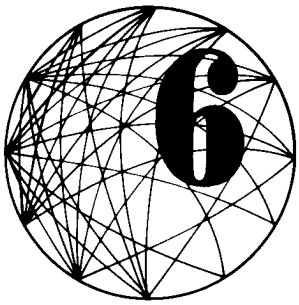

Small Giants: How Grass-Roots Companies Compete with Global Corporations

When we look for new ideas on how to dig ourselves out of the economic pits, we may be gazing in the wrong direction if we fixate only on Japan and the Pacific Rim. Quietly, in such unlikely venues as Denmark and Italy, profitable new economic forces are at work that already have their parallels in the United States.

"Flexible business networks"' is the phrase coined to describe the banding together of small firms to achieve global competitiveness. Here, networking doesn't mean the much-maligned business card exchanges of the 1980s, where people sought contacts for jobs. Rather, it means the creation of jobs as coalitions of small firms develop the economic muscle to do the work of giants. Just as the large firms are forming alliances, so are the small ones.

In 1988, Denmark, with a population comparable to Massachusetts, was the economic mirror image of that state in the early 1990s: high unemployment, mounting trade debt, low corporate investment, and considerable difficulty funding public services.

With its 5 million people in a land mass the size of Massachusetts and New Hampshire, Denmark also faces the onslaught of the new European Community trade bloc, completely changing the rules at the end of 1992.

"Size is the problem," McKinsey & Company, the consulting firm, says in a government-funded report. Denmark's manufacturing companies are too small, too independent, and too diversified to compete in the global market. According to McKinsey, Denmark needs to reorganize and develop a few "industrial locomotives." "Critical mass" in financing, access to new technology, marketing, and management experience will create these multinational companies. To achieve critical mass, McKinsey recommends mergers.

Instead, in 1989, Denmark embarks on what becomes over time a $50 million program to support its small and medium-sized firms by developing flexible business networks. Denmark's plan is inspired by the notable economic success of the industrial networks of northern Italy, a vibrant source of that country's 1980s economic renaissance. In the Emilia-Romagna region, the networking movement began in the 1970s in the then depressed but now flourishing textile industry.

Danish results also come quickly. After only 18 months, "more than 3,500 firms, including many manufacturing companies, are actively involved in networks," according to Niels Christian Nielsen of the Danish Technological Institute. For the first time in its history, Denmark posts a positive trade balance with Germany, the *only* European country that can make such a claim in 1991.2 The "country consensus," according to Nielsen, is that networking "enhanced the competitiveness of small companies." Small business networks get credit as "key players" in achieving the positive trade balance.

Denmark is remarkable. A small country saves its economy by creating networks among its little firms. Can it happen elsewhere?

How a Bolt Maker "Did a Denmark"

It's fine to talk about creating networks when it's a trend sweeping a whole country. But what about the individual company? Can one company do what Denmark did—just because it's the best way to do business?

Erie Bolt Corporation did. Today, the Erie, Pennsylvania, maker of metal parts and components is a healthy company with a bright future—an example for small manufacturing firms in the United States and elsewhere.

It wasn't always so. In 1985, Erie Bolt is close to bankruptcy. Harry Brown arrives from a 15-year career at Bethlehem Steel Corporation to find Erie Bolt losing at least $100,000 annually. "Morale [was] so low you couldn't measure it; quality control had been eliminated to cut costs, the pension fund was underfunded, and payables were overdue."[3] He persuades the board to sell him a majority interest in the company through a leveraged buyout.

"We looked like a mini-GM," he says. The company employed 63 people "with five management layers separating the president from the shop floor." (Federal Express with its 45,000 people has only five layers of management.)

To stop the hemorrhaging, Brown applies standard turnaround tactics: layoffs of about 20 percent, flattening the management structure, and cutting deals with creditors, all of which "bought... some time." Then he goes after the basic question: What business is Erie Bolt in? Erie Bolt is not just a specific "product maker." It is "a company with certain capabilities ... it could forge, heat-treat, machine and perform other metalworking functions," Brown says. Regarding it this way gives "it entry to lots of different and growing markets for precision metal parts." This is the path Brown follows:

? To become a multifunctional shop, workers need cross-training on at least three machines. Brown cuts a deal with the unions, begins training immediately, and watches productivity improve dramatically.

? To be able to specialize even more, he strikes deals with competitors who can make certain parts more cheaply. One such arrangement cuts 28 percent from the cost of producing an electrical motor part.
? To simplify purchasing for customers, Erie Bolt advertises itself as "The One Source for Outsourcing," representing arrangements with numerous vendors, including 12 local artisans.

That's not all. "Brown worked closely with suppliers to improve production processes by sharing information, allowing them to use gauges and instruments (including the firm's CAD—computer aided design—system), and even lending them his engineers," Gregg Lichtenstein, who studied Erie Bolt and many other such flexible businesses, writes.[4] As a result, companies now share:

? A common gauge room;
? A library of manufacturing specifications; and
? A video library on technical subjects.

Within two years, Erie Bolt's sales grow 35 percent and the customer base quadruples to 420. In 1991, sales top $6 million. Eighty-three people now work for the company, an increase of 30 people since the downsizing. All layoffs have been rehired along with some new employees.

What lessons can be learned from Erie Bolt?

Working with other companies, sharing costs, and pooling talents create business, which creates jobs.

"When business is not good firms are willing to try anything. There will always be one or two people who will try to steal an account, but customers come back. They want fair treatment and the benefits a network of firms can provide. People are reluctant to sign forms.

When you keep a network informal, you can do almost anything. Creating relationships is a slow process," Lichtenstein writes.[5]

It's an unusual success, and Erie Bolt is not alone. Although Harry Brown acted without knowledge of the flexible business networks bubbling elsewhere in the United States and Europe, he intuitively used its principles to save his business.

Business Networking in Small Towns and Big

"Networking Comes to America," reads the Spring 1991 headline of the *Entrepreneurial Economy Review*, almost a trade journal for the flexible business network world. Although Europe leads the United States in benefiting from flexible business networks, many small American companies already are involved.

They are found in neighborhoods—like the East New York neighborhood of Brooklyn, with its 450 small manufacturing and warehousing companies. In a single square mile, there are 150 metalworking shops and suppliers, so many, "we could make a car," says Kart Joerger, owner of Woodhaven Telesis Corporation, which does metal stamping.[6] In one industrial park, nearly one-third of 66 companies are metalworkers. Now there's an East Brooklyn Metalworking Industry Network. Its first product is a directory of names, products, and technical resources, step one in building a collaborative network of business relationships.

For all we hear about the very big companies and the success or failure of the economy, it is myriad small companies that produce nearly half of America's industrial output. This is the heart of flexible business networks—micro-industrial centers, engaged in commerce at the grass roots. Little shops employing a few people— like Roberts Printing down the street from us, concentrated in a small industrial enclave in Newton, Massachusetts, that includes the remnants of a once-thriving garment industry.[7]

Across America are pockets of flexible business activity. They are

the core of the bedrock producers. Often, these pockets operate next to each other—90 percent of Boeing Helicopter's small metalworking suppliers are situated in one contiguous area near Philadelphia. Assembled, they are the Metalworking Initiative, designed to bring Total Quality Management practices to the member firms. Boeing now requires this quality capability from its suppliers. Separately, they cannot afford to retrain all their workers in quality methods; together they can.

In just a few years, "at least 50 nascent networks of firms" have appeared, operating in at least 14 states and involving "more than 1,500 small firms," according to the Corporation for Enterprise Development (CFED), the Washington, D.C.-based association of state economic development organizations.[8] This core group, identified by CFED, is unusually successful—and it is evidence of the larger trend among enterprises to join flexible networks. The number takes on gargantuan proportions when you fold in all the informal alliances that businesses create on the fly. One state with innovative activities is in the Midwest:

- In the Appalachians of Ohio, ACEnet, a network of 30 firms across an 11-county area, produces accessible housing retrofit products, aimed at a niche market of the disabled and elderly population.
- In the Southern Ohio Wood Industry Consortium, 22 companies—most of them sawmills—cooperate in training, finance, R&D, and product innovation.
- Twenty Ohio forging companies belong to the Heat Treaters Network, providing process technology and diffusion of new ideas.

One-at-a-time network formation is often a painfully long process. It took two years for the Heat Treaters Network to get off the ground. "Intensely competitive, the small heat treating companies that came to form the Heat Treaters Network chafed at the cooperative bit. [They] would not have participated if there had been any reasonable hope that they could save themselves individually," ex-

plains Dennis Giancola, the marketing consultant who facilitates HTN.[9] Elsewhere:

- In Michigan, 70 machine-tool manufacturers combine forces to pursue vital R&D in basic technologies as the Michigan Manufacturing Technology Association; 21 firms establish the Independent Parts Suppliers as a cooperative for marketing, quality standards, and training; and nine firms—four companies employing between 100 and 350 people and five employing up to 20 people—belong to the Northern Michigan Furniture Manufacturers Network to share training in continuous improvement.
- In Massachusetts, the Metalforming Network, five metalworking firms, each with 50 to 100 employees and annual sales of $2 to $4 million, are jointly developing environmentally sound technology for reducing use of solvents in parts cleaning. Alone, they couldn't afford the R&D costs; together, they can. To undertake the project, they received a $30,000 grant from the Massachusetts Office of Toxic Use Reduction and $10,000 from the Bay State Center for Applied Technology. Each firm's $5,000 investment leverages the whole: $65,000.
- The Oregon Wood Products Competitiveness Corporation encourages secondary wood products businesses to find joint solutions to common problems: exports, product development, marketing, and publicity. State legislation—Oregon passed two bills in its 1991 session that support flexible business networks—set up the agency to assist its 1,200 firms employing 20,000 people to become "the finest, most competitive value-added producer in the world."
- In a rare three-way arrangement involving business, government, and labor, the Garment Industry Development Corporation (GIDC) is a nonprofit service center for New York City's $12 billion apparel industry that directly employs 110,000 workers in 4,500 factories. Besides offering vocational training programs and marketing and technology assistance, in 1992 GIDC initiated Fashion Exports/New York, aimed at expanding the city's apparel exports.

New Ideas in the Old South

BORN IN ATLANTA

At a large March 1988 meeting in Atlanta, Georgia, southern business leaders and public policy makers gather to discuss the health— or lack thereof—of the region's manufacturers. According to the findings of the Southern Technology Council (STC), a regional consortium of states, the South had missed the glory days of the mid-1980s as it struggled to overcome the recession at the beginning of the decade. With many jobs lost, existing plants, with their aging technology and shrinking skilled workforce, couldn't compete. Public economic development policy had been reduced to fierce local competitions for the few new branch plants offered by national firms.

In retrospect, this meeting is a turning point in public sector endorsement of flexible business networks in the United States. A critical mass of the key actors in flexible networks on both the world and national scene convenes at the conference in the hopes of adapting the Italian lessons elsewhere: Italian economists Sebastiano Brusco and Danielle Mazzonis, firsthand witnesses to the revival in northern Italy; MIT professor Charles Sabel, whose 1984 book, *The Second Great Industrial Divide*, written with Michael Piore, focused attention on Italy; and C. Richard Hatch, a major policy adviser to Denmark, among others.

In his address to the meeting, Stuart Rosenfeld, then executive director of STC, offers a compelling case for improving the region's manufacturing base by helping small business:

? Though vital to the region's economy, small and medium-sized firms, who often can't meet standards required by corporate suppliers, are at risk.

? As large firms downsize, they rely more on small suppliers, whose quality and quickness become key factors in overall competitiveness.

? Governments—who do precious little for small firms—cannot possibly help companies on a one-by-one basis.'[0]

Rosenfeld proposes interaction among firms to share the costs and risks associated with innovation and modernization: "flexible manufacturing networks," described as "new forms of interfirm collaboration." The group endorses the idea, setting in motion what would become dozens of pilot programs throughout the South. STC describes seven of its North Carolina pilots in a January 1992 newsletter:

? They span the state geographically.
? They involve diverse technologies: joint development of a production monitoring system, just-in-time manufacturing, vendor quality certification, environmental marketing, and
R&D.
? Companies match the average network grant of $10,000 on a scale from 50 percent to 100 percent."

The STC report also does a roundup of other flexible network activities in the South:

? The Florida High Technology Council wants to duplicate the remarkably successful Technology Coast Manufacturing and Engineering Network in other sectors: pharmaceuticals, laser optics, tool and die, software, environmental firms, and minority defense contractors.
? Alabama—with four target sectors: apparel, electronics, metals, and wood products—sponsors a certified metalworking apprenticeship program through a community college.
? In South Carolina, Enterprise Development, Inc., is "leveraging resources at the University of South Carolina, Spartanburg, the State Technical Education System, the Southeast Manufacturing Technology Center, and the Spartanburg

Chamber of Commerce." It's launching a network challenge grant program with seed money from the Appalachian Regional Commission.

? Kentucky has pilot projects in biotechnology and wood products, including the 20 members of the Kentucky Wood Manufacturers Network who will do joint market development and training.

? Maryland's Office of Technology Development funds six Regional Technology Centers and sponsors a network broker program, the people who facilitate flexible business networks.

? In Virginia, a public-private task force, partly funded through the state's Economic Development Department, plans two pilots, focused on the wood products and furniture industries in Southside, Virginia, and defense contractors in the north. And, of course,

? Arkansas, in this issue reporting on the Arkansas Industrial Network Project, which trains network brokers.

A SYMBOL OF HOPE IN ARKANSAS

Commemorative Wood, Inc., designs, produces, and distributes "A Symbol of Hope"—literally. The five-company firm sells a special product by that name: a solid oak plaque with photo, political highlights, and the signature of native son Bill Clinton, commemorating his election as 42nd president of the United States.

But Commemorative Wood, born just two weeks after the 1992 presidential election, is not just a plaque producer; it is an excellent example of a small, flexible business network that comes together to exploit a particular market opportunity. Alone, none can produce the final product; together, they can. A wood shop in Arkansas's Delta glues together previously discarded scrap pieces of oak to form a blank. Another shop cuts the edges. In central Arkansas, a printer prints the artwork that a manufacturer in the western part of the state applies and finishes. Commemorative Wood in Little Rock is the distributor.

The tie-in to Clinton is not gratuitous. He had been briefed on Emilia-Romagna by Rosenfeld; Richard Hatch; and Mary Houghton, president, and Ron Grzywinski, chair, of the Executive Committee, Shore Bank Corporation in Chicago, the most successful economic development bank in the United States. (Houghton and Grzywinski were already working with Clinton in setting up the Southern Development Bank Corporation in Arkadelphia.) In the late 1980s, as governor, Clinton took time on a trip to Europe to spend two days in northern Italy, and saw Emilia-Romagna's success for himself. He also had a long-standing interest in manufacturing issues, participating in numerous conferences and seminars. In 1987, Rosenfeld, as executive director of the Southern Technology Council, had invited Clinton to be the opening speaker at the Southern Legislative Conference Annual Meeting, which featured manufacturing policy issues.

When Hatch traveled to Magnolia in southwest Arkansas to talk with metalworkers about starting a network, he was joined by John Ahlen, the president of Arkansas's Science and Technology Authority (ASTA).'[2] Clinton asked Ahlen to go on the trip. A grant to the Southern Technology Council from Winthrop Rockefeller Foundation helped ASTA play its public sector role. Between November 1990 and March 1991, ASTA, in conjunction with the Southern Technology Council, sponsored three two-day "Seminars in Manufacturing Networking," training sessions attended by 30 potential network brokers. By early 1992, it had awarded six network challenge grants—the companies put up the other half of the money— in the wood products, metals, and chemical industries.

One cornerstone of Arkansas's flexible business activity is the Metalworking Connection, a joint venture involving 67 companies, with an average of 11 employees each, and three universities located in an 18-county area in a 100-mile radius. Two directors of economic development at Southern Arkansas University, one in Magnolia and one in Henderson, sparked the network, after meeting Rosenfeld and Hatch. "Clayton [Franklin, the other director] and I were going to a meeting in northeast Arkansas. We drove together for a few hours and talked and connived and started hallucinating until we

said, 'Let's do it,' so we did," says Bob Graham, the Magnolia campus economic development executive director.

Among the Metalworking Connection's achievements is a Youth Apprenticeship Training Program (Clinton attended the kick-off dinner) that addresses Arkansas's urgent skills problem. By the year 2000, 83 percent of the state's tool and die makers will be gone. To counter this trend, the program provides high school students with academic credit while they work on the shop floor. The Metalworking Connection also:

? Shares a process capability information system, which profiles exactly what machine and worker capability exists in the state's metalworking industry;
? Has undertaken a group assessment of collective purchase of all insurance with savings estimated at 25 to 30 percent, and already collectively buys health insurance; and
? Has begun implementation of a Just-in-Time Supplier program, linking major buyers in the network.

Clarksville's Gerald Stokes, president of Arkansas Technology, Inc., applies the network idea internally. As part of his new production organization, he includes firms that plug holes in his company capabilities. "This has allowed Stokes to concentrate his firm's effort on what it does best—design, engineering, and marketing, to produce the very best product," writes Rosenfeld.'[3] "The new network of eight firms has renamed itself the Arkansas Technology Manufacturing Network."

In Phillips County, eight companies, including two chemical companies and two food producers, name themselves Delta Safety Network to jointly provide their workers with safety training. In Arkadelphia, Brian Kelley of the Arkansas Enterprise Group is the spark plug for a cooperative network for small forest products firms in south Arkansas, which eventually folds in with the Arkansas Wood Products Trade Group. The Trade Group draws from Arkansas's 700 companies in the secondary wood products industry, employing more than 17,000 people.

Sandra Miller of Winrock International, the foundation that helped get the trade group off the ground through the Arkansas Rural Enterprise Center'[4], was amazed at the results of the group's first survey of its members. "I never would have guessed in a million years that worker's compensation is the number-one issue for the secondary wood products industry in Arkansas," she says. Thirty-eight of the firms have started a task force to assess alternatives, including self-insurance, and evaluate proposed legislative reforms.

In Little Rock, the Woodworkers Manufacturing Network, seven minority-owned firms—design, marketing, engineering, and cabinet building—are in a joint venture to build a high-tech router. CNC (computer numerically controlled) devices are the core high technology for many machine-based industries: they provide precision, which is what high-skilled labor is all about. The goal is to produce the router at a cost in the $30,000-to-$70,000 range, considerably less than the $200,000 turnkey system currently on the market. The technology will provide access to a new market and a new product line: the 32-mm cabinet industry for which the network will supply components. They're even considering selling the router technology itself to other firms like their own.'[5]

The really good news is that Arkansas is not alone in its efforts.

NORTH CAROLINA'S SUCCESSFUL PILOTS

The combination of Rosenfeld's unusual commitment and talent and the economics of North Carolina's industries has produced an unusually rich set of flexible business networks. North Carolina produces 60 percent of U.S. hosiery products, grossing $1.5 billion in annual shipments. Of the state total of 11,000 firms, 82 percent employ 100 or fewer people. More than half of the hosiery firms are based in North Carolina's Catawba Valley. In other words, small companies produce most of the U.S. domestic hosiery output. So the hosiery industry is a logical target industry for one of the pilots Rosenfeld proposes at the 1988 Atlanta meeting.

After a series of disappointing starts, the program begins to

move when some company owners assume leadership roles in the fledgling networks.

Bill Wyatt, a retired apparel firm owner with 35 years' experience, is a good example. He offers to be the North Carolina Sewn Products Network's unpaid broker or coordinator. "I had been involved in networking before by subcontracting with a company that had a series of mills that worked for them," Wyatt recalls. "I saw [that] it ... built business. It took business that one firm couldn't handle, like a big order, [and gave it to] a network that could handle [it]."

In the next five months, the network coalesces. A critical mass of firm leaders, a committed broker, and a clear project all come together. They decide to offer their services through a *Capabilities Directory,* which combines their collective resources for prospective large customers. The directory also facilitates the network's ability to subcontract between one another. The directory is introduced at the September 1991 Bobbin Show in Atlanta, *the* annual industry event.

The Sewn Products Network is not the only one to form out of Rosenfeld's initiative. Randall Williams, president of Advanced Fabrication Technology, Inc., is the spark plug for the North Carolina Precision Metal Fabricators Association (NCPMFA). In a February 1989 presentation, U.S. Amada, a major supplier of equipment to the industry, warns that the region is becoming "technologically unqualified." In response, Williams calls a meeting of sheet metal fabricators and educators to launch the NCPMFA. Its initial objective is joint training. It takes a few months' time, but in November of that year, North Carolina's first state-of-the-art training facility opens, using equipment donated by U.S. Amada. Two years later, a major training center for the sheet metal industry is complete, rivaled by only three other facilities in the United States.

Not all the pilots are successful, however. The Composites Industry Network, a coalition in the eastern North Carolina boat industry, still struggles to crystallize a year after a November 1990 symposium introduced 77 firms to the idea. The Component Manufacturers Network, another group, seems destined to succeed when

it begins with what looks like an ideal set of initial conditions, but eventually founders when members are unable to agree upon a clear business need.

AN ASSOCIATION BECOMES A NETWORK

Perhaps the most successful pilot is the Catawba Valley Hosiery Association (CVHA), a 30-year-old trade association that transforms itself into a flexible manufacturing network. By creating a network within a network, it marries high-tech competitive-edge technology with its low-tech industry.

Although the CVHA as a whole is big—it has 275 members, including 115 hosiery mills and 160 industry suppliers—each member is quite small. "The typical CVHA mill is small, has no industrial engineer on staff, and is often unable to afford in-plant training."[6] This makes the network ripe for its first initiative: an industrial engineering and employee training assistance center. Since this word-of-mouth industry documents very little, in-plant training curricula become a high priority. Next, the network tackles costs: reducing telephone and health care costs through pooled buying. In another counter-intuitive but cost-effective move, CVHA chooses a self-funded plan, managed by a third party, which yields the members 30 to 40 percent savings on health insurance.

The third initiative is the most daring—and the most potentially lucrative. It solves the "10-day delivery problem," which most U.S. hosiery customers now demand of their suppliers. The supplier no longer controls the supply; the customer does by refusing to warehouse inventory, and by insisting on buying virtually on demand. To even process orders requires EDI, meaning that people can submit their orders electronically and that order status is trackable at all times.

The 1950s and 1960s machinery used in these North Carolina firms indicates the depth of the problem. Machines now worth $1,200 to $1,500 have to compete with $35,000-to-$40,000 state-of-the-art models. These Italian and Japanese engineering marvels

are worth it: they triple production and reduce pattern change time from hours to minutes. The promise of quick response opens up new possibilities for manufacturing capacity sharing. This leads to TEEMS, software produced by a flexible business network within the CVHA network.

A TEAMNET IN A TEAMNET

TEEMS (Textile Efficiency Engineering Monitoring Software) is a "production monitoring system which can be installed in hosiery mills utilizing old and/or state-of-the-art hosiery knitting machines." It "allow[s] the introduction of state-of-the-art technology in hosiery mills one step at a time." With a target price of $6,000, the software will be much more in the range of CVHA members than the currently available $30,000 products.

TEEMS is a joint venture of Digital Eyes Company, a systems integration firm, CVHA, and STC. Digital Eyes president Stephen Cowan is the spark plug. He convinces CVHA and STC of the value of his idea when they realize that the technology can benefit all knitting firms—large and small. Cowan works closely with Dan St. Louis, the CVHA staff member who developed the in-plant training curricula, and with CVH A's 24-member Knitting Technology Committee. Together, they design, develop, manufacture, install, and market TEEM 5?17

"Steve Cowan. . . realized he did not have the capability to complete the TEEMS project for CVHA on his own," write William Meade and Ray Daffner.'[8] "He lacked the programming expertise required to develop the full range of software and the electrical engineering skills to develop the data collection devices. . . . [So he] decided to use a network to create TEEMS, identifying firms with unique and complementary skills. These partners required minimal initial investment to participate."

Computer Strategies, a local four-person software engineering firm, develops the TEEMS software platform in exchange for future revenues. For a small retainer, Eridani, a local two-person electrical

engineering firm specializing in design, puts together a proprietary data collection product. It keeps the exclusive manufacturing rights in exchange for Digital Eyes having the exclusive marketing rights. As a result, an estimated $100,000 software development project requires just $40,000 in actual cash. And it is quick. It takes just a year from the product concept to the first installation. The target price is more than met: CVHA members can license the program for $1,000; nonmembers can license it for $2,500. First-year revenues are estimated at $500,000, quite a healthy return on the investment. According to CVHA members, most mills will initially install TEEMS on 20 to 30 machines, gradually moving it to all their machines.

The next project is to set up the Manufacturers' Bulletin Board, proposed by Paul Fogleman, CVHA's executive director: "It is not unusual for a large hosiery mill operator to walk into the plant on Monday morning and find a message from a major retail customer inquiring about the ability to complete a potential order of 50,000 dozen socks within 10 days.... The system we propose will enable a greige goods mill [the first in the value chain which knits product from raw yarn] to notify all CVHA members. . to determine their available production capacity. . and offer it."

AN ENCYCLOPEDIA OF **FLEXIBLE NETWORKS— IN HYPERTEXT**

Northwest Policy Center publishes as close to an encyclopedia of basic information about U.S. manufacturing networks as we've seen: it's upbeat, informative, and thought-provoking, and it's available only in hypertext!'[9] It includes a directory of the key players in the flexible manufacturing network world and such wisdom as this:

> ? The competitive *disadvantages* of small firms "provide the most powerful rationale" for flexible networks. When you're small, you have no time to think about new markets and product development; limited access to new technology; and low productivity.

- ?The "three sine qua nons" of networks: (1) network brokers, the spark plugs who guide the networks into existence; (2) "challenge grants," small amounts (usually $10,000) of public sector money that companies match; and (3) a "goal definition process" by which the companies in the network commit to a mutually beneficial purpose.
- ?The private sector, not government, drives these networks, which ultimately limits public sector involvement.
- ?Not every country's experience with networks has been an unqualified success. The Australian clothing industry, with its labor-intensive history of small firms serving as subcontractors, raises serious questions about "severe exploitation of the home-based workforce."

The 1992 *Catalog of U.S. Manufacturing Networks,*[20] compiled by Gregg Lichtenstein and published by the National Institute of Standards and Technology (NIST), is an excellent, thorough source of examples. These models are changing the face of America's small businesses. What makes them work?

Five Principles of Flexible Business Networks

Flexible business networks combine *independence* with *interdependence*. They pool resources and capabilities to obtain the benefits of scale and diversity. By cooperating, small firms can play effectively in the global market. Their flexibility and swift responsiveness to change provide a global competitive advantage. Network flexibility comes from many small entrepreneurs able to make quick decisions and to act immediately to accommodate change. These benefits apply not only to manufacturing networks, but also to business networks of all descriptions, whether product-based or service-oriented.

In *Flexible Manufacturing Networks: Cooperation for Competi-*

tiveness in a Global Economy, a prescient 1988 pamphlet, Richard Hatch describes the phenomenon this way:

> A flexible manufacturing network is a group of firms that cooperate in order to compete—that collaborates to achieve together what each cannot alone.[2]'

Every flexible business network definition we've seen contains the cooperation/competition duality in some form. 'A network is the cooperation and the mechanisms of cooperation that allow a small company to compete successfully with the best of the large," Denmark's legislation reads.

1. UNITED BY THE COMPETITIVE PURPOSE

Flexible business networks must have a clear, common purpose that all participants ascribe to, the first critical success factor. "Joint solutions to common problems" is a popular slogan in the movement, and an apt one for this critical catalytic element of teamnets: purpose. Regardless of the specific reasons why competitors cooperate for common benefit, which vary as widely as the types of business, *some* particular purpose represents the core of every network.

Broadly speaking, business networks tend to organize either vertically or horizontally. Vertical networks integrate the parts of a process, product, or product line, like ACEnet. Horizontal networks gain benefits of scale and flexibility, such as the Metalworking Initiative. Networks-of-a-kind are especially common among smaller businesses, while larger firms typically look for product and process complements.

Networks may satisfy more than one business need. The most common purposes for networks are:

?Joint marketing;
?Industry-specific training programs;
?Technology transfer;

? Sharing expensive equipment; and
? Bulk buying.

The chart provides a more detailed list of reasons why business networks come together.

Business Reasons to Network

Marketing	? Co-marketing/pool selling
	? Market research
	? Common needs assessment
	? Common brand
	? Export services/international offices
Training	? Specialized and expert trade skills
	? Basic trade/professional skills
	? General skills
Resources	Purchasing/pool buying
	? Common stock/warehouse
	? Vendor coordination
	? Specialized equipment
	? Professional services
R&D	? Joint product/service development
	? Joint process development
	? Shared research and innovation
	? Technology transfer and diffusion
Quality	. Joint quality program
	? Benchmarking
	? Shared internal standards
	? International standards certification

2. INDEPENDENT SOVEREIGN COMPANIES

Network members must be independent, the second critical success factor. Networks thrive in the challenging dynamic of co-opetition. The basic units of networks are independently incorporated firms, whether small craft shops in Italy or woodworkers who partner to

build a state-of-the-art spray painting facility in Bemidji, Minnesota.

"Networking is *not* about giving up independence. The small company in a network is still an independent sovereign company," says Nielsen emphatically.[22] Small businesses, wherever they are, highly value independence. This is a source of great strength in networks, and is also, of course, a source of great weakness. When there are not strong countervailing cooperative forces, competition can split networks apart.

Enterprises are classic components of networks: they have a life separate and apart from the network. They are self-reliant. Like a PC, when the network goes down, local work still gets done. However, independence is only part of what leads people to see a network. When "independents" link "interdependently," they generate a viable flexible form.

3. LINKING SOVEREIGNS

Networks must have many channels of communications and rich relationships among members, the third critical success factor. While purpose motivates, connections between members put the network into motion on a day-to-day basis.

Many people associate "networking" only with people-to-people connections. A rich set of personal interconnections is a sine qua non of successful business networks. In the computer world, "networking" means the physical methods of electronically connecting distributed places of work. This underscores an important attribute of networks: the existence of real channels of communication between members. In networks, communication is essential, and time-consuming. Technology connections are critical, whether low or high tech. (Even a telephone tree is a technology strategy, albeit a low-tech one today.) Facilitating effective and efficient interaction is of critical practical importance.

Biological metaphors suit networks well, even better than mechanical ones. Networks naturally start small and grow over time.

They grow through communications, diverse interactions around common concerns, and the deepening of relationships, person to person and firm to firm. Different people and different cultures communicate differently. Yet, all communicate. Information, like oxygen, is in the lifeblood of every network, coursing between its members.

4. MULTIPLE LEADERS, PRIVATE AND PUBLIC

Networks must have more than one leader, the fourth critical success factor. By its nature, a flexible manufacturing network has many leaders. First, there are the business people who represent the firm members, individuals who sit at the top of their own firm's totem pole, whatever its size. Then, there are the network brokers, technical consultants, government agency representatives, and retired industry leaders who help a network through some of its growth pains to self-motivating cooperation.

Private sector leadership is critical to network success, according to people who have successfully catalyzed networks as well as those who have failed. Without direct business leadership, networking programs, whether publicly or privately stimulated, always fail. Yet, without some outside support, it is often difficult for a private group to establish the requisite common ground that leads to a viable network. So, besides multiple individual business leaders in a network, networks also often involve brokers, consultants, and other public, nonprofit, and educational leaders.

5. PLUGGING IN AT MANY LEVELS

Successful networks must hook in at a variety of levels within the larger economic system. In flexible manufacturing networks, the fundamental commandment is to respect the integrity of every member firm. At the next level, the network as a whole must func-

tion as a coherent system. Finally, at the level of many networks functioning in a region, the whole set of networks becomes an economic strategy. Large-scale dynamics can help networks flourish or leave them to wither and die. Systemic integration across levels depends upon respect for the systems involved.

We remember vividly the excitement of Jean-Pierre Pellegrin, the French economic development official who came to the John F Kennedy School of Government at Harvard for a few months to study American manufacturing networks. He sat in our Networking Institute office in the fall of 1991, marveling at the wider world of networks beyond the boundaries of flexible manufacturing networks that we have been researching and reporting on since the late 1970s. We, in turn, have him to thank for deepening our knowledge of the international flexible manufacturing network community, which we see as the most dramatic business networking development of the last decade.

Watching a Paradigm Shift

In the broad view, the flexible manufacturing movement is a spontaneous development in the world economy. It exemplifies the larger trend to networks at all levels. We catch a rare detailed view of just how a new paradigm emerges as we trace the multilevel threads of the story.

It begins in Emilia-Romagna in the 1970s. Inspired by the Italian success, Denmark in the late 1980s designs a plan to catalyze "spontaneous" networking. Denmark's success in adapting the Italian model in turn leads to adoption of the idea in other parts of Europe and the United States.

In 1984, MIT economist Michael Piore collaborates with political scientist Charles Sabel to produce *The Second Industrial Divide*, where they provide an economic context for the phenomenon and coin a new term:

"Flexible specialization"—the emergence of loosely connected small economic units in the emerging wave of economic activity.

C. Richard Hatch is a catalytic node in the flexible manufacturing network world. Because of his love of race car driving, Hatch, director of the Manufacturing Network Project at New Jersey Institute of Technology, happens to be living in Italy when the "Third Italy" begins to bloom. Also a motorcycle enthusiast, Hatch runs a specialized metalworking company in Modena, Emilia-Romagna, that is part of a flexible manufacturing network. Hatch lives the experience, understands the phenomenon he is observing, and soon exports his knowledge.

After returning to the United States, Hatch leads the first U.S. study tour to Emilia-Romagna, sponsored by the German Marshall Fund, and does the seminal 1988 study of the Emilia-Romagna networks for the Corporation for Enterprise Development. Hatch is also instrumental in conveying the Italian lessons to the Danish government, and the Danes are subsequently helpful to the state of Oregon and other networking efforts in the United States. In 1992, Hatch designs Oregon's Network Broker Training Program and completes a NIST-sponsored manual on broker training.[23]

If people mention Hatch's name in the first breath of the U.S. flexible manufacturing network movement's "Who's Who," then Stuart Rosenfeld's is the second. "He's the leader of the movement from a convening sense," says Anne Heald, a key node in the network and an expert in the transfer of learning internationally. She describes Rosenfeld as a "prolific, prodigious worker who connects everyone nationally while doing fieldwork."

Before starting her Center for Learning and Competitiveness,[24] Heald was at the German Marshall Fund, where she sponsored a number of seminal projects. The Fund had a longtime intellectual interest in the Italian "miracle" because of the foundation's director of programs, Peter Weitz, who had done his dissertation research in Italy. Like Hatch, Weitz had studied the Emilia-Romagna renaissance.

In 1986, Heald funded Hatch's proposal to bring a delegation of

Italian experts to the United States. The meeting, held at New York Port Authority, brought together many early leaders in the already bubbling network in the United States, and was followed by five regional seminars that firmly planted the idea around the United States.

A year later, Heald funded Hatch's proposal to lead a group of Americans interested in manufacturing on a study tour of EmiliaRomagna. That trip proved to be catalytic in spreading the idea to the United States. It included: Mary Houghton and Ron Grzywinski of the South Shore Bank in Chicago, who carried the idea back to Clinton; Bob Friedman, now chair of the Corporation for Enterprise Development and an early convenor of the movement; Bob Coy, who under then Pennsylvania secretary of labor Harris Wofford developed the Manufacturing and Innovation Network that enabled firms in four diverse industries in the state to assess their global competitiveness; and Brian Bosworth, a public policy expert on interfirm cooperation, who has worked on nearly every major network project in the United States.

Oregon's legislative initiatives are direct outcomes of that trip. In its 1991 session, the state legislature passed two bills that mandate formation of business networks, one under the leadership of Senator Wayne Fawbush, and the other under then Speaker of the House and now Portland mayor Vera Katz. Sparked in part by the crisis in the timber industry, known nationally through its famous northern spotted owl controversy, both bills encourage the creation of networks of firms and authorize funding of network broker training.

Big changes often appear "suddenly" because processes of many little changes reach some critical mass. The new economic order is being built one team, one company, one network at a time. Individually, these are often slow processes, sometimes painfully so. As more boundary crossing teamnets assemble, the simultaneity of many slow processes begins to show rather rapid large-scale change. Feedback from the larger environment in the form of examples of success and failure helps new networks form faster. It is this whole system that develops over time into a new, healthier, more flexible economy.