16
DIVERGENT PATTERNS OF BUSINESS ORGANIZATION IN SILICON VALLEY

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This chapter examines the politics of business organization in Silicon Valley. It contrasts two patterns of institution-building among the region's technology firms: one which is externally oriented and seeks to insure the competitive position of the industry's largest producers by influencing federal policy, the other which is integrative and enhances the flexibility of small and medium-sized firms by providing collective services and fostering the innovative recombination of resources.

Externally oriented organizations, such as the Semiconductor Industry Association (SIA) and the American Electronics Association (AEA), are nationally recognized as representatives of Silicon Valley because of their active lobbying in Washington, D.C.Integrative organizations such as the Semiconductor Equipment Manufacturers International (SEMI) and the Software Entrepreneurs Forum (SEF), by contrast, operate at the sectoral and regional level and remain largely outside of the public eye.

These contrasting patterns of business organization reflect the hybrid character of the Silicon Valley economy, an industrial region in which mass production corporations coexist with a dense agglomeration of small and medium-sized specialist producers.[1] While mass production and flexible specialization—and a variety of intermediate forms—have coexisted in the region for decades, each faces distinct problems of reproduction and has generated distinct forms of collective action among local producers.

Associations of business in the US are traditionally studied in their role as pressure groups, yet some of the most active business associations in Silicon Valley today operate at the regional level and engage in little, if any, lobbying. Rather than attempting to shape policy or influence elections, these associations play an essential coordinating role for the specialist producers in a fragmented industry by providing collective services and fostering the exchange of information and technology.

The experience of Silicon Valley highlights some of the political obstacles to the elaboration of such integrative institutions in the American context, obstacles which grow out of the historic hegemony of mass production (and its institutional practices) and the strength of individualistic traditions in this country. The failure of the region's specialist producers to develop a political agenda suggests the vulnerability of the regional economy, and has relevance to other regions with similar flexible, decentralized productive systems (Scott and Storper 1988; Maillat and Lecoq 1990; Piore and Sabel 1984).

The chapter begins with a brief overview of the Silicon Valley economy and the problems of coordination in a decentralized, region-based productive system. It then

analyzes the history and activities of four of Silicon Valley's leading business associations, locating them along a spectrum from externally oriented to integrative. The third section examines the conflicts that have emerged in the region over issues such as trade policy and the Sematech consortia, arguing that externally oriented groups dominate US technology debates. The concluding section suggests that Silicon Valley remains vulnerable because the individualistic world views of its specialist producers limit their ability to develop an alternative political vision and elaborate systematic regional and sectoral coordinating institutions.

SILICON VALLEY: AN INDUSTRIAL HYBRID

While Silicon Valley is famous for large electronics firms such as Hewlett-Packard Co. and Apple Computers, the regional economy is also populated by thousands of small and medium-sized specialist enterprises.[2] Each of these firms focuses on a narrow phase of the production process and relies on the external economies of the region and its dense concentration of skill and technology to introduce new products for diverse and changing markets. This decentralized industrial structure is reproduced through an ongoing process of new firm formation: entrepreneurs continually leave existing firms and recombine local resources in order to pursue new technical and market opportunities.[3]

As they grow, these enterprises develop linkages with customers and suppliers outside of the region, yet most remain embedded in the technical and social infrastructure of the regional economy as well.[4] Silicon Valley's most flexible and specialized semiconductor firms, for example, collaborate closely with local computer systems producers to develop innovative, high value-added products for semicustom and niche markets. The region's flexible mass producers of computer systems producers rely on face-to-face relations with local contract manufacturers in order continually to introduce new products for fast-changing markets. Even the mass producers of semiconductors, which seek to minimize the unit costs of general-purpose products by achieving high-volume production, depend on the dense concentration of skilled labor in the region.

These different productive strategies—and a range of intermediate ones—have coexisted in the region for decades. They are complementary in many ways: producers of specialty computer systems, for example, depend on access to large quantities of low-cost memory chips, while the mass producers of these commodity semiconductors require customized manufacturing equipment. Silicon Valley is thus an industrial hybrid, with a mix of productive strategies ranging from relatively autonomous high-volume producers to highly interdependent flexible, specialized firms.

The patterns of business association which have emerged in Silicon Valley over the past several decades reflect the hybrid nature of the regional economy. Silicon Valley's mass producers of semiconductors, for example, have formed externally oriented trade associations whose primary purpose is to lobby the federal government for favorable trade policy and related legislation. Their suppliers, the specialist producers of semiconductor equipment, by contrast, have created integrative organizations which provide collective services, set standards, sponsor trade shows, and foster networking and information exchange.

Externally oriented organizations like the SIA behave as classic pluralist pressure groups. Their structure and activities are easily accounted for in the literature of American politics, which focuses on the lobbying activities of corporations and their trade associations. Yet some of the most active business organizations in Silicon Valley today engage in little, if any, lobbying. Associations like SEMI, which play an integrative or coordinating role for the firms in a region or sector, have received far less scholarly attention in the US.[5] Historians are only now uncovering the records of America's nineteenth-century industrial districts, and we still know little about their institutional foundations (Scranton 1989).

This focus on business associations as pressure groups reflects the historic dominance of mass production in the US. The central regulatory problem in a system of mass production is to maintain a consistently high level of demand to amortize the costs of heavy fixed investments and to insure stability in the supply and price of inputs (materials, components, and labor) so that production lines remain fully occupied. Such coordination is typically accomplished by the governance structure of the large, vertically integrated corporation and the macroeconomic activities of the federal government.

The key coordinating institutions in a mass production system are thus the large corporation and the nation-state, and associations of business are oriented primarily toward shaping national policy. In the US, where the vertically integrated mass production corporation is widespread, business organizations remain relatively weak (particularly in comparison with their European counterparts) and individual corporations are increasingly important lobbyists and political players in their own right (Yoffie 1984).

The industrial decentralization which characterizes a flexible, region-based system of production, by contrast, requires stabilization at the local level (Scott and Paul 1990). When production is fragmented among a multiplicity of specialist firms, there are many potential sources of market failure. The price system does not convey sufficient information to producers, particularly in an environment of immense complexity and rapid technological change. Moreover, no individual firm can bear the costs of gathering this information. Institutions which provide market information and foster the diffusion of technology are thus essential to preserving the dynamism of the system.

Specialist firms must also rely on external mechanisms to insure the continued availability of resources. The small and medium-sized firms in a regional economy like Silicon Valley have little incentive to invest in long-term training, education, or research and development programs—activities which are traditionally achieved by the hierarchy of the large corporation—because the fluidity of local labor markets and openness of information flows limit their ability to capture the benefits of their investments. Yet the region's dynamism derives precisely from the ability of local entrepreneurs to specialize and to recombine such resources rapidly.

Extra-firm institutions are thus essential to insure not only the availability of market and technical information, but also the reproduction of a skilled labor supply, investment in long-term research, and the continued supply of capital. Some of these services are provided by the private sector in Silicon Valley: by market research firms, technical consultants, venture capitalists, and universities. However other services, such as training and long-term research, require collective action and even the provision of public resources.

A variety of public and private institutions play such a coordinating role in Europe's industrial districts. In Germany's Baden-Württemberg, for example, the trade associations coordinate joint research projects, support industrial research in local universities, and provide a forum for negotiation and conflict resolution among specialist firms (Herrigel 1988). In the Third Italy, local governments and producers' associations support industrial parks, vocational training, regional research centers, and market research. They even finance and run "service centers," which supply information on technology and markets to specialist firms in a particular sector (Brusco and Righi 1989).

This is not to suggest a direct correspondence between technology, institutions, and politics: a variety of different institutional arrangements can meet the needs of mass production and flexible specialization. Nor is it to imply a one-to-one connection between a firm's organization, strategy, or technology and the political stances of its managers and executives.[6] However, the sectors of Silicon Valley's technology industry have organized different associations to address their distinct problems of reproduction—associations which have often defined conflicting political agendas.

PATTERNS OF BUSINESS ORGANIZATION IN SILICON VALLEY

Four Silicon Valley business organizations exemplify the differences—and potential tensions—between the region's externally oriented and integrative associations. The SIA is a classic American trade association. It seeks to define its members' interests as those of the region and the nation in order to gain supportive trade policy and funding. The AEA is an intermediate case. It played an active integrative role in Silicon Valley during the 1960s and 1970s, but followed the lead of the SIA during the 1980s and redirected its resources almost entirely towards lobbying for national industrial policies.

SEMI and the SEF, by contrast, coordinate the activities of the region's small and medium-sized specialist firms. They foster innovation and collaboration by developing a common technical language and standards to allow engineers and firms to work together, by providing collective services such as trade shows, market forecasts, management training, and technical seminars, and through forums which strengthen the social and professional networks in Silicon Valley.

The Semiconductor Industry Association

The Semiconductor Industry Association is the most prominent business organization in Silicon Valley. To many outsiders it embodies the interests of Silicon Valley, if not all of American high technology—even though only 13 of the region's technology firms are members.

The SIA was founded in 1977 by the chief executives of Silicon Valley's four largest semiconductor firms, all friends who had worked together at Fairchild Semiconductor. While the initial aim of the SIA was to provide a voice for the region's new merchant semiconductor firms against established and politically active firms from outside the region (particularly Texas Instruments), it quickly shifted its attention toward the threat of foreign competition.[7] Frustrated with the perceived ineffectiveness of existing

electronics associations such as the broad-based AEA, SIA founders sought a more focused approach.

Executives from SIA companies traveled to Washington regularly during the late 1970s to lobby for favorable government policy and to testify concerning Japanese trade practices and policies which they saw as unfair.[8] These efforts met with little response initially, but the association quickly gained political sophistication. They began positioning the interests of the SIA as those of the nation by linking the health of the semiconductor industry with national competitiveness and security concerns. By the mid-1980s, the SIA had built a powerful political presence in Washington.[9]

With this single-minded focus on lobbying, the SIA behaves more like a traditional American trade association than any other business organization in Silicon Valley. It has clearly had the greatest influence on policy. Within less than a decade from its formation, the SIA had achieved the passage of the landmark bilateral trade agreement with Japan (which reflected virtually all of the SIA demands)[10] and gained a commitment of $500 million in support from the Department of Defense for the collaborative manufacturing consortium, Sematech.[11]

The SIA demands—particularly the trade accord—reflect the agenda of a mass production sector in crisis. Faced with massive losses in commodity semiconductors during the early 1980s due to Japanese competition, the established chip makers sought a political response. The SIA mounted an extensive lobbying campaign and six member firms filed legal actions for trade relief. The resulting trade agreement was designed to shore up demand for the commodity memory products of the SIA's large chip makers.[12] Price floors were designed to eliminate alleged Japanese practices of illegal price cutting, while guarantees of market share in Japan were intended to expand demand for the output of US producers. In short, the agreement sought to stabilize the mass market for US commodity chip producers.

Since that time the SIA policy agenda has included continuous efforts to insure that the conditions of the trade agreement are enforced and to insure extension of (and even increase in) support for Sematech. The SIA experienced its only major failure in 1989 with the folding of the proposed memory chip consortium, U.S.Memories, which it actively supported. The SIA also lobbies on related issues such as antitrust reform, tax policy, and intellectual property rights; and the organization compiles and disseminates semiconductor trade statistics and forecasts.

The SIA's successes are typically explained by its ability to speak efficiently and quickly, without the dissensus of a large organization (Yoffie 1988). The association currently has only 37 members, and is dominated by a smaller group of activist firms. Membership is limited to US-based producers, not surprising given the nature of their concerns—yet there are more than 250 specialist semiconductor producers in the US which do not belong to the SIA. In short, the SIA represents the interests of the established US producers of commodity semiconductors (although it includes a few producers of semicustom chips as well). Nonetheless, the association has succeeded in positioning itself as the voice of Silicon Valley to the outside world.

The American Electronics Association

The AEA is the nation's most broadly based electronics industry association because it has continually expanded to include new sectors as they emerge. It thus represents all companies that design, manufacture, or conduct research in electronics, components, and related information technology products. AEA membership exceeds 3,500 firms nationwide, more than one-third of which are located in California. The AEA is headquartered in Silicon Valley, also the home of the largest of its 21 regional councils.

When the AEA (then the West Coast Electronics Manufacturers Association, WEMA) moved its headquarters to Silicon Valley from Southern California in the early 1960s, it identified itself with the region's fast-growing new technology firms.[13] Unlike the older Electronic Industries of America, which represented established East Coast electronics firms and was based in Washington, the AEA made an explicit commitment to "be where the new companies are" and to build a solid base there before expanding elsewhere. The AEA thus consciously forged an independent identity among Silicon Valley technology companies distinct from the "old-line" electronics businesses of the East. (By 1980, the AEA had greatly surpassed the EIA in membership, with close to 3,000 member firms compared to the EIA's 300.)

The AEA's focus during the 1960s and early 1970s was almost exclusively on fostering the development of the local electronics community by assisting the management of emerging firms, rather than on lobbying on behalf of established corporations.[14] It sponsored seminars to promote the exchange of ideas and information, and management training sessions on subjects ranging from finance and high-tech marketing to production and export assistance. These activities were welcomed by the managers of Silicon Valley firms, who typically had technical rather than managerial backgrounds or training.

The AEA also encouraged the growth of the social and professional networks which bind Silicon Valley firms together by hosting frequent meetings for local CEOs and managers. In the words of a local newspaper:

> Perhaps the AEA's most significant contribution to the electronics industry is what it did to foster networking. Most top executives of young, fast-growing electronics companies are relatively inexperienced in some important management areas. The AEA, with its frequent seminars and monthly meetings of company presidents, provided an excellent opportunity for those executives to meet and learn from their peers.[15]

The article goes on to point out the crucial role the AEA played in integrating the specialized firms in a highly fragmented industrial structure:

> Electronics companies are uniquely systems-oriented. Almost no firm manufactures from the ground up a stand-alone product. A company either draws on other people's components or makes products that fit with other people's products into a system. Friendships made through the AEA help the companies develop products that work together.[16]

This integrative role is confirmed repeatedly in interviews with Silicon Valley managers: one CEO reported that she had found most of her customers through AEA functions, others value the opportunity to stay in touch with old friends and colleagues from prior employers, still others see it as a source of market information, customers, or partners.[17] In fact, when the AEA expanded beyond Silicon Valley, its leaders recognized the importance of these networks. They developed regional councils which replicated the original Silicon Valley structure.

The AEA abstained from national politics throughout most of the 1970s. It did not even open an office in Washington, D.C. until 1980. Moreover, when the association finally hired a Washington lobbyist in 1975, he was relocated to Silicon Valley for five years to gain first-hand understanding of the industry.

The organization's first major policy victory came in 1978, when CEOs of AEA companies traveled to Washington to lobby for a reduction in the capital gains tax. But it was only after 1984, when the US electronics industry recorded its first trade deficit ever, that the AEA increasingly directed its attention toward the federal government. Following the lead of the SIA, and championing the cause of international competitiveness in electronics, the AEA began lobbying for federal policies to reduce the cost of capital, increase investment tax credits, increase funding for R&D, and improve engineering education.

This decision to engage actively in lobbying reflected a decisive shift in the AEA. During the 1980s, funding for education and management training programs was dramatically cut, while the public affairs budget tripled. In 1987, the AEA Public Affairs Office was moved from Silicon Valley to Washington in order to increase the association's presence there. The association now supports three full-time staff members in Washington and four more in its Tokyo office. While its 21 regional councils continue to organize activities for local communities, the central focus of AEA efforts has clearly shifted to lobbying for national policies to improve the competitiveness of the electronics industry.

Despite the potential advantages of its broad membership base, the AEA is often criticized for being ineffectual.[18] It has repeatedly failed to take decisive stands because of the conflicting political agendas of its member firms, particularly the commodity semiconductor firms and the computer makers. The cross-cutting membership, which makes the AEA the sole organization which could represent the shared interests of the technology firms in Silicon Valley, has thus undermined its political strength.

The Semiconductor Equipment and Materials International

The Semiconductor Equipment and Materials International (SEMI) serves the specialist firms in the semiconductor equipment and materials industry, an industry which, even by the standards of Silicon Valley, is highly fragmented and technologically sophisticated.[19] Many of its members produce equipment for only one specific step in the exacting process of semiconductor manufacturing, and many have only one or a handful of products. This specialization means that the top 14 US semiconductor equipment companies account for only 55 percent of total industry sales (Congressional Budget Office 1987).

SEMI thus has a very broad membership base of 1,750 corporate members and it is dominated by small entrepreneurial firms. Two-thirds of its members have fewer than 100 employees and under $10 million in annual sales, and only 5 percent have more than 500 employees or over $50 million in sales (SEMI 1990). And while its membership is concentrated in the US and it is headquartered in Silicon Valley, SEMI is open to foreign members.

SEMI was founded as the Semiconductor Equipment and Materials Institute in 1970 by three Silicon Valley-based semiconductor equipment vendors who were dissatisfied with the minimal attention they were receiving at WESCON, the regional electronics trade show.[20] Thenewly formed organization conducted its first trade show, called SEMICON, in 1971, to promote the products of semiconductor processing equipment, materials, and service firms. Today SEMICON shows are held not only in California but also in several other US regions as well as Europe and Japan. Many of the industry's small equipment ventures depend on the trade shows for their survival. [21]

In addition to conducting trade shows, SEMI sets standards, promotes technical exchange, and provides education programs for firms in the industry. Establishing standards and solving shared technical problems is especially important in a highly fragmented, technically complex, and rapidly evolving industry. In 1973, for example, there were close to 2,000 specifications for silicon wafers in use by scores of US silicon vendors, and the wafers were manufactured in a variety of different shapes. This lack of uniformity created problems of wastage, inventory, and planning for both vendors and customers. Despite skepticism from semiconductor manufacturers, a standards committee defined and publicized specifications for emerging 3—inch wafer lines. By 1975 over 80 percent of all new wafers met SEMI specifications.

SEMI's Standards Committee now oversees the definition of specifications for the materials, equipment, and processes used in semiconductor manufacturing. Standards setting is a strictly voluntary process of defining consensus specifications, and the use of all SEMI standards is voluntary. More than 3,000 engineers from the equipment industry and their customers work on the standards-setting process, which is coordinated by more than 100 international committees, subcommittees, and task forces. According to many engineers, the process of standard setting is at least as important as the standards themselves, because it helps to forge close understandings and working relationships between suppliers and end users and enhances industry cooperation.

SEMI also organizes education programs for its members. Volunteer committees of SEMI members organize symposia, dinner meetings, information seminars, and conferences. For example, technical symposia are held at the SEMICON shows to keep members informed on research and technological advances in the industry. These forums foster technical interchange between customers, academics, capital providers, and SEMI members, and are widely credited with helping diffuse technology and know-how among firms in the industry.

Finally, SEMI's annual three-day Information Services Seminar (ISS) provides market forecasts for the equipment and materials businesses and the overall semiconductor industry. This provides a vital service to small firms because, as SEMI describes it:

> The vast majority of SEMI member companies are very small, with annual sales

> of less than $10 million, making them too small to support any kind of ongoing market research judgments on the condition of our rapidly changing industry.
>
> (SEMI 1990)

SEMI is thus a highly participatory organization, whose operating style is one of small groups of engineers helping each other behind the scenes rather than in the public eye.

SEMI abstained from involvement in public policy throughout the 1970s. In 1984, it initiated a government relations program in order to keep its members informed about federal government activities which directly affected them. However the organization explicitly maintains a low profile in Washington, only lobbying about immediate concerns such as export licensing regulations. SEMI did not support the SIA's trade demands, although when SEMI/Sematech was formed as a chapter of the semiconductor manufacturing consortium, 84 companies joined as individual members (rather than through SEMI at large) in order to qualify as potential recipients of Sematech equipment contracts.

Through its trade shows, standards setting, and education programs, SEMI enables its member firms to remain specialized and survive in a technologically sophisticated and fast-changing industry. By setting standards that build a common framework for competition, organizing trade shows to underwrite the costs of marketing, establishing education programs which spread technical information, and promoting networking and interchange with customers, SEMI preserves the specialization and flexibility which allow its members to innovate.

The Software Entrepreneurs' Forum

The Software Entrepreneurs' Forum (SEF) is an association of over 500 Silicon Valley-based software developers, consultants, and software service providers. The SEF plays a central role in supporting the thousands of entrepreneurial software firms in the region. Explicitly regional in focus, it plays only a minimal role in formal politics. The organization is best seen as an attempt to institutionalize the social networks and the culture of information sharing and collaboration which characterized Silicon Valley during the 1960s and 1970s. In fact, it is reminiscent of Silicon Valley's earlier hackers organizations, such as the Homebrew Computer Club.[22]

The SEF was founded in 1983 by a group of 14 software "hackers" who recognized that more than programming talent was needed to publish and sell software. While they knew how to design and develop a product, they still needed to get the software to the market—which required good documentation, packaging, production, advertising, financing, and legal advice. The founders thus defined the formal mission of the SEF as providing the software entrepreneur with the resources needed to sell products and services. According to one member:

> SEF is a group of entrepreneurs who have learned that by working together to network and build their business and technical skill base they can preserve their fierce independence…and create software on their own terms. [23]

Today the SEF is the largest regionally based organization of its type in the nation, and

has spawned at least five other organizations modeled after it in other states. It sponsors monthly members' dinner meetings, special interest groups, and week-long skills seminars. These forums encourage members to meet with industry leaders, share technical information, develop business skills, establish commercial and social relationships, and learn about new opportunities. The SEF also publishes a monthly newsletter, which keeps members abreast of meeting and seminar highlights and reports on new product releases and other significant news announced by members.

The SEF dinner meetings have become a Silicon Valley institution. They typically feature industry leaders speaking on issues ranging from industry trends and strategies for building a business to up-to-date advice on legal and financial issues. These meetings not only provide information, but also help to create a shared language and culture among the members of a highly fragmented industry. The special interest groups, which are organized around particular functions or operating systems (such as Marketing, Networking, Hypermedia, PC/Windows, and Macintosh), similarly offer an opportunity to obtain technical information and business skills first-hand from prominent professionals in the field.[24]

SEF dinner meetings and seminars are typically well attended and highly participatory. Many local entrepreneurs and start-ups credit their successes to the information and advice gleaned from SEF seminars as well as the relationships developed at these forums. According to the vice president of one software start-up: "I joined SEF because I was impressed by the unusually high level of member participation, which greatly exceeds that of most trade or professional organizations."[25]

The SEF is a non-profit organization run by a board of directors (who meet monthly), a board of advisors (who meet yearly), and a paid executive director. The board of directors supports and develops relationships with other state and national organizations that affect software entrepreneurship. There is a legislative representative and liaison to the Software Services Association (SSA), which maintains a lobbyist to monitor state legislation that affects the software industry. Recently, for example, the SEF undertook a write-in campaign to protest a bill that would penalize software companies which did not display support information at the point of sale.

But such political activity is distinctly secondary to SEF's primary agenda of providing technical, professional and social support for local software developers and entrepreneurs. One successful member says of SEF:

> It's invaluable. For me, its been a place to listen and learn. When you're a small company you can't afford to make mistakes; you have to learn from others. And you can't learn everything from books.[26]

As the SEF continues to grow, it plans to expand its seminar and interest group offerings in order to preserve the sense of community that has been at the core of its success. According to SEF President Stephen Friedman, 'I'd like the next 500 members to feel the same level of community and involvement as we share today."[27] The SEF thus plays a crucial coordinating role through its support for networking and information exchange among the enterprises in a highly competitive and fragmented industry.

Other Silicon Valley business associations

While these four groups are not the only business organizations representing Silicon Valley's technology firms, the other associations in the region all follow a similar pattern. The Computer and Business Equipment Manufacturers Association, for example, is a classic Washington-based trade association which represents established computer firms, while the recently formed Computer Systems Policy Project, a pressure group for eleven of the nation's leading computer firms, was explicitly modeled on the SIA.

The Silicon Valley-based International Disk Equipment Manufacturers Association (IDEMA), by contrast, was modeled on SEMI and provides integrative services for the hundreds of specialist firms which supply materials and equipment to the highly fragmented disk drive industry. Finally, the Santa Clara County Manufacturing Group is an explicitly regionally based association dedicated to preserving the physical infrastructure of the region for technology producers.

THE POLITICS OF BUSINESS ORGANIZATION IN SILICON VALLEY

While mass production and flexible specialization can be complementary forms of production, their coexistence generated a series of political tensions in Silicon Valley during the 1980s. Throughout the 1960s and most of the 1970s, the region's high-technology producers shunned political activity altogether. The fierce independence of these entrepreneurs was reflected in *laissez-faire* attitudes. As they began to lose market share to Japan during the late 1970s, however, the region's commodity chip makers turned to the federal government to address their trade grievances. [28]

The SIA quickly became the only organization in the region with a clear policy agenda, and thus shaped the political debates in Silicon Valley during the 1980s. The AEA increasingly followed the lead of the SIA, focusing on lobbying for national policy to support large technology firms; while the region's integrative organizations, like SEMI, repeatedly rejected SIA initiatives, but failed to define an independent vision—and often rejected politics altogether.

The conflicts among the Silicon Valley business community emerged with passage of the Semiconductor Trade Accord. The agreement, which represented the triumph of the mass production sector in crisis, was intended to insure stable and profitable markets for commodity chip makers by eliminating the price collapses they experienced as a result of recurrent cycles of overproduction.[29] However, it had immediate adverse impacts on other sectors of the regional economy. Computer systems firms, in particular, were directly damaged both by the resulting increases in memory chip prices and subsequent shortages of computer memory (as US producers backed out of the memory chip business). Other local firms which rely on commodity semiconductors—from disk drive makers to contract manufacturers—were similarly hurt.

Not surprisingly, none of the other business associations in the region supported the SIA's trade policy demands. Even the region's specialty chip makers shared the systems firms' view of the trade agreement as a protectionist measure aimed at supporting a

handful of uncompetitive firms. One executive from a local computer company accused the US government of being prepared to sacrifice one industry for another, claiming that "We have twelve companies that benefit from this. We have about 5,000 losers."[30]

The SIA became increasingly isolated from the wider electronics community in Silicon Valley during the 1980s–just at the moment it was gaining widespread attention and national political support.

Trade protection was not the only possible response for the commodity chip makers. They could have learned from the strategies of the region's specialist chip makers, which remained profitable even during the industry's worst downturn in 1984–6 and introduced innovative, higher value-added products and processes; or they could have learned from Japan to interact closely with their suppliers to improve their manufacturing processes. Either strategy would have allowed them to collaborate with—rather than alienate—their customers and suppliers.

Sematech reinforced the antagonisms in Silicon Valley. While Sematech was hailed nationwide as a pathbreaking form of industrial cooperation, the consortium received mixed reviews at home. None of the region's specialist semiconductor firms (the most technologically innovative producers in the nation) joined Sematech, largely because its prohibitive fees exclude all but the largest firms.[31] In fact, only 14 of the 293 semiconductor producers in the US are members. And while a small group of semiconductor equipment firms were belatedly included in the effort under the auspices of SEMI/ Sematech, computer and software firms are still excluded.[32] Even the AEA did not support federal funding for Sematech.

Some critics argue that although the purpose of Sematech, to improve semiconductor manufacturing processes, is laudable, its prohibitive fee structure and narrow membership base are problematic in a highly fragmented industry. They have not, however, mobilized to promote an alternative, more inclusionary model of collaborative research or manufacturing.

Others view Sematech simply as the vehicle for a handful of aging firms with political influence use public resources to shore up their market positions. In the words of the CEO of a local semiconductor firm: "Sematech is a carefully constructed lobby effort" of large producers "to deliberately and systematically exclude smaller companies."[33] These critics articulate the laissez faire view shared by many Silicon Valley entrepreneurs, that government intervention which interferes with the workings of the free market must be avoided.

The debates over trade policy and Sematech clarify the conflicts between the mass producers and the more flexible and specialized firms in Silicon Valley. SIA policies privilege member firms at the expense of customers and suppliers, as well as competitors. They thus mirror the autarchy inherent in their approach to mass production, one in which producers remain at arm's length from both their customers and their suppliers. [34] Moreover, their exclusive emphasis on lobbying for national policy reflects the assumptions of a traditional mass production system, where the key coordinating tasks are performed at the national (or the firm) level.

The integrative policies pursued by organizations like SEMI and the SEF, by contrast, provide coordination at the regional and sectoral level. They support the specialist enterprises in highly fragmented industries by providing technical and market

information and by fostering the recombination of skill and know-how. They implicitly recognize the importance of openness and collaboration to their flexibility, and seek to institutionalize those interdependencies.

Yet while the region's specialist producers regularly oppose the programs of the SIA, they have refrained from playing a broader political role in the region or the nation. SEMI and the SEF thus remain entirely reactive in policy debates. In many cases they do not simply reject SIA politics, but political activity altogether. Rather than defining a coherent alternative strategy (one which reflects their integrative approach), they have adopted the traditional *laissez-faire* view of American business, criticizing all forms of public activity. Silicon Valley's specialist producers thus celebrate entrepreneurship and individual achievement at the same time that their integrative institutions provide the collective services and foster the relationships without which such entrepreneurship would be impossible.

CONCLUSION: THE VULNERABILITY OF SILICON VALLEY

The divergent patterns of business organization in Silicon Valley underscore the vulnerability of the regional economy. The region's externally oriented associations have effectively articulated a political program which serves the needs of the region's large technology producers. They are organized to lobby for industrial policy measures, such as funding for HDTV research or antitrust reform, in the name of national competitiveness.

Silicon Valley's integrative organizations, by contrast, have failed to articulate the importance of the region and its dense networks of small and medium-sized firms to the nation's competitiveness. Viewing their successes as the result of individual effort and entrepreneurship alone, the specialist firms resist efforts to define political strategies which might insure the continued dynamism of the region's decentralized productive system. Perhaps it will take a crisis to mobilize the region's specialist producers into political action—but by then it may be too late.

The industrial fragmentation which accounts for the flexibility and adaptive capacity of the Silicon Valley economy thus represents its greatest weakness. More extensive and explicit coordinating institutions are necessary if decentralized regional economies such as Silicon Valley are to survive in the challenges of intensified international competition.

While the region's integrative institutions play an important role by setting standards, running trade shows, and promoting information sharing and networking, they remain limited. Associations such as SEMI or even the AEA could take the lead in enhancing the regional infrastructure by providing training, education, joint R&D, and by insuring the availability of long-term capital. Insuring that representation cuts across industry lines might also foster recognition of the extent of common interests among the firms in the region.

Over time, such institutions could provide a forum for resolving conflicts between local firms (small and large, firms in different sectors) as well as the capacity to plan and respond systematically to challenges such as external technological shifts. [35] In short, they would provide a region-wide capacity for systematic thinking, debate, and response to shared challenges. Just as mass production and flexible specialization coexist, so

externally oriented and integrative institutions can be complementary. The challenge for Silicon Valley's producers will be to create a political vision which transcends individualism and articulates the importance of the region and its relationships to their technological dynamism.