Optimizing World Technological Resources for Mankind

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Perhaps the best way to launch this presentation is by noting the enormous need in our world for more technological innovation that reaches more individuals to make their lives more meaningful and more productive. In the future, this need will be increasingly recognized and fulfilled in large part because it will provide the best profit-making opportunity for business. Already there is a growing sense, in business and other sectors of our society, that concentration on narrow self-interest must give way to more enlightened efforts on behalf of the public at large, if our present Western economic and political systems are to survive.

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Let me emphasize here that I am *not* talking about just altruism or huge increases in government spending or the reordering of societies. What I *am* talking about is more efficient utilization of existing technological resources, achieved primarily through widespread cooperation, motivated by profit and the recognition of wider responsibilities.

All that may sound unrealistically idealistic, and it should, because substantive change can only be sparked with radical ideas. What I am talking about is a pragmatically idealistic process whose implementation is based largely on experience.

Before going further, I need to define technology. Widely varying perceptions and misperceptions of the nature of technology create barriers in people's minds that hinder its utility. Too often, technology is equated with environmental destruction or with anything big, whether it's business, government, universities, nuclear power plants or supersonic transports, along with the ill effects all of these are perceived to have on people's lives. In reality, as you well know, technology is an instrument that can be used either for good or for evil. I define it broadly as "a way of doing things" or of organizing actions to achieve desired results. I use the words "technology" and "know-how" interchangeably. I use the broad definition in order to relate technology to the everyday experiences of people and to help them gain broader understanding.

Technology comes in two forms, physical and human, depending on whether its origin is from the physical or social sciences. I like to use the term "*human* technology" to increase awareness of the pervasiveness of technology in daily living. Most practical technology embodies elements from both the physical and social sciences. The telephone, for example, is derived primarily from the physical sciences, but the technology of using it most effectively has its origins in the social sciences. A popular training course, "Selling: The Psychological Approach," teaches human technology.

Technological innovation is also a widely misunderstood term. It is the process that creates new products and services and produces improvements in existing ones. It yields increases in productivity which permit a higher standard of living. It fights inflation. And, vitally important, it is the single, richest source of new jobs.

Whether we like it or not, technology dominates virtually everything we do, and technological innovation is crucial to human and economic progress. Capital is important, but, without innovation, it is not very effective.

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That technology could be better used is attested to by a quick scan of the world scene, where one sees rampant inflation, persistent unemployment and underemployment, and other ills that are eroding the quality of living for many people in Western society. In addition, there are large numbers of disabled persons who are being denied the opportunity to lead a productive life; too many people are troubled and frustrated, and millions are groping for more meaningful living. At the same time, most of those living in the other three-quarters of the world have yet to gain even a decent standard of *material* living, and the gap between the richer and poorer nations is widening.

Underlying causes for the growing disparity are interrelated and include illiteracy, inadequate health care, malnutrition and widespread unemployment in developing countries. And, unfortunately, these countries also are burdened with most of the major ills of Western countries caused by the demise of cheap energy, growing environmental degradation, material resource limitations and lagging innovation.

Obviously, agricultural and industrial production must be vastly expanded in developing countries. At the same time, the West is facing the staggering challenge of cooling inflation by increasing productivity

in environmentally protective ways, with rising employment. In addition, the needs of the disabled, the troubled and those seeking more meaningful lives must be better addressed. The major means of accomplishing these interrelated and often conflicting objectives is a worldwide acceleration of technological innovation.

Considering the years that woes of both developed and developing countries have existed, and their ever-growing dimensions, it is also obvious that traditional ways are not working. A new approach is long overdue. The key strategy is to achieve more efficient utilization of resources by vast increases in technological cooperation. More cooperation is needed as an underpinning to the needed acceleration in innovation noted earlier. Forms of cooperation are well known. They include license agreements, joint projects, jointly owned companies and various combinations of these techniques.

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High priority must be given to the reduction of illiteracy which is the major impediment to human progress in the world today. The last estimate I saw is that three-quarters of a billion adults cannot read or write. And the number is growing. Yet it would be mockery to attempt to educate vast numbers of illiterate, poverty-stricken people with little chance to better their lot. Actually, this is an unlikely real-life scenario, because people cannot be motivated to learn without reasonable expectation of achieving an improved standard of living as a result of their learning.

Therefore, hand-in-hand with providing education, there must be a greater expansion of economic opportunity in developing countries. For reasons I'll get to later, needed expansion in agricultural and industrial enterprise can best be accomplished with small-scale enterprise – small farms, small food processors, small manufacturing companies and small services companies.

In order to achieve the needed expansion in small enterprise, technology must be made more accessible and assembled in forms that are more useful to individuals and small enterprise and more controllable by them. This will provide the means for individuals to exercise their innate creativity for expanding innovation. It also will help them regain the control over their lives which has been eroding steadily due

to ever-shrinking and more specialized roles in larger and larger organizations.

What is most needed then is more technology applied for humanistic purposes and the creation of an environment where large organizations who have most of the technology will package it so that it can be more readily converted into products and services by small enterprise. That is the great technological need and the great business opportunity which goes hand-in-hand with broad-based cooperation among all sectors of society.

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COOPERATION

Before elaborating on these points and the assembly of technology in ways that make it useful by small enterprise, I need to review the underpinning that must be provided by increased technological cooperation. Illiteracy, malnutrition, inadequate health care, environmental degradation, the high cost and declining availability of energy, inflation, unemployment and underemployment, and other societal ills are massive in scope and size and massive technological resources are required to address them in an adequate and timely manner—resources that are far larger than any single company or country can marshal. The only practical answer is worldwide technological cooperation with an appropriate sharing of costs between industry and government.

For 20 years, I have advocated and Control Data has extensively practiced technological cooperation. Results for Control Data have been gratifying; and, in recent years, the practice has been gaining broader acceptance by other organizations. Although this is not happening as rapidly as needed, acceleration will occur from the accumulating desperation of unsuccessfully meeting expanding needs in an environment of inexorably increasing resource limitations.

INFORMATION AND TECHNOLOGY DATA BASES

An already growing area of cooperation is in the assembly and dissemination of technological information. Massive expansion in availability of information via the computer is already underway, and individuals and small organizations have greater access to information than ever before. This is beneficial, but inadequate. Information is not knowledge or the "how to" of technology.

Small business, not being self-sufficient in technology, needs much better access to it – as do average individuals, be they doctors, dentists, engineers, architects or farmers – to keep abreast of change. There is

an anamoly here. Enormous volumes of information and technology are created by university laboratories and government agencies, yet much of it lies dormant; little is transferred to small companies and individuals for conversion to new or improved products and services.

Similarly, large stores of underutilized technology exist in business firms. Most firms use only part of their technology in their own commercial activities. The remainder may have commercial applications elsewhere but is left unused for the good of our society. Even more importantly, firms utilize technology in one product that has applications to other products, often in very different industries. But transfer between companies is constrained, by concern for proprietary protection. Much of this concern is unwarranted, because even in the few areas of significant technological breakthrough in recent years, the new technology was diffused so rapidly that any initial business advantage was soon lost. Thus, in most industries, several companies are selling the same product, differentiated only by features which improve user application and appearance. Hence, much of the technology of one firm *can* be used by others with little competitive threat.

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With a well-defined technology transfer system, the flow of technology to individuals and small business can be substantially increased. One important element is the commercially available, computer-based information storage and communication systems mentioned earlier. Massive amounts of information can be stored in the computer memory and quickly recalled. By including two types of information in the data bases – one consisting of descriptions of technologies in terms that show prospective buyers the kinds of problems the technologies will solve, and the other describing the problems that are to be solved – interaction can be facilitated between providers and users of technology.

As the benefits of increased technology transfer are more widely perceived, organizations will identify their technologies, package them into useful forms, and then inventory them in computer data bases which can be linked through networks with those of other organizations. The computer can readily keep track of information and technology transfers so that owners can be paid for usage by those accessing them.

INDUSTRIAL INNOVATION

In shifting now to industrial innovation, it should be noted that it has been proven that small organizations are highly effective innovators

and have, in recent years, created the majority of new jobs in most Western countries. Also, it should be noted that they are the best source of more urgently needed jobs for young people and handicapped persons. The variety and flexibility of small enterprises enable them to employ effectively many of those who do not fit easily into the standardized employment patterns of large firms. Belatedly, Western countries have awakened to the contributions of small enterprise in innovation and job creation and are now legislating more support for small business that includes tax breaks and increased availability of capital financing and R&D subsidies.

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While this type of support is important, it is not nearly enough to stimulate the vast increase needed in the number of new businesses and small farms. The only feasible way to achieve this is through the better utilization of existing resources to avoid big increases in government spending and unnecessary diversions of scarce talent.

Major resources that are presently underutilized are not only the technologies, but also the professional and management resources of big business, universities, research institutes and government agencies.

Helping small enterprise is a major business opportunity for big business. There are enormous opportunities for large companies and small companies, working together, to address such major needs of society as alternate and less costly sources of energy, more energy conservation, more conservation of natural resources, urban revitalization, more efficient food production, and better rural living.

Large and small companies can cooperate directly or through consortia formed to assemble the diverse resources that are required for holistic solutions to problems such as substandard urban and rural living. This is not mere theory, because Control Data is participating in consortia and working directly with small companies. Let me provide examples of both.

The direct approach consists of providing a wide range of services to

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help small enterprise. Only two Control Data services will be cited as examples, starting with training.

TRAINING: Critical to success in small enterprise is more relevant, higher quality, more accessible and lower cost training. Control Data is addressing this need with its PLATO computer-based education service. Training is currently delivered in learning centers and with terminals installed on the user's premises. The cost is substantially less than that of classroom-based courses in large companies because it enjoys economies of scale.

Many courses are being developed for small enterprise, including courses in how to start-up and manage a small business or a small farm. A number of courses have been tailored to the needs of the woman entrepreneur. I will have more to say later about computer-based education.

BUSINESS SERVICES CENTERS: Another important service for small business is our Business Services Centers, which provides various combinations of consulting, shared facilities and services for facilitating the successful start-up and growth of small businesses. In the larger centers, called Business and Technology Centers, a cluster of buildings containing flexible laboratory and office space is subdivided and leased to small businesses. The buildings contain such centrally shared facilities and services as a library; model shop; clean rooms; drafting, accounting, consulting, purchasing and legal services; as well as a complete range of computer services, including technology locating and transfer services and computer-based education.

Economies of scale make it possible to provide occupants of the center and small companies located nearby with needed facilities and services of much higher quality for considerably lower cost than each would be capable of obtaining or providing for itself. Benefits also are obtained from the enhanced environment for peer interchange.

CITY VENTURE: Illustrative of the consortium approach to provide improved environments for better urban living is City Venture, Inc. which was founded by Control Data, 12 other companies and two church organizations.

City Venture plans and manages the implementation of innovative and comprehensive programs for both rebuilding existing urban areas and for creating new cities. It is also assembling a broad range of new and advanced technologies, from both the physical and social sciences, to implement these innovative programs.

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The City Venture approach mandates that any plan for building or restoring a community must be based on meeting residents' needs for high quality, accessible and affordable education and training, and, even more important, decent jobs.

Small enterprises are a major source of those jobs, as well as an important means for building, rebuilding, and maintaining housing and commercial centers. Small businesses also participate in providing health care, education and other social services, together with a myriad of other needed products and services, including food production, processing and distribution, and waste recycling.

To reinforce my earlier plea for better utilization of existing resources, I'll note that the great majority of the management, professional and technological resources required for building and restoring communities lie underutilized within large corporations. Managers in large companies are relatively unchallenged for a good part of the time, and professional people cannot work productively on one type of problem continuously. Also, many of the technologies of one company can be used without threat by other, non-competitive companies, especially small companies.

AGRICULTURAL INNOVATION

Obviously, achieving adequate industrial innovation to meet urban needs will require cooperation on a vast scale. Achieving sufficient agricultural innovation is an even greater challenge. A glimpse will provide a grasp of the awesome magnitude of this need in the world. There are over one billion small farmers in the developing world, yet per capita food production is declining in all developing regions except in Asia. Without great improvement in small-scale agriculture, there is little hope for significant economic progress, because the initial

progress achieved with large-scale "green revolution" agriculture of the last half century has slowed sharply.

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More efficient small-scale agriculture is also urgently needed in most Western countries to reduce food costs, lessen environmental degradation and reverse farm to city migration.

Migration records show that from 1950 to 1970, over 1.5 million people left farming each year in the West. The international labor organization estimates that, on the average, one million will leave each year between now and the year 2000. Efficient small-scale agriculture would sharply decrease this migration and eventually cause a reversal.

It is now evident that with proper selection and application of new and emerging technologies, and with adequate ongoing R&D, small family farms and food processing operations can reduce the cost of food, make a significant contribution to food production, do it in more environmentally protective ways, and provide a decent living for the operators. These results cannot be accomplished overnight, but there is enough existing applicable technology to make meaningful progress in a few years and, with adequate and continuing support, to reach objectives in a significant number of areas in 10 to 15 years.

Computer technology is the centerpiece of the strategy to accomplish these objectives. Control Data is implementing a small farm program based on this strategy. A data bank of agricultural technology which is consistent with high production, low capital investment and decreased consumption of fossil fuels is being assembled. Optimum selections of crops, livestock, equipment and other technology are made by computer for each small farm. Comprehensive computer-based education and training programs will enable individual farmers to appy the technologies efficiently.

Because of the vast diversity of agricultural technologies required to implement this approach over the wide range of geographies encountered on nationwide and international scales, a consortium has been formed called Rural Venture. This organization is composed of business corporations, religious organizations, farm cooperatives, foundations and individuals.

While Control Data agricultural and Rural Venture efforts are still in

early stages, it is clear that the necessary technologies *can* be assembled. Through the use of the computer, the technologies can be selected and optimized for small farms, individuals can be trained to successfully apply those technologies, and ultimately all of this can be done anywhere in the world.

Through cooperative efforts and use of the computer, results similar to those in small-scale agriculture can eventually be obtained in selected industries. Technologies can be aggregated into sets or systems in different fields, and the application of those technologies can be taught by computer-based education so that an individual can successfully start-up and operate a small business with them.

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INNOVATION FOR THE INDIVIDUAL

Having reviewed industrial and agricultural innovation, it is time to consider the expansion of innovation for the direct personal benefit of individuals. At the head of the list is education.

EDUCATION: The only practical way to make major progress in solving the massive and urgent problem of worldwide illiteracy is through the use of technology, primarily television, audio/video tapes, telephone, cable and satellite transmission coordinated in a network learning system with computer-based education.

For 18 years, Control Data has been engaged in cooperative programs with many other organizations and individuals to develop such a system called PLATO computer-based education.

PLATO computer-based education is accessible today anywhere in North America and Western Europe and in a few large cities in other countries. Usage is expanding rapidly as costs of the system continue to decrease and the volume and variety of courseware increases.

PLATO computer-based education has been proven cost-effective in many fields, including vocational training and teaching basic skills – areas of critical importance to developing countries and to the disadvantaged in Western countries. Computer-based education will penetrate virtually all areas of education as courseware becomes available, as costs continue to decrease with increased uses, and as electronic component costs continue their phenomenal descent. Needed expansion of computer-based education worldwide can only be accomplished through cooperative programs among educational institutions, governments, companies and individuals; and Control Data is encouraging widespread cooperation.

HEALTH CARE: Adequate health care is another massive and urgent need crying for more appropriate technology. In Western society, cost is the dominant issue, whereas in developing countries, to a great extent, it is neither affordable *nor* available.

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In order to devise a realistic approach, one has to have grappled with some of the very worst problems in health care. In the United States, they are present in many Indian tribal reservations, where available health care is appallingly poor. Here, except for widespread malnutrition, conditions are essentially the same as in developing countries.

On South Dakota's Rosebud Indian Reservation, Control Data has worked with tribal leaders to apply computer technology and managerial resources to improve health care delivery dramatically. Five years ago, one woefully understaffed small hospital was responsible for the care of 8,500 Native Americans. Those who required care had to travel up to 130 miles on dirt roads, with little or no transportation, to get it. Today, Control Data's medical van travels the reservation providing care to 900 residents per month, with significant improvement in the health of the tribe. In addition, four clinics have been established and Indian paramedics have been trained.

Substantial gains have been made, but there is still urgent need for further improvement at Rosebud. The next phase of the program is to teach tribal members self health care aimed at the avoidance of illness, using PLATO computer-based education. This is a gargantuan task, but it is the only possible way to achieve the needed improvement in Indian health and of other impoverished people. In fact, in all of Western society, the pathway to better health at an affordable cost has

to be directed toward preventing illness as opposed to after-the-fact medicine.

In addition to technology for improving education and health care, there are a host of human technologies for reaching individuals to improve personal well-being and interpersonal skills.

Applicable human technologies are wide ranging. Exotic ones like genetic engineering have their roles, but I am going to focus on the more mundane that, if given increased attention, would have widespread benefits in a relatively short time.

EAR: One example is a service available to employees of subscribing organizations called EAR, which is the acronym for Employee Advisory Resource. EAR serves the whole range of personal, family and work-related problems.

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Use of EAR by a troubled employee or family member begins with a toll-free number that establishes contact with a counselor who can help diagnose the problem and provide a solution.

Behind that simple description lies human technology that copes with complex human issues. Most of the problems are so personal, or the opportunity for reprisal so real in the employee's mind, that absolute anonymity must be maintained initially for the employee. Only with that confidence is there willingness to proceed with the process of seeking solutions.

The counselor receiving telephone calls cannot be simply a well-meaning individual. The employee with a problem is often unable to articulate the causes of that problem. Each counselor is trained in crisis intervention, a human technology that is especially effective in bridging the distance between the counselor and the calling individual.

The employee is helped by an EAR advocate to make contact with the appropriate community service for help or treatment if necessary. In the case of work-related problems, the advocate's task is to assist both managers and the employee to seek and interpret the relevant facts until a just conclusion is reached for the employee and the company.

Annually, the results of the program are evaluated, and have included reduction in turnover, absenteeism, and medical costs, for example. The savings exceed costs of the program many times. Dwarfing the cost savings are the immeasurable, but real, benefits to the well-being of employees, and I should add that human technology is far more important than physical technology in achieving this success.

PERFORMANCE APPRAISAL: Another important human technology is more effective performance appraisal—a tool that supervisors have used inefficiently for years. When properly used, it can increase the productivity of both supervisors and employees. The difference is the addition of human technology that includes better defining of the relationship between performance and the job, regularly sharing information on appraisals between supervisor and employee, training supervisors in the necessary communication skills, and training employees in reasonable expectations.

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CONCERNED OTHERS: A third example is computer-based education training for adults who are trying to deal with problems related to alcohol and drug abuse within their families. The object of the curriculum is to educate the participant about the basic facts of alcohol or drug abuse, how to determine if the use of either is a problem in the family, and where and how to get help. The privacy and immediate availability, along with the depth of learning that can be achieved and the low cost of computer-based education, are all important in solving chemical dependency problems which cause tremendous trauma within a family.

HOMEWORK: The last service to describe with a major component of human technology is called HOMEWORK. The objective of HOMEWORK is to provide training and employment alternatives to the severely disabled homebound population. Tragically, this group of people has a wide range of unused skills and capabilities. Therefore, a service was created to develop training and job opportunities for them using a PLATO computer-based education terminal in their homes.

The first work selected for the Homeworkers to perform was designing, developing and evaluating educational courseware. Additions are gradually being made to the types of work performed, such as computer programming.

HOMEWORK provides training and education as well as a means of communication for the disabled person. A counselor participates in the computer network along with the other employees. It is truly a network of disabled individuals learning different skills at different rates but sharing the learning experience.

Finally, HOMEWORK will not be restricted to only the disabled population, but will also become an employment alternative for the able-bodied.

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Many other examples of human technology could be cited. However, I believe the point has been made that people can and must be more intimately reached and helped, in humanistic ways, by technology.

CONCLUSION

And with that thought, I will start to conclude. Again, I believe that priority must be given to technology that addresses the needs of individuals for better education, better health, better interpersonal skills, better understanding of themselves, and more control over their destinies.

Hand-in-hand with this humanistic emphasis must go the means of economic improvement, which can best be accomplished with small-scale enterprise – small farms, small food processors, small manufacturing and small services companies. Small enterprise not in lieu of big business, but in cooperation with it for mutual benefit.

Most applicable technologies are scattered, not easily located and accessed. Clearly, if technology is to be efficiently used by small enterprise, it must not only be located but assembled in appropriate forms and made readily accessible. Doing so will provide the means for individuals and small enterprises to exercise their innovative capabilities. Technological innovation and the creation and growth of small enterprise will then occur on an unprecedented scale. Providing technology on a royalty basis to small enterprise will be a large and profitable business for those organizations willing to make the investment to find, assemble and disseminate it.

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Small-scale agriculture best illustrates the potential. Technologies for small-scale agriculture will be developed and assembled through the cooperative efforts of countries, corporations and consortia of organizations. The computer is used to collect, select, package and distribute the technology. The computer readily inventories and keeps track of transferred technology so that owners can be paid for usage. Each set of technologies for an individual farm will be optimized to achieve maximum use of land, equipment, labor and capital wherever located in the world. Companion, computer-based curricula will train each farmer how to employ each technology or knowledge skill. Also through the use of the computer, the small farmer can exercise his initiative and creativity in productive ways by adapting technology selections to his own needs and preferences.

Given holistic technology, the successful start-up and operation of small farms can be accomplished on a massive scale. And the same can be said for many other types of small enterprise. Technology for successfully launching and managing small businesses is well established, and there is a wide range of general courses available on start-up and management. Again, through cooperative efforts, results similar to small-scale agriculture *can* be obtained in selected industries. Technologies *can* be aggregated into industry sets and the application of the sets of technologies taught by computer-based education to help individuals successfully launch and manage small businesses centered on those technologies.

My final thought today, and one which to an extent summarizes what I have been saying, is that widespread technological cooperation, with the aid of worldwide computer-based communication networks, will bring useful technology and, most importantly, the control of that technology into the hands of individuals and small enterprises to a much greater extent than before, not only for their benefit but for the greater benefit of all of society. Instead of technology being mainly controlled by a few large organizations, technology will become the province of many.