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BERKELEY TECHNOLOGY LAW JOURNAL
University of California, Berkeley, Boalt Hall School of Law

COMMENT

High technology Consortia: A Panacea for America's TECHNOLOGICAL Competitiveness Problems?

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I. Introduction

In the face of increasing competition from abroad and declining innovation at home, the United States is searching for ways to maintain, and in some cases regain, its economic and technological competitiveness. U.S. corporations are trying everything from massive investment in university and industry research ventures to the establishment of programs in which American scientists go abroad to learn the techniques and technologies that make certain foreign products successful. Many believe that consortia are a panacea for America's competitiveness problems.[1]

The term "consortium" has come to connote a cooperative effort among companies, universities, industries, and/or government, typically aimed at helping the participants maintain their leadership position or gain an edge over their international competitors in a particular industry. Consortia are becoming increasingly common in the United States,[2] with the current interest stemming largely from fundamental technological and economic changes occurring within the United States and abroad. For example, modern technology has grown rapidly and has become increasingly complex in recent years.[3] Many of today's products embody technologies from multiple scientific and engineering disciplines.[4] As a result, single companies are discovering the advantages of joining forces with other companies to acquire the expertise or to develop the quality products they need to stay competitive in increasingly multi-

disciplinary industries.[5]

Also, individual national markets are being integrated into a single worldwide market.[6] Significant advances in communication and transportation systems now make it impossible to ignore foreign competitors. Approximately seventy percent of the manufacturing done in the U.S. is subject to foreign competition.[7] It is no longer possible for an American manufacturer to maintain its world market share without improving upon, or at least meeting, any new quality standards that are set by foreign competition. By widening the industrial playing field, the level of competition has escalated.

In light of these technological and economic changes, some observers have charged that American industry is not keeping pace with world competition.[8] In recent history, the U.S. consumer electronics industry, for example, has faced a series of economic retreats as foreign competition has successfully conquered major portions of the market.[9] Similarly, the American automobile industry has slipped significantly. Once, U.S. production of cars dwarfed that of the rest of the world; the United States now stands third in production behind Europe and Japan.[10]

This comment analyzes the current debate surrounding high technology consortia. It is based upon the Symposium on High Technology Consortia (the "Symposium") held at Stanford University on May 4-5, 1990. The Symposium consisted of panels of leading scholars, practicing attorneys, and businessmen[11] who presented their views on consortia. The discussion ranged from the economic and legal implications of cooperative arrangements to the practical realities of joining forces with competitors.[12]

To provide a context in which the current debate surrounding consortia may be understood, Section II examines the evolution of cooperative efforts in the U.S. It begins with a look at the consortia environment prevailing in the 19th century and follows the consortia movement through to the present. Section III analyzes the impact of existing antitrust law on high technology cooperative ventures. In particular, the National Cooperative Research Act of 1984[13] and the incentives it provides for consortia activity are examined. Given the existence of antitrust obstacles, Section IV considers the experiences of past and current consortia participants to see how they have dealt with antitrust issues and other problems facing consortia participants. In particular, Section IV analyzes the Sematech, General Motors-Toyota, U.S. Memories, Microelectronics and Computer Technology (MCC), and Advanced Computing Environment (ACE) joint ventures in the U.S. as well as the Japanese and European consortia experiences abroad. Section V discusses alternative approaches to acquiring and developing technology, including informal alliances, acquisitions, licensing arrangements, and technology transfers from university research projects. Finally, Section VI concludes that although consortia can help promote technological growth, exclusive reliance on consortia as the solution to U.S. technological competitiveness problems will fall short of achieving its goals.

II. Background on Consortia in the United States

In the second half of the 19th century and most of the 20th century, general sentiments of distrust toward collaborative alliances among competitors existed in the U.S. The passage of the Sherman Antitrust Act[14] in 1890 and the Clayton Antitrust Act[15] in 1914 reflect this sentiment. Through these Acts, antitrust laws have protected the rights of individual entrepreneurs and restricted the cooperative activities of large corporations.[16]

The mid-1970's, however, marked the beginning of a significant change in the attitude toward cooperation in the United States. During this period, the U.S. began to realize that it could not take for granted its previously unquestioned technological and economic leadership position in the global market. Powerful competitors in the Far East and in Europe arose to seriously threaten America's previous dominance.[17] America suddenly awoke to the realization that in certain industries, such as the automobile industry,[18] the semiconductor industry,[19] and the consumer electronics industry,[20] it had fallen behind. With the threat of increased competition from abroad, there emerged a belief that cooperation among domestic competitors was necessary to help the U.S. regain its international competitiveness, and that relaxing the enforcement of antitrust laws was essential to encourage such cooperation.

The landmark case of *Continental T.V., Inc. v. GTE Sylvania, Inc.*[21] represented the beginning of the end of strict antitrust enforcement and the start of the movement to help the United States regain its competitiveness through joint ventures.[22] During the Reagan Administration the Antitrust Division at the U.S. Department of Justice, under the direction of Assistant Attorney General William F. Baxter, saw relatively few actions against potential antitrust violators[23] and witnessed many more mergers and acquisitions than before.[24]

The pendulum had fully swung from strict enforcement of antitrust laws and intolerance of cooperative activity from the 1940's through 1970's to minimal enforcement of the antitrust laws and permissiveness with respect to cooperation in the 1980's. Many feel that the time has come for the pendulum to swing back towards stricter enforcement.[25] The current debate concerning the degree to

which antitrust laws should be enforced has taken on added importance to those who believe that cooperation is essential to help the United States catch up and win the high technology race, where the future of the American economy may be at stake.[26]

Presently, proponents of consortia emphasize that in today's world of increased competition from abroad and rapidly changing technologies, cooperation is necessary to remain competitive.[27] They point to the advantages of minimizing the costs of developing new technologies,[28] spreading the risks of research and development,[29] reducing unnecessary duplication of research effort,[30] obtaining immediate access to new technologies, new markets and cheap production sources,[31] and making otherwise formidable research projects possible.[32]

Consortia opponents, on the other hand, contend that overemphasis on consortia as a means of solving U.S. competitiveness problems distracts from the real issues behind America's slipping competitiveness and wastes billions of dollars to no avail.[33] They advocate alternative means of acquiring technology through informal alliances, acquisitions, licensing relations, and university research programs.[34] Opponents believe that the potential antitrust violations,[35] funding problems,[36] and lack of commitment from management and scientists[37] that often accompany consortia make these joint ventures inappropriate vehicles for bolstering U.S. competitiveness.

III. The Effects of Antitrust Law on Consortia

One of the primary considerations facing potential consortia participants is the impact of U.S. antitrust law on the venture. In recent years, as the sentiment towards corporate cooperation has shifted from suspicion to encouragement, antitrust law has drawn heavy criticism. Many believe that antitrust law needlessly inhibits the formation of strategic alliances.[38] Recognizing that uncertainties in the old antitrust law and that the potential for treble damage litigation may have discouraged U.S. firms from participating in cooperative research arrangements, Congress enacted the National Cooperative Research Act of 1984 (NCRA).[39] The NCRA stipulates that "joint research and development ventures" must not be held illegal per se.[40] In addition, the NCRA eliminates the availability of treble damages, provided that the parties to the arrangement first register their venture. While the NCRA heads in the direction of creating an environment conducive to cooperation among competitors, critics of antitrust law still find problems with the Act.

A. Criticisms Of the National Cooperative Research Act

The most serious shortcoming of the NCRA is that it only protects pure research activity and commercial activity "reasonably required" for research.[41] As a result, the NCRA fails to provide protection against antitrust enforcement of valuable joint manufacturing and commercialization efforts.[42] Unfortunately, U.S. competitiveness problems stem more from weaknesses in manufacturing and commercialization than from problems in research.[43] For example, in the electronics industry, the major scientific advances, including the semiconductor chip and the video recorder, were American inventions.[44] Yet the U.S. failed to capture these product markets as a result of its lack of attention to manufacturing and commercialization.[45] In light of these circumstances, the NCRA's protection of research consortia alone seems particularly misplaced.

Another troublesome aspect of the NCRA is the lack of guidance it offers to potential consortia participants. The Committee on Science and Technology in Congress has stated that "very little official guidance exists as to what constitutes a lawfully structured joint [research and development] venture or what conduct will ultimately be considered lawful by the courts."[46] The rule of reason standard as outlined in NCRA states that

> the conduct of any person in making or performing a contract to carry out a joint research and development venture shall not be deemed illegal per se, and that such ventures should instead be judged on the basis of [their] *reasonableness*, taking into account *all relevant factors* affecting competition. . . .[47]

Critics of the NCRA argue that this language is vague and leaves substantial uncertainties concerning the requirements that must be met in order to avoid an antitrust violation. Under the rule of reason standard, "[t]he ultimate question remains of such broad scope and generality that little predictive guidance is possible. The ultimate legal result continues to turn on judicial characterization of a complex factual transaction, a situation that leads to uncertainty and costly proceedings."[48] Even the case law applying the NCRA rule of reason analysis appears to be highly fact-specific and somewhat uncertain.[49] For potential consortia participants, it seems inevitable that this uncertainty will translate into hesitation to enter into joint ventures.[50]

In short, critics of the NCRA advance two major objections to the Act. First, that it protects only cooperative research efforts, excluding manufacturing and commercialization consortia. And second, the rule of reason standard offers only vague guidelines,

thereby discouraging, or at least not encouraging, cooperative ventures.

B. Responses to the Criticisms Of Current Antitrust Law

In defense of the current antitrust law, many observers point out that antitrust laws have often been unjustly blamed for the failures of consortia. Parties reluctant to join a cooperative venture or individuals looking for an easy explanation for the declining competitiveness of U.S. technology industries often point to U.S. antitrust laws as a convenient scapegoat. William F. Baxter, Professor at Stanford Law School, offers the following explanation:

> It's difficult to put together [research and development] consortia. . . . You have to turn over your carefully guarded secrets to someone else. . . . [I]f you are talking about a collaboration between four or five companies who do not have prior relationships, [and] if they are horizontal competitors, . . . there is a great deal of distrust. . . . [E]ach is saying. . . . "I bet [they] don't really turn over the best of their work. . . . So we won't give them the best of ours either."[51]

To avoid revealing this distrust, one company is very likely to say to the other, "[our company would] love to participate [with your company in the consortia effort], but our general counsel tells us the antitrust laws raise too high a risk."[52] Antitrust law can therefore serve as a convenient scapegoat to avoid accusations of mistrust.[53]

In addition, Professor Baxter argues that antitrust law is not as vague or indefinite as its critics claim. The Department of Justice considers several concrete factors in applying the rule of reason standard to potential antitrust violators.[54] First, the Antitrust Division evaluates the concentration of the relevant industry. In order to measure market concentration, one must define the relevant market. The NCRA legislative history states the "relevant market" includes all firms that "have the ability and incentive . . . to undertake [research and development] comparable to that of the joint venture in question."[55] As a rule of thumb, if the Herfindahl Index[56] for each relevant market that is likely to be affected is below 1000, the Justice Department will approve the joint venture. However, as the concentration index gets larger, the chances of antitrust violation increase. In such a case, approval becomes less likely. When the index reaches 1800 to 2000, obtaining approval becomes difficult.[57]

A second concrete factor considered in applying the rule of reason standard is where the cooperative project lies on the spectrum between research and production. The closer the project lies to basic research, the less likely the Justice Department will find an antitrust violation. The risk of collusion among competitors is much less significant when the cooperative project involves scientists doing basic research in laboratories since they are typically removed from the pricing decisions made by the marketing and sales people.[58]

Finally, the effect of the cooperation is also considered in applying the rule of reason standard. Where cooperating parties can achieve significant efficiencies or economies of scale, the Antitrust Division is more inclined to rule in favor of a joint venture since its behavior will be found "reasonable" under the NCRA "rule of reason" standard. For example, in the case of the Sematech semiconductor consortium,[59] fourteen participating companies pooled their resources to build a semiconductor chip fabrication facility costing over $300 million. The efficiencies were significant because the construction costs were spread across fourteen members and the unit cost of operating the facility decreased as the number of users increased.

IV. Case Studies: Sematech, GENERAL MOTORS and Toyota, and other Cooperative Ventures

Since the passage of the NCRA in 1983, over 150 consortia have been formed in the United States.[60] The most notable of these are Sematech, U.S. Memories, and the General Motors-Toyota joint venture. Despite immense amounts of funding,[61] considerable support from participants, government, and the public,[62] all three ventures experienced significant problems.[63] After a rocky start, the Sematech and the G.M.-Toyota ventures appear to have recovered, but U.S. Memories was never able to get off the ground.[64] The trials and tribulations of these and other cooperative ventures, including consortia movement in Japan and in Europe, are examined in this section.

A. The Sematech Experience

1. Background of Sematech

Beginning in 1984, Japanese semiconductor manufacturers began exporting large quantities of semiconductor chips into the United States, sometimes selling the chips at less than cost, thereby flooding the American chip market.[65] Many American companies were unable to compete[66] and consequently dropped out of the market for memory products.[67] In 1986 alone, the U.S. semiconductor

industry lost $1 billion in sales.[68] Japan lost $4 billion in 1986 by selling semiconductors below cost, but they remained in the market.[69] By 1987, Japan had acquired the largest market share of semiconductors in the world.[70] This caused a great deal of concern within the American defense establishment because most military systems rely heavily upon sophisticated electronics. Through a series of trade complaints filed with the U.S. Trade Representative, certain semiconductor trade associations brought their claims of unfair trade practices to the attention of the U.S. government in the hopes of gaining governmental assistance.[71]

The result was Sematech (Semiconductor Manufacturing Technology Initiative), a cooperative effort of fourteen leading American semiconductor companies and the U.S. government.[72] Sematech's goal is to help restore American leadership in semiconductor manufacturing.[73] Since its founding in 1987, Sematech has sought to develop new semiconductor manufacturing techniques, establish stronger relationships between equipment and materials suppliers on the one hand and semiconductor manufacturers on the other hand, and plan long-term strategy for the industry as a whole. The U.S. government provides just under half of Sematech's operating funds in the form of grants, and the participating firms provide the rest.[74] Although Sematech's fourteen members comprise over eighty percent of the total semiconductor manufacturing capacity in the United States, they constitute only a minority of the world market share.[75]

2. factors leading to success

There were several factors unique to the Sematech experience that allowed Sematech to operate more successfully than other ventures.[76] First, many of the industry's leaders, including IBM Corp., National Semiconductor Corp., and Hewlett-Packard Co., participated in the venture. Second, experts who believed semiconductors hold the key to U.S. economic and military strength, supported and helped organize the consortium.[77] Third, national security seemed to be at stake; thus, elements of fear and urgency served as motivating factors.[78] Fourth, the participants had a set of research problems common to all members. Finally, the collaboration was far enough removed from commercialization that firms could cooperate in the laboratory while still being able to compete in the marketplace.[79]

B. The General Motors and Toyota Experience

In 1982, the number one automobile manufacturer in the world combined forces with the number three manufacturer in an effort to produce a new subcompact automobile.[80] The resulting joint venture provides an example of how participants in an alliance can overcome the legal, organizational, and funding obstacles typically confronting a joint venture. In this section, we examine how the unlikely venture between General Motors and Toyota came about, the factors motivating each side to enter into the agreement, some of the difficulties encountered during the negotiations, the results of the negotiations, the degree of success of the joint venture, and caveats about consortia in general.

1. Background Behind the Joint Venture

In January of 1979, 850,000 unsold Japanese cars had accumulated in the United States.[81] When an oil shortage arose in 1979, gasoline prices skyrocketed and the demand for smaller, more fuel-efficient cars followed.[82]

> [From] 1979-1980 the imports of Japanese cars . . . reached twenty-two percent for the nation as a whole and fifty percent for the state of California. The Big Three simply lacked the product offerings in the small car categories to compete. Chrysler was saved from bankruptcy by the federal government. Ford was on the brink, and G.M. had lost money for the first time in six decades. In the spring of 1980, 300,000 auto workers were on lay-off, and the Big Three were forced to shut down a number of plants . . . including the Fremont plant [in northern California].[83]

General Motors had several motives for entering into a joint venture with Toyota. First, G.M. wanted an additional subcompact vehicle at a competitive price. At that time, G.M.'s major entry in the subcompact field was the Chevette, an outdated car for which G.M. was losing $400 on every car sold. A new small car model program would have cost G.M. $2-3 billion, and there was no prospect of a favorable return. Due to productivity management practices and differences in exchange rates and wages, the Japanese version of the same car would have a cost advantage of between $1,550 and $2,200 per car.[84] Second, G.M. felt that a joint venture with Toyota would give it a first-hand look at Toyota's production technology, design technology, efficient management systems, and general methods of operation. G.M. also hoped that a revitalized Fremont, California plant, which was suffering from low productivity and poor quality, would serve as a model for other G.M. plants.

Toyota, on the other hand, was being pressured both by its own government and the U.S. government to invest in the United States. Believing that a manufacturing presence in the U.S. would eventually have to be established, Toyota felt that a joint venture with a leading U.S. company was a good start. Toyota was also concerned that its systems of labor relations, management, and procurement

might not work in the United States. By establishing a joint venture with G.M., Toyota could take advantage of G.M.'s expertise in dealing with American labor suppliers in a regulatory system with which Toyota was not accustomed. Finally, an agreement with G. M. would enable Toyota to increase its U.S. market share since it was constrained by the voluntary restraint agreement[85] on the number of cars it could export from Japan to the United States. Against this background negotiations between G.M. and Toyota began.

2. difficulties encountered in The Negotiations

When the reports of the joint venture negotiations between G.M. and Toyota first reached the press in 1982, the venture was greeted with skepticism, criticism, and above all, a great deal of scrutiny.[86] After all, in 1982 G.M. was the leading industrial company in the world with a forty-five percent market share in the United States. The fact that General Motors was now turning to Toyota to learn how to build cars in the U.S. caused a good deal of controversy when first announced. Chrysler immediately announced its opposition,[87] and Lee Iacocca went on a very public lobbying campaign against the joint venture.[88] Iacocca thought that the venture between G.M. and Toyota was bad for America, and he accused G.M. of selling out to the Japanese at the expense of 300,000 American jobs.[89] As a result of Iacocca's criticism, the Federal Trade Commission immediately opened an investigation that lasted fifteen months.[90]

The presence of the United Automobile Workers also presented serious problems. The Fremont plant was a U.A.W. plant, and Toyota was at one point reluctant to deal with the U.A.W. In response, the U.A.W. threatened that if G.M. and Toyota tried to open the plant without the U.A.W., the workers would boycott and riot. This confrontation between the powerful U.A.W. and G.M.-Toyota had the potential to frustrate the entire joint venture.[91]

In addition to the general skepticism and the problems with the U.A.W., there were antitrust concerns. Toyota and G.M. had over fifty percent of the market share in the United States. Just before the negotiations for the joint venture began, Professor William Baxter, who was at that time in charge of the Antitrust Division of the Justice Department, voiced his concerns regarding the venture's ability to survive antitrust scrutiny. As a result, G.M. and Toyota consulted antitrust counsel and the FTC at every negotiation. This was especially important since product plans and pricing terms needed to be discussed at the negotiations.[92]

Perhaps one of the biggest obstacles faced by G.M. and Toyota was simply the companies' unfamiliarity with one another. The dynamics of the negotiations were such that Toyota and G.M. had virtually no business dealings with one another before the venture, and the negotiators who sat on opposite sides of the table did not even speak the same language. They came from different countries and radically different corporate cultures, and yet they had to wade through this unfamiliarity and negotiate a very complicated deal. Issues such as the division of responsibility, the level of production, the capital structure of the venture, and the allocation of intellectual property rights had to be resolved.[93]

After weeks of negotiations and a few near deadlocks, G.M. and Toyota finally arrived at an agreement acceptable to both parties as well as the U.A.W., the FTC,[94] and the Justice Department.[95] The FTC agreed to a production limit of 250,000 vehicles per year.[96] Toyota was to occupy the chief executive spot and be responsible for the day-to-day management. However, there would also be a cadre of G.M. managers to help with the start-up. With this setup, the G.M. managers could learn the Japanese management practices and eventually grow their own management within the joint venture over a period of a couple of years. Finally, the FTC prohibited G. M. and Toyota from communicating about a host of items that were listed in the agreement. For a period of time, the two parties were required to keep logs of their discussions every time they met. The FTC then audited these records to check for compliance.[97]

3. Has the Venture Been Successful?

With certain caveats, the joint venture between G.M. and Toyota has been a success.[98] It has provided G.M. with a high quality car and has increased productivity at the Fremont plant. It has given G.M. first-hand insights into Toyota's technology and efficient management practices. On Toyota's side, Toyota has gained a manufacturing foothold in the U.S. at half the cost of its Japanese competitors who established their own plants. G.M. has also introduced Toyota to the American suppliers who were most likely to meet the strict quality and cost standards of Toyota. In addition, G.M. has advised Toyota on effective ways to establish good labor relationships with the U.A.W.

While both sides gained a great deal from the venture, they also encountered some problems. The demand for smaller cars declined with gasoline prices in 1984. As a result, G.M. found itself facing a glutted subcompact market and G.M. has not been very successful at selling its subcompact cars. In addition, G.M. found that although the Toyota Corolla and the Geo Prism (one of the cars manufactured at the Fremont plant) are basically the same car, the Toyota Corolla commands a premium of about $1,000 in the marketplace. As Dennis Cuneo has stated,

> Japanese [manufacturers] now have the brand name. You put a Chevy label on a car, and consumers automatically discount it. . . . It's probably the same reason you go into Safeway and . . . pay a dollar more for a six-pack of Coca-Cola as opposed to Safeway Cola. They are probably generically the same chemicals in those bottles, but there are different things that you attribute to the Coca-Cola [for which] you are willing to pay [extra].[99]

4. Caveats Regarding Joint Ventures

It is difficult to make generalizations about whether joint ventures or consortia are beneficial or workable. Much depends upon the motivation and needs of the participants and the competitive situation of the entities involved. As a general rule, as the number of participants increases and the scope of the project broadens, the operation of the joint venture becomes more difficult to maintain.[100] For G.M. and Toyota, the venture was limited to the production of a particular kind and a particular quantity of automobiles.

In addition, commitment and support from upper-level management is important. One of the main reasons for the success of the G.M.-Toyota joint venture was that it had very strong support from upper level management:

> [T]o the chairmen of both companies, Roger Smith and Agi Toyota, this venture was their baby. . . . [T]hey placed very senior people on the negotiating team with direct instructions, "You are to make a deal." The negotiators from both sides did their homework. They tried to anticipate the cultural differences, and they really made some efforts to overcome these differences. The key negotiators, because of instructions from their chairmen, were very highly motivated to make a deal.[101]

Finally, the extent of collaboration within the industry also plays an important role in the likelihood of the alliance's success. It appears that cooperation that does not involve the entire industry is best. For example, the reasonably successful G.M.-Toyota joint venture involved only two of the five major automobile manufacturers. Thus, even though G.M. and Toyota collaborated on the production of an automobile, they still faced stiff competition from Honda, Ford and Chrysler. The consortium might have been less successful for participants and less beneficial for society if the collaboration involved all the major automobile manufacturers.

C. Other Domestic Consortia Experiences

Many domestic cooperative ventures have not been as successful as the Sematech consortium and the G.M.-Toyota joint venture. For example, the set of circumstances that contributed to Sematech's early success were not present in the U.S. Memories venture. U.S. Memories was established to help the United States regain its competitive edge in the global market for dynamic random access memory (DRAM) chips. This $500 million, production-oriented consortium consisted of leading industry players: Advanced Micro Devices, Inc., Digital Equipment Corp., Hewlett-Packard Co., IBM Corp., Intel Corp., LSI Logic Corp., and National Semiconductor Corp. Despite substantial funding and strong industry support, U.S. Memories fell apart due to poor timing in entering the DRAM market. As the consortium was forming, the cost of DRAMs plummeted while the supply grew rapidly.[102] By the time it was ready to bring its chips to the market, it was too late. Mr. Ted Vian of Intel Corporation offered the following explanation: "[With U.S. Memories], we were out of sync . . . with the marketplace as it existed at that time, and as a consequence, [U.S. Memories] was not . . . a viable business entity."[103] The issue of timing is especially important with modern high technology products, which typically have short product life cycles.[104] In such cases, it is imperative for the venture to turn good ideas into marketable products quickly.

The Microelectronics and Computer Technology Corporation (MCC) provides another example of a domestic consortium of questionable success. Founded in 1982 and consisting of fifty-six[105] corporate participants, it was the U.S.'s response to Japan's "Fifth Generation" computing effort.[106] Since its founding, however, it has failed to provide its member companies with significant returns on their investment. While corporate sponsors pay approximately $55 million each year to participate in MCC, MCC has only transferred "rather esoteric technologies"[107] to its member companies. Some attribute MCC's relatively modest success thus far to poor communication between the scientists at the consortium and the member companies sponsoring their work and to unrealistic time horizons for the research projects. Craig Fields, former director of the Defense Advanced Research Projects Agency (DARPA) at the Pentagon and current head of MCC, has urged MCC to set aside its lofty visions of boosting long-term U.S. competitiveness and concentrate instead on more short-term, precise goals.[108]

Finally, the Advanced Computing Environment (ACE) initiative, founded in 1991 by a group of computer manufacturers and software publishers, illustrates yet another strategic alliance that has recently run into difficulties. ACE's objective is to create a broadly supported, standards-based, open computing environment based upon MIPS Computer Systems' RISC-based computing systems.[109] The consortium discovered that a joint venture involving too many players with diverse interests is difficult to manage and operate. ACE is composed of twenty companies, including Compaq Computer Corp., Control Data Corp., Digital Equipment Corp., Microsoft Corp., MIPS Computer Systems, Inc., NEC Corp., Prime Computer, Inc., Pyramid Technology Corp., Tandem Computers, Inc., Wang

Laboratories, Inc., and Zenith Data Systems. Of these twenty companies, some specialize in software development, some in hardware. Some concentrate on UNIX-based systems, some on VMS-based systems, and others on DOS-based systems. As a result, some believe that the consortium's composition of too many members with frequently competing agendas has proven unwieldy.[110] Although it may be too soon to tell, some fear that ACE may ultimately find itself too fractured to succeed in creating a standard computing environment.[111]

The experiences of U.S. Memories, MCC and ACE illustrate that companies should proceed with caution in establishing cooperative ventures. "We should avoid the urge to get caught up in 'consortia-mania' too quickly in the face of some early successes."[112]

D. The Japanese and European Experiences

Because American consortia are relatively recent phenomena, few case studies are available.[113] The Japanese and Europeans, on the other hand, have had considerably more experience with consortia. In the years following World War II, Japan has developed the most cooperative industrial environment of any industrial country.[114] Several European countries have also utilized consortia for new product development.[115]

Japan has hundreds of cooperative ventures that range from private alliances to university-based consortia and from government-sponsored joint projects to international cooperative efforts.[116] The Japanese have formed consortia in areas ranging from computer aided software engineering tools[117] and biotechnology[118] to computer operating systems[119] and software development systems.[120] The government in Japan has taken an active role in supporting consortia in these areas and others to encourage risk-taking, to accelerate innovation, and to create new markets for emerging areas of technology.[121] The government promotes consortia activity through several means: by issuing conditional loans to consortia, which are repaid only if they are successful at developing the particular technology,[122] by providing considerable tax benefits to participating companies of joint ventures, and by relaxing the enforcement of antitrust laws.

Professors Jorde and Teece have described how this myriad of cooperative ventures, involving government and universities, competitors and allies, and public companies and private ones, emerged in Japan:

> With governmental encouragement, and with Japan's Ministry of Trade and Industry (MITI) as a catalyst, the industrial establishment has worked cooperatively to identify promising industrial technologies and avenues for development. This process has not involved MITI "picking winners," but businessmen selecting the most likely candidates for global industrial expansion. Once a consensus emerges among businesses and between business and government, public agencies entice and sometimes cajole firms to engage in cooperative strategies. These tactics often include cooperative research and development associations whose goal is to catch up with, or to improve upon, the existing state of industrial technologies. Once the technology is mastered, Japanese firms will then often invest in it with the object of becoming the world cost leader. At this stage, strong competition will emerge to complement earlier cooperation.[123]

The European consortia experience, while not as extensive as Japan's experience, also offers valuable lessons. European consortia tend to be more narrowly targeted at specific industries.[124] Artificial intelligence,[125] aviation,[126] nuclear power,[127] and telecommunications[128] are a few of the target areas of European cooperative ventures. The most notable consortia include the European Strategic Programme for Research and Development in Information Technology (ESPRIT),[129] Research and Development in Advanced Communications Technologies for Europe (RACE),[130] and the European Research Cooperation Agency (EUREKA).[131]

The Europeans and Japanese have learned through their experiences with cooperative ventures the importance of effective evaluative mechanisms that are built into the game plan of the consortium in order to monitor more easily the consortium's progress. Built-in evaluative mechanisms not only serve to remind the participants of the goals they are striving to achieve, but also to enable the participants and onlookers to monitor the progress of the consortium. Without such hooks, it is difficult for sponsors to know if the consortium is succeeding, and hence whether subsequent rounds of funding should be provided.[132]

In addition, the Japanese and European antitrust treatment of consortia provide an interesting basis of comparison with the treatment in the United States.[133] In Japan, there are "safe harbors," in which the government relaxes the antitrust laws for joint ventures whose participants control less than twenty to twenty-five percent of the market.[134] Typically, consortia participants get an informal advance "clearance" from the Ministry of Trade and Industry to pursue their cooperative work.[135] This is similar to the G.M.-Toyota joint venture's efforts to keep the Department of Justice fully informed of its cooperative activities and to get initial approval of the consortium from the government.[136] In addition, under Japanese law, private antitrust actions are extremely rare, and when they arise, plaintiffs are limited to single damages.[137] In the European Community, joint production ventures are eligible for automatic

exemptions from antitrust laws if the participating firms control less than twenty percent of the market.[138] Ventures that cannot obtain this automatic exemption are eligible for individual exemptions that also provide absolute antitrust immunity.[139]

Thus, as illustrated by the experiences of Sematech, U.S. Memories, and the G.M.-Toyota cooperative ventures in the United States, as well as the European and Japanese consortia experiences abroad, in order to establish a successful consortium, it helps to have (1) participation and support from the industry's leading firms, (2) a common set of goals or problems shared by all participants, (3) an exceptionally strong motivation to succeed, such as protecting national security, (4) well-defined goals that are not too broad and that do not involve too many participants, (5) the support of upper level management, and (6) flexible antitrust laws. In addition, proper timing is essential.[140] These are, of course, only a few of the many factors that may increase the likelihood of a consortium's success. No "laundry list" of factors can adequately describe all the elements necessary for a successful consortium-the mere existence of these principal elements does not guarantee success. These elements must also coalesce in such a way that competitors will work together successfully toward common goals.

V. Alternative Approaches to Consortia for Developing Technologies

Aside from forming a consortium, a firm can choose to acquire or develop new technologies through one of several approaches, including informal alliances, acquisitions, licensing agreements, investments in other companies, and government or corporate-funded university research programs. Each of these approaches is sketched below along with a brief discussion of some of the advantages and disadvantages. The best approach or combination of approaches depends upon the resources of the firm, the nature of the innovation process, the nature of the technology, and the willingness of the firm to assume risk.

Informal alliances are probably the most widely used means of sharing technologies among companies. Every time scientists from different companies get together for lunch or at conferences to discuss their current projects, they are using informal alliances to exchange ideas. This approach to acquiring ideas is desirable when the risks are small because of the low transaction costs involved and the flexibility in structuring the nature of the exchange and the type of know-how. On the other hand, informal alliances become problematic if the stakes become too high. For example, companies that allow their employees to acquire technologies through informal alliances run the risk of losing proprietary or confidential information to competitors. They also run the risk of being accused of misappropriating the proprietary information of their competitors.

In licensing arrangements, one company typically contracts to purchase needed technology from another company. This one-way transfer of technology is a relatively simple way to acquire new technologies with minimal transaction costs. In addition, licensing agreements are advantageous because the purchasing company's risk is limited to the amount of consideration paid. However, the transfer of technological know-how in licensing agreements is limited to the extent to which it can be embodied in a contract.[141]

For a firm seeking to branch out into an entirely new area of technology, acquiring an entire firm that is already an established player in the desired area often is the best approach. To the purchaser, a successful acquisition can provide a trained work force, an established research and development agenda, existing manufacturing plants, and an existing foothold in the marketplace. However, along with these benefits, acquisitions can bring difficulties in managing a new company, integrating different firm cultures, and eliminating duplicative positions that result from the merger.

Government-sponsored university research programs provide another alternative to consortia.[142] The National Science Foundation (NSF) and the Defense Advanced Research Projects Agency (DARPA), both of which provide substantial funding to university engineering and computer science programs,[143] have proven quite successful in the past.[144] Ideas developed through these programs are often transferred to the private sector for further development and commercialization. For example, many of Silicon Valley's successful companies-including Sun Microsystems, MIPS Computer Systems, and Silicon Graphics-are based upon products originally developed from NSF or DARPA research funds at Stanford University.

Corporate-sponsored university research programs have also been successful in developing new technologies. In 1987, corporate expenditures on university research totaled approximately $670 million.[145] Corporate-funded research has the advantage of tailoring the use of local funds to local concerns. For example, much of the corporate-sponsored research at the University of Michigan is aimed at reviving and modernizing the automobile industry in the area. And at Columbia University, business-university joint projects tend to involve the health care industry.[146] Unlike federally-funded research, corporate-sponsored research avoids the political opposition that arises when federal money subsidizes a geographically limited industry. Politicians from the Midwest, for example, often oppose the use of federal funds to build up the semiconductor industry in Silicon Valley, while elected officials from California frequently object to the use of federal funds to support the farming industry in the Midwest or the timber industry in the Northwest.

Companies looking to enter a joint alliance to acquire or develop new technologies should consider carefully the wide range of

alternatives to federally-funded domestic consortia. Corporate-sponsored research programs, informal alliances, cross-licensing agreements, and a myriad of other non-federally funded programs provide unique advantages because they do not carry with them the strings of government control.

The Sematech consortium illustrates how dependence on government funds can influence the direction of a venture. Sematech started out as a private consortium consisting of various firms from the semiconductor industry. After some initial difficulties pulling the consortium together, its members decided to seek government assistance. They made a pitch to the government that the survival of the semiconductor industry was inextricably linked to the maintenance of a strong national defense and therefore necessitated government involvement.[147] "They used the national security basis as a way of galvanizing the industry and galvanizing the interests in order to make it happen."[148] After successfully lobbying the government for help and receiving $100 million in assistance, Sematech was ready to proceed.

Although many of its members may not have realized it at the time, in soliciting the government's help, Sematech may have opened a Pandora's Box. Immediate tensions were created concerning its purpose and direction.[149] The government was not content to participate as merely one of the many member firms. It wanted the consortium to address broader problems that related to the defense needs of the country.[150] Some participants felt that the government was trying to force Sematech to "overspecify, overcommit, and get too much on paper too soon."

> What you had was a cooperation without trust. . . . Sematech looked upon the government as a meddler, and inept in terms of giving guidance to a commercial industry. The government looked upon [Sematech] as a bunch of guys that wanted to go to the cashier's booth at the Pentagon, take $100 million and then run with it.[151]

Sematech and the Department of Defense debated extensively on a number of important issues. First, there was uncertainty as to who owned the consortium's facilities and what would become of them when the cooperative venture ended. The Department of Defense felt that since it was putting up $100 million, it ought to own the facilities. Second, the Department of Defense wanted Sematech to focus on programs to ameliorate foreign dependence on equipment, materials, and components. After all, the Department of Defense was concerned with national security and it felt that such heavy dependence on foreign products was dangerous. Eventually, Sematech changed its original game plan to accommodate the Department of Defense's requests. Finally, the Department of Defense felt it was important to focus more on long-term goals to help the United States regain its competitiveness. This request faced resistance from some of the company participants who felt that such overly ambitious plans would lead to the demise of the consortium. They felt it was more important for Sematech to clearly define a few concrete and reasonable goals as a first step, rather than to try to solve the entirety of American competitiveness problems at once.

As the Sematech experience illustrates, federally-funded domestic consortia may not be the best way to help a struggling industry. With government money comes government control.[152] Unfortunately, the government's defense interests do not always coincide with the civilian participants' commercial interests. In the semiconductor industry, for example, much of the technology has dual applications-both military and civilian. However, the industry participants' objectives of manufacturing high quantities of chips at low costs for commercial applications will seldom coincide with the government's goals of manufacturing a few high-quality chips for military applications, whatever the price.[153] Thus, under certain circumstances, alternative means of acquiring new technologies may provide more satisfactory results.

VI. Conclusion

In today's world of rapid technological change and increased global competition, consortia can provide an attractive means of spurring growth and revitalizing an ailing industry. Collaboration provides a logical way for companies facing common competitors to develop new technologies, enter new markets, and share the costs of high-risk research and development projects more effectively than they could working individually. While problems such as potential antitrust violations exist, they are not insurmountable. The National Cooperation Research Act of 1984 and the National Cooperative Innovation and Commercialization Act of 1989, which seek to provide an environment conducive to collaboration, represent steps in the right direction. But if policy makers rely on consortia as a panacea for solving America's competitiveness problems, they will be disappointed.

Through the course of the Symposium and the research and writing of this Comment, we were struck by the emphasis placed upon consortia as the primary, or even sole means of curing America's competitiveness problems. This focus on research consortia seems particularly misplaced in light of the fact that much of America's competitiveness problems stem from weaknesses in production and commercialization of products, not from inadequacies in research. Exclusive reliance on consortia can lead to the exclusion of other, equally attractive, alternatives, including cross-licensing agreements, informal alliances, acquisitions, and joint industry-university research programs. In searching for a way to promote technological growth in a region, policy makers should examine the particular

characteristics of the industries involved. The nature of the technology, the size of the relevant companies, the resources at local universities, and the makeup of the local economy are all relevant considerations.

There can be no quick or easy way to solve competitiveness problems that have evolved over decades. Simply pumping millions of dollars into consortia activity and gathering together groups of top scientists and managers will not, by itself, restore the United States to a position of preeminence. The problems are more deeply rooted. We must address and find solutions to a wide range of interrelated problems, including the budget deficit, and its effects on the cost of capital, our troubled educational system,[154] our difficulty in achieving effective commercialization,[155] and a myriad of other social and economic problems. If the United States is to regain and sustain its competitiveness in the twenty-first century, it cannot rely exclusively on consortia. It must address these issues alongside the consortia debate.

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The authors would like to thank Professors John H. Barton and William F. Baxter of Stanford Law School as well as Rex O'Neal and Alex Silverman for their assistance in reviewing early drafts of this comment.

1. Evelyn Richards, *Consortia: The New Business Cure-All?*, WASH. POST, May 26, 1989, at D10. *But see* Lawrence Fisher, *Need for High Tech Consortiums Stressed*, N.Y TIMES, Jan. 12, 1989, at D1.

2. *See* JORDAN D. LEWIS, PARTNERSHIP FOR PROFIT: STRUCTURING STRATEGIC ALLIANCES 9 (1990) (between 1979 and 1985 the number of alliances among American, European Community, and Japanese firms grew thirtyfold); *see also Tandy, Matsushita Plan Joint Venture*, SAN JOSE MERCURY NEWS, Sept. 26, 1991, at 2C (Tandy and Matsushita plan joint venture to manufacture laptop computers); Udayan Gupta, *How Big Companies are Joining Forces With Little Ones for Mutual Advantages*, WALL ST. J., Feb. 25, 1991, at B1 (strategic alliances on the rise in the computer, biotechnology and pharmaceutical industries); G. Pascal Zachary, *Sun Microsystems and Hewlett-Packard Plan to Jointly Develop Some Software*, WALL ST. J., Feb. 26, 1991, at B7 (Sun Microsystems and Hewlett-Packard plan to jointly develop object-oriented computer software); Rory J. O'Connor, *Here's the Impact of Apple-IBM Deal*, SAN JOSE MERCURY NEWS, Oct. 3, 1991, at 1E (Apple and IBM announce joint venture to create operating system; IBM and Motorola announce joint venture to develop RISC microprocessor chips).

3. LEWIS, *supra* note 2, at 9.

4. Modern automobiles are perhaps the paradigm example-they often utilize the latest inventions from such wide-ranging disciplines as computer-controlled engines, electronic circuitry, aerodynamics, structural support, and acoustics.

5. "IBM is consciously trying to exploit new ideas and new technologies forever, wherever. The world of science and technology is a great deal larger than we can cover by ourselves. The whole race is being run faster now than it ever was." LEWIS, *supra* note 2, at 15 (quoting John Armstrong, IBM's vice president for science and technology).

6. LEWIS, *supra* note 2, at 11-12.

7. LEWIS, *supra* note 2, at 12-13.

8. MICHAEL L. DERTOUZOS, RICHARD K. LESTER, ROBERT M. SOLOW & THE MIT COMMISSION ON INDUSTRIAL PRODUCTIVITY, MADE IN AMERICA: REGAINING THE PRODUCTIVE EDGE 1 (1989).

9. *Id.* at 12-14.

10. *Id.* at 18-20.

11. Professor John H. Barton of Stanford Law School hosted and moderated the Symposium. Speakers included Claude Barfield of the American Enterprise Institute; William F. Baxter of Stanford Law School; Dennis Cuneo, President for Corporate Planning and Legal Affairs, New United Motors Manufacturers, Inc.; Mark Eaton of Microelectronics and Computer Technology Consortium; Robert Falstad, General Counsel of Sematech; Alphonso Gambardella of Stanford University; Skip Greenfield of Ware and Freidenrich; Erland Heginbotham of the Institute for Defense Analysis; Michael Morris, General Counsel of Sun Microsystems; William A. Maxwell, Vice President of the Computer and Business Electronics Manufacturers' Association; David Mowery of the University of California, Berkeley; Ted Ralston, of the Microelectronics and Computer Technology Consortium; David Teece of the University of California, Berkeley; Ted Vian from Intel Corporation; and Richard Van Atta of the Institute for Defense Analysis.

12. Six panels comprised the Symposium. Panel I examined the economics of cooperation in high technology areas. Panel II focused on the basic legal issues of consortia, including antitrust issues and tax problems. Panel III analyzed the perspectives of firms participating in consortia, including Intel Corporation and Sun Microsystems, Inc. Panel IV examined the experiences of particular consortia and included discussions about the Sematech consortium and the General Motors-Toyota joint venture. Japanese and European consortia were studied in Panel V, and Panel VI concluded with an analysis of alternatives to consortia for developing new technologies. A copy of the Symposium transcript is on files with the authors.

13. 15 U.S.C. § 4302 (1988).

14. 15 U.S.C. §§ 1-7 (1988).

15. 15 U.S.C. §§ 12-27 (1988).

16. *See* Eleanor M. Fox & Lawrence A. Sullivan, *Antitrust-Retrospective and Prospective: Where are We Coming From? Where Are We going?* N.Y.U. L. REV. 936, 954 (1987).

17. DERTOUZOS, *supra* note 8, at 25.

18. In 1955, imported cars constituted less than one percent of car sales in the United States. In 1987, this number increased to more than thirty-one percent. The U.S. now has an automobile import deficit of more than $60 billion. While America was once the top automobile producer in the world, it is now in third place. Among the many explanations for America's loss of dominance in this industry is the inability of U.S. manufacturers to innovate and keep up with modern technology. "The last major innovation that was first installed in an American car was the automatic transmission in the 1940s. Four-wheel steering and four-wheel drive, turbocharging, and antilock braking systems were all first adopted on imported models." *Id.* at 18-19.

19. In less than 10 years, U.S. production of semiconductors has fallen from 60 to 40 percent of the world supply. In the case of dynamic random-access memory (DRAM) chips, foreign manufacturers now possess 75 percent of the world market. *Id.* at 9-11.

20. Radios, televisions, and video recorders are examples of technologies that American companies once dominated which have now been lost to foreign competitors. In 1955, 96 percent of all radios sold in the United States were made in this country, but by 1975 the percentage had dropped to near zero. In the television industry, the sole American company in 1987 was Zenith, with fifteen percent of the market share. *Id*. at 7, 12-13.

21. 433 U.S. 36 (1977).

22. Fox & Sullivan, *supra* note 16, at 944-45.

23. "From 1981 to 1985, the Department [of Justice] brought only two civil and one criminal monopoly cases, compared with eleven civil and three criminal monopoly cases brought from 1976 to 1980. In 1985, the Department brought only two civil restraint-of-trade cases, compared with eighteen in 1976, nineteen in 1977, twenty in 1978, fourteen in 1979, and fifteen in 1980." *Id*. at 947-48 (footnotes omitted).

24. "In 1983, 2523 mergers were consummated, the largest number since 1974. . . . In 1984, there were 2543 mergers, worth $122.2 billion. . . . In 1985, there were 3001 mergers, which set a twelve-year record and represented an eighteen percent increase over

1984. . . . The number of acquisitions consummated in 1986 increased by twelve percent over 1985, to 3356. . . . Nonetheless, between 1981 and 1985 the Department of Justice challenged only twenty-eight mergers." *Id*. at 948 (citation omitted).

25. In 1987, a group of scholars, practicing lawyers, state enforcers, and policy makers led by Ralph Nader and Frederick Furth formed the Antitrust Policy Institute to examine the future role of antitrust laws in the United States. They shared the belief that the federal government had gone too far in its failure to enforce the antitrust laws in the 1980's. Eleanor M. Fox & Robert Pitofsky, *The Antitrust Alternative*, 62 N.Y.U. L. REV. 931, 931 (1987); *see also* Walter F. Mueller, *The Antitrust Movement* in INDUSTRIAL ORGANIZATION, ANTITRUST, AND PUBLIC POLICY 19, 27-38 (J. Craven ed., 1983) (strongly criticizing the school of thought supporting abolition of the antitrust laws).

26. *See* Stephen P. Aubin, *The U.S. Memories Fiasco*, AIR FORCE MAG., Apr. 1990, at 88 (For the semiconductor industry alone, "today's $50 billion international chip industry leverages a $750 billion global electronics market. Some 2.6 million U.S. jobs depend on that market and thus on secure chip supplies."); *see generally* DERTOUZOS, *supra* note 8 (on the importance of high technology industries to the United States economy).

27. Janet J. Barron, *Consortia: High-Tech Co-Ops*, BYTE, June 1990, at 269.

28. William A. Maxwell, Consortia: An Industry Perspective 1 (May 4-5, 1990) (unpublished paper, on file with the authors).

29. *Id.*

30. *Id.*

31. Jonathan B. Levine & John A. Byrne, *Corporate Odd Couples*, BUS. WK., July 21, 1986, at 100.

32. *Id.*

33. *Id.*

34. *See infra* text accompanying notes 141-146.

35. *See infra* text accompanying notes 38-59.

36. *See infra* text accompanying notes 147-153.

37. Levine & Byrne, *supra* note 31, at 100.

38. Thomas M. Jorde & David J. Teece, *Innovation, Cooperation, and Antitrust: Striking the Right Balance*, 4 High Tech. L.J. 1, 3 (1989).

39. S. REP. NO. 98-427, 98th Cong., 2d Sess. 4 (1984), *reprinted in* 1984 U.S.C.C.A.N. 3105, 3107.

40. 15 U.S.C. § 4302 (1988).

41. Jorde & Teece, *supra* note 38, at 52.

42. In 1989, Congressmen Boucher and Campbell introduced a bill before the House which would extend protection from antitrust violation to commercialization and manufacturing joint ventures. The bill proposes the enactment of the "National Cooperative Innovation and Commercialization Act of 1989" (hereinafter NCICA). H. R. 1024, 101st Cong., 1st Sess. (1989). Like the NCRA, the NCICA stipulates that no cooperative arrangement covered by the NCICA shall be deemed illegal per se under the antitrust laws. In addition, the NCICA requires that the parties entering into a cooperative agreement file a written application simultaneously with the Attorney General of the U.S., the Secretary of Commerce, and the Federal Trade Commission. The application must disclose (1) the identities of the parties, (2) the nature and objectives of the arrangement, (3) the current market shares in all relevant markets of all parties, (4) the estimated or predicted market share, (5) the basis for estimation or prediction, (6) the estimated concentration of all

relevant markets, and (7) the anticipated duration of the arrangement. *Id.* § 4(a)(A)-(F).

> While the bill has not yet been adopted by Congress, the NCICA goes a long way toward filling some of the gaps left by the NCRA. However, some questions still remain as to whether adoption of the NCICA will more readily encourage harmful cartel behavior by creating an environment so conducive to cooperation. The farther the parties move from pure research collaborations and the closer they move toward commercialization and marketing, the greater the risk of price fixing and other anticompetitive behaviors. . . . If the joint venture involves scientists getting together to perform pure research, the risk of cartel-like behavior at the sales and marketing level is slight. However, as the joint venture moves from basic research to advanced development, marketing and commercialization, the risk of antitrust violation increases significantly.

Professor William Baxter, Stanford Law School, Lecture (Oct. 15, 1991). Therefore, by creating an environment favorable to manufacturing and commercialization joint ventures, the NCICA runs the risk of fostering price-fixing and other anticompetitive behavior.

43. DERTOUZOS, *supra* note 8, at 9.

44. *Livermore Lab: What's Ahead?*, SAN FRANCISCO CHRON., Sept. 4, 1991, at A18.

45. The statistics are revealing: U.S. firms devote only one-third of their total research and development expenditures to improving their manufacturing processes, while the other two-thirds is allocated to the research and development of new ideas. DERTOUZOS, *supra* note 8, at 72.

46. *Japanese Technological Advances and Possible U.S. Responses Using Research Joint Ventures: Hearings Before the Subcomm. on Investigations and Oversight and the Subcomm. on Science, Research and Technology of the H. R. Comm. on Science and Technology*, 98th Cong., 1st Sess. 23-24 (1983) (statement of John Lacey, Executive Vice President for Technology and Planning, Control Data Corporation).

47. 15 U.S.C. § 4302 (1988) (emphasis added).

48. Jorde & Teece, *supra* note 38, at 40 n.100 (citing J. Bordley, *Joint Ventures and Antitrust Policy*, 95 Harv. L. Rev. 1523, 1536 (1982); *see also* Assam Drug Co. v. Miller Brewing Co., 798 F.2d 311, 315 (8th Cir. 1986) ("The rule of reason . . . is a vacuous standard and as such it provides little concrete direction for evaluating the competitive effects of a challenged restraint.").

49. The decisions in principal cases seem to depend greatly on the particular set of facts involved. *Compare* Chicago Bd. of Trade v. United States, 246 U.S. 231 (1918) (declining to find a grain price fixing practice illegal because it improved market conditions) *with* National Collegiate Athletic Ass'n v. Board of Regents of the Univ. of Okla., 468 U.S. 85 (1984) (the NCAA's restriction of television broadcasts of member institutions was an unreasonable restraint upon the operation of the free market because it raised prices and reduced output).

50. *Japanese Technological Advances and Possible U.S. Responses Using Research Joint Ventures: Hearings Before the Subcomm. on Investigations and Oversight and the Subcomm. on Science, Research and Technology of the H. R. Comm. on Science and Technology*, *supra* note 46 ("Even though research consortia are typically completely lawful, the uncertainties in the interpretation and application of U.S. antitrust laws are a major obstacle to pooling resources in research and development.").

51. William F. Baxter, Address at the Symposium on High Technology Consortia (May 4-5, 1990) (transcript on file with the authors).

52. *Id.*

53. *Id.*

54. *Id.*

55. HOUSE COMM. ON NATIONAL COOPERATIVE RESEARCH ACT OF 1984, H.R. REP. NO. 98-1004, 98th Cong., 1st Sess. 4, 1984 U.S.C.C.A.N. 3105, 3134.

56. The Herfindahl index indicates the degree of concentration or participation in a particular market. For a description of how the Herfindahl Index is computed, see RICHARD A. POSNER & FRANK H. EASTERBOOK, ANTITRUST CASES, ECONOMIC NOTES AND OTHER MATERIALS 462-463 (2d ed. 1981).

57. Baxter, *supra* note 51.

58. *Id.*

59. *See infra* text accompanying notes 65-79.

60. Chris Sivula, *Trying to Cooperate in Order to Compete,* TECH. REV., Feb.-Mar. 1991, at 13.

61. *See* Daniel J. Lyons, *Failing Semiconductor Industry Bodes Poorly for U.S. PC Makers,* PC WK., Feb. 19, 1990, at 127 (U.S. Memories had a $500 million budget); *see also Study Sees Sematech As Success So Far; Report Urges Caution On Consortium Idea,* WASH. POST, May 9, 1989, at B1 (Sematech receives $100 million in government assistance annually in addition to corporate grants).

62. Barron, *supra* note 27, at 269.

63. *Id.*; *see also infra* text accompanying notes 147-53 (concerning Sematech's funding problems).

64. Barron, *supra* note 27, at 269.

65. Although the demand for electronics and computer chips declined in the mid-eighties, Japan continued to export large quantities of chips into the United States and sell them at less than their fair value. This caused the price of semiconductor chips to plummet. For example, the price of EPROM (erasable programmable read only memory) chips fell 75 percent in 1984 and 1985. 256K DRAMs (dynamic random access memory) sold for one-tenth of their 1984 price in 1985, and the price of 64K DRAM chips fell 25 percent in the first three months of 1988 after being constant for approximately a year before the decline. Harry First, *Structural Antitrust Rules and International Competition: the Case of Distressed Industries,* N.Y.U. L. REV., 1054, 1093 (1987).

66. *Id.*

67. In October of 1985, Mostek, a former leading producer of 16K DRAMs, stopped manufacturing 16K DRAMs. Shortly thereafter, National Semiconductor, Intel, and Motorola discontinued their production of 256K DRAMs. National Semiconductor and Intel also discontinued production of 64K DRAMs. *See id.* at 1092 n.178 (citing JAPAN L. LETTER, Nov.-Dec. 1985, at 26-27).

68. *Id.* at 1054.

69. Robert Falstad, Address at the Symposium on High Technology Consortia (May 4-5, 1990)(transcript on file with the authors).

70. DERTOUZOS, *supra* note 8, at 9 (the top three merchant semiconductor manufacturers are NEC, Toshiba, and Hitachi).

71. First, *supra* note 65, at 1094.

> On June 14, 1985, the U.S. Semiconductor Industry Association (SIA) filed a complaint with the U.S. Trade Representative alleging unfair trade practices under section 301 of the Trade Act of 1974. . . . Ten days later, Micron Technology, a U.S. producer specializing in memory chips, filed an antidumping complaint under section 732(a) of the Tariff Act of 1930, alleging that 64K DRAMs were being sold in the U.S. at less than fair value. At the end of September 1985, the Reagan Administration filed an antidumping suit, primarily concentrating on the 256K DRAM chip. . . . At the beginning of October, three U.S. semiconductor firms filed a third antidumping suit, against the eight Japanese EPROM manufacturers.

Id. (footnotes omitted).

72. The fourteen members include: Advanced Micro Devices, AT&T, Digital Equipment Corporation, Harris Corporation, Hewlett-Packard Company, Intel, IBM, LSI Logic, Micro Technology, Motorola, National Semiconductor, NCR, Rockwell International, and

Texas Instruments.

73. *See* Barron, *supra* note 27, at 269. This task has become much more difficult since 1987. There has been a rapid and steady erosion among American suppliers of equipment and materials that are necessary for semiconductor manufacturing. Since 1980, the Japanese have made 162 different investments in various parts of the U.S. electronics industry. Eighty-six of those investments (more than half) are in the areas of semiconductor materials, manufacturing equipment, and semiconductor companies themselves. Falstad, *supra* note 69.

74. Falstad, *supra* note 69.

75. *Id.*

76. *See infra* text accompanying notes 102-04 (for discussion of U.S. Memories-a less successful consortia experience).

77. Falstad, *supra* note 69.

78. DERTOUZOS, *supra* note 8, at 10 ("[The Sematech] effort is being conducted under cover of national defense . . . ."). But the motivating force of the national security interest has drawbacks as well. "What the military often wants in a semiconductor chip (unsurpassed performance under conditions of conflict) is not what civilian industry needs (reliability and low cost)." *Id*. *See also infra* text accompanying notes 147-53 (concerning Sematech's funding difficulties).

79. Ironically, while research-oriented consortia tend to avoid antitrust violations more easily than product-oriented ventures, it is in the production and commercialization of products that the U.S. needs to regain its strength. The U.S. has long been an excellent incubator of ideas; however, past experience indicates that once these ideas are developed in American laboratories, foreign competitors beat the U.S. firms to the market with cheaper and better products. *See supra* text accompanying notes 41-45.

80. *Is What's Good for G.M.-Toyota Good for U.S.?*, 15 NAT'L J. 2696 (Dec. 31, 1983).

81. James Cook, *A Tiger by the Tail*, FORBES, Apr. 13, 1981, at 119.

82. *Id*.

83. Dennis Cuneo, Address at the Symposium on High Technology Consortia (Mar. 4-5, 1990) (Dennis Cuneo is the President of Corporate Planning and Legal Affairs at New United Motors Manufacturers, Inc. (NUMMI) and was a lead negotiator of the G.M.-Toyota joint venture); *see also* Tom O'Halloran, *Congress Will Act If We Don't on Auto Imports*, U.S. NEWS & WORLD REP., Mar. 30, 1981, at 25; Christopher Byron, *How Japan Does It: The World's Toughest Competitor Stirs A U.S. Trade Storm*, TIME, Mar. 30, 1981, at 54; James K. Glassman & John T. Hompe, *The Iacocca Mystique: Would You Buy a New Car From This Man?*, THE NEW REPUBLIC, July 16, 1984, at 20.

84. Jack A. Seamonds, *U.S. Giving Up On Making Small Cars?*, U.S. NEWS & WORLD REP., Dec. 19, 1983, at 56.

85. *See* Clyde H. Farnsworth, *Tokyo's Car Curbs Hailed in U.S., But Japanese Makers Are Angered*, N.Y. TIMES, May 2, 1981, § 1, at 1 (discussing three-year agreement limiting auto exports from Japan to the U.S.).

86. *See FTC's Proposed Consent Order on G.M.-Toyota Joint Venture*, 46 [Jan.-June] Antitrust & Trade Reg. Rep. (BNA) No. 1146, at 42 (Jan. 5, 1984); General Motors Corp. and Toyota Motors Corp., 49 Fed. Reg. 18,289, at 18,293 (1984) (Pertschuk, Comm'r, dissenting); G.M./Toyota Joint Venture, 48 Fed. Reg. 57,246, at 57,257 (1983) (Bailey, Comm'r, dissenting).

87. *Chrysler Launches § 7 Attack on G.M.-Toyota Joint Venture*, 46 [Jan. - June] Antitrust & Trade Reg. Rep. (BNA) No. 1148, at 124 (Jan. 19, 1984).

88. Douglas Williams, *NUMMI: What's all the fuss about?*, 164 AUTOMOTIVE INDUSTRIES 69 (Oct. 1984) ("Iacocca pulled out all the stops and marshalled all of Chrysler's resources to blow NUMMI out of existence. The battle was waged first before the Federal Trade Commission and is now underway in federal court.").

89. Cuneo, *supra* note 83; *see also Chrysler Launches § 7 Attack on G.M.-Toyota Joint Venture,* 46 [Jan.-June] Antitrust & Trade Reg. Rep. (BNA) No. 1148, at 124 (Jan. 19, 1984); *Chemical Makers Eye "Foreign" Cars With U.S. Parts*, CHEMICAL WK., Dec. 5, 1984, at 10 (The G.M.-Toyota joint venture will "hurt American part suppliers and destroy American jobs."); Richard Corrigan, *A Separate Peace,* 16 NAT'L J. 426 (Mar. 3, 1984) ("G.M. and Toyota say the venture will lead to 11,000 new jobs nationally, . . . but Chrysler Corp. chairman Lee A. Iacocca and other critics assert that it will force the rest of the industry into additional tie-ins with foreign companies for cars and parts, leading to job losses of far greater magnitude."); *FTC's Proposed Consent Order on G.M.-Toyota Joint Venture,* 46 [Jan.-June] Antitrust & Trade Reg. Rep. (BNA) No. 1146, at 42 (Jan. 5, 1984).

90. Dennis Cuneo, Address at the Symposium on High Technology Consortia (May 4-5, 1990).

91. *Id.*

92. *Id.*

93. *Id.*

94. *See FTC Accepts Consent Order Restricting G.M.-Toyota Joint Venture to Produce Cars,* 46 [Jan.-June] Antitrust and Trade Reg. Rep. (BNA) No. 1146, at 4 (Jan. 5, 1984).

95. *See Antitrust Division Supports Dismissal of Chrysler's Attack on G.M.-Toyota Venture,* 46 [Jan.-June] Antitrust & Trade Reg. Rep. (BNA) No. 1151, at 227 (Feb. 9, 1984); *see also Antitrust Division Claims Chrysler Lacks Standing to Challenge G.M.-Toyota Venture,* 46 [Jan.-June] Antitrust & Trade Reg. Rep. (BNA) No. 1152, at 265 (Feb. 16, 1984).

96. *Is What's Good for G.M.-Toyota Good for U.S.?*, 15 NAT'L J. 2696 (Dec. 31, 1983).

97. Cuneo, *supra* note 83.

98. *Id.*

99. *Id.*

100. *Id.*

101. *Id.*; *see also* William Maxwell, Address at the Symposium on High Technology Consortia (May 4-5, 1990) ("[I]n order to work, . . . the participants [must] have commitment from the highest level. The CEO or someone at the top level management must recognize and reward their top researchers who go off and do consortia work.") (William Maxwell is the Vice President for International Affairs at Computer Business and Electronics Manufacturers' Association (CBEMA), a computer industry trade association).

102. *See* Aubin, *supra* note 26.

103. Ted Vian, Address at the Symposium on High Technology Consortia (May 4-5, 1990).

104. Maxwell, *supra* note 28, at 1 ("Increasingly short product life cycles mean that return on these huge investments must be realized over only a few years, before the technologies become obsolete.").

105. Evelyn Richards, *Chief Sees New Aim for MCC: Consortium Pushed to be Businesslike,* SAN JOSE MERCURY NEWS, May 5, 1991, at E1.

106. Edward A. Feigenbaum & Pamela McCorduck, THE FIFTH GENERATION 222-24 (1983).

107. Richards, *supra* note 105, at E1 ("MCC hasn't come close to fulfilling early expectations. While MCC officials can produce a list of 150 rather esoteric technologies transferred to member companies, including NCR Corp., Digital Equipment Corp., and Control Data Corp., they concede it is far too lean a return on the $372 million funnelled into MCC to date.").

108. *Id.* ("Fields began the revamping of MCC by restating its purpose. He has set aside lofty visions of boosting long-term competitiveness, a goal he said is far too complex and amorphous. . . . Many MCC scientists and researchers . . . say the new emphasis on setting precise goals and timetables for turning technologies over to companies brings a welcome sense of purpose to their work.").

109. ACE: Advanced Computing Environment (published by MIPS Computer Systems, Inc.) (on file with the authors).

110. John Markoff, *Talking Deals: A Computer Plan Runs Into Trouble,* N.Y. TIMES, Oct. 17, 1991, at C2.

111. *Id.* ("[T]he consortium is likely to find itself ultimately fractured among six incompatible operating systems. The attempt to impose uniformity on a group of companies with very different agendas has failed.")

112. *See* Lawrence Fisher, *Need for High Tech Consortiums Stressed,* N.Y TIMES, Jan. 12, 1989, at D1.

113. *See supra* text accompanying notes 14-26 on the history of consortia in the U.S.

114. *See infra* text accompanying notes 116-23.

115. *See infra* text accompanying notes 124-31.

116. Mark Eaton, Address at the Symposium on High Technology Consortia (May 4-5, 1990).

117. *Id.* (Mitsui CASE (computer aided software engineering) tools, for example).

118. *Id.*

119. *Id.*

120. *Id.*

121. *Id.*

122. Jorde & Teece, *supra* note 38, at 29 (Such loans usually come with a variable interest rate that depends upon the degree of success of the consortium. Professors Jorde and Teece described this form of consortia funding: "In 1983, a new system of public financing was established exclusively to support joint R&D [in Japan]. . . . [F]our-fifths of Japanese government loans are [now] extended to joint projects. . . . [T]he Japanese government subsidy system is disproportionately generous to joint research projects." (quoting R. Samuels, Research Collaboration in Japan (MIT-Japan Science and Technology Program, Working Paper No. 87-02, 1987)).

123. Jorde & Teece, *supra* note 38, at 27.

124. Ted Ralston, Address at the Symposium on High Technology Consortia (Mar. 4-5, 1990).

125. *Id.* (ECRC, the European Computer-Industry Center, is a private consortium consisting of participants from Western Europe that focuses on knowledge-based expert systems research).

126. Jorde & Teece, *supra* note 38, at 31 (discussing the consortia environment in Great Britain).

127. *Id.*

128. *Id.* at 33 (discussing RACE); *see also* Ralston, *supra* note 124.

129. ESPRIT was established to reverse the trend of Europe's increasing reliance on imported technology in the area of information

systems. Formed in 1983 by the European Economic Community and private industry, its focus is on research and development related to advanced microelectronics, data and knowledge processing, and office and factory automation. Jorde & Teece, *supra* note 38, at 33; *see also* Ralston, *supra* note 124.

130. Jorde & Teece, *supra* note 38, at 33; *see also* Ralston, *supra* note 124.

RACE was set up to enable the European Community to gain technological superiority in the area of communication systems. It is made up of roughly 100 separate projects. Eaton, *supra* note 116.

131. Jorde & Teece, *supra* note 38, at 33; *see also* Ralston, *supra* note 124 (describing EUREKA as a consortium of approximately 297 projects doing research in telecommunications, robotics, biotechnology, energy, new materials, and the environment).

132. Ralston, *supra* note 124.

133. *See supra* text accompanying notes 38-59 (concerning the antitrust environment in the United States).

134. *See supra* Maxwell note 28.

135. *Id.*

136. *See supra* text accompanying note 92.

137. Maxwell, *supra* note 28, at 5.

138. *Id.*

139. *Id.*

140. *See supra* text accompanying notes 102-04.

141. David Mowery, Address at the Symposium on High Technology Consortia (Mar. 4-5, 1990).

142. *See* Wayne Biddle, *Corporations on Campus*, SCIENCE, July 24, 1987.

143. DARPA funds approximately seventy percent of all academic computer science research. At some universities DARPA funding is as high as eighty to ninety percent. Interview with Professor Michael Dertouzos, Director of M.I.T.'s Laboratory for Computer Science and co-author of MADE IN AMERICA: REGAINING THE PRODUCTIVE EDGE, *supra* note 8, in Cambridge, Mass. (Feb. 1988). Approximately $10 billion is given to universities throughout the U.S. for basic research each year. Most of this funding is from government sources. Lewis, *supra* note 2, at 194.

144. *See* Michael Dertouzos, *DARPA and U.S. Technological Future*, BULL. OF THE ATOMIC SCIENTISTS, Mar. 1985, at 62 (DARPA research funds are responsible for technologies such as time-sharing computing systems, packet networks, Lisp Machines, artificial intelligence, multiprocessors, and distributed systems. "These activities, along with the microprocessor chip and the personal computer (not funded by DARPA), constitute the bulk, if not all of today's brightest [commercial] prospects in the field of information technology.").

145. *Id.*

146. *Id.*

147. *See* DERTOUZOS, *supra* note 8, at 10.

148. Richard Van Atta, Address at the Symposium on High Technology Consortia (Mar. 4-5, 1990).

149. *Id.*

150. Professor Michael Dertouzos of MIT has explained how defense-motivated government funding affects the research direction of scientists. "Congress looks for research projects that have shorter-term objectives with clear military applications before providing funding." Interview with Michael Dertouzos, *supra* note 143.

151. Van Atta, *supra* note 148.

152. *See* DERTOUZOS, *supra* note 8, at 10.

153. *See id.* at 13.

154. Many believe that our educational system inadequately prepares entrants for our workforce. *See How U.S. leaders view our efforts at competing*, SAN JOSE MERCURY NEWS, Mar. 24, 1991, at E1 ("We must make major improvements in our elementary and secondary education systems if we want to remain the world's leading economy, regardless of what the Japanese or anyone else does. Our education system is one of the great Achilles' heels of the American economy when one looks out over the next two or three decades." (quoting Michael Boskin, former professor of economics at Stanford University and currently chairman of the Council of Economic Advisors)).

155. *See supra* text accompanying notes 41-50.