from the sale of depreciated equipment.

Selling copiers machines instead of leasing them did not end the damage to Xerox profits. As soon as the most lucrative leasing deals were concluded the ex-Xerox independent dealers were now ready to seek new opportunities how to make money. If one bears in mind that the lease-finance defectors from Xerox were among the most skillful salespeople, it did not take much time for the Japanese firms to discover that the best way of attacking the formidable Xerox sales organization was through an engagement of ex-Xerox mercenaries now available for hire as distributors. The Japanese invasion of the US market, now benefiting from the advice of some of the most experienced copier salespeople, picked up speed by depending on local dealerships for marketing Japanese office products. What Xerox previously believed to be an insurmountable obstacle to market entry, now became a low cost wedge that made it possible for Japanese copiers to gain market share.

A Fatal Injury

I went for lunch with Ray Hay shortly after the outright sale prices and the new sales commissions were set for selling copiers instead of leasing them. It was early in 1975. We were supposed to discuss how to make rapid changes in an increasingly complicated sales compensation application. Ray's conversation kept drifting back to the decision to alter the philosophy of Xerox as a customer-care driven firm that could be used to sell any office products, regardless of technology. Previously, when copiers were placed with customers who retained the right to cancel the install — no questions asked — the sales person and the support technicians devoted much effort to hand holding and worrying about customer satisfaction. It did not matter what type of equipment was installed because

Xerox would earn revenues that would trickle in monthly on the basis of how many copies were made.

When copiers would be sold outright the motivation of the sales force would now shift from the placement of copiers in ways that would be most convenient for customers, to maximizing company salespeople's commissions from one-time purchases. Although the Federal government was blamed for dictating the departure from the monthly rent-only policies, Ray blamed Archie and his financial staff for implementing the copier outright selling plans in ways that would foster an alienation of customers. Once a customer was saddled with a copier, the incentive to rearrange locations or to upgrade to different models for sake of customer convenience would vanish.

Years later, when I was asked about the origins of the eventual descent of Xerox from the pre-eminent position of profit leadership as a provider of copying-as-a-service to that of a battered reseller of commodity-priced and Japanese made equipment, I backdated the start of our decline to the memorable lunch with Ray Hay. Shortly after that the customer-focused Ray left Xerox to become the CEO of the Dallas-based giant LTV Corporation.

Strategic Planning

Peter McColough tended to buy companies without much analysis about possible consequences. I guess that his reasoning grew from a generally accepted Xerox legend that the Haloid Corporation had to reach to an external invention to make progress. The inability to innovate was also reflected in the myth that no inside corporate analyst would have ever endorsed what Chester Carlson was offering. Over the years I heard the often-repeated tale how corporate staffers from IBM and Kodak rejected a chance of paying a relatively puny amount of money for an exclusive license to electro photography. Such rationalizations did not account for the fact that Chester Carlson was proposing the substitution of dry copying for silver-based wet copying, which were related methods and had identical customers. Whether the history of the Carlson invention also applied to the transformation from limited function copiers to the broadly diversified world of digital applications was never considered as a completely different solution. What Xerox was facing now was a far more demanding change in the customers' fundamental habits how to operate in an office environment. In the case of Haloid/Xerox, customers could switch from wet copying to dry copying instantly and easily. In the migration to the digital world the customers would encounter a multi-decade long transformation in working habits. The Carlson analogy simply did not fit.

I dwell on discussing these beliefs because they were reflected in speeches by McColough and by Stamford headquarters executives. The digital office workplace would be totally different challenge from offering only an optical copying service. The jump from copying to digital document management would be a big leap. Glib assumptions about this jump circulated in Stamford and became transformed into myths that steered

how executives would be acting without a critical examination of the workplace.

When I arrived at Xerox in 1969 it was conceptual thinking and daring visions that always prevailed as a way of winning any argument. The overhead foils had words and bulleted phrases, but hardly any statistics and never any hard numbers except as products may be defined in terms of their manufacturing costs. The customer and customer habits were hardly ever mentioned. All discussions were in terms of supplying technology and hardly any in terms of demands for technology. With cash flowing in and the stock price zooming to new heights this approach was the generally accepted wisdom. A boisterous damn the limits attitude was prevalent that always referred back to a mistaken interpretation of what Chester Carlson invented. I do not recall much discussion about the patience and understanding shown by Joe Wilson over a decade of trials because much credit was heaped on the executives who created afterwards the formidable marketing machine to sell the Xerox 914.

After failing with diversifications into computers in 1973 and into education soon after the time had come for Xerox to take another long shot gamble. This found its proponent in the person of the ex-Ford VP of R&D, Jack Goldman, a dedicated poker player. Jack found a ready listener in Peter McColough who was always ready for another venture investment but never with patience to nursing it for more than three years.

Goldman proposed to launch a diversification not based on costly acquisitions but on a company managed R&D development. Taking the shambles of XDS and converting that into something that would lend itself to building on it for the future was not an option. Jack was an opponent of XDS anyway and recommended a long-term investment in a totally new R&D laboratory whose culture would differ completely from the ways research was conducted by Xerox in Rochester and El Segundo, or by IBM in Yorktown Heights. Goldman's proposal was backed by Abe Zarem who was an entrepreneur used to high tech ventures. Abe had sold the Electro-Optical Systems business to Xerox and became a consigliore to Peter McColough. Abe was steeped in the style and in the innovative culture that had been nurtured by the Defense Department that was always seeking breakthrough technology innovations during the Cold War. It is

also noteworthy that Zarem opposed the acquisition of XDS because he thought (correctly) that it was a bad deal.

In 1971 a new team of corporate staffers took over from the education-focused strategic planners who had worked for years for Joe Wilson when the diversification into education looked attractive and carried a public service flavor. The mission of the new strategy team was to find ways of fulfilling Peter McColough's visions of Xerox becoming an architect of information for the office of the future. The term architecture of information remained a mystery after the initial press conference except for conveying the idea that Xerox would guide organizations how structure their office technology investments. Even foggier was the term office of the future, which could be interpreted by anyone as they wished. When you stripped out all of these labels to bare facts you could net all the public relations hoopla to only one tangible mission for Xerox: how to compete with IBM. Xerox would now engage IBM not through mainframe computers, such as XDS machines, but through devices that were yet to be invented. This had a great appeal. The new Xerox laboratory did not have to deliver much of anything for the next 5-7 years until such time when it would start delivering the next Carlson-like invention.

The idea of besting IBM became an obsession in executive conversations in the early 1970s. That was ultimately also shared by PARC researchers but only conceptually and on ideological grounds of a West Coast anti-establishment culture, and not in terms of battling for market share or delivering to the copier marketing organization volume products to sell. It became the big white whale hunt war cry that would be included in every pronouncement made after the creation of PARC. Reducing IBM's preeminent position was believed to be the destiny of Xerox, as articulated by the Xerox EXVP of Marketing, Bill Souders, in an interview with *Forbes* magazine. It is ironic that the carrying out of this mission was actually accomplished after 1990 but not by Xerox but by other firms that reaped many of the benefits from the path-breaking technology innovations conceived by Xerox researchers at the Palo Alto Research Laboratories (PARC) from 1971 to 1980. IBM would lose its leadership position for almost a decade after an onslaught from Microsoft. In terms of profitability, IBM never again recovered its customary margins.

The Planning Job

As the prospects of a successful XDS venture were fading away Xerox top executives started looking for another high-risk and high-payoff investment. There was an ample supply of cash available, if one includes opportunities to borrow money. Even though I held the position as the Chief Information Officer of Xerox from 1969 through 1976 I was simultaneously drawn during this time as one of the leading planners to participate in numerous tasks forces and committees. Perhaps as much as a third of my time was devoted to this effort though the involvement was sporadic and often occupied nights and weekends. Finally, in 1976 I was promoted from the CIO role to become the global Vice-President of Planning in the Information Products Group. IPG was responsible for all non-copier businesses, except for the Education Division.

The IPG included all acquisitions that were purchased, in rapid sequence, by Abe Zarem's business development organization located in sumptuous quarters in Beverly Hills. This group consisting of high priced consultants with Wall Street background who somehow believed that buying unrelated office product component firms would add up ultimately and somehow to an office automation enterprise. I was always stuck by the show-business flair of these people. They were adept in making presentations, but somehow whatever they were doing never added up to Xerox growth.

Over a period of less than eight years none of these component firms that were acquired managed to combine and to generate material profits for Xerox. Firms that started as profitable enterprises at the time of acquisition ended up as crippled organizations and were sold off after 1986, mostly at fraction of the original acquisition price. The companies collected into IPG were Redactron, Xerox Computer Services, Office Products Division, Diablo, Shugart, Versatec, Century Data Corporation, Western Union International, Optimem Disks and Kurzweil Computer Products. It also included whatever was left of XDS that was sold off to Honeywell Computers for a bargain price to unload already installed XDS assets, including computers that I operated within Xerox. For a while it included the computer printing business. It was a patchwork of firms that were sup-

posed to combine for a synergy that would result in an office of the future enterprise but never achieved that objective.

As profits for Xerox declined IPG research funding was getting strangled while it was expected to deliver sustainable profits. With the original founders of the various acquisitions becoming rich after cashing generous buyout payments as well as stock options, they had little patience to remain a part of an organization that had no plans how to grow into a prosperous enterprise. Only Versatec management was an exception to this pattern because Xerox never interfered with its operations. Whatever remained were OEM (Other Equipment Manufacturers) firms that would be striving to remain profitable in a cutthroat business fighting aggressive competitors. Even while Zarem was buying companies, there was never a defined and persistent corporate strategy to aggregate such purchases into coherent growth for Xerox except for some vague hopes that ultimately it will all add up. The directions for acquisitions were set by phrases on PowerPoint slides de jour.

Planning for the Office of the Future

Into the strategic vacuum in the executive quarters in Stamford entered a group of office-automation planners now headed by a newly hired corporate Vice President of Planning, Donald Pendery. Don, an ex-IBM computer scientist was always thoughtful, critical and carefully analytical. For the next ten years I must have spent more than a fifth of my time in meetings presided or organized by Don. Often these were wildly speculative exchanges where only Don was able to sustain a sober perspective. To reflect the culture of the Xerox organization all planning ideas were a topic of loose group discussions either as a committee or as a designated task force. This involved a constantly changing cast of participants. Somehow I always ended up as one of the members in most of such meetings.

The most persistent presence in these sessions was the enthusiastic George White who became the chief protagonist to favor digital printing as the starting Xerox competency for the next seven years. George held to that position even as corporate directions kept changing and the memberships on the various tasks forces kept bringing in executives with

more expansive views. Meanwhile, the influential Bill Souders represented a point of view that digital printing was too small a market segment to warrant Xerox principal attention.

I met George shortly after reporting to Xerox. I was asked to join a committee that would convene in a dingy motel near Stamford because the new corporate headquarters did not have suitable offices. The motel provided the only conference room that would be available while the new headquarters outside of Rochester was still getting organized and Peter McColough was engaged in overcoming objections from the Greenwich zoning authorities to approve construction of corporate headquarters near the White Plains airport.

The purpose of the 1969 task force was to revisit current strategic thinking to reflect what to do with the recent purchase of Scientific Data Systems. George's position was that Xerox is not a computer company and should not aspire to be like IBM, but should forge new directions that would be principally related to digital printing in the immediate future. It was remarkable that George held on to these views during sessions that occupied my time while I was working as the chief computer executive. George was dedicated to the idea that it would be through printing that Xerox would find the most attractive immediate path for growth that would be based on digitally driven non-impact printing. It was George who articulated the idea that Xerox could not hope to become a viable competitor of any mainframe manufacturer in the foreseeable future. The immediate opportunities for the company was in extending the Carlson's innovation from the direct scanning of images to the printing of images from digitally encoded text. His views were not welcome by top executives who could not see how concentration on electronic printing could offer a sufficiently large market to deliver the expected revenue numbers. Though George's views were well articulated as he explained a way of making a modest but profitable market entry that argument was never accepted. Loaded with cash and with high stock market valuation McColough continued to chase acquisitions that would somehow fulfill the need for an enormous addition to the portfolio of products to be sold by the Xerox sales force. As yet undefined, the architecture of information visions seemed to promise that there would be new equipment that could be marketed to customers

by the copier salesmen. In reality this assumption turned out to be wrong. The domain of electronic systems was totally alien to the experience and capabilities of the Rochester-based copiers salesmen who were selling boxes that did not require any software to function and did not involve the complexities of hardware/software configuration management.

It is noteworthy that at the time of this writing, thirty-eight years later, the evidence is overwhelming that George was right all along and that the current shrunken product portfolio of what remains of Xerox remains rooted in printing, while the most lucrative portions of office laser printing — which Xerox developed and totally owned for a brief period — drifted into hands of more focused competitors, such as Hewlett-Packard.

PIMS Research Findings

From an intellectual standpoint perhaps the greatest influence on my own thinking came from Sidney Schoeffler, the founder of the PIMS (Profit Impact of Market Strategies) research organization. I met Sidney in 1959 while he was working for the General Electric Company. Afterwards our contacts lapsed until I became a Xerox strategist. Sidney employed what was a cross-sectional analysis of corporate financial results. He examined if there were any correlations between corporate profitability and any other indicators of performance. This effort had its origins in the problems with the allocation of capital that arose when GE created 250 business units, each with its own financial reports. Corporate HQ needed a way of sorting out budget demands that each business unit general manager claimed as a profit-making opportunity. Sidney discovered that there were only a few variables, such as market share, product quality and cost structure that could be used as predictors of business success.

GE spun off Schoeffler's project into an independent research organization with the aim of collecting data from a cross section of US and international firms. Originally, PIMS started as an academic project, but soon it converted into a non-profit research institute. The results that were generated over a period of twenty years were spectacular. For a time the PIMS findings were the basis of much management thinking among leading consultants in the US. Companies such as the Boston Consulting

group based much of their advice on what Sidney discovered. Doctorate dissertations mined PIMS data to come up with new insights. Much of my own thinking about the prospects of XDS and about the future of the STAR workstation was shaped by the PIMS emphasis to concentrate on the creation of a sustainable market share.

Xerox management had no interest in using the PIMS methodologies to validate their plans. It was alleged that Xerox would not be an ordinary company and therefore it would not be subject to the economic rules that Schoeffler and others connected with GE were practicing. There was an element of arrogance, borne out of success, in this attitude. I think that Xerox management was too deeply steeped in the case study approach that favored solving problems by means of inductive reasoning that calls for starting with generalizations and only then developing anything that is specific. Such an approach has origins in Aristotelian thought. Strategy would be fashioned from anecdotes that Peter McColough and key Stamford executives, such as the leading planning executive Bill Glavin, would find convenient to alter as rapidly as conditions changed.

The other approach, the deductive approach, or what could be termed as the scientific method did not receive any acceptance from the Stamford executive group that did not include engineers as decision-makers. Deductive reasoning insisted on starting with observations and only after testing coming up with generalizations. A disregard of research findings from Schoeffler, GE or the Boston Consulting Group explains one of the principal reasons why Xerox top management never developed an approach for developing a sustainable business after Joe Wilson succeeded with copying. Instead, the advice from the consulting firm McKinsey & Company prevailed at all times. That firm embodied the easy to apply inductive reasoning that was practiced and promoted by the Harvard Business School where clever and improvised arguments in a class would always prevail. McKinsey's strength was in their ability to adapt to whatever they thought would be realistically acceptable to their clients.

The Pendery Papers

What became known as the Pendery Papers was delivered to PARC early in 1971, with draft copies circulating weeks before that. I was given the tasks of focusing on strategies how to improve the productivity of office workers by means of relatively inexpensive equipment. In those days the median total compensation for office workers in major corporations was $15,000. Any technology costing more than $1,500 per year, as a total cost of ownership, would require at least a 10% gain in productivity. With training and start-up costs, which was the subject of my expertise, this suggested that only a device with a capital cost of less than about $4,000, including software, start-up and support, would be acceptable to most customers. Even then, these numbers would hold true only for the leading users, not the average office population that was still immersed in paper-intensive processes that were not integrated in any way. Improving office worker productivity by 10% for the general office workforce would be a stretch objective for ten years.[4]

I was asked to author two studies that would be included in guidance to be forwarded to PARC. The first study was titled *A View of the 1980s*. It would offer a forecast of the business and demographic conditions into which any PARC products would have to be placed. I offered a detailed analysis supplemented by statistical tables. A follow on paper, *The Office of the Future*, was an executive level narrative that described the behavior of office personnel working with computer-aided support.

The planning horizon of the two papers was dictated by the need of the copier sales force to have viable products available by the end of the decade so that they could be sold as mass-produced office equipment to customers that could not be served by the IBM Office Products Group.

After analyzing the steadily declining US productivity I concluded that future gains from office automation would have to come from improving the productivity of the masses of office workers and not a selected few. Here are a few passages:

4 Parts of this paper can be found in "The Office of the Future: Information Management for the New Age," *Technology Review*, December, 1980.

> "… Exhibit E.3 illustrates one of the principal factors we have identified in our questioning of continued and extrapolated economic growth rates: the relatively unproductive "white collar" and "service" component of our total work force is becoming the most predominant mode in which people participate in the economy.
>
> Even though the estimated 1968 "white collar" employment of 35.5 million far exceeds the total estimated "blue collar" work force of 27.5 million workers, the unskilled "white collar" component is estimated at 12.8 million and is expanding rapidly to an estimated number of 17.3 million clerical workers in 1980.
>
> From a strategic standpoint, we at Xerox must devote significant amounts of attention to the needs of the unskilled, nonproduction office workers for productivity enhancement products since this area is especially suited to the mass economies in production and in global service support which only very few companies are in a position to offer at this point."

My position was that the Xerox sales force that was used to moving hundred thousands of office boxes into the marketplace would have to now target the secretarial and administrative workforce as customers before engaging the professional workforce that did not use a keyboard and did not consider office work with office equipment as socially acceptable. I then proceeded to levy on PARC the task to engage in studies that would increase their understanding of the office workforce so that they could channel their research into constructive directions:[5]

5 My explorations about the future extended beyond the office environment, though I kept that outside of my staff work because of low tolerance in Stamford for far reaching ideas. I am particularly proud of a paper I prepared on "Information Systems and Literacy," Bailey, R.W., and Fosheim, R.M. editors, in *Literacy for Life*, The Modern Language Association of America, 1983.,

> "… personnel without authority over employees or without authority to commit funds, largely to be found in the "clerical worker" category. Again, inadequate detailed research and information sources exist in this area. Since we are dealing essentially with economic and behavioral problems of human beings operating in offices, schools, factories, etc., it is important that we at Xerox have a much better understanding of these trends so that we could translate economic forecasts into product concepts by means of which our firm could make a productive impact on this environment."

This paragraph addressed the question of spending for any products that Xerox would be offering. Since the ultimate customers, the clerical and administrative personnel did not have any authority over funding PARC was admonished to pay particular attention the purchasing cycle and to the purchasing authority.

The PARC organization was deaf to such guidance. They paid no attention whatsoever to the clerical and administrative workforce. They conceived the follow-on product to the ALTO to be the improved Xerox STAR workstation that was an exorbitantly expensive, proprietary minicomputer, using a proprietary operating systems and not at all suitable for general office use. PARC did not engage in the study of the inefficiencies of the white-collar workforce at all. Instead the STAR machine would become a tool for grinding out mostly research papers and occasional presentation slides. Ultimately PARC did hire a social anthropologist, Lucy Suchman, to study details of man-machine interactions, at the time-motion level of analysis, but certainly not dealing with anything that would address the economics and habits of the office workplace. There was no interest in understanding whatever inefficiencies existed in the work of secretaries and administrators that could be displaced by whatever PARC had to offer. Although many conceptual papers about the impact of office automation emerged from PARC, these were of academic interest and dealt mostly with problems encountered by the researchers and not by customers.

My papers also defined the customer set who would have to be served by products ultimately emerging from PARC research:

> "… One of the pervasive characteristics, on a worldwide scale, underlying the growth of "white collar" labor is the systemization of paper flows in large organizations whether governmental or in private industry. Although much research needs to be done in analyzing the frequency, distribution, and contents of documents, of forms, and of copies throughout the economy, based on available statistics it is becoming apparent that the large government bureau, the large insurance company, the bank, the credit card operation, or the large corporation are the prime sources for generating highly standardized and controlled paper flows requiring large organized inputs of clerical labor for processing, manipulation and filing. The underlying economic force behind this trend is the increasing concentration of production and services in a decreasing number of organizations. It is estimated that perhaps as few as 1,000 organizations may account for more than 75% of the world's GNP."

This passage was a warning flag that the products emerging from PARC would have to find their place at first in large corporate and government bureaucracies and not in specialized and small-scale operations where intellectuals and academics congregated. Xerox completely neglected to understand that IBM's success in the 1970s and Microsoft's success in the 1990's was entirely dependent on the placement of equipment with large organizations.

PARC was allergic to a view where its products should be positioned. Their counterculture ideology, including extremely liberal politics, was that the big firms were the enemies that should not be supported. Instead of organizing the flow of paper for the benefit of Xerox customers, they would rather devote their efforts to create autonomous individuals who were individually empowered by powerful personal computers, or Dynabooks, if at all possible. Needless to say, the concept of autonomous contributors who could operate as individuals, without corporate connection or corporate allegiance, was in the early 1970s a leading ideology in places advocated in places like the University of California in Berkeley.

Meanwhile, PARC continued to press on with computers that would require considerable sophistication to be useful, while neglecting the reality that clerks and ordinary office workers would be acquiring simple devices that would allow them to perform elementary and individual office tasks that would be a part of the workflow of office transactions:

> "… The trends in concentration of manufacturing capacity, capital investment, and employment are of strategic significance from a marketing standpoint and require further research to deal with information processing experiences where the "product" is completely perishable and ever changing. Hence the current notion of arraying clerks or machines along "work stations" and then "assembling" standard documents into standard outputs contains a fundamental fallacy that information processing or information consumption can be standardized in all of its aspects. It seems that the environment will be increasingly receptive to the consumption of high technology and high capital value devices *for localized adaptations*."

The Pendery Papers, which formed official corporate guidance to PARC, also included details about the kind of technologies that would be desirable, from a Xerox point of view, for capturing information and storage of information. In every respect the stated corporate guidance would fit the specification for the functions of a personal computer, as delivered twelve years later by IBM, with Microsoft software. Had PARC followed most of the guidance that was issued early in 1971, Xerox would have been in a far superior position than IBM to launch the personal computer era. The exceptional hardware design skills of the PARC researchers, their software prowess and vision of computers as a communication device placed them in an advantageous position to accomplish that. Unfortunately, PARC people were marching to a different tune. Xerox corporate management had neither the understanding, nor the will nor the ability to get PARC to listen to music that would satisfy the PARC real agenda while also delivering to Xerox an overwhelming lead over the IBM and Microsoft latecomers to office automation.

The Architecture of Information

Peter McColough had a speechwriter, George Marshall, whose job was to provide text that would be sufficiently inspirational so that it would mask some of the rumbling that was coming from the financial community about the lack of Xerox directions in the computer business.

At one of his next talks to financial analysts McColough slipped into the text the phrase Architecture of Information as the theme that somehow unified XDS and PARC even though in reality Xerox had already started the process of disengagement from the computer business and PARC was still a gleam in Goldman's eye. Nevertheless, the phrase caught on and was acquired by PARC as a suitable cover for what is was trying to accomplish. It was the concept that Xerox was now dedicated to the architecture of information that would make it possible for human beings to communicate with one another electronically, without central computer intermediation.[6] When Marshall was asked what was the meaning of that phrase he referred everyone to Goldman for an answer, which varied depending on the time and the person who asked the question. In candid moments Goldman explained that documents of the world, now optically transferred to a selenium drum, would ultimately travel in the form of electronic bits directly from keystrokes to digital printers. I shared this view and so did Dr. George White, who over the next ten years became an associate in the numerous tasks forces contemplating the future of Xerox.

There were already many precedents in Xerox for viewing documents as a digital source instead of having an optical original. As early as 1968 Xerox had running, in its Henrietta Laboratories near Rochester a drum copier where the image was transferred to it digitally by means of a series of light flash sources. In fact, it was the first generation of what subsequently became laser printers. When PARC was created the work of the Henrietta Laboratories, together with all researchers, would be transferred to Palo Alto. That removed from Rochester their last connection to an electronic future. Needless to say, as PARC started developing its own ideas the

6 I find an echo of this in the current pronouncements by Google. I consider Google an intellectual descendant of PARC.

gulf between Palo Alto and Rochester/Webster got deeper, never to be overcome.

Many of the concepts credited as PARC inventions came from other organizations. For instance, the concept of the personal workstation gestated for years at the Stanford Research Institute (SRI International) by Douglas Engelbart. What became Ethernet was derived from the AlohaNet that was sponsored by ARPA. Much of the early graphics work as well as concepts that eventually became Postscript came from the firm of Evans & Sutherland from Utah. That should in no way detract from the pioneering contributions by PARC where a collegial assembly of spectacular talent, not hindered by a bureaucracy and amply funded was capable of producing what is still considered to be break-through innovations.

The Information Products Group

With the demise of XDS the attention of Xerox management shifted to office automation. The first product in this field would be from an acquisition, Redactron, which offered an effective word processing device. A decision was made to keep office products from Rochester and therefore a plant was set up in Dallas. Ray Hay hoped that independence from the central bureaucracy in Rochester would provide a good environment for the growth of start-up businesses. Engineers from Rochester were transferred to Dallas to manage these start-ups to be managed by Bob Potter, who believed into engineering perfection of feature-rich products that would match in robustness and capability what was characteristic of the copier monopoly business.

When I joined IPG my boss was David Culbertson who had just been moved form running the Education Group to heading the newly formed Office Products Group. David was a thoughtful, considerate and soft-spoken former IBM education executive, with controllership background. He certainly represented safe custodial hands but would not be able to control operating units that were acquisitions with entrepreneurial origins. Culbertson, his CFO Chuck Carey, his personnel executive Joe Charlton and myself spent most of our time on the road traveling from one plan and budget review to another. Since most of IPG assets were on

the West Coast I averaged about one Los Angeles or San Francisco trip every week.

In the fall of 1978 we suddenly received a new boss, John Titsworth, who came from the Control Data Corporation where he headed their computer and peripherals business. John was a likeable, friendly engineer and I developed a close personal relationship with him to this day. His roots were from extremely modest circumstances on a Midwest farm. He was certainly unlike his tight shirt ex-IBM's from Rochester or different from the wild Silicon Valley operators. Mr. Titsworth hit it off well with David Kearns who was looking for a computer executive to ride herd on the uncoordinated and the undisciplined IPG collection of firms. The only problem with John was his readiness to compromise and to avoid conflict with Bill Souders, the marketing EXVP and the leading representative of Rochester interests in Stamford. To give John a tight-fisted support, the corporation assigned the ineffective Tom Winter as his CFO.

The Xerox 860 Word Processor

As was the case that would be repeated many times over the next decade, after the acquisition of Redactron the transplanted Rochester engineers embarked immediately on the development of an improved version of that device, which was then discontinued. Instead, Dallas now offered the Xerox 860, a high feature word processor that was then advertised and sold as a premium product. It was an expensive system for $14,000, with maintenance costs to match. The costs of marketing this machine were also high. After full accounting for development, training materials and overhead it was not profitable, especially after other firms, such as IBM's text editor and the Wang Laboratories word processing systems entered the market with lower priced equipment. The Xerox 860 was actually a minicomputer that was based on the CP/M operating system. Soon every major office products firm competed in this market segment (even Exxon ventures had an offering) and the market share of Xerox word processors shrank rapidly. The Xerox 860 was a superbly engineered and over-featured product that offered the preparation of documents that could automatically contain line numbers, generate a table of contents, format footnotes

and type outlines. It had a spell check function with 88,000 words in its dictionary. The full-text monitor could display 70 lines of 102 characters. It stored working files on one of the two 8" floppy disks. Each disk catalog could store up to 560 documents.

The objective of IPG was to make its divisions profitable. Instead of pressing for further product improvements and cost reduction, IPG jumped to concentrate on producing an extremely low-cost electronic typewriter that would be based on the daisy wheel mechanism acquired from a Diablo. When Tom Winter became the CFO for the Information Product Group product development in the document-processing segment shrank while funds were getting diverted into the typewriter business. The document processor business was quietly abandoned four years later while pursuing other directions. There never was a product that Tom Winter could not choke. Titsworth let the Xerox 860 die slowly as a new executive emerged as the President of the Office Products Division in Dallas, Don Massaro, formerly President of Shugart. Massaro had a different agenda than the pursuit of a small but stable document processing business.

Xerox 820 Microcomputer

For its time the Xerox 820 eight bits microcomputer was a reasonably competent machine that was an also run, without any distinct competitive advantages. It was rushed into production by Massaro and positioned as the initial Xerox entry into the distributed computing business. The Xerox 820 was driven by CP/M and was equipped with competent Shugart floppy disk drives. The CRT itself was a 24-line, 80-character white-on-black monochrome display that was quickly surpassed by competition. Its main feature was the MicroPro WordStar as well as Microsoft BASIC-80 but little else that would make it attractive though its price of $3,000 was moderately under IBM's offering. When software developers shifted their attention to writing hundreds of applications for the IBM/Microsoft offering the Xerox 820 became an irrecoverable failure. Whether an upgrading of this microcomputer could have salvaged this product line is debatable because Xerox management was now spending time dithering about ad-

ministrative costs and how to sell computers to national accounts. Instead of upgrading the Xerox 820 some scarce funds were diverted to development of a battery powered hand-held microcomputer with only a two-line LCD screen. Without much funding and without a capable technology the Xerox 820 as well as the two-line device would be abandoned.

Digital Equipment Corporation's Personal Computer

The IBM Personal Computer, commonly known as the IBM PC, was introduced on August 1981 and shortly thereafter received general acceptance as the industry standard. Meanwhile, the Xerox 820, with its slow CPM operating system and with limited application software was no match for what IBM plus Microsoft were offering. As was usually the case in corporate thinking, Xerox was going to buy into a competitive technology and hope to offer a product that would exceed in quality what IBM was offering.

There was only one option that matched the quality requirements. It was the Digital Equipment Corporation's Professional 325 (PRO-325) and the Professional 350 (PRO-350) that offered software that was completely different from the Microsoft/IBM combination. DEC offered devices that were essentially PDP-11 compatible microcomputers that used minicomputer peripherals.

Win Hindle was DEC's Senior VP and a classmate from MIT. All it took was a phone call in January 1982 to receive an invitation to come to see what DEC had to offer. What I saw was impressive from an engineering standpoint. Circuit boards were slotted in a cage, with gold-plated contacts as if it were a minicomputer. The boards were fastened with knurled connectors that were for all practical purposes shockproof. The power supplies had excess capacity. The display screen was mounted in a reinforced chassis. What I saw was a jewel of a microcomputer, with a price to match. The software could draw on a library of scientific programs, but only on a limited collection of business applications.

So that I could demonstrate to Xerox management the unique qualities of what DEC had to offer, I ordered for immediate delivery a PRO-350. I was assured that it would be in my hands by the end of the

week. After two weeks passed, I called DEC. When Hindle intervened, a truck was dispatched and delivered to my office a PRO-350. It came in over ten carefully packed containers. Keyboards, floppy disks, circuit boards, manuals and cables were each in separate boxes. The disk drives have to be field installed and the printer had to be assembled. The CRT came in two individual cartons. Everything was ready in heavy-duty cartons that obviously met export requirements. What we received was a shrunk minicomputer that required technical labor for assembly and for expert testing before anything would work.

As compared with the IBM PC the DEC PRO-350 was over-featured, costly and certainly not suitable for general office use. I recommended against its adoption as a follow-up to the Xerox 820, which meanwhile started experimenting with upgrades that were starved for funding. Four months later Xerox decided that it would not pursue the microcomputer business.

DEC never gained a foothold in the low cost PC market. That signaled the decline of the computer industry in New England as nearly all computer manufacturers located there were focused on minicomputers, from DEC to Data General, Wang, Prime and Honeywell.

Diablo Data Systems

Diablo Data Systems was acquired in 1972. The principal reason for the inclusion of Diablo in Xerox was its daisy-wheel impact printer that was faster and more flexible than the dominant IBM's "golf ball" impact devices. Though the Office Product Division was already buying Diablo Data Systems printers for its Redactron text editors the corporate acquisition staff thought that Diablo was a good match for Xerox and bought it after which the original founders of the firm departed. As would be the habit in other IPG acquisitions in due course some worthy engineer from Rochester or El Segundo would be promoted to take over as General Manager of the acquired firm and proceed to change its directions.

After trying for seven years to make Diablo profitable this Division finally focused on the development and selling of the Diablo 630, which was mostly sold to other firms such as DEC (Digital Equipment Corpo-

ration). The Diablo 630 was capable of letter-quality printing that was equivalent to the quality of an IBM Selectric typewriter or Selectric-based printer, but at a lower cost. The printer could run at 30 characters per second that was roughly twice the speed of the Selectric. It had many features that could not be matched by any competitor, including its capacity to quickly change printer fonts.

Xerox interfered with the running of Diablo and distracted its attention from its prime strength, which was competence in impact printing and selling through OEM channels. Diablo then decided to diversify into making minicomputers, which would set them up in direct competition with their customers. After spending a great deal of money, the minicomputer project was abandoned.

When Massaro was looking for additional winning products for the Office Products Division, a dormant but attractive daisy wheel technology improvement was found in Diablo. The prospect of converting Diablo into a typewriter supplier instead of just supporting the word processing computers looked very attractive. One of Massaro's key lieutenants, Bill Jackson was then detached to get OPD into a mass produced typewriter business that would be selling well below $500 and be at least twice as flexible as comparable IBM offerings. To obtain such a low price would require mass production, standardization of components as well as a large reduction in the number of parts to make a typewriter.

In an unbelievably short time Bill Jackson organized the construction of a highly automated factory near Dallas to produce Xerox daisy wheel typewriters. It took less than half an hour of labor to assemble a Xerox typewriter because it was made of only a minimum number of parts. Copier sales people could now sell typewriters. These machines would be marketed to secretaries who were using the machines to create original paper copies and edit drafts from a limited memory that was also provided. The advantage of the new typewriter was that it could be marketed in ways that were similar to the methods of selling copiers. For a while the Xerox typewriter was well received though it never achieved its projected volumes. The advent of the personal computer shifted the work of secretaries from the production of paper copies to creating text on a screen. Once the text was captured in this manner, computer printers could then gen-

erate the printed pages automatically. Though the Xerox typewriter was modified to be compatible with personal computers that did not work out because the engineering to make a low cost device reduced the flexibility of the mechanism to adapt to a variety of commands now dictated by Microsoft.

When the attention of Xerox management turned to computer printing connected to large mainframes, Diablo was left to lapse into an unimportant Xerox subsidiary. It never picked up the challenge of innovation that has now migrated to Hewlett-Packard who picked up laser printing from not having any research or product in this market to a dominant market share in a matter of few years.

Shugart Floppy Disks

Of all of Zarem's acquisitions Shugart held the greatest promise because it pioneered the aggressive development of floppy disks. These were originally an IBM invention but it took Al Shugart to lower the costs and to improve the performance of floppy disks to make them a widely used storage medium for use in the exploding microcomputer business. Much of the success of the original Apple II computer can be attributed its offering of attached Shugart floppy drives.

When Al Shugart, rich with Xerox stock left, Don Massaro became President. Don was a representative of a Silicon Valley braggadocio, exuberance and ambition. He had a fast wit and could be very funny and entertaining. For a short while Shugart flourished with rapid expansion and new product introductions that were fueled by Xerox capital. The problem was that Don's ambitions grew with every month as he discovered that there was a complete leadership vacuum in Xerox to exploit its non-copier business. I spent a great deal of time at Don's home talking about strategy and PIMS except that Don's drive was focused on power and position, possibly aspiring someday to become the CEO of Xerox.

When Culbertson and then Titsworth started putting a squeeze on Massaro to start delivering profits his solution was to outsource the most labor-intensive part of Shugart operations to Taiwan. Massaro outsourced the disk arms that contained the microscopic disk read/write

heads. Shugart realized instant labor cost savings of a few dollars per head with the predictable outcome that they put the Taiwanese into the business of making low cost floppy disks. When Shugart was rapidly losing market share to Taiwanese firms, Massaro was gone to become President of Dallas Operations where he developed into a vocal and abrasive candidate with known aspirations for rapid promotions in Xerox.

Titsworth and I were with Massaro on a private jet flying over the Channel from London to Paris to attend a show when Don started fidgeting about his need for some sort of a symbol or mascot that would characterize the aggressive position he was taking in promoting his leadership of the office of the future. I pointed out that the Road Runner would be an ideal mascot for the Office Product Division. I knew the creator of the Road Runner, Chuck Jones. For a fee we could obtain the necessary copyrights. Massaro was titillated by this idea and asked me to proceed. As the relationship between Rochester and Dallas inevitably deteriorated he adopted Wile E. Coyote as an icon. It did not take too long for Road Runner flags getting hoisted throughout the Office Product Division offices, with the Coyote chasing a paranoiac bird that looked a bit like Massaro. Massaro went out of his way to use his caustic tongue to alienate most of the Stamford executives who would have to support him even though we was immensely popular in Dallas. He did not hide his ambitions though he was right in viewing the management in Stamford as incapable bumblers.

While he held the position as President of the Office Product, Massaro launched in rapid succession a series of products that were never completely engineered. Instead of pursuing a patient and focused development process he jumped from one product to another until Xerox was left with only shards of technology without a future.

Century Data Corporation

Shortly after acquiring Shugart Abe Zarem's acquisition staff was ready to spread Xerox investments to acquire a hard disk manufacturer, Century Data Corporation. This was a relatively small but profitable producer of removable disks cartridges that had a higher capacity than anything that Shugart could satisfy. Both the ALTO as well as the prospec-

tive Xerox STAR would make good use of removable disk drive cartridges. Why it was necessary to include a small disk manufacturer with a marginal market share in Xerox holdings so that we could include it in support of a limited number of office workstations is a mystery. Our quarterly visit to Century showed that the original investors as well as original founders were long gone. The company was profitable, but far below the usual Xerox returns on investment because it was located in the Los Angeles basin with high labor costs. In the highly competitive disk drive business there was no apparent reason why any future needs for hard drives could not be satisfied by OEM purchases.

Xerox management in Rochester had a long history of accommodating to labor unions, which was justifiable in the early days by extraordinary profits as well by a heavy reliance on outsourced components. When union leaders connected to Rochester discovered that the Century Data Corporation was not unionized, they intervened with Peter McColough, who promptly ordered John Titsworth to fire the General Manager of Century who was resisting unionization because the entire disk drive industry on the West Coast was non-unionized. With a new General Manger and a reorganized management it did not take long for the unionized Century to pass into oblivion.

When it came to unionization and to promoting equal opportunity appointments the position of Peter McColough was uncompromising. He operated on rules adopted and practiced during the heyday of Xerox in the 1970s. Applying such rules to IPG was not only disruptive but also destructive. In due course Xerox promoted a large number of equal opportunity employees into senior positions while the company was starting to shrink. That created a disgruntled group of people with former seniority whose advancement was now managed with a bias. In the ensuing conflicts the equal opportunity personnel created interest groups (caucuses) that started defending their interests in a collective manner. I have no way of knowing to what extent this influenced morale or employee loyalty except that it could not have been favorable to the fortunes of the company.

Versatec Electrostatic Printing

Versatec, acquired in 1975 and added to the portfolio of the Information Products Group was by far the most fun Division, almost entirely on account of its president, Renn Zaphiropoulos. Renn was perhaps the best storyteller around and gained a reputation as a raconteur as well as a person who enjoyed good food, classical music and good life. Versatec perfected a method of printing on plain paper, utilizing a solid-state write head to electrostatically release a pattern of dry toner particles from a toner carrier. The pattern of released toner particles would be accelerated across an air gap to affix to specially treated paper.

Versatec was a relatively happy acquisition because it did not fit into IPG at all. Its technology was limited to the engineering markets, which was unrelated to the office equipment market. Versatec's technology was specialized to generate drawings and was too slow to be of use as a printing device for computer printing, word processing or a text workstation. Why Xerox acquired Versatec was a puzzle except that it was in the printing business and somehow Xerox wished to own printing assets. A goodly sum of money was paid to Versatec shareholders, Versatec employees and made Renn a rich person who could then indulge in a luxurious home (with an expensive Bossendorf piano). Xerox visitors from IPG were gloriously entertained in Renn's home with panache and good taste. On my 50th birthday Renn gave a party that included a gift of a bottle of 1929 (my birth date) Courvoisier that must have cost a fortune.

Xerox did not mess with Renn who was a superb diplomat and graciously paid respect to the people from Stamford as long as they left him alone. There was never a question about replacing Renn as the General Manager. He continued to preside over Versatec affairs in great style (riding an elephant to a company party) while also getting some benefit from corporate research. While operating as a Xerox subsidiary Renn enlarged the Versatec business, continued its profitability and was viewed as one of the few happy acquisitions except that his synergy and contributions to Xerox were negligible other than in the case of engineering drawings that were used and promoted effectively by Fuji-Xerox.

The standing debate with Renn was his vociferous critique of ink-jet printing which ultimately turned out to replace most of electrostatic printing in offices. We could never stop Renn from pursuing a long dissertation why the physics of ink-jet printing was infeasible. To this day I happen to marvel how high-resolution ink-jet printing, in color, can function at all.

Kurzweil Computer Products

Kurzweil was a late acquisition, in 1980. They pioneered innovations in the fields of optical character recognition (OCR), text-to-speech synthesis and speech recognition technology. Their products were hand crafted and had very limited sales but attracted enormous amount of publicity, especially with their reading machine for the blind. Ray Kurzweil was a researcher and tinkerer who flitted from one invention to another. When Kurzweil was dropped into the lap of IPG Titsworth and I went to look at the operation, which produced only a limited number of handcrafted devices. The technology was impressive and the applications were unique. I simply could not figure how we could possibly leverage its research environment into anything useful. Ray cashed his large Xerox check and immediately proceeded on the next venture because he enjoyed development of innovative products that attracted publicity. It did not take too long afterwards for Xerox to sell off almost all of Kurzweil for a fraction of the original purchase price though a small part of the technology still remains in use in a partially owned Xerox subsidiary.

Western Union International

Though WUI was formally assigned to IPG, it was always run by the Xerox Development organization funded, operated and separately managed out of Beverly Hills.

The acquisition of WUI came to me as a complete surprise even though I was aware that one of the exceptionally bright and capable Zarem staffers, Paul Lykins, had been working on a microwave-based local area network for some time. The idea was that Xerox would offer document

delivery services using a private low cost network that would rely on limited range transmitters in each metropolitan area. WUI (renamed XTEN inside Xerox) was bought as a vehicle for obtaining radio spectrum licenses through an established telecommunications carrier. This entire operation was clothed in tight secrecy though I learned that Lykins and Zarem's people were buying up radio spectrum throughout the US. It appears that there was sufficient bandwidth available at reasonable prices to support as yet unmet needs. I have no idea how much money was spent. By the time Lykins was done Xerox owned substantial spectrum positions in major metropolitan markets in the US, which was everywhere that mattered.

When Xerox decided to enter into financial services and had to start incurring debt to finance acquisitions of insurance and credit firms, corporate management decided to cut off further diversification into telecommunications. The spectrum that was owned was sold off. It took Xerox less than three years to go in and to get out of the local area transmission business. Twenty-five years later others would auction off the bandwidth owned by Xerox for billions of dollars.

Xerox Computer Services

All was not well with the ethics of SDS. Immediately after the acquisition by Xerox in 1969 corporate HQ dispatched an Assistant Controller, Leon Berg, to have a better look at some of the financial aspects of SDS book keeping. Why such an examination was not done prior to the acquisition was not clear. The agreement to purchase SDS was a closely held matter in the hands of Peter McColough and a few close confidants.

As was often the case in the computer business, signed (but cancelable) orders were booked as sales. Commissions were paid on orders. That encouraged overstating customer commitments. Some of the idle computer inventory was also transferred to a new subsidiary, Xerox Computer Services, who entered into an on-line services business. That was also booked as an outright sale even though XCS managed its assets as short-term rentals. The orders I placed for installation inside Xerox for an unspecified future delivery depended on whether a software-as-a-service business would ever materialize. The net result of all of this was Berg's

discovery that much if what Xerox thought they bought as SDS assets was an accounting figment.

As was often the case with many other Xerox ventures, the idea of using XCS as a way for delivering manufacturing systems for a reasonable monthly rental per terminal would make it possible for small firms to acquire sophisticated applications at a reasonable cost. The time sharing technologies of the Sigma 6 and 7 were well suited for this purpose and could support a limited number of terminals better and cheaper than whatever IBM could offer. XCS operated a hybrid system. On-line Teletype terminals entered data inputs and could extract answers to simple inquiries. Messengers would then deliver voluminous output printouts to customers by truck. XCS also managed to acquire licenses to innovative software solutions that applied to specialized markets. For its time XCS offered a solution that would meet the needs of a few small firms that did not wish to hire a staff to manage on-site minicomputers.

The imaginative XCS people, headed by Jim Campbell, were now seen as business pioneers. The problem with all this was that Xerox top management were pressed by Wall Street critics and needed to demonstrate rapidly rising revenues and profits from its computer services business. That was not possible because XCS was a start-up venture in a market place that found it difficult to rely on the dependability of services over telephone wires. Here again was a case where Xerox viewed itself as an innovative competitor and as a creator of a completely new business segment. XCS was a great idea, but economically not viable on a scale or time horizon that Xerox was willing to invest in. It would take another thirty years before on line computer services would become at least marginally viable. Without subsidized computing power from XDS as well as without corporate support XCS operations were not sustainable. After some manipulations of the depreciation numbers to pretty up the reported financial results XCS was quietly allowed to disappear.

Though XCS reported through IPG and I attended all of the obligatory quarterly financial reviews, there was nothing one could do to influence the XCS destiny. Especially after the demise of XDS our on-demand-computing business was yet another isolated and unrelated venture that did not contribute to Xerox growth. A thorough strategic review could

have revealed that this start-up in a new market segment could never amount to much, especially since it continued to be underfunded.

Computer Laser Printers

It is noteworthy that the laser printing research that would support printing from IBM mainframe computers had to be taken out of the hands of the PARC researchers who had no interest in developing high volume computer peripherals that would be fed by IBM print protocols. PARC would have nothing to do with that and would favor only the development of local convenience laser printing that could be shared by workstations connected via local area Ethernet. To make any headway with the laser printing technologies, the engineering and implementation had to be transferred to the data-center experts still remaining from whatever was left of XDS initially in El Segundo. The tough jobs of finding solutions to technical problems such as laser defects, laser failures, scanning synchronization, customer support and software compatibility with IBM computers were solved by experienced computer professionals of the main-frame heritage.

The claims made in the succeeding years that it was PARC that invented and developed laser printers simply does not hold up. Laser printing ideas were imported to Palo Alto from Rochester. Laser printing, as a commercial product, was brought to the market by the people from El Segundo, with very little help except perhaps for the contribution in perfecting laser reliability, which was made by the Electro-Optical division in Pasadena. The integration of laser imaging to fit on top of the existing high volume copiers came from Rochester. How Xerox could finally bring to the market a product, as result of several years of often unsuccessful attempts, using the resources of the entire corporation, could have served as a useful lesson how to extract innovation out of PARC and to deliver it to customers by experienced Xerox management who had both the technological as well as market understanding. Such extraction never took place. The research and single-minded view of PARC to preserve its control over the office of the future technologies blocked the practical translation of laser printing into data center printing.

I was present at the key 1977 meeting to decide whether to proceed with the production of the Xerox 9700, which would be our first non-XDS product for the data processing community. This product has been in development for more than five years and represented the third or fourth engineering version because it was a complex device. The business case was poor, with excessive maintenance costs due to very short laser life. Print volume was estimated optimistically at not more than 400,000 pages per month. The capital cost for this machine was also very high, engineering was immature and the acceptance of a single Xerox product in the data center uncertain because it required special software to interface with IBM mainframes. Finance, always holding a veto power, opposed the project and asked Bob Adams, president of Computer Printing, to go back and see what can be done to improve laser life expectancy.

To everybody's surprise Adams received an immediate go ahead to proceed with the 9700. After spending a fortune Xerox was now under pressure to have something to show in the computer business. Management was willing to commit to a computer printer despite dubious prospects. Xerox also needed a product that could be promoted as originating from PARC. The laser computer printer turned out to be a success, even though it did not fit the PARC architecture. Except for housing Gary Starkweather, PARC would have nothing to do with anything that touched a data center. Monthly copy volume soon exceeded a million copies per machine. Engineering improvements from El Segundo made the 9700 a modestly profitable offering, but without the potential of becoming a major contributor to Xerox revenue growth. The Xerox 9700 Electronic Printing System was a 300dpi duplex Xerographic (Laser) printer operating at 2 pages per second with raster font selection and forms capabilities. Since it was introduced in 1977 and for many years afterwards it was the premier high volume page printer unmatched by competition. It used a modified DEC PDP-11/34 as its engine which proved that much of what Xerox was aspiring to do with acquisition could have been accommodated by OEM suppliers.

As long as the Xerox 9700 was able to leverage the technology of high-speed duplicators — something competitors could not easily achieve — the laser computer business remained a nice but strategically

isolated business that was treated by corporate finance as a cash cow. Bob Adams somehow managed to keep the computer business out of the hands of the Rochester bureaucracy. He deployed his own salespeople and his own maintenance force. This was relatively easy because the total population of Xerox 9700 machines was never large and always remained concentrated in large data centers. I must give Bob Adams credit for managing the only computer related business over a long period that maintained independence, integrity, technological innovation and profitability.

Starkweather did see the handwriting on the wall at Xerox. He left the company in 1987 after 24 years of service. Following a ten-year stint at Apple Computer, Starkweather joined Microsoft Research in 1997. I am mentioning this migration as an example of what happened to the one-time stars of PARC. There is a long list of alumni that ended up in companies that continued to push forward with the visions once nurtured at Xerox.

Xerox failure to successfully launch an office laser printer would represent anther major failure to take advantage of an invention conceived entirely by Xerox. PARC cared about laser printing only as an output device for its Ethernet connected workstations, which had a limited applicability. The idea of developing an office laser printer as a competitive product, something done successfully and profitably by Hewlett-Packard, never came up on the PARC agenda. The Xerox laser printers used at PARC were modifications of existing copier equipment based on selenium drums. That made such printers very expensive to purchase and even more expensive to maintain.[7]

When PARC needed non-impact printing, they were still talking in terms of hundreds of devices that would be shared by many workstations. Though the costs of such devices and low reliability was a problem, in the arithmetic of PARC that did not matter because in the research environment they never had to deal with mission-critical outputs. PARC was concentrating on proofs of concept and was satisfied with a "Press" software protocol that would provide a slow interface between worksta-

7 My own interest in non-impact printing is reflected in an article jointly authored with Charles Willard from Bob Adams' shop on "The Evolution of the Page Printer," *Datamation*, May 1978.

tions and printers. That was followed with a proprietary InterPress that was supposed to safeguard that only Xerox laser printers would be able to connect to a network.

Meanwhile Hewlett-Packard proceeded late in 1979 with offering of a low cost laser printer that was based on disposable cartridges and ultimately on the open software protocol "PostScript". They would make their money on the supplies — the toner cartridge and ink for the ink-jet print technology. As a result, Xerox was beaten to market by Hewlett-Packard, which introduced the first low cost personal laser printer in 1980. While Xerox planners were thinking about office printing in terms for hundreds of units, H-P was soon selling millions of printers, which for a number of years accounted for almost half of the profits for the entire firm.

Splitting Marketing

The visit by top Xerox executives to PARC to get an appreciation of progress can be seen as a failure because no follow-up actions existed. Though several task forces were assembled to contemplate how an ALTO-like product could be launched in the market place within two to three years, how to do that was never resolved as intra-corporate conflicts how to manage such a transition to the market remained unresolved.

I believe that the mortal wounds to any prospects of ever staging an orderly transition from research to an initial market introduction were inflicted in what, at the time, looked like viable compromise arrangements. The most serious errors was a negotiation between the new Executive Vice President, John Titsworth, who has now assumed the role as the person would be responsible for bringing all non-copier systems products into the market place. John, a most amiable and well intentioned novice to Xerox politics, succumbed to the arguments of the well seasoned Bill Souders — the corporate EXVP of marketing, but really the representative of the Rochester marketing establishment. During a lunch, and without any prior discussion or staff work, Titsworth accepted Souder's argument that all office laser printers (except for computer printers, which was an El Segundo turf) would be henceforth a product that would be planned, developed and marketed by the Rochester copier bureaucracy. I suppose,

that Souders could prevail because Titsworth's empire was consuming too much cash and had been throttled for development funds. It was also experiencing a rapid turnover in management and in organization structure. When Souders offered to take office laser printing out of Titsworth's hands it looked like a good compromise except that Rochester could never see a way to sell office lasers as a profitable stand-alone product that would meet their customary gross margin and sales commission objectives. Technically, you needed a workstation to drive an office laser printer. The problem was that the workstation business was now drifting out of control of PARC into a hastily assembled new business unit in Dallas (OPD) that would control only engineering and would not be able to do marketing.

When Titsworth came back from the lunch with Souders and told me of having divested himself of product responsibilities for office laser printing, I was devastated. It was one of the few times in my career when I raised my ire and declared that a decisive blow has been imparted to the hopes of Xerox ever extracting out of PARC a successor to the ALTO as a viable commercial product.

From my administrative productivity studies, and harking back to the Pendery Papers, the immediate high payoff opportunity from a successor to the ALTO would be to deliver a high-end workstation that would offer a premium customer exceptional value added from what I then called instant publishing, or what became ultimately known as desktop publishing. Although the capacity to produce business graphics and a variety of fonts would be certainly useful, the greatest economic value from such as system would be extracted from a capacity to instantly deliver high quality and high-value business documents. For that an office laser printer would be essential, but only if it could be designed as a system product that would be directly linked with the workstation producing the original text. Though PARC was very much interested in such integration, as they demonstrated by attaching laser image generators on top of a modified Xerox copier, the prospects of Rochester developers working closely with PARC were not realistic. PARC would be glad to receive additional funding to do such work but held to its own agenda of a research-based workstation and would not sway from that. Rochester developers immediately blocked the transfer of any funding to PARC because they did not trust them. The

Titsworth-Souders accommodation served no purpose except to further deepen the chasm between competing corporate factions.

The second damage to the future of Xerox future as a systems company was inflicted without much executive discussion, but nevertheless with almost deadly consequences. John Titsworth proceeded with the plans to leverage the existing resources in Dallas as a core of an organization that would have the capacity to guide product development, marketing and support office printing products that would generate text from computer originated instructions. In due course this would include the management of newly acquired text editing machines and electronic typewriters that would adapt the daisy wheel printing technologies that was acquired by the Diablo company, now a Xerox subsidiary. Though engineering, product planning and marketing for these underfunded and limited production products was completely decentralized, when time came to leverage the Xerox sales force, most of the administration — which included billing — remained as an add-on to the copier business. That did not work at all. Rising overhead costs ultimately killed all of the efforts to add non-copier products as add-ons to the products sold by the copier sales force. The salespeople were now struggling with a rapidly dropping market share in copiers and from the demoralization related to the selling off the installed copier equipment.

PARC

Goldman and Zarem sold McColough on funding a new laboratory in Palo Alto that would be devoted to the creation of the office of the future. The idea was to replicate what Carlson has done as an inventor. If the laboratory was successful one could repeat past achievements by buying companies that would then complement what would be developed in Palo Alto. That explained why Xerox was buying Diablo, Shugart, Century Data, Versatec and others in anticipation of what Palo Alto may need someday.

The theory was that after research delivered results one could then turn over the invention to an organization that could then develop a commercial product to be ready for sales as was the case with the Battelle Institute and then by Haloid. Initially I accepted that was a plausible scenario. Unfortunately, none of this turned out to be true. Palo Alto research delivered concepts that did not fit the marketplace. There was no nursing place that could make PARC products adaptable for customer use. There would be no marketing organization to influence how the Palo Alto invention could imitate the path of xerography.

Palo Alto was chosen to place Xerox in the just emerging Silicon Valley. The objective was to get the laboratory as far as possible from Rochester and Stamford. There was an understanding that for more than five years corporate staffers would be kept out of Palo Alto. Corporate finance would have to be satisfied with a minimum of reports about progress for at least six years. There was a special injunction against any marketing people showing up until PARC was ready with whatever they invented.

Though XDS wished to get the new R&D facility close to them so that they could shift research expense for the next generation of computers to the corporate till, Goldman would have none of that. The new lab,

now known as PARC (Palo Alto Research Laboratory) would be operating without any restrictions. It would have a charter to pursue the exploration of office technologies that nobody has ever seen before. The ghost of reincarnating Chester Carlson into the digital world was never far from the heady speculations about PARC directions in those days.

Assembling the Staff

Goldman was well connected with the academia that surrounded the work done for the Department of Defense. He was on the DoD Science Board and knew George Pake, the Provost of Washington University. Pake was a quiet, unassuming scientist-administrator who worked with the Defense Advanced Research Projects Agency (ARPA), which was nursing ideas about the use of images and of text into the world of numerical computing. Pake left academia and joined Xerox as the head of PARC because the new laboratory offered unrestricted opportunities to exploit concepts that meanwhile started languishing, as budget cuts constrained ARPA. Xerox was now offering generous funding to continue ARPA work in a quasi-academic environment.

It did not take long for Pake to assemble a group of stellar researchers. In 1972/73 Congressional legislation limited funding for defense research and many researchers were now without a contract income. All that took was to get a list of the most promising doctorate or post-doctorate students who worked on ARPA projects in the field that PARC would be interested to pursue. A key in this hiring process was Bob Taylor, who had been distributing ARPA funding for work which was already well on its way when budget cuts limited the amount of money available. Taylor was not a scientist himself, nor a Ph.D. but a skillful administrator with a master's degree in experimental psychology. The graduate students eking our a meager stipend doing advanced work were now enticed to move to a collegial environment where the salaries were exceptional, the food was superior, the accommodations were spectacular and the purse was sufficiently loose to afford the purchase of whatever equipment they needed. The PARC laboratory would be creating an opportunity to build not only for Xerox but also for the entire world computer systems that were differ-

ent from anything that XDS or IBM have conceived. I can characterize the PARC researchers as people filled with messiah zeal. Their loyalty was never to Xerox but to the intellectual challenge of taking information technology research out of the stranglehold of mainframe computing characterized by the dominance of IBM. From the inception, PARC researchers detested everything that was represented by XDS or IBM and would have no part of engaging in any shared work with El Segundo. Xerox would be used to fund what the PARC researchers were trying to deliver as a follow-up to work started in ARPA. It was a marriage of convenience that would last only as long as money was coming in from the corporate till. I talked with Bob Taylor often and it was apparent that he a deep contempt for all persons from Rochester and Stamford. Since I was the keeper of mainframe computers in Xerox, I was always viewed with special suspicion though Taylor recognized that I understood his game, which was manipulating the work of PARC out of the reach of Xerox.

The myth of a Chester Carlson reincarnation through PARC was now embedded in the minds of some of the leading lights in Stamford and in Palo Alto. All it took is a few phone calls from Taylor and the chosen researchers signed up. The interviews for employment were conducted by PARC peers and not by supervisors. That put into motion unprecedented ways how to create an innovative environment. To this date PARC has the reputation as the incubator of much that subsequently became the source of many software technologies. The alumni of PARC went to founder a long list of companies. To this day, the originators of firms such as Adobe and Google are proud to identify their origins during their years at Xerox. For a period of about six years PARC has developed from a start-up to become one of the most respected shining examples of Silicon Valley know-how. For a short interval PARC researchers generated more published papers than IBM's Yorktown Laboratories that employed a multiple of research staffers.

First Encounter with PARC

The primary objective of my November 1970 visit to PARC with Don Pendery and George White was to engage in conversations how cor-

porate management from Stamford could provide guidance for PARC research directions. George Pake would welcome receiving a brief that could become the basis for further corporate reviews of PARC progress. Pendery doubted whether that would do any good, since written presentation material from leading PARC researchers made it clear that they were following a path that had been already outlined six years before by ARPA. As PARC researchers saw it, they would proceed to implement visions that had been maturing since 1966 how to transform computers from centrally managed arithmetic engines to autonomous and universal communication medium for cooperation and personal interactions. These were lofty statements, punctuated with philosophical pronouncements how personally managed computers, without oversight by executives like myself, would become a liberation force from what was then seen as the totalitarian Big Brother IBM. We were dealing here not with anarchists but with extremely capable computer scientists whose technological insights were peppered with phrases that I would recognize as originating from then popular campus activists such as Abbie Hoffman. The technology was surely that of the Department of Defense, which was primarily concerned with the survivability of computer-based command networks under condition of a nuclear attack from ballistic missiles. However, the rhetoric reflected the ideas of the German philosopher Herbert Marcuse, the widely quoted critic of capitalist society. These ideas permeated California university campuses and were adopted by the leftist student movement in the 1960s as a roadmap for reforming the US.

What I was hearing was a badly disguised ideology to take computers out of the hands of the bureaucracies and to hand them over to self-sufficient people whose livelihood dispensed with organized forms. The most vocal person in the presentations was Alan Kay who over the years cultivated his anti-organizational positions even though he frequently changed employment to serve large firms looking for unconventional ideas.

Pendery's and my problem with all this was a total lack of an outline how such ideas would propel Xerox towards its desired goals in the foreseeable future. It was clear that what the PARC people talked about was a revolutionary new way how to restructure information systems. The PARC approach passed the test of advocating completely new ways for

organizing computer architectures. It offered ways for bypassing IBM's entrenched positions though the question remained how this would be accomplished and when.

Conceptually, and without probing into potential customer utility, the declarations that came back from our visit to PARC held enormous appeal to Peter McColough and to Jack Goldman. In the early 1970s Xerox was still swimming in cash and spending about $60 million per year on PARC seemed as good a gamble to the poker addicted Xerox top executives as any other acquisition.

What was missing was a connection between invention and practical use. Though PARC was clothing itself in a Carlson-like image of achieving a breakthrough by means of innovative technologies, such a claim was either a misunderstanding of history or a deliberately misleading propaganda. What we know about Carlson's thinking is well documented. Before he even started his search for a non-photographic solution to copying he clearly articulated what could be the economic benefits of a direct imaging process using plain paper. In fact, I can summarize Carlson's, as well as Joe Wilson's thinking as placing economics ahead of technology. PARC had this sequence exactly in reverse. They would build a working instantiation of the ARPA visions regardless of economic utility. The world would then come to embrace this invention with enthusiasm. Chester Carlson and Joe Wilson were focused on delivering customer benefits through reasonable improvements in what already existed. PARC would offer a new way how to perform work in ways never done before, regardless of affordability.

During our visit we were also told that the first product from PARC would be a personal workstation offering unique graphic capabilities. Later, this workstation would become known as the ALTO computer. It would be delivered, using a Data General computer, within two years. How such a computer would be tested and evaluated would depend on how well it would perform internally within the PARC environment. Every researcher would start using their networked ALTO to improve their delivery of research results. At that time I did not realize the consequences of this approach to technology assessment. What PARC was proposing was to build an expensive computer network that would be evaluated strictly in terms how it satisfied the needs of a research elite that was operating at the ex-

treme of computer science. Such an introspective approach to designing the office of the future would become one of the many reasons why whatever would be delivered from PARC would never meet Xerox marketing needs.

Copiers had been conceived as result of original research. After a long gestation period, Xerox finally delivered something that eased the workload of office workers, economically and simply. During this long journey Xerox had introduced two products using selenium imaging that did not succeed commercially, even though they did not lose money. Nevertheless, even those unprofitable ventures generated valuable insights from customer engagements. What PARC proposed now was not even remotely comparable to whatever represented the Xerox heritage. Whereas Xerox was in the dry copying business for decades prior to the introduction of the first successful product, what PARC offered was without a precedent. Whereas Xerox marketing delivered several xerographic products to paying customers prior to getting its third offerings right, PARC had no such plans. The ALTO was an expensive and subsidized tool that would be subjected to critique only from the standpoint of computer scientists, not from paying customers. When PARC was pressed to show how this equipment could work elsewhere, fifty ALTOs were donated to Stanford University, Carnegie-Mellon and M.I.T computer science departments to demonstrate its utility.

How customers would benefit from whatever PARC would deliver always remained murky. Carlson and Wilson reflected the approach exemplified by the pragmatic philosophy of John Dewey, which was deeply embedded in the way Americans have learned how to think and act. The thinking of PARC leaders was ideological and deductive. It reflected not only the philosophy of Marcuse, but also of other European professors. No wonder that some of the leading intellectuals from the increasingly radicalized universities flocked to PARC in search of academic fame and social fulfillment, enticed by intellectual ferment, brilliant personalities as well as very good money.

PARC and XDS

The Xerox Palo Alto Research Center (PARC) was opened in July 1970 with the intent of finding ways how to fill the growing research gaps in XDS. The assumption that PARC would ever work with XDS or make up for its deficiencies was one of the many major errors in judgment by Xerox executives how to attain their expansionary ambitions. In every conceivable respect, PARC represented the counter-culture of the tradition–breaking 1960s. The leaders in Palo Alto had a gut-level aversion for the technologies and the personalities in El Segundo. It was a gap that only widened as XDS fortunes declined. The opinion-formers at PARC had also no respect for Xerox ex-IBM executives, even though it was the Rochester people who generated the cash that paid for the large increases in the compensation of researchers who until then eked out meager sustenance from research grants. It would take a cultural anthropologist to describe the dynamics of the dysfunctional relationships that prevailed between PARC and the rest of Xerox and ultimately led to its negligible contributions to the Xerox bottom line profits. It was the deliberate isolation of PARC from the rest of the corporation, during its most creative period, that was one of the many flaws that would inevitably lead to the failure of PARC to lead Xerox into the future.

I visited PARC in November of 1970, together with Don Pendery and George White, in their temporary quarters Porter Drive in Palo Alto. My purpose was to review a capital appropriation request from PARC to purchase a Digital Equipment (DECSYSTEM-20) time-sharing machine. In my capacity, as the chief information executive, I had to sign off on such requests on the basis of economic justification. The situation was aggravated further by the fact that I was in charge of getting XDS equipment installed throughout the company as quickly as possible. XDS was losing sales, most often to equipment made by DEC. Therefore, approving the purchase of a multi-million DEC installation for PARC while our warehouses were full of high capacity XDS time-sharing machines, would surely come to the attention of the computer industry and I would have to answer for that. Under ordinary circumstances, I would take such a request and disapprove it, unless there were extenuating reasons to purchase

a DEC computer. Where Xerox held only a minority interest, such as in Rank-Xerox and in Fuji-Xerox it would take a visit and some arm-twisting to have such a request withdrawn.

In the case of PARC I was advised to tread carefully and to offer to the PARC staff one of the corporate Sigma 7 machines that could be made available for very little expense. At PARC there were no takers for an almost free Xerox time-sharing computer. The reasons for the rejection did not seem to me to be well documented except for the insistence that the PARC staff could now tap into a number of programs they had previously used while working under a research contract paid for by the Department of Defense. This argument was not credible and bordered on capricious dislike of anything that XDS had to offer. For the huge difference in the cost between the DEC and the XDS alternatives, spending money and time on making some applications interoperable could have been easy to justify. Besides, that could yield to XDS access to innovative software that could give access to a community of scientists now associated with Defense Department's Arpanet project. At the time I was not aware of the antipathy of ARPA scientists towards XDS.

As this matter could not be resolved locally, I refused to sign off on purchasing request. After my return to Stamford, I was told that the key PARC staffers offered to resign because they would not be able to continue carrying on with their work. George Pake, the patient and diplomatic Director of PARC offered, as a compromise, an opportunity to construct a one of a kind computer which could emulate DEC, but would also allow the development of unique software and hardware what the researchers wished to do anyway. From the standpoint of Xerox this would not make much sense because it would involve additional spending and a diversion of researchers to develop a brand new computer. As seen by PARC, the opportunity to invent unique computer architectures and a new operating system would add to their credentials of exceptional professional achievement. In fact, that is exactly what they accomplished.

In an incredible short time the PARC built a brand new computer, named MAX, which was basically a copy of the DEC-10, using DEC components plus a number of original features the scientists were eager to have anyway. Naming this computer MAX was considered an in-your-face pun

that reflected on the independence of PARC to operate without the support from Max Palevsky, the CEO of XDS. The MAX turned out to be the first confrontation between Xerox and PARC and Xerox yielded without a whimper. This small incident set the tone for everything that would be coming in the future. PARC was allowed to operate in complete isolation and to build technologies that were designed to demonstrate the brilliance of PARC researchers without any consideration of how this could possibly relate to the future of Xerox.

PARC and the Internet

The Internet progenitor was the Advanced Research Projects Agency Network (ARPANET) of the US Department of Defense. This is an important fact to remember, because the support and style of management as conducted by ARPA was crucial to the success of ARPANET and became reflected in PARC's behavior. After all, the leading lights in Palo Alto were all formerly paid from ARPA funds. As the Internet developed and the struggle over the role the Internet in business communications unfolded, its influence on PARC must be remembered in how the network developed and how the culture that it was connected with evolved.

J.C.R. Licklider was chosen to head this effort. Licklider came to ARPA from Bolt, Beranek and Newman, (BBN) in Cambridge, MA in October 1962. The spirit of a closely-knit community that developed among the researchers working on ARPA project was related to Licklider's interest in having computers help people communicate with other people. Licklider's vision of a network connecting people represented an important conceptual shift in computer science. This vision was also an important beginning to the ARPANET. After the ARPANET was up and running, the computer scientists using it realized that assisting human communication was the most fundamental advance that the ARPANET made possible. The ARPA theme was that the promise offered by the computer as a communication medium between people dwarfs the historical beginnings of the computer as an arithmetic engine. Starting in the spring of 1967 at the University of Michigan, ARPA held its yearly meeting of the principal investigators from each of its universities and other contractors.

A community of like-minded researchers was getting formed. Peer group commentators quickly sorted out the leaders who would start sharing the vision of communication-based computing which would be based on distributed computing, without central control.

At UCLA SDS and then XDS scrambled to build a host-IMP interface for ARPANET. XDS wanted many months and many dollars to do the job since Internet was not on top of its priorities. A grad student at UCLA stepped in and offered to get the interface built in six weeks for a few thousand dollars using DEC equipment. If the relationships between XDS and PARC would have been cooperative, a PARC led effort could have opened for XDS an opportunity to participate in the explosive growth of Internet. That did not happen and most of the Internet hardware was supplied by DEC.

With the creation of PARC a well-funded center was created for the pursuit of Internet development using DEC hardware. PARC researchers, with help from an extended network of similarly expired researchers, were now able to place themselves into an easily identified key position that would engage in the construction of a new way how to build an information based society. None of that would be done in a way that would benefit Xerox.

The Xerox ALTO

The ALTO was the first personal computer or workstation that used bit-mapped graphics, a mouse, pull-down menus, icons representing documents and other features that would become the basic technologies of today's PCs. The designers also created the Ethernet local area networking protocol to link ALTOs within the PARC research community and with Internet (then Arpanet).

ALTO was a dedicated Data General minicomputer with a premium priced high-resolution screen, with a huge magnetic hard disk, a mouse and custom-made proprietary software. Even after discounting for the rapidly dropping costs in electronics it was clear that only a highly compensated scientific elite in research departments could afford such machines. The PARC researchers had no clue how much a mass-produced

ALTO would cost, though I estimated that number to be roughly equal to the average base salary of PARC personnel. If that was so, only a device that could double (that is a 100% gain) the productivity of a sufficiently large number of knowledge workers could meet Xerox marketing requirements. For ALTO that did not matter because it was a research prototype to demonstrate the feasibility of integrating a range of features that previously were found only in isolation, in specialized devices.

I believe that it was sometime early in 1975 that the PARC researchers completed the installation of Ethernet linked ALTO computers. The scientists' self-contained personal computers were now linked and could share printing and perform document filing. To celebrate this accomplishment and to demonstrate the capabilities of a totally innovative approach to organizing office automation the entire senior staff, including McCollough, were invited to a carefully orchestrated show of what was accomplished.

When the large delegation from Stamford finally showed up at Palo Alto to see what the researchers had delivered the various demonstrations were seen from the standpoint of what Ford or IBM executives would judge as something that was promising and commercially viable. I was a part of the delegation of about twenty Stamford executives and heard every presentation. What finally broke PARC credibility was a flamboyant presentation by Alan Kay, the most publicity-conscious of all PARC researchers. Alan talked about the future of personal computing which could deliver a wide range of graphic capabilities. Alan's demonstration covered rudimentary displays, such a the capacity to draw squares, circles and connected lines on what was an admittedly very expensive graphic computer. The product-focused officers from Stamford were not impressed. Jim O'Neill, the acerbic and influential chief of staff, wrapped up Alan's show by commenting that this was hell-of-a of an expensive etch-a-sketch toy for his grandchildren.

Alan was also carrying around a cardboard mock-up of a laptop not bigger than a sheet of office paper and as thick as a textbook. Alan called this a Dynabook. It would offer an easy to use graphical user interface he called windows. Alan maintained that with rapidly falling prices of semiconductors a commercial version of Dynabooks could become af-

fordable soon, especially if produced in enormous quantities. I did not believe that a laptop — what was then described by Allan as the future technology — was economically feasible by 1980 that was as far a horizon that Xerox executives could think about. In fact, it was not until sometime after 1996 that Alan's projected semiconductor costs based on the well known Moore's Law would make laptops economically attractive. When the paper mock-up was waved in front of the skeptical Xerox viewers it was viewed as yet another unrealistic speculation.

I think that Alan quickly figured that he was losing his audience and decided to editorialize on the significance of what he was demonstrating. As a way of finally getting attention, Alan sallied forth with a commentary that the devices that will be emerging from the work at PARC are harbinger of the paperless office. He certainly touched a sore point. Embedded in the Xerox mythologies was an awareness how plain paper xerography made obsolete photographic copies. One of the topics that always appeared on the agenda of corporate strategic planning sessions was the question whether xerography itself could become technologically obsolete. Such apprehensions were not alleviated by the fact that IBM, always viewed as the primary adversary, had been engaged in the prior five years in a concerted advertising campaign about the advent of the paperless office. Though IBM supported its claims with only a handful of examples from banking, the evidence was overwhelming that the pieces of paper that were optically scanned on Xerox copiers were hardly ever originated from IBM computing. Nevertheless, the talk about an office where there were no paper originals to copied, was a sufficiently popular topic to spook Xerox executives. Follow-on conversation at dinner kept drifting back to the question whether PARC technologies were not only speculative, but also potentially subversive to future Xerox profitability. That is why on the second day of the corporate visit to PARC much of the attention focused on the implications of laser printing technologies and led to the decision to start investing in non-impact computer printing that would make a dent in IBM's lucrative impact printing revenues.

The result of the group visit to Palo Alto was the decision to order PARC to proceed with market probes that would verify the suitability of a follow-on version of ALTO to enter into market. I consider the decision

to charter Palo Alto with the job of conducting a market probe as one of the many deadly errors in the history of Xerox entry into the office automation business. By now Xerox top management forgot that when Joe Wilson nursed the Chester Carlson invention from a laboratory prototype another decade were spent in experimentation that was closely guided by a Joe Wilson who had an intimate understanding of the copying business. In the lean years that started with a working laboratory model to something that could be sold in the market there were three failures that were nevertheless used as a learning experience. Joe Wilson would never trust Chester Carlson or the Battelle Laboratories to be qualified to conduct a market study for xerography.

Elkind Probes

Joe Wilson, despite several reverses, always retained a long-term focus on developing a product that would meet well-understood customer needs. Xerox would now engage in a market probe with a short fuse. When Joe Wilson tested the market that was always done in close participation with his marketing people. Xerox would now engaged in a probe did not have any marketing involvement because the entire responsibility was now placed in the hands of Jerry Elkind, one of the PARC researchers not directly participating in the development of the ALTO. Elkind was from MIT and was considered by the PARC establishment as an outsider. As it developed, the purpose of the Elkind market probe was not the gathering of insights about customer needs. The objective was certainly not to learn something about customer economics. This probe violated everything that was stated in the promptly forgotten Pendery Papers because there was no way how one could justify giving to a secretary or to a typist a workstations that cost substantially more than their salaries. As the probe progressed, it became a three-year effort to demonstrate that improved versions of the ALTO could function in an environment that was very much like PARC and where services and functions were delivered to users who were operating like researchers working in computer science. The Elkind probe was not a probe at all but an engineering validation exercise. The testing of the ALTO product was initially well funded and resulted in the distribution of

computers to quasi-academic institutions such as ARPA (the Defense Department Advanced Research Projects Agency) as well as friendly research sites such as Carnegie-Mellon and SRI International. The only major commercial installation was at Boeing but was not a business test at all because it was used in the Aerospace Division to prepare proposals for the Air Force where costs were not a consideration.

What Elkind was doing would not pass muster as market validation test. It was primarily a means for gaining time for completion of engineering for the forthcoming Xerox 8010. The testing was almost exclusively with customers who had similar characteristics as PARC. These were technologically advanced and knowledgeable computer experts working in loosely structured organizations and working primarily as individual contributors. At the test locations costs were part of R&D and not reflected in Sales, General & Administrative expense which originally had been the objective articulated in the Pendery Papers. Elkind's thinking, like the beliefs held by the PARC leadership, was concentrated on the supply-side of technology. No attention was given to the demand-side that would find out what customers would be willing to pay for a Xerox product purchased in large quantities. The Elkind market probe, as the opener into the Xerox of the future, was entrusted to promoting the technologies, conceived by the technologists and readied for the technologists. There was no test for a device that could offer a reasonable prospect for a copier-like revenue-creating proposition that was what the Stamford executives were hoping to realize.

The praise and admiration for the technology that were voiced by Elkind's customers for a chance to play with an advanced technology at practically no expense were projected by the PARC denizens as a prediction that they would deliver another xerography to Stamford. The books that have been written subsequently about the STAR computer echo this theme. That is a distortion of what really happened. Xerox, on the urging of PARC and always eager to score a publicity victory, proceeded to launch the Xerox 8010 Workstation that never had a chance of succeeding. It had poor technology and it was premature. It was unaffordable for just about every administrative office use and did not display the care and patience of Joe Wilson to bring to the world a path-beating product.

Why the disconnect between the design of the STAR, as it evolved from the ALTO, was not discovered in the product gestation period from 1976 to 1980 is not a mystery. It is one of the untold stories that would remain hidden in everything that has been written about the origins of Xerox STAR.[8]

From ALTO to a Product

Late in 1978 PARC leaders who emphasized the importance of innovative computer science, believed that they have delivered to Xerox a research product that would be ready to be handed over to engineering and marketing. At corporate headquarters nobody had anticipated the speed of PARC innovation. Marketing people were specifically blocked from having anything to do with Palo Alto. The logical vehicle for steering PARC innovations into the marketplace would have been the Office Product Division in Dallas under Bob Potter, who was fully engaged with text processing and did not have a clue what an Ethernet based office environment would look like. Potter reported to David Culbertson, whose role was largely custodial in keeping the many component diversifications of the Information Products Group profitable. John Titsworth has not as yet appeared on the scene to take over IPG and therefore there was a complete leadership vacuum for taking the ALTO out of PARC and making a business out of it.

When Massaro ditched the Xerox 820 he directed all of his attention to a completely new market segment that was represented by a high-end workstation. A transplant from PARC, David Liddle, now joined Massaro. Their objective was to take a product version of the experimental ALTO computer and make it available to customers. Liddle dominated what came out of this effort. Massaro in the absence of other options delivered a workstation conceived to meet PARC-like needs, operating in a PARC like environment, using PARC-like applications, applying PARC special-

8 Johnson, J., Roberts, T.L., Verplank, Smith, D.C., W., Irby, C., Beard, M., Mackey, K., "The Xerox Star: A Retrospective," *IEEE Computer*, September 1989 .

ized software that was not used by anybody else in the world (MESA) and operating with a microprocessor that was of a unique PARC design.

The Xerox STAR 8010 offered one of the most significant demonstrations of an innovative computer system. It was by PARC, for PARC and not suitable for office customers where only the cutting edge prospects would spend the cash to buy a unique and overpriced workstation. The Xerox 8010 represented the first most complete implementation of the Desktop Metaphor of any systems until the advent of mature desktop graphical interfaces later on the Macintosh.[9] It was a full fifteen years ahead of its time with sophisticated WYSIWYG document composition, built in Ethernet, email, networked laser printing, an object development environments including Smalltalk, and much more. The Xerox STAR came standard with a 29MB Shugart hard drive.

The STAR workstation, introduced in 1981 for the list price of $16,595 per workstation (plus the cost of printers and servers it ran over $28,000) has gone down in computer lore as a remarkable piece of software engineering whose commercial prospects were crippled by its high price tag and a total lack of suitability as generally used office equipment.[10] The software designers' ambition outstripped the hardware's power to support it. The maintenance costs for the STAR were extremely high and service technicians were not available which resulted in a poor quality of service. STAR was what one could call barely an Alpha version of usable office equipment since it was unique in every respect with regard to hardware and software. The machine would not be interoperable or compatible with anything that was offered by anyone in the market. PARC people supporting Liddel saw to it that no other software company could support the STAR, which would be entirely a Xerox proprietary creation except in cases where Xerox purchased licenses to be resold at a part of the

9 After Liddle and Massaro left Xerox in 1982 they formed a STAR look-alike firm named Metaphor. When Xerox claimed royalties from the use of STAR technologies, Liddle and Massaro countersued, claiming that did not use Xerox proprietary know-how.

10 The actual costs of the STAR workstation would be never known. The market acceptance projections were completely overstated. Though large R&D costs were never charged against the STAR, it lost money if one takes into account only variable production costs.

purchase price. STAR turned out to be a monument to imagination and a demonstration of great innovativeness. It was therefore hailed as a great research accomplishment that set forth the directions of micro computing for years to come. Nevertheless, Xerox should have never allowed STAR to be launched as a viable business offering. It was a failed product that was doomed to failure from its inception.

The design, market positioning and the engineering of the STAR was fundamentally flawed and could not be corrected when the system was finally launched with a great fanfare and accolades from the computer science community. The device appealed to the computer scientists since it was designed to fit the unique environment in a research center where the principal product was a research paper. This defect in an understanding of an office productivity product was carried forth by David Liddel into the launch, where the STAR would be now advertised as a professional workstation. The fact that just about every business professional would have only extremely limited uses for such machine was overlooked and papered over by the initial publicity. American technical and professional workers did not operate text-editing devices. That job was delegated to typists and secretaries who required substantial training to work with any Xerox advanced equipment. It was only in PARC and in a few similar laboratories where the researchers keyed in their own text because that is how it was done in an academic setting from where PARC researchers came from.

I was one of the early recipients of the STAR 8010 and had it installed in my home with an impact printer that was later upgraded to one of the first small laser printers. It took sixteen eight-inch floppy disks, loaded in a complex and tightly prescribed sequence, to get the STAR workstation operational. There was only a limited catalogue of applications. STAR was a superb machine for producing graphic originals for overhead foils and was useful in making frequent revisions in presentations. Its Bravo text editor was attractive, innovative and easy to use but only after substantial training. STAR offered a completely proprietary solution that used a completely proprietary, Xerox-designed operating system. From the standpoint of cost of ownership it would require the presence of large amounts of high-cost graphics to justify purchasing this machine provided that the STAR would offer some sort of a migration path for a customer who bought it. In fact,

I found only one completely documented case where the STAR workstation was cost effective. That was in the case of proposal preparation for the Department of Defense by the Boeing Company where urgency and frequent revisions of high-value documents could deliver savings by offering a quick turnaround to revisions of extremely voluminous proposals. In the case of Boeing that was a one time deal, after which Boeing proceeded to buy other equipment and never expanded its STAR population. Xerox did not offer a software or application upgrade path for STAR.

The PARC denizens never had any interest in helping to bail out anything that could be classified as having commercial uses. After the Xerox 8010 launch they redirected their efforts to the construction of advanced computer hardware that addressed scientific needs in artificial intelligence by building a series of LISP computers such as the Xerox 1100, aka "Dolphin" (1979); the Xerox 1132, aka "Dorado"; the Xerox 1108, aka "Dandelion" (1981); the Xerox 1109, aka "Dandetiger"; and the Xerox 1186/6085, aka "Daybreak". To produce these machines PARC ran a bootleg manufacturing operation, which could afford selling unique equipment at low prices while Xerox was subsidizing the research center at Coyote Hills and there was nobody who could sort out the costs anyway. A few of the LISP machines were sold to universities where graduate students were delighted to produce PhD dissertations using Dorado equipment. As a business, the LISP machines were a complete failure to be quickly overtaken by commercial firms. From the standpoint of PARC the LISP venture advanced computer science and that was all they were interested in.

The Nixdorf Visit

Though the STAR workstation was seen by PARC as a proof of miraculous creation and received universal accolades for that (from its peers), in fact STAR was incomplete from an engineering standpoint and should have never been allowed to parade before the world as the Xerox answer to the office of the future. This insight was finally brought to my understanding when I was asked to accompany Heinz Nixdorf on a visit to Palo Alto for a pre-announcement review of the Xerox STAR. Heinz was an engineer's engineer, who grew perhaps the most successful computer

company, Nixdorf Computers, ever launched in Europe by delivering robust, cost effective and highly serviceable mini-computers to small and mid-size businesses. When we arrived, Heinz refused to sit through the customary presentation and insisted seeing the heralded STAR machine immediately. The specifications of STAR had been leaked out for several weeks. After a cursory examination of the STAR applications, they were only a handful and remarkably clunky, Heinz asked to see the innards of the box that housed the electronic engine.

The computer housing was opened without hesitation, which I found remarkable because I would have objected on the grounds that a yet-to-be launched revolutionary technology should be protected, especially when shown to a knowledgeable CEO of a potential competitor. So far as I know, Heinz did not even have to sign a non-disclosure agreement, which was a meaningless piece of paper, but at least a pretense about proprietary protection. The PARC people had been previously instructed to show Heinz everything to accommodate our German Rank-Xerox unit that had been cooking up some sort of copier deal with the Nixdorf firm. I cannot tell how much of the STAR had already become a widely held property except that judging by the openness with Nixdorf I became convinced that copycat versions of the STAR could be appearing soon and any competitive advantage would quickly vanish.

Mr. Nixdorf altered such apprehensions. When he saw how the circuit boards were engineered and placed in the STAR enclosure, how some of the connectors were obviously improvised and patched, how jumper cables were clipped on and how the critical components were placed, he announced that STAR was not at all finished to be suitable for office uses as a low-cost and maintainable machine. After dismissing the engineering of the hardware, he started asking questions about the processor, the operating systems, diagnostics and support utilities. Mumbling in German, which I understood, it was obvious that the Xerox STAR was no threat to either existing Nixdorf products and certainly not a model what the future would look like, despite what he had been told. Heinz was particularly unhappy with the home-brewed and improvised characteristics of the operating systems software. With considerable grace he then thanked

us profusely and cut his visit short, obviously relieved that his business plans would not have to be altered.

Xerox 6085 Professional Computer System

In 1985 Xerox built a second generation of the Xerox STAR hardware and new versions of the STAR software. The new hardware was called the Xerox 6085, and the software was completely revamped though its operating system, microprocessor and software were still proprietary. It was significantly faster and more polished. It allowed the user to do multiple things at once, something that Macintosh couldn't do until mid-1987, and Windows even later. The 6085 product came with an unprecedented nineteen inches monitor. There was only a limited production of the 6085. It was too expensive, it was not adequately supported and the Xerox corporate subsidies dried up. If it could not deliver profits, it will have to be abandoned. Without patience, or a willingness to commit to serving a limited market in high-end document production, the entire product line was dropped. The pattern that started with the casting off the Education Divisions when they instantly did not produce profits, with the abandonment of Xerox Data Systems when it did not become a huge success and with the scuttling of innumerable small enterprises that would not somehow grow into copier-size opportunities, the pattern of first buy, then tamper with it, and then abandon it was now firmly entrenched in the Stamford executive psyche, as represented by Peter McColough and his staff.

In 1983 Xerox acquired Crum and Forster as diversification into financial services. In 1984 the Xerox Financial Services subsidiary was formed. Xerox now turned its attention to becoming a financial services company and incurred debt to pursue this completely alien direction. Mel Howard, the CFO ultimately became the Vice-Chairman of the firm.

When Xerox bid good-bye to the office equipment and the office productivity business my days in working for this company that I loved and that I could support were numbered. As a postscript I would like to add that the diversification into the financial services business failed a few years later with enormous losses, questionable financial accounting practices and a precipitous drop in the price of Xerox shares.

The Decline of Xerox

When a corporation rots, the disintegration starts from within. An attack from an outsider succeeds only after the inside rot had already corroded internal defenses. For a corporation to reform that must begin from within. That cannot be achieved through an alien transplant, such as through acquisition. Those insights are not mine. They were extracted from the works of the historian Arnold Toynbee. He taught me how to understand what appeared to be unforgivable misdirection perpetrated by a vacillating leadership.

The failure of Xerox to fulfill its promises has produced a large number of critical analyses that were looking for the causes of its ultimate decline. I cannot possibly enumerate all of the hypotheses except to identify some of the most influential sources.

Professor Gary Hamel is perhaps one of the most influential proponents of innovative corporations. He has argued that the capacity to continually evolve is necessary to maintain a competitive advantage. Hamel has identified four principal evolutionary risk factors that inhibit growth.[11]

Hamel defined the first risk factor as a narrow business definition that limits the scope of innovation. Did that apply to Xerox? I do not think so. If anything, Xerox business definitions were excessively diverse, never managing to concentrate on anything beyond electro photography. Xerox kept hopping from education to computers, to office equipment, to workstations, to telecommunications to financial services, to mention only a few examples. Did Xerox pursue a narrow business definition? Decidedly not, it could be characterized perhaps as practicing business promiscuity.

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11 Hamel, G., "Management *a la* Google," *The Wall Street Journal*, April 26, 2006

The second risk factor was a hierarchical organization that overweighs the views of those who had a stake in perpetuating the status quo. Did that apply to Xerox? Decidedly not. If anything, the conduct of business in its educational, office equipment, peripherals and international operations did not have much of a bureaucratic hierarchy, except for quarterly financial reviews conducted by a slim corporate staff. In the case of PARC, corporate staff was for all practical purposes unable to influence whatever was done there. In the various technological and geographic diversifications you could not find much of a hierarchy anywhere.

Hamel's third risk factor is a tendency to over-invest in the "what is" at the expense of "what could be." Again, in the case of Xerox that was not the case. Numerous acquisitions were made with high priced stock, diluting shareholder equity. That was followed by several years of generous subsidies until management gave up. Underinvestment in innovation was not one of many Xerox faults.

Whether Xerox can be characterized by the fourth risk factor, namely creeping mediocrity in which bozos replace good people is certainly not the case. Acquisitions brought in a huge influx of brilliant people. As demonstrated in its diverse operations, for a while Xerox was the place to where brilliant people migrated. The problem with Xerox was not hiring incompetents, but not being able to keep the brilliant people as management kept changing directions and leaving the inevitable power struggles unresolved.

Xerox did not suffer from one of Hamel's four sins. It suffered form a marketing arrogance.

The habit of barging into a new business and then abandoning it after it did not succeed in less than five years was to repeat itself in the laser printing, education, telecommunications, facsimile, electric typewriters, disk memory, laser sensors, demand printing, office software, graphics applications and many other high-technology ventures. In each case highly valued Xerox stock would be traded for an acquisition with expectation that it become a promising addition to the business growth portfolio. There were only a few homegrown ventures in businesses unrelated to copying, despite huge R&D expenditures. These never matched the profit expectations that were implicit in the exceptionally high stock multiple that was a

reflection of expected enormous future gains. In due course, most of what Xerox divested turned out to be successful, but only after many years of gestation and certainly not as Xerox gains. The ultimate beneficiaries were new firms such as Apple, Adobe, Microsoft (such as the Word text editing software included in the enormously profitable Office suite) and Hewlett Packard (for office laser printing).

Five years later, after observing such repetitious behavior, I developed a hypothesis that could explain the rationale for what a student of psychology could identify as manic-depressive management. That insight dawned on me after getting appointed to a committee charged with the divestiture of XDS. This included David Kearns, VP of Marketing, Jim Campbell, the CEO of XCS, Don Pendery, the corporate VP of strategic planning and myself, representing XDS's largest installed base with 140 XDS computers. Acquiring SDS by means of an overpriced purchase and then discarding it before it could succeed formed a pattern that could not be explained as capricious behavior.

Xerox paid a billion dollars for SDS because it fitted a model of technological breakthroughs enshrined by mistaken re-interpretations of what had been achieved by Chester Carlson. Top Xerox executives were overwhelmed by the wealth that became unleashed by xerography. Initially, the cash flow and the stock appreciation were legendary. Overnight people acquired wealth beyond all aspirations. A pervasive myth, echoed by the eager media, became an article of faith that somehow xerography was a miraculous invention that was instantly brought to life by Xerox management and particularly by Xerox marketing people despite everybody's opposition and rejection. Professors and consultants perpetuated this myth because it suited the intellectuals' sweat-less conceptualizations that if you have a sufficiently radical new way of doing things, the world will beat a path to your door and pay a premium price for such an offering. Even if you miss a few revolutionary inventions, the one that will deliver results will compensate for all losses as long as you gamble on a venture that nobody else would support. It was a high-risk kind of a view of technology that depended not on organic growth from internally generated discoveries, but on discovery and acquisition of an otherwise neglected opportunity developed by others. It was marketing arrogance that

destroyed Xerox because top management, and particularly McColough, was convinced that good marketing could create tremendous opportunities from under-rated technologies.

It is hard for me to talk about my experiences in the Xerox years without mentioning personal characteristics of the many un-named people who devoted their lives to delivering something that was, at the time, seen as a notable contribution to improving the life of the office workforce. When I joined Xerox, it was a much admired and respected firm, ranking among the top few examples of American technological and business accomplishments. As the condition of Xerox rapidly deteriorated as one of the foremost American enterprises, collateral changes were taking place in the lives of many of its employees.

Don Pendery

Donald Pendery, the VP of Corporate Planning, was a thoughtful but dour New Englander who did not tolerate much of the nonsense that increasingly dominated corporate conversations. I admired him a great deal. By 1982 he diverted his attention from the office of the future because it was now a lost cause. He saw how Xerox was hemorrhaging cash and rapidly losing market position in the heartland copier business. He started advocating a major shift of resources from losses in the Information Systems Group to the languishing copier business.

It was in 1983 when I had lunch with Pendery. He had just returned from a meeting with David Kearns, now the CEO. Pendery's verdict was that Kearns was a wonderful person but with the short-term outlook of an IBM Branch Manager. Apparently Kearns advocated superior execution and improved quality of marketing programs while Pendery was pleading to fix what was now a slowly sinking ship. Shortly thereafter Pendery went to see Kearns to restate his case again. I do not know what happened but Pendery resigned on the spot. He did not even return to his office but walked out of the HQ building never to return even to pick up his belongings. Shortly thereafter died under unusual circumstances.

Retrieval of Information

As I browse through my strategic planning papers dated in early 1971 I continue to be amazed by insights that anticipated many of the developments in years and even decades to come. I do not believe that I was endowed by a gift of technological prophecy. Concepts about the directions in which information technology was headed were floating around in bits and pieces that could be extracted from leading papers from ACM and IEEE. It seems that at Xerox I had the ability to summarize the most likely directions and pass them around as strategy papers to Pendery, for further distribution as guidance, or as the case would be, inconclusive debates. My 1971 paper on *A View of the 1980s* contained a section about the retrieval of information that was addressed to the importance of Xerox entering into the computer storage business. Indeed, shortly thereafter Xerox acquired and then ruined Shugart and Century Data:

> "… The economics of retrieval of information today is entirely dictated by its storage technology, even though we are just now at the threshold of file-independent information systems in certain advanced computer databases. The basic problem of information retrieval in large organizations is being solved today by a combination of schemes, the most prevalent being information broadcasting by means of the copying/reproducing process which is basically deficient in its inability to contribute to the subsequent ease of retrieval or search except by providing for more convenient filing.
>
> Since information retrieval has the highest 'value added' from all of the various information manipulation processes and from the standpoint of its automation is most difficult to achieve (since it requires the execution of complex and non-standard functions), its human operator value as in terms of work experience is of the highest order.

The strategic implication for Xerox is then to 'architect' work station products in a manner which facilitates the highest possible degree of human operator intervention and participation in the retrieval processes — essentially endowing the work station with characteristics of a device suitable for 'learning' — rather than imposing a hierarchical or structured query sequence as is currently the case in many primitive inquiry systems.

Incidentally, this strategy gives relief from the extremely costly and ineffective need for heavy software investments, which so far have been essential to equip any computer system with a capability to retrieve information from files. This strategy also implies: a need for decentralized file manipulation processors, the availability of communication accesses to multiple files, and the absolute prerequisite for 'systems sales' wherein information capture, information storage, and information retrieval technologies can become installed in a modular, evolutionary, and technologically adaptive sequence.

The workstation of the 1980s will then act as a communications terminal between people engaged in solving the complex problems of coordinating the logistics of the service industries. This would be made possible by the lowering of the costs of information capture and information storage, thus providing the technological basis for the high payoff interactive retrieval functions. Such workstations will also permit production industries to carry out existing administrative and clerical functions without a need to increase the costs of such staffs, as was not the case during the late 60s. The increased productivity of the remaining staffs will thus aid in the maintenance of profit margins which otherwise would become eroded even further than indicated by current trends.

The net result of such processes will lead to the gradual altering of the function of the non-skilled clerical worker as well as of

> certain non-skilled service workers from performing standardized and specialized 'assembly line' functions to becoming active and individual participants in the information processing functions themselves. In this fashion, we will be able to provide for our new (and differently motivated generation) workers with a work environment where it is technically possible — and indeed desirable — for each worker to seek an enlargement of his work contents. This is made feasible by the perfectly flexible and asynchronous nature of his workstation wherein the worker can, subject to certain agreements with management, instantly enlarge the scope of functions executed, or, instantly extend the range of his tasks. Such an environment had previously existed only during the handicraft era and had to be eliminated when the discipline of synchronized manufacturing physical processes dictated the establishment of a rigidly controlled work environment."

The central theme of this part of corporate guidance concerned the need to place in the hands of the clerical workforce the means for the enlargement of the scope of their work, involving an engagement of personal judgment with data presented by a computer. PARC disregarded that. They did not study the needs of the Xerox customers. The limited number of expensive pilot studies that were launched under the direction of Jerry Elkind to verify the suitability of ALTO to perform office functions were managed to check out the functionality of a limping and unreliable technology that was still in a prototype configuration. There was no data collection or testing of the efficiency and effectiveness of office administrative personnel. None of the PARC pilot studies were ever engaged in measuring verifiable productivity gains.

Document and File Control

My experience in managing computers taught me the importance of controlling the reliability and accuracy of the sources of information. Unclean data is a form of pollution. Once polluted data is allowed to enter

into an automated data processing stream, the computer-generated results will never be trusted. Correcting faulty information entries further downstream is not only horribly expensive but also never completely assured. A section of my strategic guidelines to PARC attempted to attract the attention of PARC people to the needs to assure the integrity of information that would be unleashed through a network. That would be absolutely necessary for information management in commercial installations. In the case of communications in the research environment, that was irrelevant and most likely a deterrent. What PARC ultimately delivered reflected the habits and the culture of a self-disciplining research community through voluntary peer reviews. The utter disregard of even a semblance of auditing methods and authentication of locally made entries doomed anything coming out of PARC from becoming accepted by corporate executives who were accountable for information processing. The following narrative was never considered worthy of discussion in subsequent meetings at PARC:

> "… While aggregate clerical turnover figures are extremely high (by 'blue collar' standards), they still do not convey the full story in terms of performance reliability at each workstation. In addition to the basic turnover probability, there are vacations, absenteeism, workstation shifts, and relief operators. Depending on the nature of the information processing function performed, the probability of having the same workstation occupied by the identical worker to process a set of functions requested by one person (such as a given customer) becomes very small indeed. Consequently large organizations find it essential to extend control over all files, documents, correspondence, etc. entering the system since each element of paper becomes increasingly relevant in achieving predetermined service reliability once we assume a given level of maintenance. The reliability of an information processing system is much more perishable; it depends on human performance at any instance of time.

> In projecting needs ten to twenty years ahead, we have to increasingly visualize a hierarchy of information, data and document storage devices that lend themselves to a high degree of centralized procedural control and decentralized inquiry (and manipulation) capability. These devices and high technology equipment components will offer a variety of options to effect a compromise between cost, controlled accessibility, response time to inquiry, operational complexity, and general ease with which the machine will communicate with the human operator in a 'tutorial' mode. To illustrate the last point: One of the factors that militate against job enlargement, lead to position specialization and result in cumbersome procedural manuals — all of which are resulting in low productivity — arises from the need to construct jobs that can be learned by an average candidate in a reasonable time. Hence individuals become 'pigeonholed' in jobs, develop vested job interests and a builtin resistance to change. The work station we are projecting into the 1980s must have the important attribute of being operable either in an automatic 'tutorial mode' or, in an optional supervisory 'assist mode' wherein a supervisor can connect directly into a work station to share, in a teacher-pupil relationship, in the solution of a nonstandard situation. The implications of such workstation arrangements go far beyond the economical, efficiency or productivity factors discussed so far. Live experimental installations will be needed before we fully understand the real performance character of these technologies."

The papers I authored as strategic guidance for PARC early in 1971 contain a long list of additional requirements of what would be expected to make PARC originated products commercially viable. Though the papers were received with courtesy and mostly with respect, in reality the net result was like throwing pebbles against a wall. PARC had committed itself to directions that had practically nothing in common with the interests of Xerox to launch in directions that would outflank the established IBM way of how to manage computerization.

Search for the Carlson Legacy

To probe the into the depth of the mentality of Xerox top management I became fascinated with the origins of xerography and how it could suddenly blossom into an unprecedented bonanza whereas everything else we touched was turning into mud. By the mid 1970s the role of Chester Carlson in laying the foundations to Xerox prosperity had receded into a historical fog. His brilliance and persistence in pursuing electro photography remained a legend and was always acknowledged. What was hardly ever mentioned was Carlson's career not as a research scientist, but as a highly skilled patent attorney. Shortly after graduation from the California Institute of Technology he started working in the patent department of Bell Telephone Laboratories. After that he worked as a patent attorney, rising to the position as head of the patent department of P.R. Mallory, an electronic firm. In 1936 he began studying law and received his law degree in 1939. The foundation of Xerox wealth were Carlson's patents for electro photography that were exhaustively complete and not penetrable, even by imitators. Electro photography was a single-minded obsession with Carlson. There is no evidence that he ever pursued any other patents. Carlson's strength was creating patent protection for a concept that was only remotely feasible. Carlson never participated in the development or in the engineering of copiers.

Carlson, a quirky person, had converted to Buddhism and spent much of his new and substantial fortune on supporting spiritualist and world peace causes, including the construction of a Buddhist retreat in the Adirondack Mountains. Such roles were not a suitable occupation for the founding father of a fabulously rich company. Stories were circulated that Chester did not care about money at all. The formidable Xerox public relations machinery now emphasized the roles of Peter McColough as the marketing leader who translated Carlson's hard-to-use invention into a profitable office machinery business, with credit given to Joe Wilson. It then dawned on me that the success of Xerox was based on the acquisition of licenses that turned out to be successful beyond anybody's expectations. It was not Carlson who invented the xerography-based copier. All he did was to write an extremely tight patent in 1938 to protect the application of

well known light-sensitivity of photoreceptors. It was ten years later that the non-profit Battelle Institute — a research venture incubator — would convert Carlson's patent in something that could be seen as an early prototype of a copier. It would then take Joe Wilson, the president of the Haloid Company, desperately looking for a new product, to take xerography out of the Battelle laboratories and manufacture two versions of xerographic copying machines — not yet the legendary Xerox 914 — drawing on decades of prior engineering and manufacturing experience in making wet process copiers.

The original Haloid, founded in 1906, used photographic (silver-halide surfaces) paper to make copies. It was Haloid marketing that would recognize and then swiftly take advantage of the increasingly centralized corporate and government bureaucracies that would develop an unlimited appetite for copies of every conceivable document. After the dry process (xerography) became available it was from the roots of a good understanding of customers that the marketing skills could now flourish to deliver an overwhelming success. The figment of the Carlson myth was that by 1972 all it would take now was to discover yet another unexploited opportunity that was ready to be delivered to the waiting customers without much delay through a formidable Xerox marketing organization.

The truth was that the Xerox copier was not an instant success. It took a long gestation period and a fortunate coincidence of many developments for that to happen. In 1935, Haloid purchased the Rectigraph Company, an early pioneer of wet-process photocopying techniques, and acquired the know how to produce rapid turnaround copies. Rectigraph was unique because it produced un-reversed prints, thus overcoming the inconvenience of photocopiers that used to produce first a negative image before it could be re-copied to produce a true copy image, Haloid then acquired the license for a new kind of technology, called electro photography, in 1947, from the Battelle institute. That happened nine years after Carlson filed for his patent!

Electrophotography would later be renamed xerography after the Greek words for "dry" and "writing." Haloid's first commercial copier, the Model A, went on sale in 1949. It used a flat plate selenium photoreceptor. It was marginally successful and received limited acceptance because

it was used to make masters for photo-offset printing. There was also an unsuccessful Xerox Model D machine that nobody ever mentioned when the importance a long period of learning and experimentation became unfashionable as a model for Xerox to follow.

A second-generation model called the XeroX followed six years later, in 1955. This machine now had a selenium rotating drum, which turned out to be a technology breakthrough, but without much acceptance in the marketplace because it was a complex and too expensive piece of specialized equipment. Finally, in 1959 the company revolutionized office technology when it introduced the first fully automated office copier, the Xerox 914. It is only after the introduction of the Xerox 914 that this machine received widespread acceptance as a preferred means for office copying.

It took thirty-two years to learn about copying. It took nine years from patent to the demonstration of a prototype copier. It then took another twelve years of sacrifice and unswerving commitment by Joe Wilson to deliver a marketing success that was as surprising to Joe as to everybody else. It is only after that when Peter McColough entered into the picture and propelled a startling discovery towards its great marketing achievement.

As a student of the history of xerography, having actually read Carlson's original notebooks and some early correspondence, I have formed a different interpretation of the transformation of the Haloid Company to the Xerox Corporation than what was the generally accepted view prevailing at corporate headquarters executive meetings. It is true that Chester Carlson, of Swedish descent, was a lone inventor, whose experiences as a patent attorney using many copies, led him to totally focus on seeking a breakthrough application of properties of materials that would avoid using expensive photographic (silver halide) paper. Such properties were originally discovered in 1817 by the Swedish chemist Jons Jakob Berzelius and came to the attention of Carlson as result of persistent bibliographic researches at the New York public library. To verify the feasibility of electro photography, Carlson hired Otto Kornei, an impoverished immigrant physicist who had fled the Nazi regime in Germany.

They set up their laboratory in a back room of a house in Astoria, Queens. Following much experimentation, on October 22, 1938 they finally had their historic breakthrough. It was Kornei who wrote the now famous words "10.-22.-38 ASTORIA" using ink on a glass microscope slide. It was Kornei, not Carlson — contrary to popular lore — who prepared a zinc plate with a sulfur coating, darkened the room, rubbed the sulfur surface with a handkerchief to apply an electrostatic charge, then laid the glass slide on the zinc plate, exposing it to a bright, incandescent light. It was this demonstration using a sulfur layer on zinc, not selenium as was generally believed by Xerox people, that gave rise to a view that all that was required for success was somebody else's discovery, finding it, patenting it and then protecting it with marketing power.

Such sequence of events was further reinforced by the story how John Dessauer, another refugee physicist, discovered an abstruse reference to Carlson's patent in a scientific publication and brought it to the attention of Joe Wilson, now desperately seeking ways how to keep Haloid financially viable.[12] It was not Haloid, but the Battelle Memorial Institute — what we call these days a technology incubator — who demonstrated the practicality of using a selenium photoreceptor to reflect an image illuminated by a light source. Whether Chester Carlson can be identified as a professional inventor is arguable since there is no record of him having invented anything prior to "10.-22.-38 ASTORIA" or anything after that. He did not participate in further development of his patent at Haloid and subsequently avoided contacts with Xerox altogether.

I must give here credit to the engineers in the Haloid Company, and especially to Joe Wilson, for an understanding what the Battelle Institute had to offer while everyone who was given first choice to use it turned it down. It was the customer-specific understanding, plus the realization of likely failure unless coming up with an innovation that made Haloid receptive to a revolutionary new idea. Most importantly, it was Joe Wilson's commitment to pursue electro photography, even by taking out a mortgage on his home that made the difference in bringing xerography to the

12 Dessauer, J.H., *My Years with Xerox: The Billions Nobody Wanted*, Doubleday, 1971.

world. In my view the hero of Xerox was the conservative and cautiously experimental Joe Wilson and not those who succeeded him.

Myth Making and Myth Exploitation

Haloid was a supplier of photographic paper and of devices for making photostatic copies in a niche market. Its sales force was marketing a sophisticated and costly Rectigraph product, which was a labor-intensive conventional optical lens camera device. The Haloid sales force had an understanding of the behavior of court stenographers, patent attorneys, and court-related bureaucracies who needed quality copies that would stand up as an authentic archival record. The Haloid Company and particularly Joe Wilson, cultivated an in-depth customer understanding of the utility of copying while competing against their Rochester giant, Kodak, who could produce photographic supplies more economically than Haloid, but paid little attention to developing equipment that would be comparable to the Rectigraph. The highly specialized Haloid understood the preferences and the desired equipment features of the premium-priced copying business. They had an ingrained understanding what kind of a machine and what kind of marketing it would take to offer an acceptable machine that would minimize operating labor costs and maximize the original-to-copy process.

Kodak looked at Carlson's patent just as another photographic process that would cannibalize its lucrative photographic paper supplies business. Kodak was always looking at selling inexpensive copying machines (even if they produced awfully smelly low quality copies), with profits generated from the supplies business. Haloid, now marketing a very expensive Rectigraph copier, would be far more attuned to getting revenues from equipment rentals producing quality copies on plain paper.

IBM, another firm that had a look at the Carlson patent, viewed the world through digitally driven dot-matrix impact printers. Transferring images to a semiconductor for quality printing did not make any sense when seen from the standpoint of their business model. IBM was focused on extracting premium profits from electromechanical printers in data centers, which had been an IBM core competency. Besides, the

feasibility of producing an efficient non-impact computer printer was yet more than twenty years away.

Though I have never managed to get to see what was alleged to be a report commissioned by IBM sometimes in the early 1950s by the consulting firm of A.D. Little, I was told by a reputable source that the consultant concluded that: A. electro photography could not ever keep up with the speed of electromechanical impact printers; B. Copying would not offer an economic advantage when IBM would enter into the office equipment business; C. Copying, without integration with sources creating digital originals, was a dead-end business.

It is ironic, that IBM's three major reasons for rejecting electro photography in the 1950s, would be eventually proven to be wrong. When Xerox set out, twenty years later, to prove that IBM was indeed wrong, it did not succeed except in computer printing. Xerox never managed to cultivate an in-depth understanding of customer needs in the digital world as possessed by the Haloid people when they first heard about xerography. Meanwhile, Xerox executives derived considerable satisfaction from telling that IBM turned down xerography before it was offered to Haloid. This became another legend spun by Xerox as a proof of IBM's shortsighted approach to information management that would be now overcome by Xerox superior insights.

Xerography was successful because Haloid had a cadre of sales people who understood the customer needs and were able to identify with customer preferences. After three marginal attempts to introduce xerographic copiers over a period of twelve years they finally got it right with the Xerox 914. It was not just the Xerox 914 that was able to succeed, but it was also correct pricing as well as a workable equipment configuration that delivered acceptable tradeoffs between pricing, features, speed and quality. That was a marvelous accomplishment!

As seen in retrospect, the probability of hitting an optimum combination of capabilities and features, with a brand new technology, with innovative pricing and a change in customer habits — moving copying from central services to the proximity of the office water fountain — was an exceptional innovation. A little luck also helped, as the Xerox 914 coincided with increased centralization of corporate bureaucracies that were hungry

for making copies. I give much credit to a generation of accumulated experiences in marketing copiers which made the Xerox 914 machine not a miracle suddenly appearing from nowhere, as it became represented as a sort of immaculate revelation, but as an experience-nurtured evolutionary advancement.

The executives who launched the Xerox 914 became the interpreters of the history of Xerox. They found it convenient to perpetuate a view of the firm as a miracle that reflected a defensive rationalization for coping with the increasing attacks on Xerox's patent monopoly and on exceptional profits. The emphasis of the firm's uniqueness in taking enormous risks with Carlson's patents would be used to justify marketing methods that would compensate for the risks of innovation. The dramatization of Haloid's daring exploits in the press and in business school case studies, now became useful because anti-trust lawyers, the Federal Trade Commission staff and class action plaintiffs began sniffing for violations of legitimate business practices. Upholding Carlson-related myths also offered a vindication to Xerox employees who now became multimillionaires. Years of deprivation, while Haloid was struggling for survival, now became an entitlement.

The story of the fabulous success of the Xerox 914 would be explained as great marketing achievement. I believe that one of its decisive advantages was a most imaginative approach to product pricing. It was a lower-ranking market staffer who understood that the Xerox 914 would not be acceptable if it were sold outright. The price of a machine, now weighting close to 1,000 pounds and requiring a great deal of maintenance, would surely inhibit its acceptance. Joe Wilson made the decisive bet in offering the 914 not for sale, but for monthly rent based entirely on the number of copies made. He took the risk of absorbing any maintenance costs.

There were precedents for that because Haloid profits were derived primarily from the sale of photosensitive supplies. With plain paper consumption on the Xerox 914, the only way for extracting profits would be by selling reproduction of originals as a service. A simple counter would accumulate the copy volume. A service man and subsequently the copier operator would fill out a pre-punched tabulating card and note the date and the copy count. The card would be then returned, in a self-addressed

envelope, to Xerox in Rochester to be processed for billing. This innovation, which solved the problem of installing expensive and high-maintenance support for capital equipment was truly revolutionary.

Looking back on its record, one could characterize the Xerox management's strategic thinking in the 1970s as seeking to recreate past success to perpetuate explosive growth. The magic formula for that would be to follow a four-step process: First, to discover an unexploited niche technology. Second, to buy it with overvalued Xerox stock. Third, to fix it up so that it could be handed over to Xerox marketing that could sell any office equipment. Fourth, to use every means to gain a dominant market share and keep competitors out.

That was the formula for XDS to compete with IBM. Although the time line for accomplishing all four steps to success was never spelled out, the expectations were to deliver demonstrable gains in short order. Such persistence in seeking instant realization of a huge success disregarded what should have been obvious to anyone who would care to study the history of technological innovation. For the understanding of the market place it took Xerox at least twenty-five years — from Rectigraph to the 914. From the time of the invention it took twenty-years to deliver a useful product. From the first commercial product based on selenium it took ten years of continued experimentation and learning, from Xerox Model A to the 914. It then took another four years of understanding the customer to finally deliver a record-breaking offering. All of that required patience, painful learning from failures and organizational maturity.

It seems that Xerox management starting in the 1970s forgot everything that their own history could have taught them. Breaking into a new business, such as into business data processing, would be much more difficult and would take much longer than what the now mythical Xerox miracle. Entrenched competitors would be blocking Xerox in the computer business with technologies and market positions that only exceptional innovation could overcome. The huge, arrogant with success and the over-compensated Rochester bureaucracy could not possibly imitate the characteristics of the nimble, small and tightly knit team surrounding Joe Wilson while scrambling for survival with very little money to spare. Relying on what remained from the aggressive SDS marketing organiza-

tion to a switch from scientific computing to commercial data processing was completely unrealistic.

The assumption underlying the persistent belief that an otherwise unappreciated innovation could be transformed into gold was now deeply imprinted by Harvard Business School professors in the outlook of Xerox leaders. According to then prevailing HBS thinking, what matters as a condition for any success was superiority in marketing. If an organization could operate a marketing machine, they could then leverage that capacity to sell products that were invented by others. The future corporate captains, who were passing into leadership positions during this era, were nursed in such beliefs at the Harvard Business School, followed by a tour of duty as marketing strategists in one of the leading consulting firms, such as McKinsey. Case studies glorifying firms such as IBM, Coca-Cola and Procter & Gamble and Xerox. Cases were used to prepare a whole generation of future corporate CEOs to concentrate on marketing in preference to all other corporate functions, with the exception of finance, for the less exuberant types.

To reinforce the marketing mystique Xerox management sent every year two shifts of about thirty most promising executives for an in-depth exposure to Harvard professors. These executive courses were usually held at one of the elite New England schools, such as Exeter. It was the sign of my being either a misfit in an organization of marketing and finance types, or a gamble that I was being groomed for a higher position. I was sent to executive courses three times during my first ten years at Xerox. The imprint of Harvard was reinforced further by making sure that one seat on the Xerox board of directors was always held by either a senior Harvard professor or by an ex-Harvard Business School partner of McKinsey & Company. I met with these fine gentlemen often. They were erudite and impressive in their gravitas. None of them had a clue what business data processing was all about. Their opinions could be easily traced to whatever articles had appeared in the most recent issues of the *Harvard Business Review*.

In no way do I wish to diminish the importance of superb marketing in the fortunes of any firm. Unfortunately, in the case of Xerox the emphasis on marketing became a obsession that explains while only short

term attention and care were given to acquisitions or innovations that would not lend themselves readily to feeding the Xerox selling machinery that needed growing opportunities to earn commissions and to support the high stock market multiples.

In the case of XDS and the STAR none of these beliefs could apply. The stark reality was that by no stretch of imagination was it reasonable to expect that the copier sales force could be somehow converted to marketing sophisticated XDS scientific computers or advanced STAR office workstations. Feeble efforts were made to send some of the ex-IBM sales people to take accelerated courses in computer literacy, but that was a sheer waste of time because a successful IBM salesperson had only conversational knowledge about the technical aspects of computing. This misunderstanding was to be repeated many times, culminating by the total mismatch between the skills, habits, compensation practices of the Rochester headquartered copier equipment sales people and the Dallas-based organization that was chartered to introduce office automation machinery to Xerox customers.

The Paperless Office

After the 1977 review of PARC by the Xerox top executives I walked, disappointed with the lack of resolution about computer printing, into the parking lot. On the way out I was passing the stock room. On the spur of the moment I asked the man in charge of office supplies to start reporting to me, monthly, about the consumption of Xerox paper. It was gnawing on me that the executive review was debating the question of the paperless office without any facts. By this time, every researcher in PARC had an ALTO workstation. The Ethernet network connect these workstation to strategically located laser printers, which were Xerox 2700 copiers modified to act as laser printers at a horrendous cost. Without paper intermediates here would be a clear opportunity to collect data about paper usage in an environment where everything was digitized.

In the months that followed I kept receiving reports about the number of boxes of Xerox paper that were consumed by PARC. The numbers were amazing. Instead of the average of less than 10,000 sheets per

capital consumed in offices of paper intensive banking firms, PARC was now using 25,000 sheets of paper person and that number was climbing steadily. I reported that high capacity laser printers connected to work stations gobbled up paper at unprecedented rates.

The cause was not in the increased printing speed but in the elimination of labor standing at a copier plus the tremendous ease with which researchers were able to create page originals. The ALTO workstation made it attractive to generate a huge number of versions of drafts of research papers that could be then produced on demand. Much of the copy volume that was consumed was subsequently discarded or reissued as drafts of work in progress.[13]

Paper Merchants

It was late in 1977 that I received an urgent call from Xerox marketing that a speaker was urgently needed to address a meeting of the American Paper Manufacturers Association in New York on the subject of the paperless office. At that time the bond ratings of the APMA firms were in a severe recession as environmental regulations imposed huge added costs on paper firms to treat their pollution such as dioxins, hydrogen sulfide and sulfur dioxide that would be then dumped untreated into local rivers. Adding to the troubles of the paper manufacturers was the steady publicity, largely fomented by IBM, of the coming of the paperless office that would reduce the demand of cut-sheet paper, which was by far the most profitable product. The manufacturers would be able to cope with the environmental regulations, because every firm would be incurring such costs equally. However, the threat of the paperless office was hanging over the prospects of future profitability because it would cut demand.

My news that an office equipped with laser printers and driven by text processing machines would increase the consumption of cut sheet paper was received with jubilation. I had hard facts about paper con-

13 Much of what I learned is reflected in my testimony before the Joint Committee on Printing of the United States Congress (98th Congress, 2nd Session, October 1983). I delivered a presentation on "The Future of Electronic Printing" that anticipated the widespread use of office laser printers.

sumption trends and the labor savings in the production of documents by means of Ethernet delivery of originals to printers. I illustrated the compulsion to create multiple drafts of text when that would become easy. The word about my presentation quickly spread through the industry. I started receiving numerous invitations to speak at meetings of paper industry associations.

My only notable memory about such talk was a brief to be presented at a meeting of paper merchants representing the Union Camp Company in December of 1978. The event would be held near Savannah, Georgia. When I arrived at the airport I found a group of merchants arriving by private plane. They were all dressed up in leather clothing with knee-high boots and with bags with one or two large bore automatic rifles. This would not be a meeting at all but a hunting party to hunt wild boar into the enormous woods owned by Union Camp. My presentation would make the entire event tax deductible as education. I was not prepared for this at all. I was dressed in a business coat and jacket and had only a jogging suit with sneakers in my bag.

After dinner in a log cabin deep in the woods, the group started organizing into two-man hunting parties who would go out to their stations at 4 AM. I was not expected to participate because I did not have the rough clothing and did not bring a gun. I protested against the exclusion on account of my World War experiences, while making mention about shooting German sentries. As a consolation I was assigned to go alone to an outpost that was at the farthest end of the Union Camp reservation. As a weapon I picked a World War I Springfield bolt-action rifle that had been always favored as a sniper weapon. At the appointed time I was driven to my post in my jogging outfit and a borrowed sheepskin. It just happens that I had sniper training and knew that slowly rotating my head back and forth would improve my vision in almost complete December darkness. It must have been shortly before 5AM when a saw a silhouette of a boar slowly walking by at about 50 yards. Aiming a few inches back from the snout I shot it. The silhouette disappeared and I stayed behind my tree because I was warned that a wounded boar was very dangerous. At 6AM I heard a few shots in the distance, but waited for our guides to show up. At sunrise, about 7:30 they came to pick me up, but I insisted to

go into the field to see if I could find a trace of what I shot. To my surprise, in a ditch was lying a three hundred pound ugly boar with big tusks, with a single shot right through the heart! Needless to say, the Union Camp people were very unhappy. The hunting party wounded two boars that were never caught. Union Camp offered to take the boar's head to a taxidermist so that I could mount it at home. I politely declined having any part of the boar and donated the meat to the locals. It seems that by not waiting for the sunrise my shot spoiled the excitement of others who did not know how to shoot in the dark.

Swedish Royal Academy

It did not take too long for my reputation as the spokesman for the office of the future and the paperless office to spread worldwide. From 1977 until my retirement from Xerox in 1985 I must have given 200-300 formal presentations on these topics. My talks were in Canada, Brazil, Mexico, England, Ireland, France, Sweden, Finland, Portugal, Norway, Switzerland, New Zealand, Malaysia, Communist China, Singapore, South Africa, Holland, Belgium, Spain, Mexico, Italy, Germany, Australia and Japan. Local Xerox managers would arrange such talks because they would be always looking to gain customer attention. Except for one or two instances, my visits were always very brief. There are a few occasions where I was away for only one working day, including trips to Europe. I did not take an opportunity to use such travel for a vacation that would always belong to my family.

The most noteworthy of these trips were my increasingly frequent visits to Sweden where the topic of a paperless environment was a key to their thinking about the future of the Swedish economy. Though Sweden had developed as an industrial power, the largest share of their export earnings came from paper and paper products. The Swedish government also set aside a large part of research funds for eliminating pollution from the paper and pulp processes. They were now grappling with the question whether to continue making such investments.

The setting for two or three meetings of the Swedish Royal Academy and the Swedish Royal Engineering Society were stimulating and

well arranged. My presentation was usually one of the keynotes. Although there were other American presenters who were talking about the future in terms of exclusively electronic communications, my views seemed to have prevailed because after five years the Swedes did not back off from their emphasis on the paper-making sector of their economy. When I became better acquainted with some of the industrial representatives there were follow-on visits to meetings organized by Swedish and Finnish paper firms. Many of the ideas that I developed for my presentations in Stockholm ultimately found their way into chapter ten my 1985 book *Information Payoff*.[14]

Lobby Exhibit

McColough's wishes to obtain zoning permits to build a new corporate headquarters in Greenwich were not successful. The temporary quarters in a Stamford office park were too small and inconvenient. To demonstrate the company's priority the top executives gave to marketing, capital investments were now concentrated to complete a mammoth sales training complex in Leesburg, Virginia. When that was finally completed in 1974, the decision was finally made to purchase a new site for the Xerox World HQ in Stamford, to be completed in 1979.

A prominent architect was hired. In due course, sometime early in 1976, the architect delivered a table size model of what the new building would look like. The showing of the model took place in the temporary Xerox boardroom. As one of the leading executives I was invited to the showing of what looked to me as a conventional office edifice. By this time I had acquired in New Canaan one of the fifty-four notable homes listed as representing the best of the Bauhaus architectural traditions. I expected that Xerox, always priding itself on innovative art (the company owned a

14 *Information Payoff*, The Free Press, 1985. A well-designed version was published in Italy as *Organizzare Informazione E Lavoro nell'era Electronica*, 1991, translated by my good friend Franco Guazzoni. The Brazilian version was titled *Os Frutos da Informatica* and appeared in 1986. The Russian version appeared in 1987 as *Informacia v Vek Electroniky.* The Japanese version came out in 1987, Bletchley Park, but I cannot translate even the title.

Picasso drawing and used it in advertising) would reflect such aspirations in the architecture of its headquarters. The hierarchical arrangement of the inner space reflected conventional thinking and must have mirrored Archie McCardell's ideas of automotive utility.

While viewing the model spread out across the boardroom table, I did my best to conceal my disappointment. When the architect lifted the roof cover of the model to offer to a glimpse of the three story high lobby, much attention was devoted to the description how the lobby would be housing exhibits of Xerox equipment, starting with the original model 914 and extending to whatever was currently offered to visiting customers. At this point I could not contain myself and remarked that the lobby would look more like a warehouse than a reflection of the heritage of a company with exceptional aspirations. McColough, so far rather quiet, spun around and asked, "Strassmann, if you do not like the lobby as a product exhibit, what would you put in instead?" The entire executive group now faced their computer expert and expected that I would receive my comeuppance. Caught totally unprepared, I improvised by pointing out that Xerography is one of mankind's great achievement by making it easy to distribute written communications. I would place in the lobby one hundred objects to represent the evolution in mankind's quest to preserve knowledge. Xerography would be therefore shown as a milestone in human progress, leaving room in the exhibit for an empty space of what would follow xerography. Peter appeared to be intrigued with the idea of placing a historical exhibit in the lobby. How would I acquire the objects to fill the displays? I responded that as a hobby my wife and I have been collecting ancient manuscripts. I was aware what were the prices such objects would fetch. Archie now chimed in, obviously displeased with the drift of the conversation. How much would it cost to accumulate such a collection? Sensing that my audience was now captivated by the idea of a historical display I watched what appeared as fencing between Peter and Archie. I responded with a totally reckless repartee: "Archie, whatever is in the budget for the lobby I will take it and will deliver hundred historical objects that the company could be proud of." At that time I did not have the slightest idea about the budget except that I was aware that the architect would be commissioning non-representational abstract artifacts, as was the corporate fashion

in those days. Such objects, produced by artists such as Calder, adorned several recent corporate headquarters including the one recently build for IBM. The artists' commissions for such artifacts were enormous, often running in hundred thousands of dollars in addition to exorbitant fees paid to dealers and agents. I considered most of this non-representational art, usually welded hunks of steel, as offending what I considered as centuries of artistic skill that emphasized workmanship, content and ideas.

Peter now turned around to Archie and made a pronouncement that would influence much of what I would be doing for years in addition to the work I was actually paid for. Peter said, give Strassmann a checkbook to spend whatever has been budgeted for the lobby. Afterwards, Ray Hay, my future boss, who was delighted by the entire byplay, warned me that I was risking my career since it would be Archie who would be deciding how much money would be available. Indeed, Ray was right. The money allocated to what would be now the *10,000 Years of Writing* collection was an amazingly small amount. In addition, Archie insisted that all decisions about purchases should be made jointly with Bill Senter, a good businessman and president of a Xerox educational division. As an added safeguard, I was told that the management as well as the collection of exhibit items would be outsourced to a University or to a museum.

Following such guidance Bill Senter made arrangements to visit the director of the Morgan Library, one of the foremost collections of ancient books that were the result of years of accumulation by J.P. Morgan. The visit was a disaster. Prior to the visit I acquired a UNESCO book celebrating the 500th anniversary of Gutenberg. It listed works that were deemed to be milestones in the progress in printing. I supplemented this with an enumeration of artifacts that were more ancient, such as those showing hieroglyphics, cuneiform tablets, Coptic papyri and Roman scripts. When we handed our list of one hundred milestone artifacts to the Director of Morgan we were congratulated on our excellent taste. Xerox management was praised for respecting cultural heritage. Now, how much money would we be willing to donate to the Morgan Library so that they could take over the installation of an exhibit? Of course, a corporate lobby was not a suitable place to hold valuable historical artifacts. Morgan would provide us with copies of the desired objects in return for a tax-deductible donation of

at least a million dollars. Such terms ruled out Morgan completely. We did not have a million dollars. The idea of placing copies in the lobby would devalue comprehension of the difficulties encountered in making progress in how written communications would be produced. Mona insisted that only originals would convey my intended message.

Senter and I then visited H.P. Kraus, perhaps the best-known US dealer in ancient books. When we showed him our list we were given a copy of his most recent catalogue showing the asking pre-auction prices. Kraus's prices would have allowed us to buy perhaps five items. A follow-on visit with Maggs Brothers, in London, showed slightly lower prices but still totally out of our reach.

My insistence to proceed with a do-it-yourself approach was not completely insane, though Bill Senter thought so and detached himself from the project except to remain as an amused observer. Over the years I had been accumulating a collection of ancient manuscripts and books (incunabula) dated shortly after the invention of printing towards the end of the 15th century. The prime works created in that period were priced sky-high by collectors who bought books as an investment. In the case of the Xerox exhibit we would have to display only the form and the technology used over ten centuries in written communications without the requirement to demonstrate historically valuable content. Visit to dealers in ancient books and artifacts taught me to look for items filed in the back-rooms of stores and to disregard what was offered in auction catalogues. For instance, a large and illustrated sheepskin document from the era of Charlemagne (about 800 AD) would be offered for sale starting at $100,000 provided that it had been cited in a scholarly text. A small sheepskin, with identical Latin script, could be had for $100 without fear that it would be a forgery. From the standpoint of offering objects representing the evolution in the writing technologies and of the progression in the representations of messages an inexpensive sheepskin would serve us equally well.

Seeking out bargain-priced items to fill the list of one hundred objects had thus changed into a treasure-hunt which provided me with welcome diversions from the otherwise stressing experiences in maneuvering through corporate political minefields as the corporate global director of

information systems. In this process I learned that the value of anything is not intrinsic in any object by itself. Value is created by organizing what may not account for much if taken in isolation but could gain enormously by combining what had been fragments into something that could be viewed as a functioning whole. What mattered in my case was the learning, pleasure and shared experiences that ultimately rewarded me beyond all expectations. Mona and I spent three years traveling worldwide as an add-on assignment to my job as the most senior information systems executive. The Xerox exhibit became an enriching gift to my life experiences. Similar sentiments were echoed by many Xerox people who interpreted the *10,000 Years of Recorded Information* in the lobby of their global headquarters as a symbol that the company's roots were still in the written message and not in computers, telecommunications, finance, insurance, education and many of the other fads that the firm tended to cultivate for a short time only to drop them a few years later.

Chester Carlson's Notebook

From the standpoint of Xerox, the single most significant item on display was the original laboratory notebook kept by Chester Carlson in Astoria, Long Island, on October 22, 1938. Page four of the notebook was open showing the day's entry starting with the memorable phrase "Today Kornei and I made the attached parchment prints by the fooling method…" Attached, with ordinary Scotch tape, was the world's first xerographically reproduced message. It was this entry, and the attached scrap of ordinary wrapping paper, 1.75" x 1.25", on which one of the most profitable patents ever granted would be based.

It must have been sometime in 1990 when I was asked to guide a group of visitors around the Xerox lobby. It appears that there was nobody left in the building that could offer a satisfactory description about what was in the illuminated cases. As I approached the Carlson's notebook, I rattled off my usual description about the visitors now having a chance to see a scrap of ordinary parchment paper such as was used to wrap fish, but leading to hundred millions of profits. The now famous icon 10.-22.-38 ASTORIA was missing! I rapidly concluded the guided tour and called the

building manager. Where was the notebook attachment? He did not have a clue. When was the case opened last time? It took a while to drag out the answer as several management layers relapsed into denial. Xerox, to reduce costs, had outsourced the cleaning and maintenance of the headquarters building. Though the exhibit cases were sealed somebody has decided that time had come to dust off the inside of the cases. The keys were issued to the cleaners who then proceeded, without supervision and contrary to written procedures, to brush off the content. When a small scrap of paper fell off, the cleaners swept it into trash.

I picked up the phone and insisted to be connected to Dave Kearns, then the CEO. When I told him about what happened, he instructed me to generate another copy of the famous ASTORIA original and have every item, then on loan, returned to their lenders to be replaced by photographic copies.

I am certainly not a superstitious person. But the Carlson jinx must have materialized. Shortly after the disappearance of the origin of all Xerox profits the price of the Xerox stock plunged to an all time low of around $4. That was far below the $175 per share for some of the stock options I was holding to fund my retirement.

The Carlson Jinx

When I discovered that Chester Carlson's widow was still living in Rochester, I decided to pay her a visit. I needed to find out why and how xerography could be brought to a stage of development where the current generation of Xerox executives could make it a fabulously successful product.

The visit turned out to be an otherworldly experience. I was waiting in Mrs. Doris Carlson's living room surrounded by rare oriental sculpture and artifacts one could identify as Buddhist religious objects. The air was fragrant with incense. Finally, Mrs. Carlson descended from upstairs. She was a beautiful silver-haired lady, extremely pale in an unearthly sort of way. She looked to me more as an apparition, in floor-length black frock lined with delicate white embroidery. In a singing voice she welcomed me and said that my visit was announced many weeks ago by her spiritual

connections. I was welcome because I came to honor the spirit of her late husband with whom she was still in communication. After such a startling welcome her tone changed, and over a cup of fragrant tea, she told me that I was the first person from Xerox who had visited her in many years. What was my purpose?

I explained that while collecting objects to be displayed in the lobby of the planned new Xerox global headquarters, I gained access to the collection of Chester Carlson papers that had been stored in the archives of the New York City Library on 42nd Street. While perusing Carlson's notebook, including the pages in which he pasted in the "10.-22.-38 ASTORIA" original of the first xerographic image, I was overwhelmed by the depth of Carlson's thoroughness in the three days following the invention of the xerographic process. The notebook contained a detailed description of how facsimile equipment would function, without any indication that Carlson could knew anything about the electronics to accomplish that. The notebook also contained a description of high-speed xerographic machines that would use a flexible belt instead of a drum. It would then take almost forty years later, and hundreds of Xerox scientists and engineers, to develop a reliable belt-based copier. I also mentioned that in the physicist's John Dessauer's book there was an observation that the way xerography worked could not have been predicted by anything that was physical science. Another way of looking at Carlson's accomplishment was to view it merely as a patent attorney's expansive effort to extend the scope of a small experimental demonstration in the physics of a light-sensitive material to cover every conceivable possible application in the future.

Mrs. Carlson smiled and explained that xerography was an inspiration originating from spiritual forces. She felt that it was a gift to humanity for sharing ideas and truth. Chester Carlson was only a medium to carry the message. She felt that the current management of Xerox had betrayed what Carlson has created and therefore would have to suffer consequences. This message was conveyed in a prophetic tone and without any acrimony. I responded that all would not be lost. The technologies of Xerox were now shared with Fuji-Xerox. A member of the board of directors of Fuji-Xerox, a retired banker and Buddhist scholar, Mr. Toneo Noda, has started a discussion about the future of Xerox, which would be somehow hidden

in the essence (Zen) of the firm. Mr. Noda believed that every successful enterprise possesses a "soul", which must be cultivated by employees as well as recognized by customers. Would Mrs. Carlson consent if I make arrangements for Mr. Noda to visit her next time he comes to Rochester? Mrs. Carlson agreed, commenting that my telling her about the prospective visit from a Buddhist scholar from Xerox confirmed signs she has been receiving for some time.

It was the conversations with inspired people like Mr. Noda, Mrs. Carlson and Sid Schoeffler, whose research showed that it takes anywhere from five to seven years before one could tell if a completely innovative venture would have a chance of succeeding, that convinced me that the persistent impatience by those who followed Joe Wilson had a misunderstanding about the long time elapsed between Carlson's original inspiration in 1938 and its gradual realization years later. Xerox top executives were apparently working with a clock that started running after outsiders proved the feasibility of xerography and after delivering at least two poorly functioning models of selenium-based xerography. Accordingly, all that it would take in the 1970s for Xerox to replicate the past success would be to latch on to an already proven emergent technology, by acquisition, and then expand it using ample cash and the marketing power now in place in the copier business. If entering into a new market did not work out in short order it would be sent into oblivion because it was somehow flawed in that it could not match the financial profile of the Xerox 914. The Xerox mentality was that they have won by committing to a "bet your farm" risky xerography. They managed to win despite the odds. They could now keep repeating such high-risk bets, without taking precautions how to protect against the downside perils. Unfortunately, that set them up for failure in every successive venture. Peter McColough must have believed that he defied doubters and taken a huge risks before. While betting on Haloid was clearly a winner beyond all imagination it ultimately blinded him and the board of directors to the possibility of abysmal failures.

The Carlson jinx was further compounded by the rising influence of financial executives who were hired from the already declining fortunes of the Ford motor company. Archie McCardell, a financial man who became the president of a Ford subsidiary, was hired by George Peck to be-

come the Chief Operating executive of Xerox. Jim O'Neill, a brilliant and highly disciplined former chief financial executive of Ford Europe, became the chief staff officer. Donald Lennox, became the head of manufacturing. Mel Howard, a smart and manipulative operator, was a former Ford financial analyst. If a venture could not make profit in a hurry, or missed financial targets, the financial establishment weighed in using the usual Ford method to increase profits through mandated cost reductions that in due course squeezed out the potential out of whatever was originally conceived to be a promising addition to creation of new wealth.

During my sixteen years at the corporate headquarters and over eleven years of sitting in many of the key deliberations about various investments, a repetitious pattern emerged. First, a company was acquired. Second, it was then optimistically launched as a major contribution to corporate growth. Third, it was subjected to financial controls that met the conservative criteria of the Ford-bred financial executives who were immediately seeking operating profits. Fourth, when the operating profit criteria were not met, it would become insufficiently funded and treated not as a long-term venture investment. Invariably, this sequence led to crippled organizations while their original owners walked away rich, beyond all expectations, with Xerox stock that was quickly sold off while its prices were still high.

The Xerox pattern of uncreative destruction (to borrow a term from Joseph Schumpeter) would be imitating the behavior of a farmer who purchased a rare cherry tree sapling only to discover that after the first two years the crop would not meet his expectations. When the ever-present consultants called for a re-examination, the farmer would pull out the struggling sapling, examine its roots and replant it. Next year, when no cherries showed up, the procedure would be repeated. After few repetitions like that the cherry tree would be ripped out and replaced with pear tree saplings. Again, the pears would never get a chance to grow for a farmer who expected too much, too soon.

It is true that Chester Carlson, as a lone inventor and holder of what he believed to be valuable patent rights, persisted despite all naysayers. What finally made the difference was the readiness of the Haloid Company to understand what Chester Carlson had to offer. What differentiated

Haloid from the firms that turned down Carlson was customer-centered understanding of the utility of copying? Only a firm that understood customers' habits and preferences could bet on Carlson's theoretical discovery. I cannot emphasize sufficiently the critical importance of synergy between the marketing know-how about customers and the engineering of technological innovation. Whereas Xerox management wished to reincarnate the experience how xerography was brought to the market, in the cases of XDS or the STAR workstation (to mention only a few), they proceeded to do so only as a technological breakthrough. There was always an absence of a corresponding market understanding, at all levels of management, of what the customer would be ready to purchase. Neglecting the history of copying, which spanned many decades of learning from mistakes while practicing frugal financing of short-term acquisitions turned out to be a fatal flaw.

Xerography was successful because the firm had a rare combination of visionary leadership in Joe Wilson, in making global alliances under the guidance of Sol Linowitz, and in a number of marketing people, such as John Glavin, who understood customer needs. This team was able to empathize with customer values and to come in with correct pricing and correct configuration that would sweep the marketplace into an unprecedented success. The original "xeroids" deserve all the credit and accolades they received because, in retrospect, the probability of an innovation hitting the marketplace with an optimum configuration, with a brand new technology was rare indeed. I attribute much credit to the twenty-five years of experience in placing Rectigraph machines with customers. When viewed from this point of view the Xerox machine cannot be branded as a revolution, in ways it has become represented through the years. It was not an *ab initio* creation arising out of nowhere, but a large but nevertheless evolutionary step.

The Mirage of a Miracle

Xerox always cultivated an image that what it has accomplished and what they aspired to was nothing but a miracle. John Dessauer, the German physicist who found a reference to Chester Carlson's patent in

a journal said that the discovery of xerography was miraculous. The totally unexpected gusher of Xerox wealth, salesperson commissions and the totally unpredictable customer acceptance of copiers were not predictable using conventional business methods. Xerox marketing reinforced its views about the miraculous origins of their products by launching an eminently successful "Brother Dominic" advertising campaign. The sixty second TV spot always ended up with a plump Jewish actor, attired as a Dominican monk, raising his sight to the heaven and pronouncing that "it's a miracle" after obtaining a Xerox copy. Brother Dominic made a career out of appearances at Xerox sales meetings for more than a decade.

Despite a long and non-miraculous history of hard work and failed experimentation the persistence of the myth of "out of this world" origins of Xerox found acceptance among Xerox marketing management. Bringing a miracle to the world could certainly justify extraordinary prices. Miraculous origins could be then peddled as a priceless revelation. Unfortunately, waiting for miracles to happen after the success of xerography entangled Xerox in a series of ventures that were not and could not be successful because the accepted mythology did not fit the reality. The contradictions between beliefs in miracles and the actuality of what customers were ready to buy were demonstrated in the ways the innovations from Xerox PARC became doomed to failure. It was not the failure of Xerox management to leverage the breakthrough technologies from Palo Alto after the launch of the STAR computer, as has been steadfastly asserted by the PARC alumni. The hoped for miraculous architecture of information that was advocated by PARC and expected by Stamford was never destined to happen at all. Transforming technology miracles into quick commercial success does not occur in that way. My position is that the PARC venture was genetically flawed in that both the mother (PARC researchers) and the father (Xerox Corporate) entered into a union with incompatible genomes. Perhaps you can get a mule by mating a horse and an ass, but affinity was not the case here, despite contrary claims. The mating was rather like between birds and livestock.

PARC failed because it was managed to product launch by technologists and not by businessmen. The brilliant PARC researchers primary interest was in advancing with the coolest possible technology that

had been gestating, under-funded, in ARPA sponsored university labs for years. Their game was to come up with as many wow-effect features as possible that would thrill their academic colleagues. The greatest satisfaction was from getting published in ACM or IEEE proceedings. The PARC people were thrilled with the idea of radical change, as seen by the researchers and certainly not how that would be seen as improvements by paying customers. The PARC engineers did not have the slightest understanding about the resistance to change in office routines unless that would be enormously attractive and without much disturbance in the existing social relationships. The PARC technologies were conceived to fit the world of PARC-like peers, where neither costs nor technical inconvenience would matter. Their product engineering was always improvised and never took into consideration customer costs, support effort, ease of installation or training inconvenience.

A number of books have been produced which reflect the West Coast bias and interpretations of why the output of PARC never delivered the expected profits to Xerox.[15] [16]

Fumbling the Future blames the large corporate structure without providing insights into the corrosive influence of the PARC researchers who diverted generous research funding into developments that could not possibly be of benefit to the business needs of Xerox. This book represents anti-establishment thinking and finds that Xerox management must bear the full responsibility for the failure of PARC innovations. I consider this book a complete misrepresentation of what really happened.

Dealers in Lightning contains a long list of fictional accounts, largely reflecting interviews with PARC people who started cultivating a growth in self-aggrandizing importance with the demise of the STAR workstation. They diminish the importance of what Xerox has done for them (e.g. almost unlimited funding and the false claim that they occupied a ramshackle building adjacent to Stanford University). They keep emphasizing that "… PARC's occupants would prove to be the greatest gathering of

15 Hiltzik, M., *Dealers in Lightning: XEROX PARC and the Dawn of the Computer Age*, Harper Business, 1999.

16 Smith, D.K., and Alexander, R.C., *How Xerox Invented, Then Ignored, the First Personal Computer*, iUniverse, 1999.

computer talent ever assembled." The book reiterates "…PARC conceptualized the desktop computer before IBM launched its PC, and it laid the foundation for Microsoft Windows." Even though that is true it skips over the issue why the new inventions could not be used. The accusation that "… Xerox failed ever to grasp the financial potential of such achievements" is misleading since whatever PARC produced could not be transformed into a financially successful offering. Even the claim that PARC invented laser printing is deceptive. The only money that was ever made by Xerox from laser printers were computer peripherals attached to IBM mainframes and brought to the marketplace by personnel from the former XDS in El Segundo. Though Gary Starkweather, one of the chief proponents of laser printing, was housed in Palo Alto, he was really a Rochester transplant working with Bob Adams in El Segundo to bring a computer printer to the market. PARC could not care less about computer printing attached to IBM mainframes.

Much has been made about Steve Jobs' visit to PARC which led to the introduction of the LISA computer in 1983. The immaturity of PARC's design is best manifested in the failure of this product and the limited market share penetration by the Macintosh computer in commercial use. The descendants of the STAR, through various versions of the Macintosh, never gained more than 3% market share in the personal computer business while Apple had experienced two near-death experiences until its recent increase in profitability from an entertainment, not a productivity enhancement product. The claim that Xerox could have had a profitable business with the generations of hardware that followed the STAR is without merit especially if one takes into consideration the amortization of R&D investments that Apple did not have to incur. The Apple computer company inherited the PARC arrogance of offering bundled proprietary hardware and software while the by far more successful Microsoft garnered excessive profits by concentrating on software that invited developers to construct thousands of applications that improved office worker productivity. Microsoft was successful because it relied on competing manufacturers of personal computers to deliver lower priced devices that could be then economically justified. A view how Xerox could support office productivity improvement never entered into PARC planning.

The spokesmen from PARC remained silent about the largest loss to Xerox from developments that were of direct benefit to Microsoft. The inconspicuous Charles Simonyi jumped over to Microsoft in 1981 and took with him from PARC the formidable BRAVO text-editing program, which was quickly transformed into the hugely successful Microsoft Word application. Word software accounted for a large share of Microsoft's billions of profits.[17] The adaptation of BRAVO to the secretarial/administrative environment, running on inexpensive microcomputers could have delivered to Xerox the profit-making opportunity it was seeking. When Massaro was blindsided by PARC advocates to launching the STAR instead of upgrading the more plebeian Xerox 820, the idea of delivering to secretaries a good text editor would never again enter on the agenda. While nobody was watching Xerox let perhaps its most valuable software property escape to Microsoft without even a whimper.

After 1981 the leading lights of PARC migrated to other opportunities that led to the formation of many successful firms. A placeholder management remained in charge without delivering to Xerox anything of substantial value except to continue the propagation of the myth of PARC greatness.

A Historical Point of View

It was the British historian, Arnold Toynbee, who sharpened my understanding that flourishing civilizations start on the path leading to their decline when they are at the peak of their fame and prosperity. As is the case in Greek tragedies, it is at the pinnacle of their achievement that they are blinded to commit what Toynbee calls a fatal flaw. At the time when the damage is inflicted, there is little awareness about its ultimate consequences. The proponents of the damaging act may actually use well-reasoned arguments why they are committing themselves to a course that may ultimately destroy their greatest achievements. Toynbee also teaches

17 Charles Simonyi was recipient of early Microsoft stock options for his contributions to Microsoft profitability. According to *Forbes* magazine he is a billionaire many times over exclusively from Microsoft shares and now indulges in outer space adventures.

us that when external enemies (and competitors) finally deliver mortal blows, that takes place many years after a society has damaged itself from within as a consequence of internal strife.

It is interesting to contemplate a similar fate that befell the once vaunted IBM Corporation, which was rated for many decades, by FORTUNE magazine, as the most admired global company. Similarly as in the case of Xerox, I can now backdate the start of the decline of IBM to the long-standing decision to sell equipment outright instead of renting it. It is true that such a change was to have been dictated by the US government. The fatal flaw was inflicted in ways how IBM implemented pricing and customer care policies. The introduction of plug-compatible peripherals and computers then started draining cash out of the rich IBM till. Customers would now shift from a dependency on IBM systems engineers to consultants and in-house staffs. By de-coupling itself from an intimate understanding of customer needs — an IBM traditional strength — to increased emphasis on winning orders, IBM sapped itself of the sources of its erstwhile power.

Parenthetically, I would also like to note that the current malaise that is inflicting another industry giant, Microsoft, has many similarities with the patterns I have observed in the deconstruction of both Xerox and IBM. In 2003 I pleaded, in vain, with the Chief Technical Officer of Microsoft, Craig Mundie to offer its products as a fully supported service instead as an increasingly commoditized software product. To this day Microsoft insists on selling it's over-featured and insecure software for an outright license fee while the customers bear all of the costs of operating and maintaining what they purchased.[18] The economics of Microsoft have now turned against it, as the costs of ownership of their software now far exceed the purchase expense.

It was from these observations that I started formulating a point of view on how to introduce and manage complex technological innovation. In the first half of 1970 information technologies had entered into a stage of development where computers actually worked. There were occasional

18 On March 3, 2008 Microsoft finally announced that it would conduct a market test in September of 2008 with software as a service.

failures, but in each case they could be ultimately traced to a human failure, not to breakage of the technology. The rising complexity of interactions between organization structure, corporate planning, untrained technical talent, software engineering, telecommunications and data center operations would soon exceed the capabilities of just about every corporation to run and operate their own information systems establishment.

The management of information technologies calls for rapid and dynamic innovation. For vendors of IT that necessitates close and continuous involvement with customers as problems arise. When a sales force is allowed to degrade into promotion peddling, proposals and order taking, the value-added of this asset will decline and thus open the door to low-priced imitators. The worth of a sale force is in its "knowledge capital" that can earn extraordinary profits if it can price itself as a value-priced service instead of as a commodity expense. Customers are willing to pay for solutions. They have limited uses for any information technologies that, in isolation, cannot deliver useful results.

It was the MAX confrontation between Stamford and indirectly with XDS that heralded what would evolve as a pattern that progressively lead to the alienation between PARC and everyone else. PARC researchers would be seeking recognition from their professional peers through manifestation of brilliant research innovations. They were, fundamentally, post-graduate university students who become accustomed to receiving generous corporate privileges, but without any of the responsibilities to sustain the body that was feeding them. Their metric of success would be the number of professional papers in which their contributions would be cited. In fact, that was achieved beyond anybody's ambition, as the soon to be delivered networked ALTO computers that allowed PARC researchers to generate more published professional papers than anybody else.

Xerox corporate funding, initially without any oversight, kept nourishing the uniqueness of PARC by pumping more money into PARC's research capabilities that made it extremely productive in designing and building of equipment that was reflecting the needs of researchers, rather then the needs of the prospective buyers of office productivity enhancement devices. With laser printers, highly capable text preparation equipment and Ethernet connectivity, the PARC recruiters could entice just

about any brilliant researchers to join their team that was managed efficiently and generously, in contrast with the measly academic living of assistant professors waiting for years to attain tenure. The only problem with the equipment built by PARC was that it was of alpha quality, which was barely functioning prototypes. PARC was a research laboratory and had ample support staff that made sure that any problems were quickly fixed. In fact, problems were seen as an element of the research environment.

Several books have been written on the amazing speed with which PARC people developed various versions of the ALTO, MAX and Mesa machines. These stories represent a one sided view of PARC accomplishments as a prodigiously effective research laboratory that nevertheless did not build anything that would have practical commercial use. To this date the books about PARC leave the readers pondering the puzzle why Xerox could not take advantage of perhaps the single largest outpouring of creative innovation that took place in a single research laboratory, in a period of only ten years. The reason for this monumental failure, that has now become a frequently cited example of a corporate foul-up, rests with parts of a story that have never been told. The commonly accepted lore about PARC has been presented on the basis of interviews that reflect mostly the tales, as told by PARC proponents.

Placing the blame on PARC alone is unfair. The story of intrigues and miscues, that reflect the Stamford and Rochester reality have never been adequately told in any of the published books because the Stamford HQ points of view was never told. PARC turned out to be without any benefit to Xerox because corporate management, and particularly McColough and Goldman allowed that to happen. Without engineering, manufacturing and market planning the seeds that created PARC would grow quickly into a fruit-bearing tree producing strange fruit except there was nobody there to convert it into something useful. The problem was that the tree would bear a luscious harvest that would be open for collection by everyone except by those who planted and irrigated it.

I found it interesting that when George Pake received the coveted National Medal of Science in 1987 from President Ronald Reagan, the citation was for services delivered to American science. PARC with its pioneering efforts was indeed a national asset, but not a Xerox asset.

A Postscript

Don Massaro and David Liddle, who were responsible for the Xerox 8010, left early in 1982 and formed the Metaphor Company. They would offer a workstation that was a STAR look-alike except for some modifications, such as a numerical keypad. Following the PARC tradition of catering to intellectual workers, they offered sophisticated special purpose software for use by market researchers and brand managers who were believed to be able to afford the steep price for what was represented as an executive workstation. Massaro and Liddle hoped to succeed where Xerox had failed by concentrating on clever solutions that manipulated databases that offered unique solutions to marketing problems. As in the case of PARC, what they marketed was not competitive with the inexpensive approaches, such as what was offered by Microsoft. Metaphor repeated the arrogance of the PARC leadership who believed in bundling proprietary hardware with proprietary software. Unfortunately, such an approach would always lose to inexpensive, general-purpose hardware that would be capable of running ten thousands of applications produced by thousands of independent developers. It was only a matter of time before improved versions of the Microsoft multi-purpose operating system could produce whatever results could be obtained from Metaphor.

One way of looking at the Metaphor venture is to view it as an attempt to reincarnate the failed STAR in another form, in a different market, without the encumbrance of what was alleged to be the restrictions imposed by the Xerox bureaucracy from Stamford. Unfortunately, Massaro and Liddle could never succeed, even without corporate staff oversight, because their approach was faulty. It suffered form every bias they acquired from the PARC way of thinking about the needs of the workplace. The failure of Metaphor can be seen as one of the proofs that it did not take

flawed Xerox management to make a direct successor of the Xerox 8010 die from self-inflicted wounds.

It is interesting to note that sometime in 1989 Xerox sent Metaphor a letter accusing them of violating many of the proprietary features of the Xerox 8010 and Xerox 6085 and requested royalties. Xerox always viewed Metaphor as an imitation of much that had been developed in PARC. Metaphor counter-sued Xerox Corporation seeking a declaration that Metaphor's database software products did not infringe on Xerox copyrights (which it did not) while ducking the issue whether it was a STAR look-alike. The merits of the Xerox claims and Metaphor allegations were never completely resolved because soon after Metaphor sold out its database products to IBM and Xerox could not press its claims against hardware and a firm that disappeared.

Metaphor was amply funded as a start-up. It had a unique chance to prove that what PARC had produced was marketable and profitable. Metaphor could at least partially prove the PARC leaders were right and that Xerox was wrong. That was not the case, because of a misunderstanding of what were the needs of administrative and office automation personnel in the 1980s. Although Metaphor received generous support from IBM, who ultimately bought the company in 1992 to salvage its database software, even a partial reincarnation of PARC was not feasible because of its fundamental flaws.

Proceeding with Retirement

Late in 1984 Xerox engaged in a cost reduction campaign, which included an attempt to lower rising costs of medical premiums. Xerox would claim that its employees had superior health and therefore the costs of any insurance should be lowered accordingly. Additional gyms were created at Xerox locations, with an increased emphasis on weight reduction and a healthy diet. To prove that Xerox employees were superior, the personnel department selected what was a representative sample of employees and sent them for an eight-hour medical examination.

I was selected. The results of a comprehensive questionnaire, together with the usual test results, were then sent to the University of

Michigan for analysis. In dues course I received findings about my health, which was excellent. My life expectancy, with 75% probability, was 94.5 years. However, I was slightly overweight. If I could lose 15-20 pounds immediately my life expectancy would increase to 95.3 years.

The University of Michigan analysis amused me. I received great enjoyment from Mona's chocolate mousse, which she made from confectioners' chocolate imported from Switzerland. I was not going to deprive myself to possibly live another 0.8 years forty years hence.

At the time I was crushed by my son's death as well as discouraged with my rapidly declining influence at corporate HQ. If I had another 40 years ahead of me, which was more time than what I had spent working so far, I surely did not wish to spend any of it with Xerox that was now eager to shed staff, especially at the executive levels. I would be eligible for retirement at the age of 56 with retirement benefits that would be counted as if I had stayed until my mandatory retirement, which would be now 62. It did not require calculations to figure out that I should quit immediately and seek another career while I was still able to do that. I would now go home to be with Mona most of the time.

My formal retirement from Xerox was on May 1, 1985. Even though I was not reporting to the CEO, David Kearns presided at my retirement party and gave me a cordial send-off. As a bonus, the Company funded me for another two years to be available for customer and public interest presentations, which was fully utilized. I would be also receiving monthly checks from a retirement fund that was an accumulation from payroll deductions and from profit sharing. Xerox would be acting as a Trustee for such funds. When I discovered that the Trustee was investing a large part of these funds in Xerox stock, I decided to withdraw the entire balance. With reluctance, Xerox agreed but I had to sign that I would not come around begging for support in case I mishandled my funds. Apparently, lump sum distribution of pension funds frequently ended up as risky investments.

My odyssey, which started 40 years before in Slovakia now arrived at a major milestone. There would be another 40 years, God willing, to see where life would take me.

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