Appendix F

Research and Development Consortia[1]

The scale of investment required to catch up with Japanese and European HDTV projects naturally leads to the consideration of R&D consortia. U.S. industry (and govemrnent) have traditionally viewed consortia as unnecessary (given a technological lead), inefficient, and possibly illegal (for antitrust reasons). But times change, and there are clear signs that the climate of opinion in the United States is changing. Many consortia have sprung up: industry-university consortia for basic research, like the Semiconductor Research Corp.; private sector consortia aimed at long-term basic research, like the Microelectronics & Computer Technology Corp. (MCC); and consortia aimed at developing manufacturing technology, notably Sematech and the National Center for Manufacturing Sciences (NCMS).

Aside from simple catchup, there are good reasons for this flowering of consortia in the United States. As manufacturing processes become more complex and technology more sophisticated, the cost of R&D is rising rapidly. Consortia offer a way of sharing these costs and risks, which are becoming increasingly difficult to bear. For example, Yasuro Matsukara, general manager of NEC's VLSI division,[2] said that it would have cost his firm five times as much to develop their electron-beam lithography system independently. In contrast, six U.S. semiconductor equipment manufacturers attempted to develop e-beam systems independently in the early 1980s. Only Perkin-Elmer succeeded, with the others eventually writing off losses of more than $100 million and quitting the market.

There are other reasons why consortia may be useful and attractive. They can help to correct the well-known U.S. tendency toward short-term thinking and strategy.[3] They may generate externalities not captured by an individual firm but available either to the economy or the industry-such as a source of competition for foreign monopoly suppliers of high-technology inputs.[4] They can train people in methods and practices not prevalent in their home corporations. They may help to diffuse new technologies, especially where consortia are designed to help companies catch up in areas of technological weakness. Finally, they can help participants create formal and informal ties and alliances which may be critical for international competitiveness and technology development.

Less tangible benefits of consortia may also be important. Some consortia may offer a forum for industry to discuss common problems and a framework for industry to quickly establish technical standards and common equipment interfaces.

Initiating cooperation among otherwise strongly competitive firms can be difficult. Strong firms may hesitate to join, fearing loss of their proprietary technologies with little to gain from weaker firms. In Japan, government support then plays an important role both symbolically and substantively in enabling such collaboration—reassuring strong firms that they will get back at least as much as they give.

Companies similarly fear the loss of their best personnel to a consortium and may consequently send their second-best. Admiral Bobby Inman initially rejected 95 percent of the researchers sent by member companies to the Microelectronics & Computer Technology Corp. (MCC—a private U.S. consortium formed in 1982). Firms are likewise reluctant to share their in-house ideas or technologies. IBM's and AT&T's donations of important leading-edge technologies to Sematech suggest how vital they view its mission.

All these elements may be achievable during the enthusiasm of starting up a new consortium, but maintaining them-especially once the high-level champions in the member firms have moved onto other problems—is a different and more difficult matter still. It is often hard for firms to agree on an R&D agenda or to maintain a long-term perspective. For example, managers are often forced to concentrate on the near-term bottom line within their firm, and therefore may in turn demand quick supporting results from a consortium-though its purpose is longer term R&D. When R&D is successful, it can still be difficult to transfer technologies from the consortium to the member firms, particularly when the firm has not maintained good in-house technical expertise. Finally, even if the member firms are confident that these barriers

[1] Sources for this section include: Mark Eaton, "MITI and the Entrepreneurial State," unpublished monograph, MCC, Austin, TX; Jonah D. Levy and Richard J. Samuels, "Institutions and Innovation: Research Collaboration As Technology Strategy in Japan," and Richard J. Samuels, "Research Collaboration in Japan," MIT-Japan Science and Technology Program; George R. Heaton, Jr., "The Truth About Japan's Cooperative R&D," *NAS Issues in Science and Technology,* fall 1988; "Co-Operating to Compete," *The Economist,* Apr. 5, 1980, pp. 74-75; Charles H. Ferguson, "Technological Development, Strategic Behavior, and Government Policy in Information Technology Industries," Ph.D. Thesis, Massachusetts Institute of Technology, 1988; Lee Smith, "Can Consortiums Defeat Japan?" *Fortune,* June 5, 1989; Sheridan Tatsuno, *The Technopolis Strategy* (New York, NY: Prentice-Hall, 1986); and interviews with personnel at the Semiconductor Research Corp., Research Triangle Pink, NC; the Microelectronics & Computer Technology Corporation (MCC), Austin, TX; and Sematech, Austin, TX.

[2] Japan's semiconductor consortium, '976-790

[3] For a discussion of the reasons behind this tendency, some of the most important of which are found in the U.S. financial environment, See, U.S. Congress, Office of Technology Assessment, *Making Things Better: Competing in Manufacturing,* OTA-ITE-443 (Washington, DC: U.S. Government Printing Office, February 1990).

[4] This was the aim of the U.S. Memories project, which failed in part because it aimed at generating externalities that might have gone uncaptured by the firms themselves.

can be overcome and that the consortium will be successful, in some cases they may have antitrust concerns to deal with.

Consortia pose potential risks as well-of being ineffective and wasting money; of reducing competition; or of hampering creativity. Cooperative long-term R&D also does not address the areas where U.S. firms have had the greatest difficulties—in manufacturing process and incremental product improvement.

Japanese consortia have provided many of these same benefits to member firms, and have suffered many of the same problems of initiating and sustaining cooperation. For example, judging itself to lead in the technology, Hitachi refused to collaborate in a $60 million 8-year MITI sponsored R&D project to develop high-power CO_2 lasers for flexible manufacturing. MITInevertheless helped fund Toshiba and Mitsubishi. Today, all three firms have comparable CO_2 laser technology and the level of interfirm competition has no-doubt accordingly increased. Some Japanese consortia have been abject failures as well. The Japan Software Co. (app. E) is an example.

Japan is famous for its consortia, and justifiably so. One-third of Japanese industrial R&D is collaborative. But these consortia take a form different from those usually used to describe consortia in the United States. Fully 90 percent of collaborations are between two firms only, usually in the same *keiretsu* (industrial grouping). Only 6 percent of Japanese industry R&D is done collaboratively between firms in the same business (i.e., direct competitors). Much of the research done within these consortia is also done on a partitioned rather than a collaborative basis, with the results being shared but the research being done by individual firms in their own labs. Fewerthan 1 in20of Engineering Research Associations—horizontal R&D consortia-have had joint laboratories. Such partitioned efforts have nevertheless been important in reducing duplication and the needed investment by any individual firm: Chapter 2 notes several examples of this for HDTV.

The critical element in the Japanese equation has been the role of MITI, not necessarily for providing the funding for collaborative R&D, but as a facilitator, supporter, and long-range voice. During the Japanese catch-up phase, MITI often negotiated for patent rights on behalf of all Japanese firms, andin many cases demanded patent rights as a condition for a foreign firm to have even a limited presence in the Japanese market. This kept patent licensing fees uniformly low for Japanese firms and provided all interested firms access to the technology—preventing any one from gaining monopoly control. In joint R&D efforts, partitioning research between firms allows the government to assign more difficult portions to stronger fins-effectively holding them back while implicitly aiding weaker firms. With all the participating firms having access to the same basic technologies by such mechanisms, competition is heightened and by necessity also moves downstream into manufacturing process-the area where U.S. firms have most lagged their competitions.

Simple emulation of the Japanese model is not possible or desirable in the U.S. environment. But as the European initiatives for science and technology show, there are many ways in which the positive attributes of the Japanese model can be captured in a different setting. It is likely, therefore, that the right consortia operating under the appropriate conditions can help U.S. industry in some critical sectors-perhaps including HDTV. The trick is to make sure that the circumstances and conditions are right.[5]

[5]A more detailed review of some of these issues can be found in OTA's report, *Making Things Better,* op. cit., footnote 3.