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HIGH TECH — COOPERATION, COMPETITION, OR BOTH?

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A group of United States high tech companies tried to start the new decade with a sort of cooperative venture. The 1990's were not even one month old before the attempt had failed. The case of U. S. Memories will soon be forgotten, but the questions it raises about high technology cooperation will remain.[1]

COMPUTERS, DRAM'S, AND U. S. MEMORIES

The main element of a computer is a central processing unit which is composed of structures that accomplish logical operations and structures that store information.[2] These structures are contained in logic and memory chips respectively. One type of memory chip within the central processing unit is the dynamic random access memory chip or DRAM. These chips provide the storage of the information that is immediately being used by the computer.[3] For example, when an article is written on a computer, both the word processing program and the material being written will be stored in a DRAM.[4] A larger internal memory allows the computer to work efficiently from more data and more complicated applications programs.

The same basic principles and working constraints govern all chips. Engineers work steadily to make all types of chips smaller, faster, and less power hungry. Nevertheless, the DRAM poses something of a special case which is revealed by its function. Each item of information used in a computer is reduced to electronic

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1. Many of the arguments which I will advance were discussed in a more abbreviated form in an article which I wrote for the *Recorder*, January 29, 1990, at 6, entitled "As U.S. Memories Fades, Some Lessons Emerge."

2. The computers we work with have other necessary peripheral components such as disk drives to store information, and user interfaces such as the keyboard, screen, and printer.

3. The DRAM is an active memory. A DRAM is analogous to what you remember right now, while the information stored on a disk is like the information you have recorded in notes or have available from a book.

4. On a specialized computer or dedicated word processor, the word processing program will most likely be encoded into a special chip, a read only memory, ROM or EPROM.

"bits."[5] Enormous amounts of electronic memory are needed to store the information used while you work on the computer. Information is stored in digital memory devices, including DRAMs, by locating an electric charge in a particular "address" or pigeonhole within the chip. If you envision a wall of post office boxes, you will have a very accurate idea of the internal workings of a DRAM.

DRAMs are very dense semiconductor chips. In order to increase the capacity of memory, more and more circuits and memory cells must be packed into the tiny chip. DRAMs place an extremely high value on improved design and especially on improved process technology. The goals are to decrease the physical size of the memory chip, improve its accessibility, reduce power consumption, and increase speed, while at the same time dramatically increasing the capacity of the chip from 256 thousand to 512 thousand to one million, four million, sixteen million "post office boxes" and beyond.[6]

Since these DRAMs are so essential to efficient computers, the computer makers need to have a steady supply or stock pile of the chips. When the supply of DRAMs drops, their price rises, sometimes sharply. Generally, there has been a good supply of DRAMS, but there have been occasional instances of shortage. Also, much of the current supply of DRAMs comes from foreign sources, especially Japan.

In mid 1989, a group of seven semiconductor and computer companies devised U. S. Memories.[7] It was to be a separate company which would combine the latest circuit designs and manufacturing technologies to produce a steady domestic supply of state of the art DRAMs for immediate consumption by computer makers. U. S. Memories also would have addressed the concern voiced by some commentators that the United States computer industry is too dependent on foreign sources.

U. S. Memories was to have been funded by combined invest-

5. "Bit" is a "blend word formed from *binary digit*, a unit of information equal to one binary decision. It can be a single character in a binary number, a single pulse in a coded group of pulses, or a unit of information capacity." M. HORDESKI, THE ILLUSTRATED DICTIONARY OF MICROCOMPUTERS 25 (2d ed. 1986).

6. Japanese and American companies appear on the verge of producing 16 megabyte DRAMs. Please see "TI, IBM making it a 16-Mbit race," *Electronic Engineering Times*, Issue 579, Feb. 26, 1990, at 1.

7. The originators were four semiconductor companies, Intel, AMD, National Semiconductor, LSI Logic, and three computer companies, IBM, Hewlett Packard, and Digital Equipment. It is important to recognize that these two different kinds of companies have some conflicting interests—semiconductor companies want to make a profit on DRAMs, while computer makers want to get them as cheaply as possible.

ment of 500 million to one billion dollars from the seven originators plus other investors. The plan ran into early trouble with computer makers when Sun Microsystems, Apple Computer, and Unisys rejected it. On the other hand, many semiconductor firms were apparently not welcome to join the new company, and some of those firms saw the plan as a direct attack on the viability of small and medium sized semiconductor companies.[8] When it came time to finance the project, investors, including many of the originating companies, simply would not put up the money.

COOPERATIVE DESIGN

Technological progress occurs when an advantage is recognized and is applied. The high technology industry offers progress in at least two distinct ways—new *designs* and new means of *manufacture*.[9] The chip industry vividly demonstrates the power of new design: improved circuit designs provide greater speed and lower power consumption. Discoveries concerning the use of new substances, such as gallium arsenide or superconductors, make it possible to design in new ways. New basic approaches can create entirely new ways of solving problems. For example, neural network chips are now being developed that might allow different logic processes to be used.[10]

Cooperation offers one decisive advantage in technology design—by sharing, parties can take advantage of *each other's* improvements. No single company or individual invents everything, and all companies are wary of "reinventing the wheel." The semiconductor industry is well aware of its dependence on basic cooperation and exchange of information. In large companies cooperation takes place internally. One department passes on its developments

8. When Congress was considering a proposal to grant U. S. Memories an antitrust exemption, T.J. Rodgers of Cypress Semiconductor Corporation voiced opposition: "In reality, [such legislation] will provide a group of only [four billion-dollar] semiconductor companies with an antitrust exemption and government subsidies." *Electronic Engineering Times*, July 31, 1989 at 1.

9. Whether a technology benefits individuals or society depends on whether it is used in a timely fashion, whether it is used for beneficial or destructive purposes, etc. Virtually every technological advance can be abused, and sometimes it is best to do things the simple "old fashioned" way. When the old way is recognized as the better way, that too is progress.

10. The standard approaches today are based on binary or Boolean logic which involves solving all problems by a decision tree that is converted to a nearly endless series of either/or choices implemented by the computer. The decision tree approach seems like an exercise of brute force when compared with the way humans imagine, think, decide, and act. It works not because it is elegant, but because computers are tireless. I have yet to meet a person who acts and decides like a binary computer does. Even more innovative than the neural network silicon chip are technologies that will use organic compounds as their basis.

to the next until a final product is designed and assembled. Both large and small companies enhance their design capabilities by purchasing technologies from others. The question concerning design cooperation is not whether it is possible, but in what forms it occurs.[11]

The principal roadblock to design cooperation is a felt need to produce profit by jealously guarding new designs. If a design offers a real advantage, it will command a higher price, and the inventing company will want to reap that price advantage. The traditional method of securing profitable cooperation is by coupling intellectual property rights to a license. Company A has a patent or trade secret which it licenses to Company B. The licensing tool is very helpful in achieving cooperation, but it is strictly dependent on the willingness of the trade secret or patent holder to license.

Undue reluctance to license creates certain identifiable social harms: resources are used on products that will become obsolete, and the public is denied widespread use of more efficient products.[12] If one were to aggregate the net profit of all companies in a given broad industry, for example, the computer industry, no doubt that profit would be lower because efficiencies were not shared. In short, an expensive time lag is imposed by licensing reluctance.

There are a number of solutions to the licensing bottleneck. All of them involve the common feature of assuring a fair return to the inventing party, while insisting on access rights for some broader constituency.

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11. High technology companies are becoming increasingly aware of opportunities for cooperation. For example, Digital Equipment Corp., Texas Instruments Inc., Ford Motor Co., US West Inc., and Carnegie Group Inc. recently formed the "Initiative for Managing Knowledge Assets," whose goal is to develop what it calls "knowledge processing software." B. Zielger, "Five Companies Form Computer Group," *Washington Post*, April 25, 1990 at 61.

12. Professor David J. Teece states:

> Business commentators often remark that many small entrepreneurial firms that generate new, commercially valuable technology fail while large multinational firms, often with less meritorious records with respect to innovation, survive and prosper. One set of reasons for this phenomenon is now clear. Large firms are more likely to possess the relevant specialized and cospecialized assets within their boundaries at the time of new product introduction. They can therefore do a better job of milking their technology, however meager, to maximum advantage. Small domestic firms are less likely to have the relevant specialized and cospecialized assets within their boundaries and so either will have to incur the expense of trying to build them or will have to try to develop coalitions with competitors/owners of the specialized assets. *The Competitive Challenge-Strategies for Industrial Innovation and Renewal*, The Transamerica Lectures in Corporate Strategy, School of Business, University of California, Berkeley at 212 (D. Teece ed. 1981).

Selective licensing of patented works can be abolished. This can be done by a simple amendment to the patent laws. Once a patentee has licensed to one party, it must license to all on roughly equivalent terms.[13]

A patent pool system could be established that allowed immediate access to patents relevant to particular products for a standard royalty.[14] Such a pool would operate similarly to the broad music licenses presently available as well as to certain practices by private patent portfolio holders. The difference, however, is that the pool would be obligatory.

Another approach is suggested by the U. S. Memories experience. Either by private initiative or by government encouragement, inventive companies could share their new designs broadly and on a fully cooperative basis. Actually, there is nothing strictly new in this approach except for the notion of broad participation. The equivalent of this kind of sharing goes on constantly today through cross-licensing arrangements and development agreements.

If the goal is industry-wide or national cooperation, the concept of *broad access* must be made an effective part of a plan. It was the absence of such access rights that made certain small and medium sized semiconductor companies foes of the U. S. Memories plan. If new technologies related to DRAMs were piped only to a selected company, U. S. Memories, in which the smaller companies had no effective participation, then their own capacity to flourish would be undermined, not encouraged!

The National Cooperative Research Act of 1984 recognizes the need for healthy cooperative efforts in high technology.[15] The Senate Report recognizes that development of new technology is expensive and that "unnecessary and wasteful duplication of effort can inhibit our (national) ability to remain competitive in the world

13. I have argued in favor of such an amendment in an essay, *To License or Not—A Proposal to Improve the Patent Law*, 5 SANTA CLARA COMPUTER & HIGH TECH. L.J. 199 (1989). Denial of licenses can have a disastrous effect on new inventors. The House Report on the 1980 patent amendments states that defensive patent litigation is extraordinarily expensive for small firms. "The result is a chilling effect on those businesses and independent inventors who have repeatedly demonstrated their ability to successfully innovate and develop new products." H.R. Rep. No. 1307, 96th Cong., 2d Sess. 4, *reprinted in* 1980 U.S. CODE CONG. & ADMIN. NEWS 6460, 6463.

14. The patent pool suggestion was recently made by a participant at the Santa Clara University/Santa Clara County Bar Association seminar on "Current Developments in Protection of Computer Technology."

15. Pub. L. No. 98-462 §§ 1-6, 98 Stat. 1815 (codified as enacted at 15 U.S.C. §§ 4301-4305 (1984)).

economy."[16] The Act removes a dual threat of antitrust claims: that joint activity may be considered a per se violation of law, and that treble damages should be awarded. The Act provides that antitrust actions against publicly disclosed bona fide research and development ventures shall be governed by a standard of reasonableness, that recoveries shall be limited to actual damages and interest, plus costs and attorney fees, and that the prevailing party (plaintiff or defendant) shall be entitled to attorney fees.[17] As of April 30, 1990, 178 different ventures had registered for protection under the Act.[18]

In 1989, several bills were introduced in Congress to extend the Act to certain manufacturing operations. One of these bills proposed a comprehensive exemption from virtually all aspects of the antitrust laws for qualifying cooperative efforts in science, engineering, and manufacturing. The protections of the proposed law would be available to manufacturing ventures that had demonstrated to the Attorney General or the Federal Trade Commission that the arrangement will not possess substantial market power and will not last more than a reasonable time up to a maximum of seventeen years.[19]

Thus, the ready conclusion to be offered to policy makers regarding design cooperation is: develop effective means of access to new developments. That access must be open to all qualified comers.[20] Who is qualified? Any company or group that demonstrates a firm financial backing or plan, that is nondiscriminatory in the

16. S. Rep. No. 427, 98th Cong., 2d Sess. 2, *reprinted in* 1984 U.S. CODE CONG. & ADMIN. NEWS 3105, 3106.

17. 15 U.S.C. §§ 4302-4304 (1984). Qualifying "research and development ventures," referred to as "bona fide" in the text, is defined in the Act to include any group activity for purposes of theory, development of basic engineering techniques, extension of findings into working models, and collection, exchange, and analysis of research information. 15 U.S.C. § 4301(a)(6) (1984). "Classic cartel-like behavior" is specifically excluded from protection. *See* 15 U.S.C. § 4301(b) (1984) and H.R. Conf. Rep. No. 1044, 98th Cong., 2d Sess. 8, *reprinted in* 1984 U.S. CODE CONG. & ADMIN. NEWS 3132, 3133. The protections of the Act are conditioned on identifying the parties and the general nature of the venture to the Federal Trade Commission and the Attorney General. The Attorney General or FTC then publishes the substance of the notice in the Federal Register. There are provisions for protecting the confidentiality of more specific information supplied to the government. 15 U.S.C. § 4305 (1984).

18. Department of Justice report listing *Federal Register* publications under the Act, as of April 30, 1990.

19. H.R. 1024, 101st Cong., 1st Sess., introduced by Representatives Rick Boucher (D-Va.) and Tom Campbell (R-Ca.). Under the bill, activities within the scope of approved arrangements would be exempted from damages, costs, and attorney fees under federal and state laws, although injunctions could still be obtained against an approved venture.

20. In the case of U. S. Memories, this access should have included some form of access to research and development as well as licensed devices, because that company was intended to be a well-funded superstar—a superDRAM company.

workplace, and that is able to comply in good faith with such requirements as quality control and confidentiality. Certainly, devising and drafting such an approach is hard work, but it simply calls for the skills that lawyers can offer. Contract writers and legislative drafters apply their skill to just such problems all the time.

Cooperative Manufacture

The second area of cooperation is manufacturing. U. S. Memories was a venture specifically aimed at this side of the equation.[21] The plan, however, was fraught with difficulties. It created an uneasy alliance between computer makers and semiconductor companies. Semiconductor companies want to make a handsome profit by selling DRAMs to computer manufacturers, while computer manufacturers want to reduce their costs by paying less for DRAMs.

The tension between producers (the semiconductor companies) and consumers (the computer makers) could have been resolved in practice by provisions assuring supplies and governing cost increases, and by very active pursuit of good faith and fairness in operations.[22] Often lawyers and business persons treat these concepts, "good faith" and "fairness," with a wry smile. That is, these concepts are only good to the extent they can be enforced in a court of law. Because concern about Japanese competition has been voiced in the case of DRAMs, it is wise to observe that Japanese culture and industry treat these concepts very seriously and make them work in practice. To have succeeded, U.S. Memories would have had to do the same — made good faith a reality.

A very basic problem would have remained, however, even if careful planning and good faith had succeeded in protecting the founders of U.S. Memories. The new superDRAM company would still have posed a direct threat to those semiconductor producers and computer makers who were not part of the original plan. Manufacturing "cooperation" can devolve too easily into market control, selective supply, and other abuses. It can create cartel activity of precisely the kind our antitrust laws have been set up to prevent.[23] If cooperation in manufacturing is to be fostered, cartel ac-

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21. That was the message given to the public. However, I am convinced that the proposed DRAM giant would also have acquired a formidable design portfolio.

22. Good faith and fairness are general obligations in all contracts and are part and parcel of corporate structures. *See, e.g.*, U.C.C. § 1-203; Foley v. Interactive Data Corp., 47 Cal. 3d 654, 683, 254 Cal. Rptr. 211, 765 P.2d 373 (1988); Science Accessories Corp. v. Summagraphics Corp., 425 A.2d 957 (Del. 1980).

23. *See generally* 15 U.S.C. §§ 1 et seq. (Sherman Act) and §§ 12 et seq. (Clayton Act). The Cooperative Research Act of 1984 specifically intended to deny its protections to "classic

tivity must be positively curtailed.

Thus, a second lesson can be drawn about cooperation: on the manufacturing side, economic access rights must be assured. Economic access rights are in essence the reciprocal of the technological access rights mentioned above with regard to design progress.[24] If a superDRAM company were to be formed with any kind of governmental blessing,[25] then smaller semiconductor companies would have to be assured access to manufacturing facilities at reasonable rates and schedules. Likewise, all computer makers would have to be assured some form of reasonable access to DRAMs, as these are a staple product when it comes to computer production.[26] Some legislative intervention beyond the existing antitrust laws would have been necessary because of the current high cost of pursuing these remedies and the uncertainty concerning their scope and application.

COMPETITION

The decisive advantage of cooperation is shared information and resources.[27] The advantage offered by competition is incentive to improve. The incentive of competition can be preserved in a cooperative arrangement. Sports demonstrate the basic principle of competition in a cooperative environment. In physical sports, the competitors all play with the same rules and the same basic equipment. When there are technological breakthroughs, such as improved shoes, vaulting poles, or tennis rackets, these items are usually made available to all who compete. In fact, the fierce competition of sports usually requires this kind of equipment equality.[28]

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cartel-like behavior by participants in a joint R & D venture." H.R. Conf. Rep. No. 1044, 98th Cong., 2d Sess. 8, *reprinted in* 1984 U.S. CODE CONG. & ADMIN. NEWS 3132, 3133. 15 U.S.C. § 4301(b) excludes exchanging information among competitors relating to costs, sales, profitability, and the like, excludes agreements regarding production or marketing, and excludes agreements restricting or requiring licensing or restricting or requiring participation in research and development which are not part of the venture itself.

24. *See supra* note 14 and accompanying text.

25. U. S. Memories was aware of the potential antitrust problems and sought an antitrust exemption. Please see the requirement in *Electronic Engineering Times*, July 1, 1989 at 1.

26. *See supra* text accompanying note 6.

27. *See supra* text following note 10.

28. Team sports offer additional insights into the coexistence of cooperation and competition. Soccer or basketball teammates compete for a position on the playing field and compete against each other in workouts. When the teammates take the field against another team, they cooperate as fully as they can. A different cooperation occurs in racing teams. Runners cooperate when they work out together. They push each other to higher performances and more thorough workouts so that when they get on the track, one or the other of the

Even with greater equal access to design and manufacturing technology, there will still be powerful incentives to compete. Manufacturers will place a high emphasis on efficiency, on service, on care in purchasing supplies, and on economies of scale.

An improved cooperative environment will demand as much or more innovation and invention as an environment dominated by restrictive technology practices. This proposition is easy to demonstrate. The inventor of a new device or technique can be the first to integrate the new item into its productions. The inventor will be able to derive royalties from the invention, or treat the new item as a trade secret or as an invention that it will license to no one.[29] There is no all or nothing choice between competition and cooperation. They can definitely co-exist, especially in high tech development and manufacture.

The subject of industrial competition naturally raises such topics as, "American competitiveness," "competitive edge," and the greatly overworked, "level playing field." These days, such topics relate much of the time to one particular nation — Japan. More pointedly, politicians, journalists, and some people in business are inclined to blame Japan for the United States' industrial woes. To blame Japan for problems that we may have misses the target. Japan does carry out effective long term development, while our industry focuses on quarterly profits to the detriment of the long term.[30] Even if our country were somehow to succeed in pressuring Japanese industries, efficient producers in other countries would appear. In fact, they already have.

WORKFORCE CONCERNS

The final lesson to be learned from the U. S. Memories attempt has to do with people who work. It was not as if the U. S. Memories discussion took an ill view of American labor, rather, the problem is that the issue never came up. I would like to review some of the

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teammates will win the meet. The phenomenon of equal constraints even operates in some mechanical sports, such as Formula One auto racing, where there are strict limits on the specifications of engines and equipment.

29. That would certainly be the result in a system that simply abolished selective licensing. Elimination of selective licensing leaves a patent holder with three complete options: reserve the invention to its exclusive use, put the invention on the shelf, or license all who wish on reasonable terms. For a discussion of the effects of reluctance to license, *see supra* note 12 and accompanying text.

30. The legislative history of the Cooperative Research Act of 1984 specifically notes the negative effect of the pressure for short term profit. S. Rep. No. 427, 98th Cong., 2d Sess. 2, *reprinted in* 1984 U.S. CODE CONG. & ADMIN. NEWS 3105, 3106.

problems of labor in relation to industries such as computers and semiconductors.

First, there is the problem of unemployment. Without vouching for the accuracy of any particular report, recent news reports from Eastern Europe discuss a phenomenon that is disquieting to people there in the midst of the current changes. Cities such as Cracow and Lodz are reporting unemployment which is moving up into the range of one or two thousand persons. These figures represent unemployment of far less than one percent.[31] The levels of unemployment are much higher in our country. However, no matter what the social statistic of unemployment, the number is absolute for the unemployed individual or family—it is 100%. American workers want good new jobs, such as those available in high technology.

A high technology social policy should take into account the employment needs of the nation and of individual communities. Congress can and should take an active part in encouraging new industries to locate in areas where there are long term job needs. The companies themselves can take labor needs into consideration, too, but in fairness, the policies are national and regional and must be addressed initially by government. To the extent that industries are becoming more and more international or multinational, however, Congress must find effective ways of directing corporations to pay attention to regional employment needs. One example that comes to mind is the displacement of coal miners in West Virginia which will be caused by new clean coal regulations.[32] Policy makers need to pursue placing new industries in that region.[33]

A second concern of labor is proper training. Once in a while you see cars, or more often, trucks displaying a dark blue union bumper sticker, "Honor Labor." The sentiment is a good one. One important way to honor labor is to provide training and education. Unfortunately, skills training classes such as shop are disappearing from many high schools in California. The absence of good training

31. The population of Lodz is around 800,000 and that of Cracow is about 700,000.

32. Clean Air Act Amendments (proposal), *Congressional Quarterly*, Vol. 48, No. 19, May 12, 1990, at 1427.

33. The general needs of the workforce relate to two technological problems, also. Many high tech industries will soon need to be converted from defense orientation to other pursuits. The high tech industries also have a role to play in reducing the environmental damage that they create and in addressing the worldwide necessities of turning industry and consumption in the direction of ecologically sound products. These questions are extremely important, but are beyond the scope of this essay.

injures the economic security and mobility of people who work with their hands.

There is a misplaced reliance on technical or higher education in the United States. That kind of education is very good for part of our population, but it overlooks talents and inclinations of many people. Not everyone is oriented toward analytical, abstract, or bookish tasks. Just as some people are more oriented toward doing things with their hands than doing them with a pencil or a computer keyboard.

High technology is absolutely dependent on skilled physical workers. Sweaty, backbreaking labor is reduced in many phases of high tech industry, but physical jobs remain, and many of those require higher skill and understanding.

The semiconductor industry provides a good example of the need for skilled labor. Manufacturing and testing must be done with very sophisticated machines. The prototypes and production models of these machines must be produced by skilled workers. Production and testing of the chips must be done by skilled and knowledgeable persons. Well trained and responsible workers also reduce machine downtime and increase efficiency in many other ways.

While I have collected no evidence, it would certainly appear that industrial productivity can be raised by better training of workers. The workers benefit directly by a kind of job security that is dependent on learned and transferable skills, and by immediate satisfaction derived from doing work efficiently and well.

CONCLUSION

The U. S. Memories failure triggers some new thinking about high technology policy. One of the areas to be rethought is cooperation.

I find that high tech cooperation is not only possible, but necessary. Industrial cooperation does not undermine competition. In many ways, appropriate cooperative arrangements foster healthy competition. "Healthy competition" in inventions must include service to the public interest. There is even a constitutional dimension to public policy in invention rights. The Constitution specifically mandates that patents and copyrights may be established by Congress to "promote the Progress of Science and useful Arts. . . ."[34] The Supreme Court has determined that the basic the-

34. U.S. CONST. art. I, § 8, cl. 8.

ory of the federal intellectual property laws is to provide a reward in order to encourage inventors to create and "advance [the] public welfare."[35]

Appropriate cooperative arrangements must be coupled with ample rights and means of technology access in favor of all generally qualified producers.[36] Consumers need to have sufficient protection against cartel or market control activities. While the normal functioning of our antitrust laws should provide such protection, lawmakers should be alert to bolster those laws when need be to assure that cooperation remains cooperative rather than predatory.

Finally, the interests and needs of American workers must be taken into account in any national high technology policy. Action in favor of labor should be recognized as central to any solid and poised version of industrial cooperation. If our public interest is to be served, we must survey the needs of our people. Our workers need training and modern work opportunities. Our nation's various regions need to develop in conformity with their environments and local heritages. Industrial products ultimately depend on skilled persons to manufacture, repair, and run the very machines that produce our high tech products.

Cooperation or competition? Let's take both.

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35. Mazer v. Stein, 347 U.S. 201, 219 (1954).
36. *See supra* notes 14 and 20 and accompanying text.