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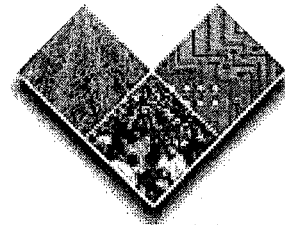
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THE ECONOMIC FUTURE OF THE SAN JOAQUIN VALLEY

JANUARY 2000

Growing a Prosperous Economy That Benefits People and Place



NEW VALLEY
CONNEXIONS

PREPARED BY
COLLABORATIVE ECONOMICS FOR
NEW VALLEY CONNEXIONS
*A Partnership of the Great Valley Center
and the Office of Strategic Technology,
California Trade and Commerce Agency*



About This Report

This report is part of The New Valley Connexions program of the Great Valley Center in partnership with the California Trade and Commerce Agency, Office of Strategic Technology. The Great Valley Center is a regional resource to help people successfully manage growth and change in the Central Valley. The purpose of the research grant was to "identify opportunities to grow technology-based clusters in the San Joaquin Valley in order to make the Valley more competitive, enhance its base of agriculture and natural resources, attract compatible investment, and improve the quality of life." The report was prepared by Collaborative Economics, strategic advisors to civic entrepreneurs, based in Palo Alto, California.

The document is intended to stimulate discussion and catalyze action. The Great Valley Center and Collaborative Economics welcome your comments and further suggestions.

The San Joaquin Valley Region

Counties: Fresno, Kern, Kings, Madera, Merced, San Joaquin, Stanislaus, and Tulare

Total area: 27,280 square miles; 17% of the land area of California

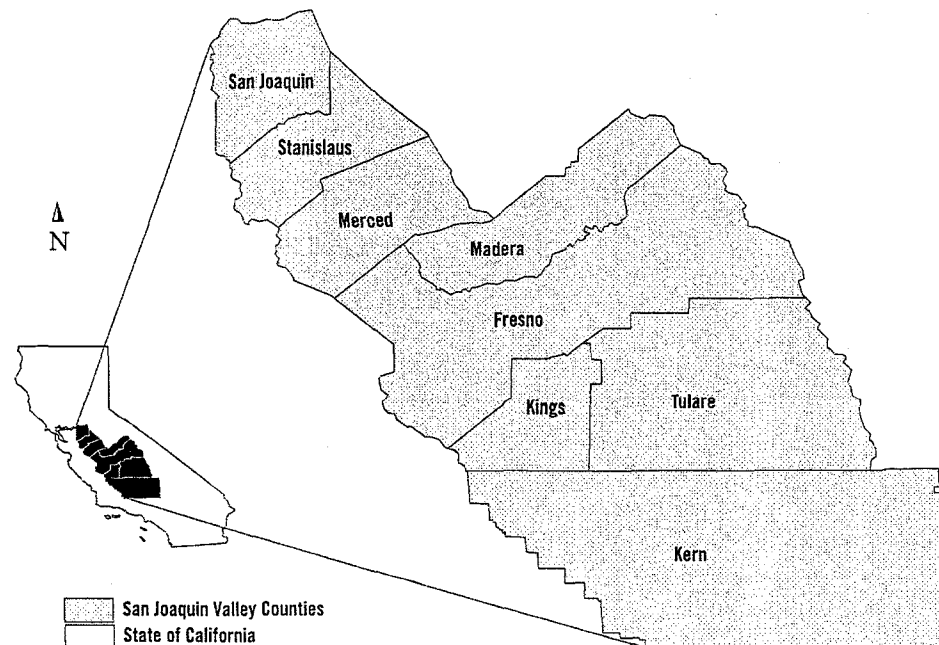
Total population: 3.3 million; 10% of California's population

Ethnic composition: 53% white, 34% Hispanic, 8% Asian/Pacific Islander, 4% African American, and 1% Native American

Age distribution: 0-9 years old, 18%; 10-19 years old, 16%; 20-44 years old, 36%; 45-64 years old, 19%; 65+ 10%

Adult educational attainment: 66% are high school graduates; 14% have bachelor's degree

NEW VALLEY CONNEXIONS PROJECT AREA: THE SAN JOAQUIN VALLEY





Executive Summary

The Great San Joaquin Valley. The richest agricultural region in the world. The low-cost place to live in California. Crossroads of California history. The next California frontier. Home to some of California's oldest families. Home to the newest and youngest Californians. A place that has changed slowly in the past decades. A place that could change beyond recognition.

The San Joaquin Valley is critically important to California and to the nation, as well as to the people who live there. The San Joaquin Valley is growing at a faster rate than the State. The region accounts for 50% of the state's agricultural output. It is vast, spanning more than 250 miles in length and accounting for 17% of the state's land mass.

In many ways the region is a microcosm of the challenges, opportunities, and dichotomies facing the state, played out across a vast expanse of land marked by both large urban centers and diffuse rural settlements. How to make the new demographics work, how to ensure sensible development patterns, where to house the next 10 million people, how to develop next-generation leaders—all have been the subject of intense speculation, research, and debate.

Yet it is the economic opportunities in the Valley that will in the long run shape these societal challenges and the context for addressing them. This report and the research underlying it examine two questions:

- What can be the economic future of the San Joaquin Valley?
- How can the region achieve that future?

Whereas others have pointed out the problems in the San Joaquin economy, this report looks explicitly at opportunities—opportunities that are achievable in the next 10 to 20 years, that build on the best assets and traditions the region has to offer, that fit with global business trends, and that will benefit companies and communities, people and place.

This report paints an achievable vision of a San Joaquin Valley economy rooted in innovation, where people and companies compete globally by continuously improving products, services, and processes. It identifies six cluster opportunity areas that can emerge as strong drivers of the regional economy and can gain national and international prominence. It argues that this economic evolution can result in economic prosperity, growth of a broad and upwardly mobile middle class, and an increasingly vital and interesting quality of life. It points out the emerging signs that the San Joaquin Valley already is poised to become a key regional player in California's new economy. And it outlines strategic recommendations for achieving these goals.

California's "New Economy"

The San Joaquin Valley is one of several major economic regions constituting the state of California. From 1994 to 1996, the California Economic Strategy Panel researched the fundamental economic change taking place statewide and identified a "new economy" transforming California's regions. The panel's report, *Collaborating to Compete in the New Economy*, defined and described this new California economy.

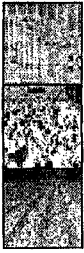


What Is the New Economy?

To many people's surprise, the new economy is not a set of new industries. Rather, the new economy is about all industries competing in fundamentally different ways. It is not just about "high tech," but about applying new ways of doing business to a wide range of products, services, and sectors. Activities in the new economy share some characteristics. The new economy is fast, global, knowledge based, networked, and technology-intensive.

- **Fast.** Time is market in the new economy. Companies compete to develop and produce innovative products and services faster than their competition.
- **Global.** New economy companies operate and sell globally and compete against foreign competition.
- **Knowledge based.** The knowledge and know-how of employees are essential to the success of new economy companies.
- **Networked.** New economy companies specialize in what they do best and develop relationships with partners, suppliers, and subcontractors to do the rest. They tap into information and innovation networks to stay abreast of change.
- **Technology-intensive.** Companies in the new economy create, adapt, and use technology—simple as well as sophisticated—to improve products and processes constantly.

What these characteristics boil down to is innovation. To compete today, companies have to innovate continuously. They must develop better products and services faster than the competition. The new California economy is an innovation-based economy. This characterization is true from apparel to agriculture, from timber to telecommunications, from light industrial manufacturing to software.



Joining the New Economy

The San Joaquin Valley can and must join the new economy. Doing so will entail a shift in how the San Joaquin Valley and its companies compete. Instead of competing primarily on low cost, more and more companies must compete on high productivity and serve increasingly sophisticated and demanding markets.

This transition is already under way, but must be nurtured and accelerated. Some signs of the new economy:

- World Color in Merced, whose flexible high-tech production process allows it to meet national demand for customized printing products
- Farmington Fresh in Stockton, whose innovative packaging provides value-added food products to the national and Asian marketplace
- Skylynx Communication in Fresno, whose innovative wireless technology is providing Internet services to growing technology-based businesses in the San Joaquin Valley and beyond.

Despite some emerging signs of the new economy, the current path of the San Joaquin Valley economy is based on population and cost-driven growth. People from Mexico, California, and other states and countries have been moving to the Valley, attracted to its relatively low living costs, and the population is expanding rapidly because of high birth rates. From 1990 to 1999, population in the San Joaquin Valley increased 22%. And an additional 885,000 people are likely between 1999 and 2010. Population growth has spurred job growth in people-serving industries, such as housing construction and retail. This activity creates the appearance of economic vitality.

The shortcoming of a population-driven strategy is that it does not lead to a rising standard of living and long-term vitality. Despite this rush of construction and retail activity, job growth has lagged labor force growth since 1990. And employment growth has actually led to a declining standard of living. Per capita income declined from \$19,800 to \$18,950 in real terms between 1990 and 1997. Sunbelt states such as Arizona and Florida experienced this phenomenon in the 1980s, when population and job growth actually resulted in a lower standard of living and the population-induced boom was not sustainable.

Just as people are attracted to the Valley's low costs, so are companies. The region has attracted companies to its growing supply of low-skilled, low-cost labor and relatively inexpensive land. Although this activity can provide a platform for future growth, competing primarily on low cost and routine production is ultimately a losing proposition. In a global economy, another lower-cost location will always develop. The southern U.S. states learned this hard lesson when they attracted textile mills from New England in the 1980s, only to see them relocate to lower-cost Caribbean locations in the 1990s. In addition to this vulnerability factor, a strategy of keeping costs low will keep household incomes low. The current path of population and cost-driven growth is flawed in the long run; it cannot lead to sustained increases in standard of living and broad-based economic vitality.

True economic vitality over the long run requires developing significant outward-oriented sectors that compete on innovation and that serve sophisticated state, national, and international markets. These driving industries will pay strong wages and provide a sustained stimulus to the growth of local-serving sectors such as retail, services, and construction.



Models of Economic Growth

DRIVERS OF GROWTH

REGIONAL OUTCOMES

Population-Driven

- Population growth
- Attraction of low living costs
- Local markets to serve

- Veneer of vitality
- Short-term/boom-and-bust cycles
- Declining standard of living

Cost-Driven

- Companies attracted to low-cost labor
- For routine production, services

- "Move-on" syndrome
- Wage increases, which put region at risk

Commodity-Driven

- Natural resource availability
- Global commodity markets to serve

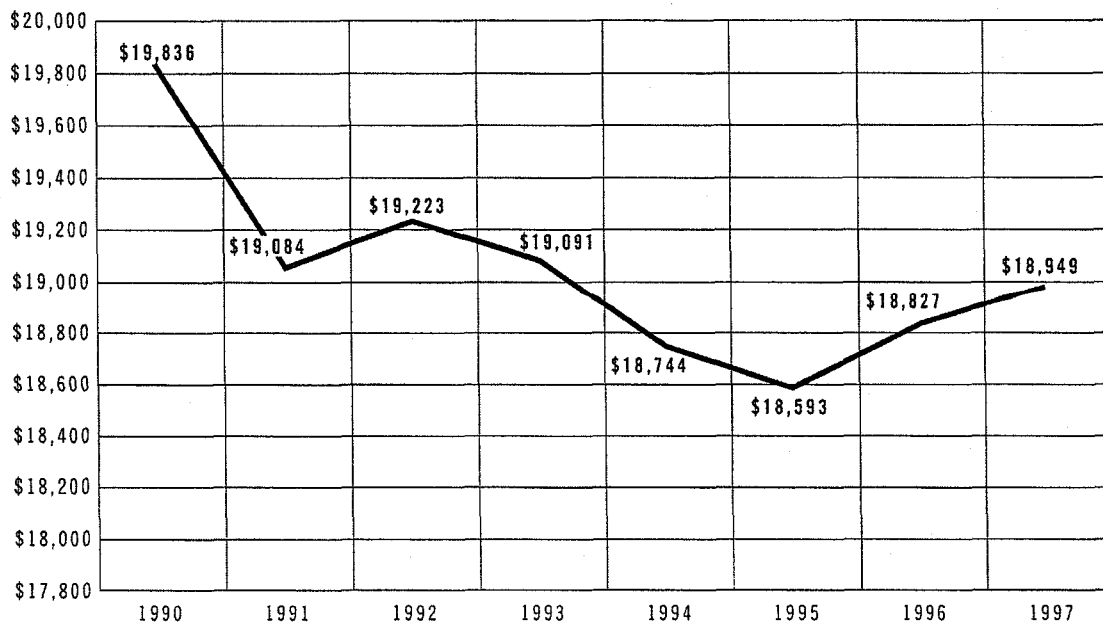
- Possibility of cycles
- Declining direct employment

Innovation-Driven

- Value creation
- Product differentiation
- Increased productivity
- Sophisticated global markets to serve

- Rising standard of living, income mobility
- Resilience
- Diversification

San Joaquin Valley Per Capita Personal Income (1998 dollars)



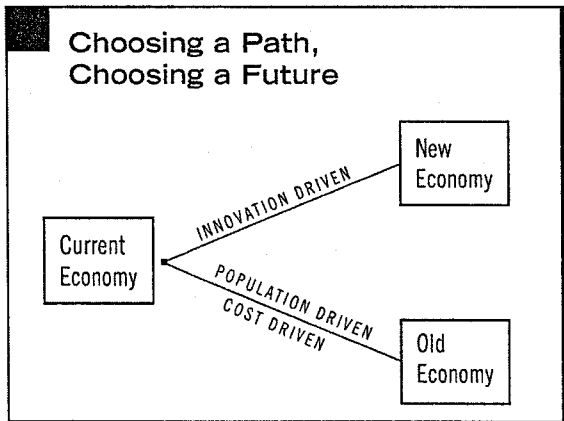


The current outward-oriented driver of the San Joaquin Valley is agriculture production. Farming accounts for 12% of the region's gross product and 8% of its employment base. A major finding of this report is that production agriculture does have many features of the new economy. It has shifted from basic to specialty crops, enjoys rising productivity, and is a major integrator of technology—biotechnology, information technology, spatial technology. And certainly farming has stimulated a host of local support industries: distribution, engineering, business services.

Yet, as the primary driver of the regional economy, agriculture production has two fundamental weaknesses. First, direct employment is declining, as farms substitute technology for labor. Second, reliance on agriculture alone subjects the region to the vagaries of global commodity markets and agriculture labor markets, absent counterbalancing economic activities.

The long-term challenge facing the San Joaquin Valley is to develop a broader portfolio of outward-oriented industries that provide opportunities for more people to earn a higher standard of living. Achieving sustained increases in prosperity requires rising productivity. Productivity growth is the basis for rising real wages for workers and consequently, for a rising standard of living over time. The way to increase productivity is to find new, more highly valued ways to leverage natural, human, and capital resources.

The Valley needs to evolve toward high-value manufacturing and service activities that compete on new economy factors: innovation, speed, global perspective, knowledge, networks, flexibility, technology. Employment in these outward-oriented, innovation-based industries must grow faster than population growth and the industries must become a more dominant driver of employment and revenue in the San Joaquin Valley.



Envisioning the Economic Future

The research underlying this report addressed the question, "What is a desirable and achievable economic future for the San Joaquin Valley?"

The research approach included quantitative economic analysis, interviews with more than 100 Valley companies and leaders, and research on industry, market, and technology trends.

The research approach rests on several key principles:

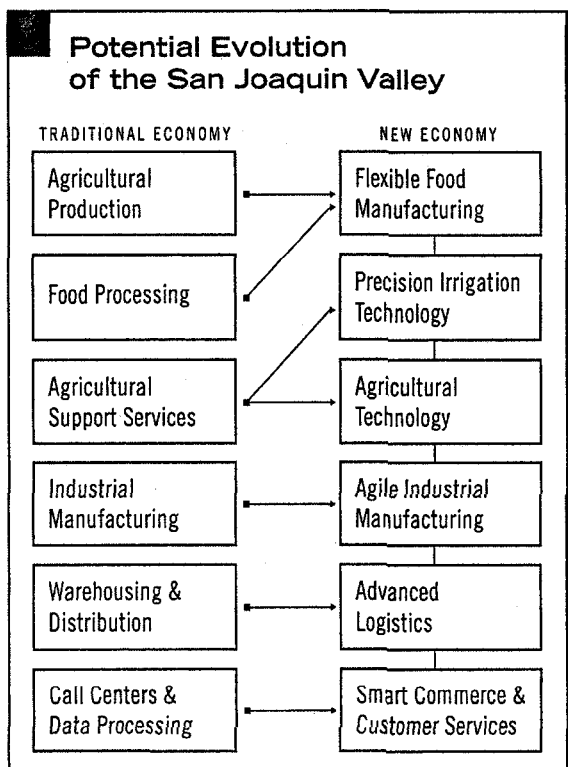
- *Regional economies grow from what currently exists.* New economic drivers evolve out of the existing company competencies and the workforce skills and experience base in a region. Driving industries must serve markets beyond the San Joaquin Valley.
- *Industry, technology, and market trends shape opportunities.* External and internal market trends and interregional dynamics create strategic opportunities for companies and industries in a particular region to grow.
- *Leadership can make a difference.* Leaders can take initiative to accelerate the evolution of an economy toward a higher-value future.
- *Catalysts can change the path.* Catalytic initiatives can spark movement of companies, institutions, communities, and people to realize the vision.



Six Opportunity Areas

This report paints an achievable vision of a San Joaquin Valley economy rooted in innovation. The vision is grounded in six specific opportunity areas that can emerge as strong drivers of the regional economy.

Each of these specialties can evolve from the San Joaquin Valley's current base of activities in agriculture production, agriculture support services, food processing, call centers, warehousing/distribution, and industrial manufacturing. Driving external forces—trends in industry structure, technology, customer requirements, competition—create these opportunities. The opportunity areas have synergy with each other. Progress in developing a single area will enhance progress in others. All these activities are nascent and require significant scale-up to create critical mass.



The six opportunity areas are described below.

- **Flexible Food Manufacturing.** A key finding of this report is that agriculture is joining the new economy. Responding to increased competition and global market opportunities, segments of the agriculture industry already are competing on new economy factors—taking risks, developing new products, creating and integrating technologies, serving sophisticated and global markets. The opportunity is to transform more agriculture products into manufactured food products—a fast-growth, high-value global market.
- **Precision Irrigation Technology.** Global demand for fresh water for urban and environmental uses will drive further innovation in the irrigation industry. Future market growth will come more from turf and landscape irrigation than from agricultural irrigation. The opportunity is to increase the competitiveness of the existing irrigation industry by focusing more on international trade and entrepreneurship development through collaborative relationships with universities, competitor companies, and water users and suppliers.



- *Agriculture Technology.* Current university-based research in precision agriculture and agricultural biotechnology can be leveraged to build a concentration of expertise that is exported worldwide. Already, California's universities are working on technologies that will transform the production of agriculture to use fewer resources, less land, and less chemicals and at the same time to be much more productive and competitive.
- *Agile Industrial Manufacturing.* The San Joaquin Valley's manufacturing base, devoted initially to supporting agriculture, has diversified over time to serve a range of specialized markets. The opportunity is to develop and connect this manufacturing base into an agile manufacturing cluster, serving diverse markets outside the region. Agile manufacturing is based on the ability to produce customized products quickly in an environment of change and uncertainty.
- *Advanced Logistics.* Logistics is an increasingly important source of strategic advantage for many industries, and the industry is growing at 20% annually in the United States. The Valley's current call centers, warehousing, and distribution competencies could evolve into Internet order fulfillment centers and specialty logistics services, driven by innovation in information technology. The San Joaquin Valley could become the West Coast's strategic nerve center for logistics innovations.

- *Smart Commerce and Customer Services.*

The San Joaquin Valley can become the "1-800" capitol of the on-line world, providing sophisticated support services to the growing electronic-commerce industry. The growth of the Internet is transforming the way commerce takes place. The region can go well beyond traditional call centers to high-value, comprehensive "smart" customer services, integrating e-mail, fax, Web interactions, and voice services.

Evolving toward these innovation-based activities can bring sustained increases in standard of living to the San Joaquin Valley people, and national and international prominence to the region. In fact, a key finding of this report is that the San Joaquin Valley economy has the opportunity to produce a large number of middle-class, family-wage jobs. These jobs are precisely the kinds that are disappearing from the coastal metropolitan regions, with their increasingly "hourglass" distribution of occupations and wages.



Characteristics of San Joaquin Valley's Opportunity Area Clusters

INDUSTRY CLUSTERS	EMPLOYMENT 1998	CONCENTRATION 1998	AAGR EMPLOYMENT 1993-1998	AVERAGE WAGE 1998	ESTABLISHMENTS 1998	AAGR ESTABLISHMENTS 1993-1998
Flexible Food Manufacturing	41,426	5.2	1.0%	\$ 31,693	2,096	-1.7%
Agriculture Technology	39,898	21	5.8%	\$ 32,134	2,618	8.9%
Precision Irrigation	5,050	1.5	1.3%	\$ 26,756	265	-1.4%
Agile Industrial Manufacturing	20,101	.8	3.8%	\$ 31,578	864	0.2%
Advanced Logistics	32,350	1.1	3.5%	\$ 32,006	2,417	2.4%
Smart Commerce & Customer Services	5,361	.4	7.4%	\$ 57,518	350	7.9%
All Clusters	139,136	1.8	3.5%	\$ 32,871	8,345	2.9%
All Industries	842,968	1.0	2.0%	\$ 27,946	66,097	3.1%
Cluster Percent of Total	16.5%				12.6%	

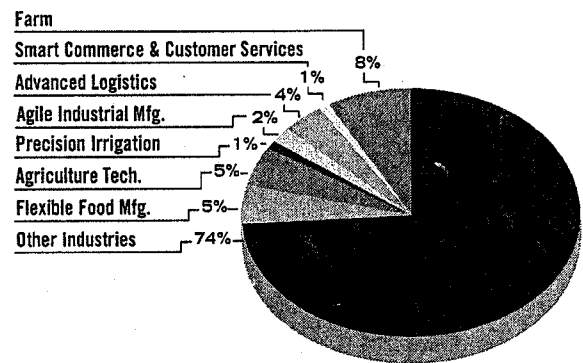
AAGR = Average Annual Growth Rate

Concentration = Share of cluster employment in region relative to that cluster's employment nationally

Source: Regional Financial Associates

Economic growth and sustained improvement in the standard of living for San Joaquin Valley residents will require that cluster industry employment make up a larger share of total San Joaquin Valley employment.

Distribution of Employment, San Joaquin Valley, 1998





Strategic Recommendations

The secret to building an innovative economy is in building an innovative community.

Significant regional initiative is necessary to transition the San Joaquin Valley to participate more fully in new economy activities.

Community, business, education, and other leaders must take deliberate action to leverage strengths, build assets, and change mind-sets.

The report makes seven Strategic Recommendations. These Strategic Recommendations represent the themes common to the more than 40 action initiatives that are proposed (which are described in the full report) to support the six specific opportunity areas. These Strategic Recommendations include:

- *Regional Leadership.* Develop "networks of responsables" in the region that will drive the testing, refining, promotion, and implementation of the vision. These "responsables" include people acting as stewards of the overall regional vision as well as of each particular opportunity area.
- *Cluster Networks.* Create intermediary institutions, personal relationships, and electronic networks that expedite collaborative partnerships among cluster companies, education institutions, and other organizations. By collaborating, the small- and medium-sized companies so predominant in the Valley can create the scale effects necessary to serve global markets and improve their efficiency and innovation.
- *Innovative Workforce.* From K-12 through community colleges and universities, develop a computer and information-technology literate workforce (technology implementers) and people capable of learning throughout their lifetimes. Increase collaboration between the education and training communities and cluster companies.
- *Technology Development Community.* Develop a community of applied research professionals in companies and universities that are tightly oriented to the cluster industries (technology innovators). Shape the basic research activities at University of California-Merced and the applied R&D activities at Fresno State to meet the needs of industry clusters.
- *Entrepreneurship.* Cultivate innovation economy entrepreneurs, and next-generation business leadership. Create the places, financial support and other resources, and the culture that encourage people, especially young talent, to recognize business opportunity and exploit it.



- *Regional Identity.* Shift mind-sets in and outside the region toward a positive vision of the future and the behavior change necessary to achieve it. Cultivate a regional identity that fits with both the region's traditional history and strong future promise and that overcomes misperceptions about limited opportunities. Perception matters for prosperity.

Examples of Required Mind-Set Shifts

- From *isolation* of companies in the region to *integration* of companies across the region
- From *low educational attainment* to *high educational aspirations*
- From serving *local markets* to serving *global markets*
- From land as *unlimited resource* to land as *limited resource*
- From quality of life as residual to quality of life as economic development requirement
- From *community leadership* to *regional leadership*
- From *attraction* of companies to home-grown *entrepreneurship*

- *Livability/Environment.* Attracting and retaining young talent and midlevel professionals is essential to achieving the vision. As an economic development tool, consciously create a high-quality living environment attractive to knowledge workers, including vital downtowns, protected open space and landscapes, preserving in some places the distinctive landmarks and physical character of the rural West.

The full report of THE ECONOMIC FUTURE OF THE SAN JOAQUIN VALLEY is available on-line at www.greatvalley.org/nvc/tech_clusters.html or from the Great Valley Center.

INTRODUCTION TO THE FULL REPORT

In addition to the Executive Summary, the full report includes the following parts:

- *Part II: Smart Food and Fiber*, describes three opportunity areas that build off of the region's preeminence in agricultural production and services: flexible food manufacturing; precision irrigation technology; and agricultural technology. This part outlines the driving forces creating each opportunity, key regional assets, and potential action initiatives.
- *Part III: New Commerce Manufacturing and Services*, describes three opportunity areas created by e-commerce and information technology that build on the region's current capabilities in call centers and data processing, warehousing and distribution, and traditional industrial manufacturing. These areas include smart commerce and customer services, advanced logistics, and agile industrial manufacturing. The section outlines the driving forces creating each opportunity, key regional assets, and potential action initiatives.
- *Part IV: Strategy Recommendations*. This section identifies six major Strategic Recommendations to accelerate development of the innovation economy. It summarizes the 30 Action Initiatives to support development of specific opportunity areas.

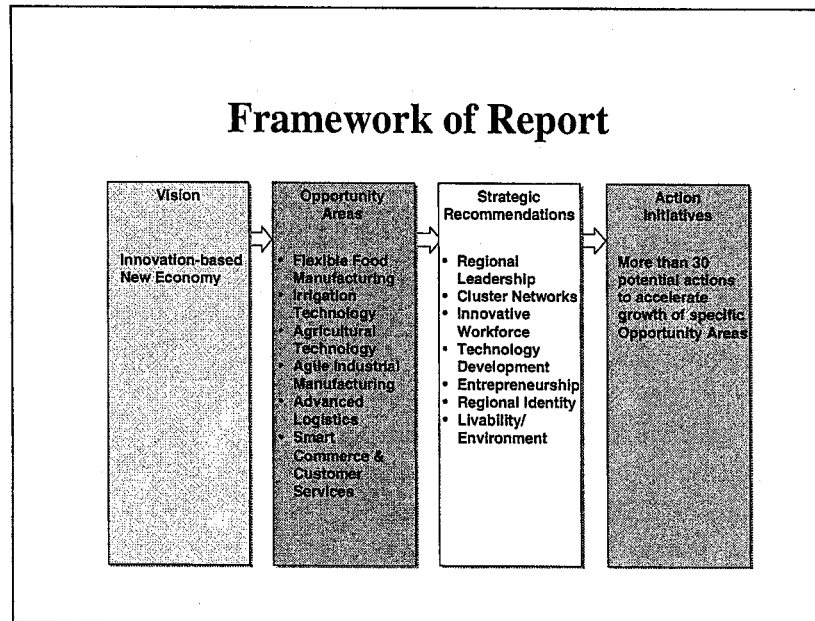


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PART II: OPPORTUNITY AREAS IN SMART FOOD AND FIBER

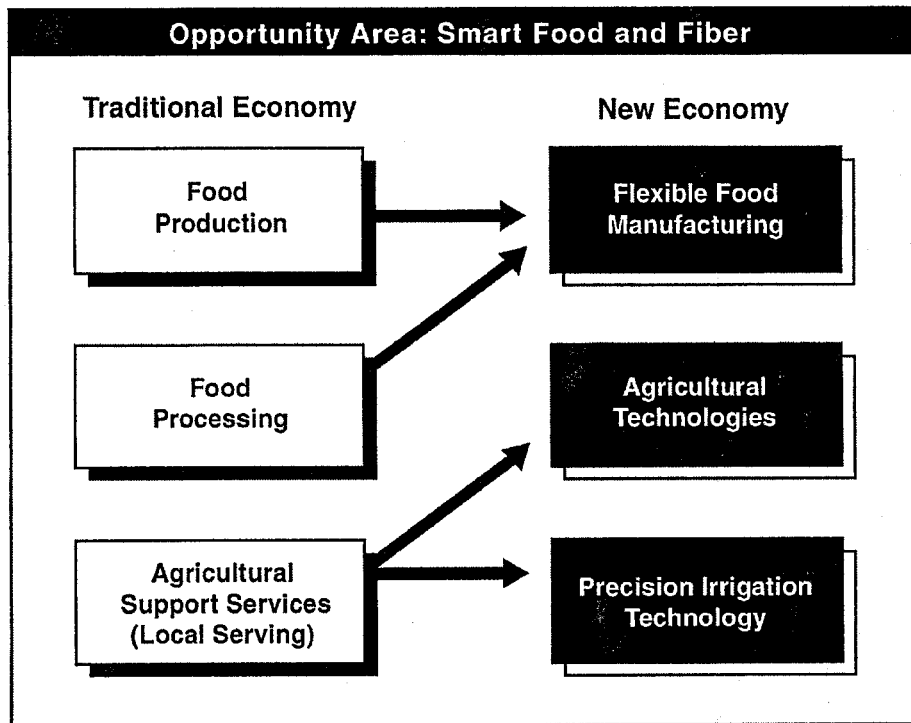
A Base to Build On

The San Joaquin Valley is a world leader in agricultural output. On an annual basis, the Valley's agricultural cash receipts total more than \$13 billion. From the current base of agricultural production, food processing and agricultural business services could grow flexible food manufacturing, advanced agricultural technologies, and precision irrigation technology. The current industries, though already active in global trade, can begin to evolve toward more technology-intensive and fast and flexible industries, thereby improving their competitiveness in the long run. A number of technological, market, environmental and political forces create enormous opportunity for the San Joaquin Valley, given the appropriate initiatives. The San Joaquin Valley can take a leadership role in capitalizing on these changes for the benefit of the entire region.

The San Joaquin Valley's evolution from traditional industries to new economy industry clusters will require building from existing assets and strengths, which include:

- Vital university and industry-based research in food production, processing, packaging and marketing
- Industry and university research in irrigation and precision agriculture technologies
- A new research university, University of California-Merced, that will focus on agricultural biotechnology, bringing high-level research and development expertise to the Valley
- A growing concentration of organic farms and natural food processors
- A growing base of skilled workers with experience in operating sophisticated machinery and electronic and communications technologies
- A strong presence of irrigation equipment manufacturing that can build demand for more sophisticated and fast and flexible contract manufacturing Valleywide
- Communications infrastructure potentially enabling use of information technologies in commodity production and manufacturing.

As a whole, these evolving assets create an opportunity for the San Joaquin Valley to be globally competitive in meeting the world's increasingly diverse demand for food products, especially products that meet stringent standards for nutritional value, taste, and quality. At the same time, the San Joaquin Valley can showcase how to meet growing expectations for sustainable practices in manufacturing and in the use of scarce natural resources.



What Is Creating This Opportunity

Increasing Worldwide Pressure to Adopt Environmentally Sustainable Practices

The San Joaquin Valley's serious environmental and resource issues, especially those related to air and water quality, will drive much of the innovation in the food and fiber industries. Food and fiber producers will increasingly move to more sustainable practices that result in zero discharge into the environment. This change means that animal waste will be converted to either energy or fertilizer, and all food processing by-products will be reused for energy or as inputs into other products. Herbicides and pesticides, if used at all, will be applied in such precise amounts that virtually no runoff will exist. Increasing pressure to do more with less means that all operations—whether in food and fiber production or food processing—will be designed and redesigned to be more efficient, nonpolluting, and flexible.

Increasingly Segmented Market

Consumers worldwide are demanding fresher, higher-quality, and specialized products, including organic foods, functional foods, fresh packaged foods, home meal replacement products, and specially processed foods. Consumers are also demanding more convenient food products that have a longer shelf life. This demand provides an opportunity for a variety of smaller to medium-sized processors to develop market niches and capitalize on those growing markets.

New Food Processing Technologies

New food processing technologies enable safer energy- and resource-efficient processing with little or no discharge into the environment. New food processing technologies enable California processors to be competitive despite stringent health, safety, and environmental

regulations. In fact, a growing market of consumers increasingly seek out processors that apply sustainable practices in their operations. Processors that adopt these practices early will reap benefits sooner.

Push toward Outsourcing

The competitive advantage for food processors is in their product development and marketing. Outsourcing manufacturing enables processors to focus on their strengths and capitalize on the expertise of process engineers who are constantly updating their knowledge and equipment.

Increasing Urbanization

Land necessary for new urban development limits the amount of land available to food and fiber production. This limitation presents an opportunity to develop local expertise in agricultural technologies that increase per acre productivity with fewer inputs and with less environmental impact.

Limited Supply of Fresh Water

Increasing population growth will demand a greater share of the state's water supply. Currently, agriculture uses approximately 75% of the state's developed fresh water supply. In the future, this share will necessarily decrease to accommodate increased urban needs. This change presents an opportunity for the irrigation industry to develop further innovative ways of applying water in more precise amounts—for agriculture as well as for turf and landscaping in the new urbanizing areas.

Smart Food and Fiber Opportunity Areas

The following sections describe in more detail three specific opportunities in Smart Food and Fiber: Flexible Food Manufacturing, Precision Irrigation Technology, and Agricultural Technology. All three are interrelated in that advances or changes in one affect each of the others. Each section addresses that opportunity area's major market drivers, the state of the existing industry and its evolution, the regionally based assets that could be further cultivated to nurture the continuing evolution of the industry, and requirements for growth.

Flexible Food Manufacturing

The San Joaquin Valley is well poised to take advantage of new technologies and forms of organization in the production, manufacturing, and distribution of food and food products. The current industry cluster of specialized, niche producers, which has grown rapidly by extending markets worldwide, could be expanded to include a larger number of manufacturers, serving increasing markets worldwide.

As the demand for natural foods and products increases, the San Joaquin Valley could become a leader in natural foods manufacturing. The San Joaquin Valley grows 250 commodities and nearly 500 varieties. Close proximity to a growing concentration of organic suppliers, as well as to a growing concentration of distributors and just-in-time manufacturers, and access to two of the nation's largest natural food markets as well as easy access to Asian markets, make the San Joaquin Valley ideally situated for responding to the unmet and growing demand for natural foods.

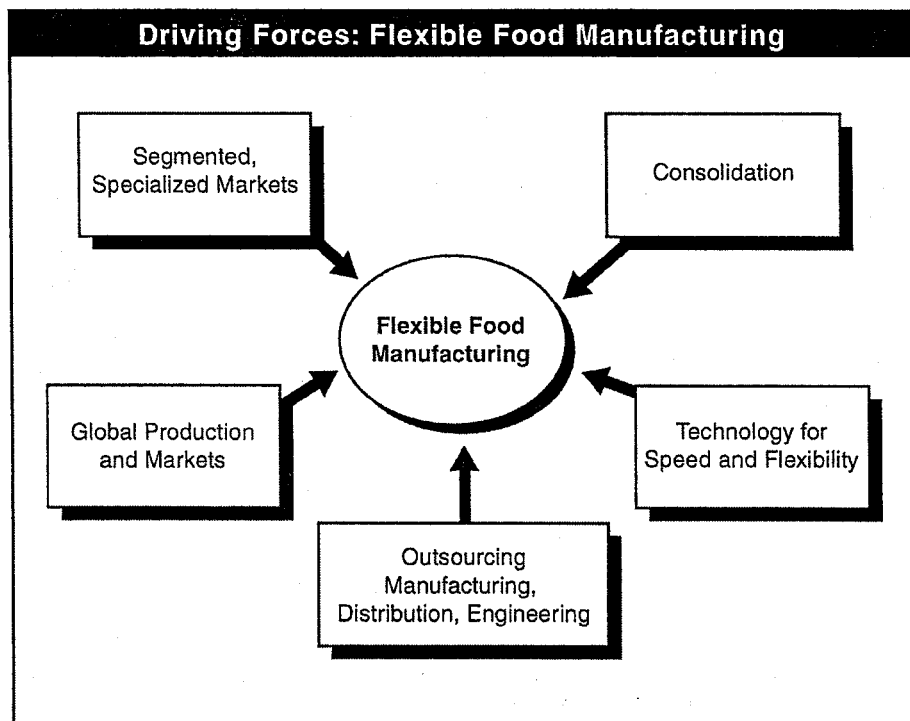
What Is Creating This Opportunity?

Five major drivers¹ are shaping the food manufacturing cluster of the future.

The market for food products is increasingly segmented. A growing proportion of consumers worldwide are demanding fresher, more convenient, higher-quality, and specialized products. Included in this grouping would be certified organic foods, functional foods, fresh packaged foods (salad or fruit in a bag), home meal replacement products, and specially processed foods. Also included are processed foods packaged to increase their shelf life or to be more convenient. For example, the growth in the markets for natural foods and convenience foods is spurring the creation of small, specialized producers of natural food products, such as California Natural Products and Odwalla juices, both located in the San Joaquin Valley. The \$25 billion natural products market is likely to grow by 11% in the next year.²

Also, the shift from a commodity focus to a market focus in food requires food manufacturers to be fast and flexible, to focus on quality rather than quantity, and to innovate continually.

Both food producers and food processors are consolidating and buying into higher-profit markets to increase their product line, to increase their market, and to increase their profits. Consolidation is also happening in the natural foods industry, primarily in the retailing and supplements markets. On the other hand, niche markets and on-line marketing increase opportunities for smaller producers and processors.



Production and markets are global. The San Joaquin Valley's growers compete with growers in Asia and South America, not just growers in Florida and Texas. And markets for the Valley's foods are also global. The globalization of agricultural industry means that prices and therefore competitiveness are dictated not by comparative advantages vis-à-vis other states or regions, but by comparative advantages vis-à-vis other countries. Other countries have trade restrictions, tariffs, price supports, and often lower prices. Global competition for commodities is based on price primarily and less on quality. On the other hand, global competition for specialized products, such as those produced by the natural products industry, is based on quality.

Technology will continue to revolutionize food production and marketing. Manufacturing operations have had a number of improvements, enabled by newer, more automated machinery and the application of more powerful, cross-platform software and information systems, as well as by new labor-management practices that increase productivity, flexibility, and speed. The food manufacturing industry of tomorrow will operate in much the same way as any other information-intensive manufacturing operation that is flexible and responsive to changing consumer needs and uses just-in-time production techniques. Food manufacturing will operate year-round, respond to changing consumer demand rapidly, operate just as profitably at a small scale as at a large scale, have ongoing productive relationships with specialized buyers (retailers) and suppliers (producers/growers), and increasingly apply communications technology throughout the entire food chain, from production to retailing.

Food manufacturing will increasingly rely on outsourcing manufacturing, distribution, and engineering. Food manufacturers know that their competitive advantage is in new product

development, product innovation, and marketing. It is not in manufacturing process engineering, design, or construction.³ The food processor is facing a flat market, and growth is in segmentation, which means lower volumes. By contracting with a third-party manufacturer, the food processor gains all the benefits of a well-trained workforce without paying a premium⁴.

Flexible food manufacturers serve multiple food-processing clients at the same time. Their competitiveness relies on investing in process design engineering and in new equipment. Contract manufacturers or copackers are well-positioned to handle shorter runs and frequent changeovers. They can also meet emergency capacity needs of larger processors or manufacture seasonal products. Contract manufacturers and equipment suppliers are increasingly providing pilot plants that can be used by a multitude of processors to test new products or new processes. This trend reduces the initial investment (and risk) necessary to market a new product and makes it easier for entrepreneurs to get a new product into the market.

Otherwise known as Efficient Customer Response (ECR), logistics will make current day warehousing obsolete. Logistics integrates the various functions of customer service and order processing, inventory planning and management, supply transportation, and distribution and warehousing with the goal of providing the largest possible bundle of customer services at the lowest cost. The net result of a better logistics operation is increased market share. By contracting packaging and distribution out to a specialized third party, a small manufacturer can take advantage of advanced systems without incurring the high, fixed investment on its own.⁵

Natural Foods: A Growth Industry Nationally

The U.S. Department of Commerce's Industry Outlook for Processed Food and Beverages⁶ estimates a 2% growth in the next year. The processed food and beverage industry sector is the largest U.S. manufacturing sector, accounting for approximately one-sixth of industrial activity. The value of shipments is approximately \$480 billion. The value of shipments has grown at an average annual rate of 3.2% (AAGR of 1% in 1992 dollars). Despite growth in the sector, employment has increased only slightly (.2% annual growth since 1992, primarily because of increased automation and advance technologies).

Natural foods, on the other hand, is a fast-growth industry. Overall industry growth has averaged 20% to 24 % annually, according to *Natural Foods Merchandiser* magazine⁷. Natural foods was a \$2.1 billion business in 1998, growing from \$1.78 billion the year before. This rapid growth has attracted the attention of venture capitalists and large food retailers who want to cash in on their customers' fast-growing interest in organics. Limited supplies, both from the farm and from the manufacturers, has kept the average growth rate artificially constrained at about 20%. As the number of organic growers increases, so will the growth in natural foods manufacturing.

Evolution of Food Manufacturing in San Joaquin Valley

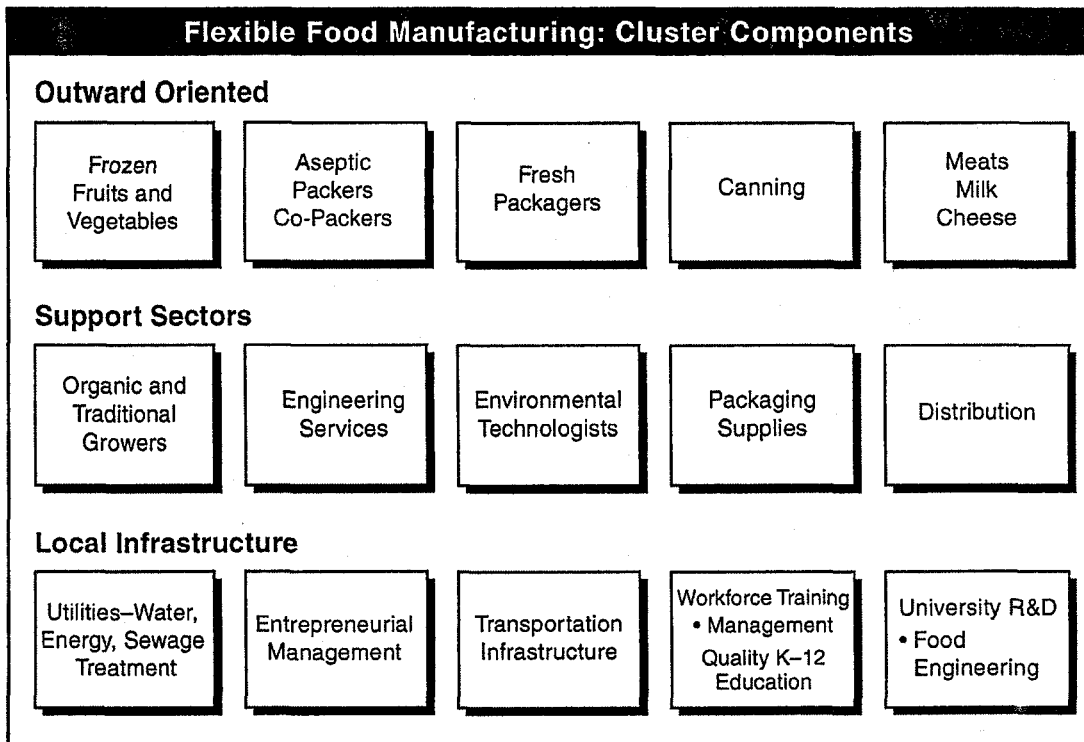
The San Joaquin Valley has a rich heritage of food production, starting in the 1940s when agriculture left the populated coastal regions of Santa Clara and Los Angeles Counties and capitalized on the state and federal water project investments bringing a stable supply of

water to the entire Central Valley. A number of food processing plants are in the region, many of them relocated from more populous regions next to both production and distribution centers (seaports and rail), including the Monterey Bay and the San Francisco Bay region. Now, packaged foods can be distributed by truck, rail, or air, but seaports are farther away, and air cargo capacity is limited.

Currently 2,100 food processing establishments are in San Joaquin Valley. Since 1992, the number of establishments, many of them small, has decreased by nearly 10%. This decrease has not affected total employment, however. Between 1992 and 1998, total employment increased from about 39,000 to about 41,000, an increase of 2.5% over the five-year period and an average annual growth rate of only 1%. A few of the establishments are contract manufacturers, which means that they manufacture foods for multiple companies and usually process more than one type of product.

Food manufacturing is more concentrated in the San Joaquin Valley than in the United States, though not as concentrated as agribusiness services and farming. An opportunity appears to exist for a larger number of food processing plants to be located in the San Joaquin Valley, processing foods locally rather than exporting them to be processed elsewhere.

Already, Odwalla, which manufactures natural juices and functional foods, and California Natural Products, a contract food manufacturer that uses aseptic packaging, has recently located their facilities in the San Joaquin Valley and compete effectively in an increasingly competitive, specialized, global market. Super-Nutrition Distributors just opened its West-coast distribution center in Visalia, incorporating value-added services such as marketing, bar-code listing, and electronic ordering.



Environmental Consciousness and High Performance

Food manufacturing facilities are increasingly adopting environmentally sound practices in their processing methods. Increasingly, food manufacturing operations are hiring PhDs in environmental technology to assist them in meeting the increasingly more stringent environmental and waste-management regulations.

Natural foods firms have always used environmentally sound processes. These firms are selling more than a product. They are selling a philosophy as well: the philosophy of sustainability. Their customers are better educated than the general public and read more. They buy products from firms with integrity that they feel confident are using environmentally sound manufacturing processes. These firms are more likely to use energy-efficient processes, invest more in training their workers, have greater worker loyalty, and treat their waste products—either using cogeneration to turn waste into energy or recycling waste.

As a result of the increasing focus on sustainability, a growing opportunity exists to create and sustain an environmental technology cluster that would assist not only food manufacturers, but other manufacturers as well. Applying environmental technology will save manufacturers water, energy, and money. It will also reduce emissions to the air and discharges to sewage systems or water tables. For instance, with the help of the Electric Power Research Institute, University of California-Davis, and others, Tri-Valley Growers developed a filtration system (patent pending) to remove salt from the brine used to process olives at its Madera olive packing plant. To meet water-quality standards, Tri Valley was faced with improving its evaporation ponds at a cost of \$42 million. Instead, it spent \$8 million for a new zero-discharge membrane-filtration system that uses ultrafiltration and reverse osmosis and evaporation. Along the way it also instituted process modifications that

reduced processing time from 12 days to 3, making the investment in zero discharge less painful⁸.

Other processors, as well as producers, are using cogeneration to convert animal and food waste into energy. Energy created at the site powers on-site operations. Already an infant cogeneration industry is emerging in the San Joaquin Valley.

Partnerships and Networking: Essential

All the above-mentioned trends driving change in the food manufacturing industry—segmentation, consolidation, outsourcing, increased use of technology, globalization—require the food manufacturer to become increasingly networked with the entire food chain, from growers to retailers. Forming and maintaining these relationships will be key to their continued competitiveness. Bringing food manufacturing closer to the growers and distributors will enhance their ability to develop and maintain these relationships.

Regional Assets

The evolution of the San Joaquin Valley's Flexible Food Manufacturing cluster will be facilitated by investments in the Valley's existing regional assets.

Proximity of Specialty Food Supplies

The San Joaquin Valley's climate, water supply, and established agribusiness service sector ensure easy access to producers of a large variety of food commodities. Not far away, in Santa Cruz County, is the Organic Farming Research Foundation, which assists farmers in adopting organic farming techniques.

University of California-Davis, Department of Food Sciences and Technology

University of California-Davis is the premier food science institution in the state of California. The Department of Food Science and Technology issues B.S., M.S., and Ph.D. degrees and conducts research on safe handling, packaging, and processing of food, as well as on developing new food products and consumer research. Students receive a broad background in food chemistry, food biochemistry, food microbiology, food engineering, and food processing and in-depth training in one of several areas of emphasis, including chemistry, biochemistry, fermentations, and microbiology—the key to a more knowledge-intensive food manufacturing industry. A strong demand exists for individuals with M.S. and Ph.D. degrees in food science. The food science graduate program at University of California-Davis is among the strongest in the world. The Food Science and Technology Department also has a pilot plant, enabling students to develop new products and test new processing methods while at school.

New University of California-Merced

The Sierra Nevada Research Institute at the new University of California-Merced will focus its research and teaching on environmental technologies, sustainability, and energy conservation. The University will also offer Agricultural Biotechnology as a research area.

Environmental Technology

A growing cogeneration industry helps producers and manufacturers process their industrial by-products to produce energy that then powers their on-site operations.

Department of Industrial Technology, California State University-Fresno

This department provides instruction in the design, management, and operation of manufacturing operations.

Available Workforce with Experience in Food Manufacturing

The San Joaquin Valley has an abundance of well-educated, hard-working individuals with experience in food manufacturing. Jobs in newer food manufacturing plants will require a higher level of schooling and literacy than jobs in older food processing plants.

Proximity to U.S., Canadian, and Asian Markets

The San Joaquin Valley has easy access to Pacific Rim nations via the busiest ports on the West Coast (Oakland and Long Beach) and to rail transportation that connects the Valley to every part of the United States. Airport freight capacity exists at Stockton, Fresno, and Bakersfield Airports, though capacity could be expanded.

Requirements

The San Joaquin Valley's Flexible Food Manufacturing cluster will require the creation of or additional investments in a number of areas, including infrastructure, workforce education, and financing.

A University Research Program for Food Manufacturing/Food Engineering

A need exists for University of California-Davis and the new University of California-Merced to collaborate more with companies in the San Joaquin Valley, to facilitate ongoing interaction between industry and academia, and to make university research more accessible through applied development partnerships in industrial technology, marketing, and the like. An institute similar to the one at Pennsylvania State University might spur additional food processing in the San Joaquin Valley. The Center for Food Manufacturing at Pennsylvania State has 26 company members, including food manufacturers, equipment suppliers, utility companies, and related companies. Members decide what the research projects will be. Though University of California-Davis has an internationally recognized Food Science and Technology program, its focus is on the biochemistry and microbiology of food processing, not the actual engineering of food manufacturing processes.

Educated Labor Force

Increasing health and safety standards and more information technology-intensive machinery in food processing requires a labor force with higher levels of education, especially in math and science. A need exists for a multifunctional labor force with skills to run a modern, automated, manufacturing plant; technologists with skills to operate food processing machinery; and managers adept at managing food manufacturing operations and

skilled at reengineering manufacturing processes and at maintaining lasting relationships with buyers and suppliers

Affordable, Competitively Priced Infrastructure

Food processing currently uses large amounts of electricity, water, sewage treatment, transportation, and telecommunications services. Newer plants place a lower load on energy and water supplies and waste-treatment facilities, though need for these services is not eliminated, and the services cost more in California than in other states.

Start-Up Financing for New Processors

For California processors to take advantage of the fast-growing niche markets, they will need financing to cover market development, product development, and manufacturing and marketing costs and entrepreneurship training.

Environmental Regulations That Enhance Export

Some additives that prevent spoilage during shipping and are required by other countries are banned in the United States, putting U.S. producers at a competitive disadvantage. Fair food safety regulations need to be established with export trade in mind.

Fair Food Safety Regulation for Imported Foods

In a highly competitive world market, products imported to the United States should meet the same food safety and chemical use standards required of U.S. producers. The United States imports almost as much food as it exports, and other countries' products don't have to meet the sometimes costly regulatory requirements of U.S. produced foods.

Agricultural Buffer Zones

Establishing government or developer-provided buffers between productive farm operations and urban development will prolong the viability of farm operations and ensure easy access to food supplies.

Available Expertise in Environmental Technology

Food processing firms will increasingly rely on environmental technologists not only to ensure compliance with environmental regulations but also to help design and implement environmentally sustainable practices.

Increased Air Cargo Capacity

Food producers and processors are increasingly shipping products to Pacific Rim countries via air. Capacity at existing airports is limited and must be enlarged to accommodate a growing industry of high-value products.

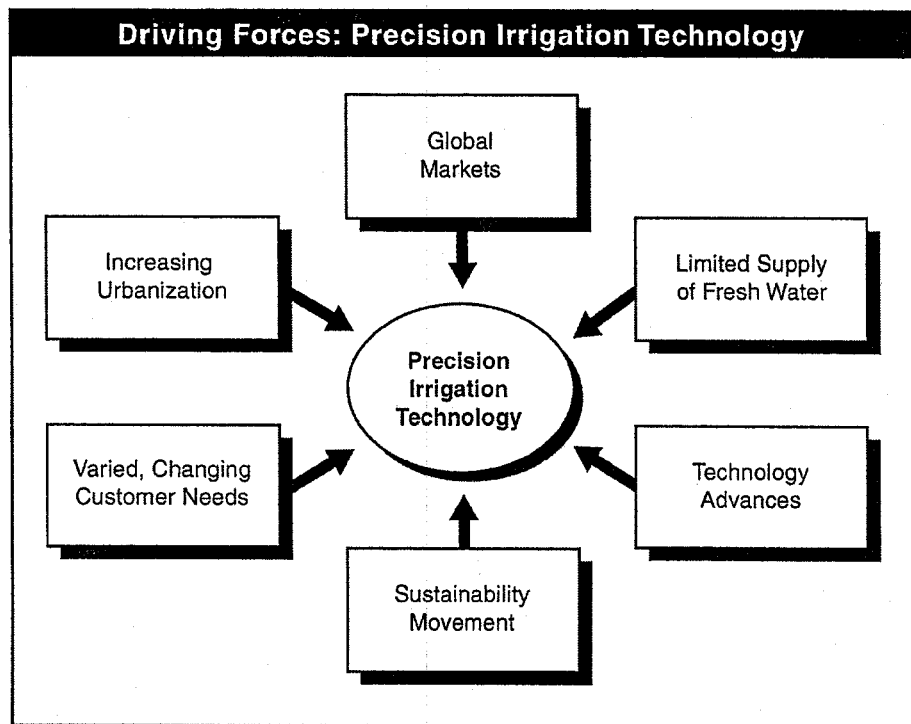
Precision Irrigation Technology

Another major new economy industry cluster is precision irrigation technology. This industry cluster is already well established in the San Joaquin Valley. The opportunity is to increase its competitiveness globally by focusing on international trade, entrepreneurship development, and on the research and development of innovative products and marketing.

What Is Creating This Opportunity?

Two major developments are changing the California irrigation industry: a more limited supply of fresh water and increasing urbanization worldwide. Supplies of fresh water are fairly constant. As the population increases not only in California but all over the world, the demand for fresh water will increase. Use of fresh water for agriculture and landscaping will increasingly become less acceptable and more expensive. Farm operations, as well as landscapers, which now use more than 75% of fresh water supplies, will increasingly look for ways to reduce their use of water without sacrificing productivity or quality. Irrigation firms will continue innovating more efficient water application systems, relying more on materials technologies, hydraulics, and plant and soil science.

Water technology of tomorrow will apply advanced technologies in the areas of communications and automatic control systems, global positioning systems, pumping, filtration, piping, and plant and soil sciences to increase the precision of the application of water in agriculture, landscaping, recreation, and forestry. Because of its dry, mostly hot summers, California will remain the leading user of water for all uses, especially agriculture. As population increases and urban areas expand, the percentage of all water withdrawn from all water supplies by agriculture will decrease significantly as lawns, parks, golf courses, and median strips that need to be watered in urban areas increase. Our increasing concern about maintaining biodiversity and the benefits that derive therefrom also will command a greater supply of water away from both agriculture and urban uses. As a result, water delivery technologies of the future will necessarily be higher quality and will enable more efficient use of water.



Evolution of Irrigation in California

The Valley's agricultural and irrigation heritages are intertwined and—up until the recent boom in landscape and turf irrigation—mutually dependent. The Valley's irrigation industry began after water delivery and power systems to power water pumps were constructed in the 1920s and 1930s. Two major projects, the state's California Water Project and the federal government's San Joaquin Valley Project built in the 1950s and 1960s, increased the availability of water and the acreage of irrigated agriculture, making the San Joaquin Valley the most productive agricultural region in the world.

Though in the 1950s and 1960s people thought that the supply of water was endless, droughts and increasing demand for water by urban users propelled the use of modern irrigation technologies. Farmers switched to modern irrigation practices to reduce the cost of water inputs.

A Highly Networked Industry

The irrigation industry in California is a network of companies, each focused on one aspect of irrigation systems. For instance, one company will manufacture PVC pipe and PVC fittings, another valves, another pumps, yet another filters, and still another automatic control systems, including the software to operate them. Very few of the companies manufacture all the parts necessary to create an entire irrigation system. Most of the companies' manufacturing operations are devoted exclusively to irrigation, although many companies devote only 10% or 20% of their business operations to irrigation. Distributors and contractors make up an extremely important component in the industry, acting as intelligent intermediaries between irrigators and manufacturers. To be competitive in the booming retail market, manufacturers must provide an entire system for do-it-yourselfers;

Toro and Rain Bird are the biggest players in this market. The firms located in the San Joaquin Valley have strong buyer-supplier collaborative relationships. They buy and sell to each other and travel to trade shows with each other, and employees easily move between companies.

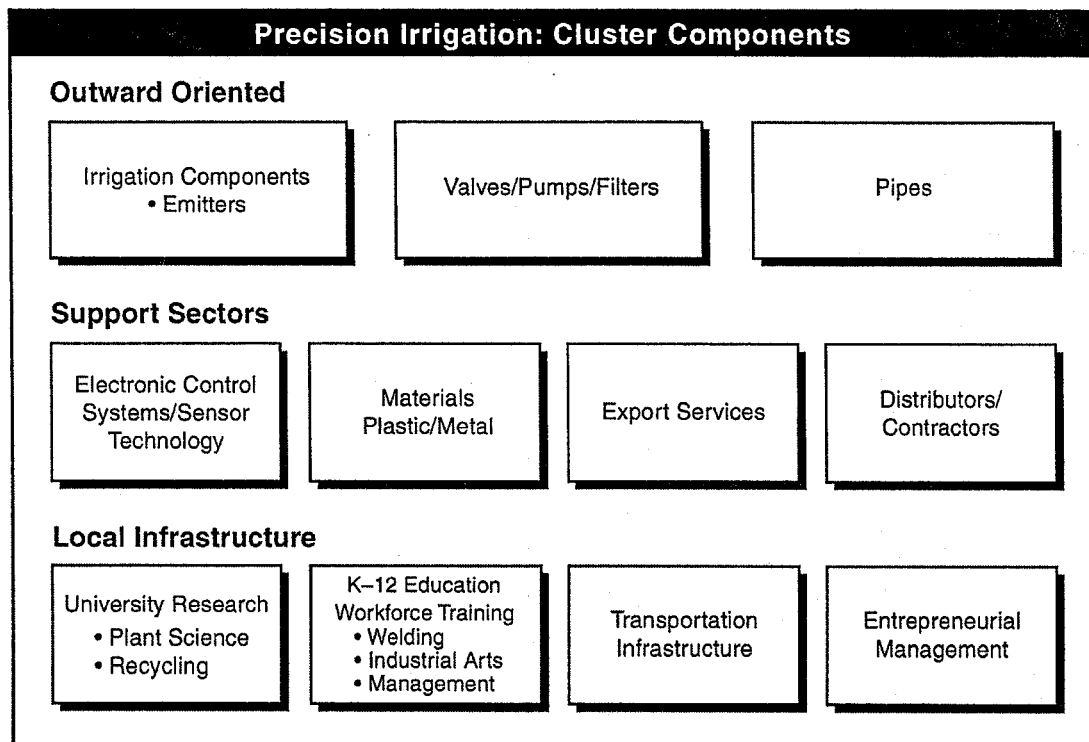
The irrigation industry has an interdependent relationship with many other major industries in California. Those industries include plastics, software development, agribusiness services bioindustry and landscape contracting. The irrigation industry is an integral part of the emerging precision agriculture industry.

Market Potential

In the mid-1990s, the irrigation business, nationwide—including equipment, design, and installation—totaled \$2.75 billion annually, with only 37% of that total attributed to agriculture. Equipment alone totaled \$1.6 billion annually. Currently, the growth market for irrigation technology is in commercial and retail landscaping, making up more than 50% of manufacturing sales in 1994 and projected to gain a greater share thereafter. The Irrigation Association estimates that the landscape irrigation business, worldwide, will grow to a \$1 billion business annually by 2010⁹. Retail landscaping equipment is likely to grow the most and makes up 50% of the landscape business.

Irrigation More Concentrated in San Joaquin Valley Than in Any Other Region

Between 1992 and 1998, San Joaquin Valley employment in irrigation manufacturing and distribution grew by 8%, from 4,700 to 5,100 workers. Because of some mergers and acquisitions, the number of establishments fell from 284 in 1993 to 265 in 1998¹⁰. Irrigation employment is heavily concentrated in California. According to the Irrigation Association membership directory, 45% of all irrigation manufacturers are headquartered in California, including two of the largest, Rain Bird International and Toro¹¹. Nebraska, Texas, and Florida, the only other states with significant concentrations of irrigation manufacturing, each have only six or seven company headquarters. Irrigation employment is more concentrated in the San Joaquin Valley than in California, making it a significant source of wealth for the region.



Technology Innovation: The San Joaquin Valley Leads the Way

It is critical that the same resourcefulness that has made irrigation such an important economic and cultural activity over the past 100 years be brought to bear in the future. If so, irrigation as whole will likely continue to adopt more sustainable practices—practices that provide both economic and social benefits while reducing environmental harm.—A New Era for Irrigation¹²

Technological advances in irrigation will enable irrigators to increase their productivity without harm to the environment. The advances will offer irrigators a way to use less, but more sophisticated human resources, less energy and chemicals, and less fresh water, potentially saving farm and landscape irrigators significant sums of money. That shift is happening already, especially in California. San Joaquin Valley's dry, hot growing season; expensive water, and strict environmental regulation have been the major driving forces in California's leading position in both using and manufacturing more water-efficient water-application systems. Between 1988 and 1994, the number of farm acres irrigated using micro-irrigation doubled, from 2% to 4% of all irrigated acres in the United States. In California, however, 13% of all irrigated acres are irrigated with micro-irrigation; 72% are irrigated using flood irrigation, a relatively less efficient method of water application¹³. Much of this method can be converted to micro-irrigation, which presents a large opportunity for California micro-irrigation manufacturers. California farmers, as a whole, pay more for their water than do farmers in any other state. As the price of water goes up and the supply of water available to agriculture goes down, reducing water use will be everyone's concern and a continuing driver for the micro-irrigation industry.

Most research and technology in irrigation system and component design happens within the largely private companies dominating the irrigation industry. The larger companies spend a significant portion of their revenues on product development and design. Innovation is spurred on by changes in the market, changes in the natural and political environment, and technological breakthroughs. The Center for Irrigation Technology at California State University-Fresno will partner with companies to “qualify” their new products for market. One of the most recent innovations in the field is drip irrigation and other micro-irrigation methods enabling landscape and agricultural irrigators to apply water directly to the roots of the plant, increasing the efficiency of water use and reducing runoff of pesticides and fertilizer, because the runoff in general is less. It is the only form of irrigation practical for orchards and vineyards planted on hillsides. Fully 100% of strawberries in California and much of the grapes, tomatoes, celery, and lettuce use drip irrigation. An increasing percentage of tree fruit and nuts are using drip irrigation as well.

The New Economy Opportunity

The San Joaquin Valley’s irrigation industry could become increasingly competitive in the national and global markets. The San Joaquin Valley industry has a strong base from which to build: a strong local market for micro-irrigation and sprinkler irrigation; a booming national market in retail landscape and turf products; a large, well-networked base of existing San Joaquin Valley irrigation companies; a concentration of knowledge and expertise in all facets of irrigation technology; and research and education institutions to support the industry. Wages in the industry are relatively low, signifying a lower-than-average use of technology—a probable reason for its slow growth despite a healthy global market.

The next-generation irrigation industry will build on its strong networks and emphasis on quality to catapult it into an agile, flexible manufacturing industry that is quickly able to respond to changing consumer needs and focuses on increasing the value added of the product it manufactures and sells. Competitive manufacturing is moving toward fast, flexible, and responsive 24 X 7 operations whose competitiveness is due to special knowledge, innovation, networks, and quality. Contract manufacturing is more the norm than the exception. To continue to compete in a global, e-commerce dominated market, the San Joaquin Valley’s irrigation industry will have to increase its emphasis on international trade, peer-to-peer technology transfer for irrigators and entrepreneurship development for manufacturers. For instance, Rain Bird International, a highly innovative firm, offers design advice on its Web site, aiding do-it-yourselfers, whether or not they purchase a Rain Bird product.

Companies will contract their manufacturing component and focus more on design, sales, and customer service. About 265 companies are in the irrigation industry in the San Joaquin Valley, many of them active in manufacturing either plastic or metal components of irrigation systems. With such a large demand for plastic and metal components, the San Joaquin Valley has an opportunity to enhance its contract manufacturing capabilities, using state-of-the-art facilities and processes. Increasing the San Joaquin Valley capabilities in plastics and metal contract manufacturing could dramatically reduce the costs of producing irrigation equipment. The consolidation that is occurring within the California irrigation industry is primarily to increase the product line offered to clients, especially commercial and retail clients, to gain access to additional markets and reduce unit costs. With an active,

effective irrigation industry network, such consolidation would not be necessary. Contracts among producers of different components would enable greater specialization and a stronger regional industry.

Regional Assets

The evolution of the San Joaquin Valley's Precision Irrigation Technology cluster will be facilitated by investments in or enhancements of the Valley's existing regional assets.

A Concentration of Expertise and Skills

With 5,000 people currently employed in the irrigation industry, primarily in and around Fresno, an excellent base exists of people already trained in plastics and metals manufacturing and in irrigation technology and system design. San Joaquin Valley firms have easy access to specialized talent from other regions—especially coastal regions—and universities.

University Education and Training Capabilities

The Center for Irrigation Technology, located at California State University-Fresno, and the Center for Irrigation Training and Research at Cal Poly San Luis Obispo are vital resources to the community of agricultural irrigators. They provide education and training on the selection, use, and management of a variety of irrigation system designs. The CIT also provides services to the irrigation manufacturers, testing the quality and reliability of their products before they are marketed to the public.

Water Resource Agencies

The Department of Water Resources and the Irrigation Districts responsible for managing the California Water Project and San Joaquin Valley Project water supply are potential sources of education and training for form and turf irrigators on irrigation technology and systems.

Location

The San Joaquin Valley has cost advantages to manufacturers providing products and services not only to San Joaquin Valley-based customers, but also to customers on the coast and throughout the Western United States, where the heaviest users of irrigation equipment are located.

Strong Local Market, Growing Global Market

The strong market for micro-irrigation, the booming retail market, and the growing global market present enormous opportunity to irrigation manufacturers.

Requirements

The San Joaquin Valley's Precision Irrigation Technology cluster will require the creation of or additional investments in a number of areas, including international trade entrepreneurship training and support, technology transfer, and financial incentives.

Expand International Trade

Growth in sales of irrigation equipment manufactured in the San Joaquin Valley will require increased export activity. Relatively few Valley manufacturers are currently involved in export trade, or taking advantage of federal tax credits for doing so. There is a need for cluster-based export services and support. Such services would include: entrepreneurship training for manufacturers on exporting, marketing and business planning; implementation of a regional irrigation exhibit that would travel to tradeshow throughout the world; support for manufacturers who travel abroad to tradeshow; and, expansion of the services offered through the Fresno City College Export Center.

Contract Manufacturing Center

Develop a teaching/research institution to foster quicker conversion to contract manufacturing, teaching local business owners how to increase the flexibility of their manufacturing operations.

Water Contracts

Legislation enabling easy selling of conserved water for other uses is an incentive to use water more efficiently. Institute tax credits for irrigation capital expenditures to motivate growers to switch to more water-efficient, and fuel-efficient, water-application systems.

Peer-to-Peer Technology Transfer

More peer-to-peer transfer of knowledge about new irrigation technologies is necessary. The biggest barrier to increased use of efficient irrigation practices is conservatism on part of the farm community. The most influential means of "selling" new water-application technologies is by having innovative farmers who have adopted these practices inform others about their experience with it. Irrigation districts, too, should take a more active role in testing and demonstration of new technologies and in educating irrigators to use cost-effective technologies.

Irrigation Network

A partnership of irrigation manufacturers, agricultural producers, turf irrigators, and federal and state water agencies should be established. The Network would buy research from the most appropriate research institution, including University of California-Merced, the Center for Irrigation Technology at California State University-Fresno, or the Center for Irrigation Training and Research at Cal Poly.

Metals Manufacturing Technical Training

Nearly all metals manufacturing firms expressed the need for more sophisticated, advanced training in metals manufacturing trades, such as welding, machining and tool and die. Just as important, there is a need for improvement in K-12 education resulting in graduates adept in communication and mathematical skills.

Air Travel

The Fresno Airport should be upgraded to allow easy access to and from LAX or SFO for easier travel to global markets.

Agricultural Technology

The Opportunity

Agricultural technology is an opportunity area for the San Joaquin Valley. Agricultural technology includes agricultural biotechnology and precision agriculture. Agricultural biotechnology consists of engineering plants to resist pests, tolerate herbicides, taste better, be more nutritious, have a longer shelf life, and process better. It also includes animal pharmaceuticals. Precision agriculture means applying information technologies—such as global positioning systems, geographic information systems, photogrammetry, telecommunications, and remote sensing—to varying inputs such as water, fertilizer, and pesticides so as to save resources, increase productivity on less land, and reduce environmental pollution.

The San Joaquin Valley opportunity is to build off of existing and future university-based research in the Valley to develop a concentration of expertise in precision agriculture and to export this expertise worldwide. Second, the opportunity is to build off university-based research in biotechnology to develop a new industry cluster around developing and producing transgenic seeds and animal pharmaceuticals that the Valley can then market to the world.

A Base to Build From

According to a report commissioned by the California Assembly, agribusiness is “arguably the most capital-intensive, most technology-intensive, and most information-intensive industry around. Government-subsidized technological improvements in machines, seeds, and fertilizers have led to vastly increased crop yields.

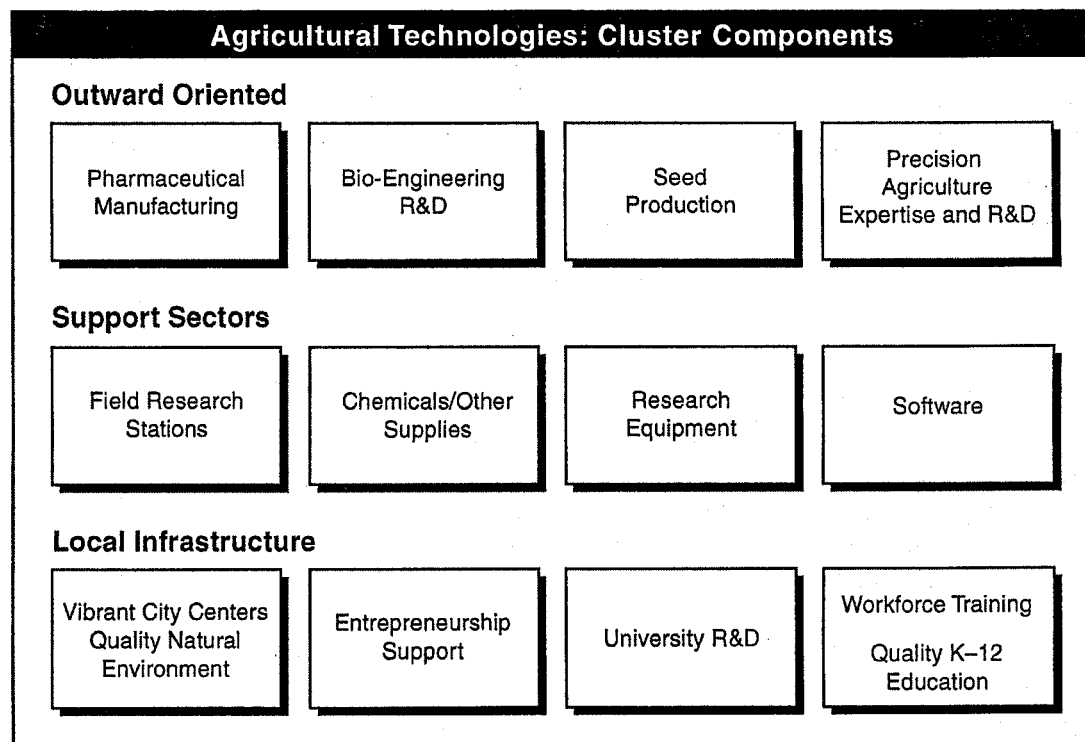
Advances in irrigation, fertilizer, pest management, seed-production technologies, and tillage practices have been responsible for more than doubling the per acre productivity of farmland since the late 1960s. Similar growth in productivity is likely in the future and will be due to plant engineering and increased use of integrated pest management and precision agriculture.

Currently, approximately 2,600 agricultural services establishments exist, many of them not technology oriented. Employment in this sector is currently about 40,000, growing at an average annual growth rate of 5.8%. Of all the clusters studied for this report, this cluster has the largest concentration of employment relative to that of the United States, being 20 times more concentrated in the San Joaquin Valley than in the United States. Wages are higher than average in the San Joaquin Valley and higher relative to those of the nation, reflecting higher use of technology-intensive processes.

Agricultural Biotechnology

Already the San Joaquin Valley is home to a number of biotech firms, including British-owned conglomerate Zeneca, Dow Agro, Novartis, Lipton, and Harris Moran Seed Co. Zeneca and Dow Agro conduct field research testing of genetically modified seeds in the California soils and climate. In addition to private field research stations, several public field research stations are in the Valley, including those operated by the University of California at Parlier, Five Points, Lindcove, and Shafter (San Joaquin Valley); those operated by Cal Poly

San Luis Obispo; and those operated by Edison Ag TAC in Tulare. Boswell farms, leader in cotton cultivation, is experimenting with new transgenic cotton seeds, and Harris Moran develops genetically modified plant seeds.



Market Potential for Agricultural Biotechnology

As of 1998, 75% of all farmland devoted to transgenic crops was located in the United States, increasing by about 250% since 1997. The five principal transgenic crops grown worldwide are soybean, corn, cotton, canola, and potato. Of these crops, only cotton is grown on a large scale in the San Joaquin Valley. However, California growers and seed companies are developing genetically modified cotton, tomatoes, apples, walnuts, lettuce, peppers, and grapes, though not on a very large scale.¹⁴ Instrumental in the current research and development efforts is the University of California-Davis Seed Biotechnology Center, which partners with firms to conduct research on a variety of new seeds.

Total industry sales for all biotechnology, including ag biotech, reached \$13 billion in 1997, a 205% increase over 1996 sales. And sales per agricultural biotech firm averaged \$56 million dollars in 1997, up 30% over 1996 sales.¹⁵ Since 1987, the U.S. Department of Agriculture has approved more than 860 applications and notification to field-test transgenic crops.¹⁶

The benefits of transgenic crops are many. Biotechnology is developing seeds resistant to infestation, more nutritious crops, more favorable ripening, and better acclimation to climate or water conditions. The benefits of agricultural biotechnology, in terms of plant engineering, are herbicide-resistant plants and insect-resistant plants. Most seed development is devoted to herbicide resistance, enabling farmers to spray less herbicide, less often, and without killing the crop. In the future, greater emphasis in plant engineering will be placed

on enhancing the nutritional and medicinal value of plants and the production of non-food products from plants.

Transgenic crops allow farmers more flexibility in managing their crops, using less herbicides and pesticides and producing higher yields and higher-grade products.¹⁷ As a result of growing transgenic crops, farms reaped a collective economic benefit of \$159 million in 1997. Global sales of transgenic crops grew from \$75 million in 1995 to \$1.2 billion in 1998. The global market for transgenic crops is likely to reach \$25 billion by 2010.

The driving forces behind the rapid growth in agricultural biotechnology are to reduce the environmental impact of farming by applying fewer chemicals—fertilizers and pesticides—to the ground, grow food more effectively and efficiently, increase productivity, and improve the quality of the food—whether in appearance, nutrition, or shelf life. The first wave of transgenic crop activity is focusing on improving pest resistance and making crops herbicide resistant. The second wave will focus on food quality, shelf life, and flavor.

Within 10 to 20 years, the San Joaquin Valley will likely be home not only to the field research stations for major ag biotech companies, but also to the manufacturing branches. The University of California-Merced will have a biotechnology program focusing on agricultural biotechnology. As this program becomes more fully developed, biotechnology firms will start and locate around the university to facilitate easy collaboration on research and development projects. So, in the longer term, the San Joaquin Valley will also be home to some research and development, situated primarily in the Merced area.

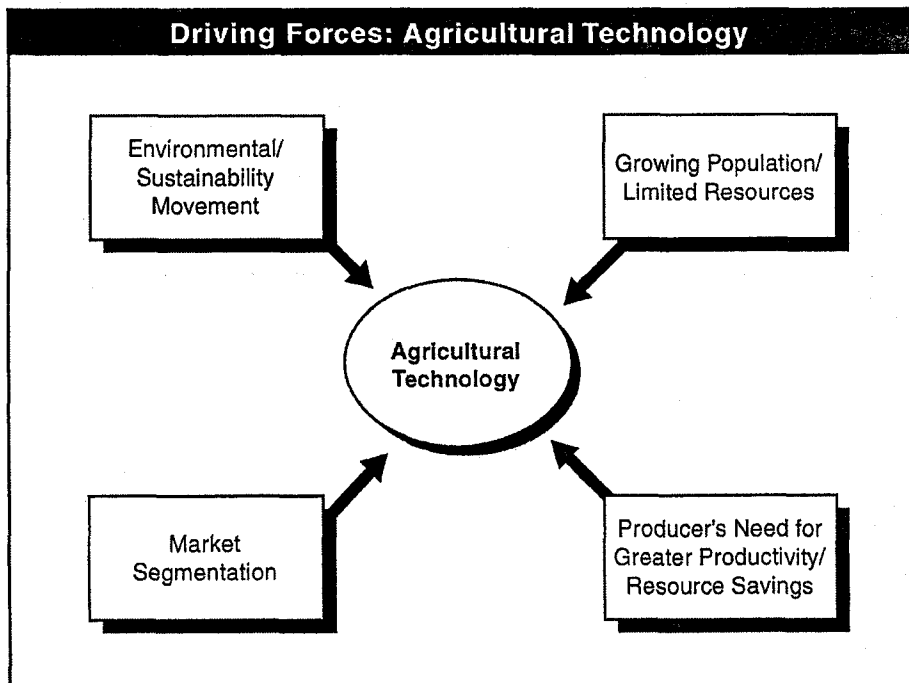
Precision Agriculture

Precision agriculture is the application of information technologies—global positioning systems, geographic information systems, variable rate controllers, infield and remote sensing, and telecommunications—to apply inputs (water, fertilizer, pesticide) at optimal rates that may vary throughout the field. Precision agriculture allows the farm manager to monitor and assess the agricultural enterprise precisely at a local and farm level and to have sufficient understanding of the processes to be able to apply the inputs in such a way as to achieve a particular goal. Global positioning system technology allows farm managers to correlate geo-based data on crop yields with geo-based data on fertilizer, water, pesticide, and herbicide application rates. Variation in crop yields relative to variable inputs enables farm managers to know more precisely the optimal amounts of inputs to apply, thereby conserving resources, increasing productivity, and decreasing negative impacts on the environment.

The San Joaquin Valley's opportunity is to build from both the university-based research and the concentration of farm production to develop a concentration of precision agriculture expertise in the San Joaquin Valley and to export this expertise to farm operations around the world. Enabling technologies—both GPS and variable application mechanisms—are being more fully developed at universities throughout the United States, Canada, and Europe, and local firms with expertise exist in the San Joaquin Valley. The market potential for precision agriculture is large, but adoption is slow. Early adopters include larger farms and those partnering with University of California-Davis in research to optimize nutrient delivery mechanisms. Adoption of these technologies is driven by the potential for

increased per acre yields with lower input costs; increasing pressure by the environmental organizations and by consumers on the agricultural community to use fewer pesticides, water, and fertilizer; and the ability to sell unused water rights on land not irrigated because of increased per acre yields.

The Fresno area includes several firms with expertise in applying GPS and GIS to farm operations in addition to other industries. These firms have evolved from relationships and joint projects with the Geomatics Engineering program at California State University-Fresno. Advances in irrigation technology, allowing precise water application, is also based in Fresno. Both of these industries provide a foundation for beginning to build a concentration of precision agriculture expertise in the Valley.



Regional Assets

The evolution of the San Joaquin Valley's Agricultural Technology cluster will be facilitated by investments in or enhancements to the Valley's existing regional assets.

University of California

Both University of California-Davis and the future University of California-Merced are powerful assets to the San Joaquin Valley region's agricultural technology sector. The current research and development that is occurring at University of California-Davis in agricultural biotechnology and food science is world renowned. A few active industry-academia partnerships bring the assets of the university and industry together to further the science of agriculture. More such partnerships need to develop.

University of California-Merced will have additional programs devoted to agricultural and environmental technology. They are the Sierra Nevada Research Institute and academic

programs in bioengineering, environmental engineering, environmental management, and resource management.

According to a State of California report on biotechnology, a critical mass of biotechnology companies and proximity to major research universities are important for start-up firms and for the development of a regional bioindustry industrial cluster. Biotechnology may emerge in parts of the state that do not have existing high-technology industries but that do have factors important to biotechnology, such as related university research and a trained technical workforce. Another research institution would be necessary to conduct basic research and to produce Ph.D. who would then work in newly created companies. An industrial education facility would be necessary to train production workers, possibly working at the manufacturing plants of Oakland- or Silicon Valley-based firms that moved into the mass-production phase of their business and decided to locate in the San Joaquin Valley.

California State University-Fresno Geomatics Engineering Program

The Geomatics Engineering Program at California State University-Fresno is the first GME degree program in the United States. The program issues approximately 25 B.S. degrees annually. Graduates and professors have formed several companies in the Fresno area. Graduates have expertise in applying global positioning system technologies as well as photogrammetry technologies in many industries, including agriculture.

Requirements

The San Joaquin Valley's Agricultural Technology cluster will require the creation of or additional investments in a number of areas, including research, technology transfer, and infrastructure.

Agricultural Biotechnology Network

More industry-academia research partnerships are necessary to build upon and sustain the Valley's expertise and competitiveness in biotechnology research and, ultimately, manufacturing. The Agricultural Biotechnology Network would be made up of universities, food commodity groups, food processors, food and fiber growers and related scientists, the FDA, the Department of Health Sciences, and related organizations that would form a network that could decide what research is necessary and raise the money to fund that research. University of California-Merced, the only research university to be located in the San Joaquin Valley, must become a major player in building the base of agricultural technology in the Valley.

Currently, the University of California-Davis Plant Engineering program is funded by a large National Science Foundation Award. To supplement this award, commodity groups and large farms and ranches have contributed funds to support research that will benefit their operations. The program has partnerships with many of the commodity groups to conduct field testing on crops throughout the San Joaquin Valley. More funding is necessary. The large diversity of specialized commodities (250) grown in California results in fewer acres devoted to any one crop. This constraint makes it very expensive for any one grower to support genome research. More government funding is necessary to support the agricultural

biotechnology research on California's specialized crops. Government support is necessary to sponsor its own genomics research for application to California products. This support will ensure that California institutions own the results of the research.

Predictability in Land Use and Building Construction Regulations

New economy companies value communities that can expedite decision making on facilities. As maturing coast-based biotechnology firms search for locations to build manufacturing operations, they will seek to locate in communities with clearly established land use and building design and construction guidelines. With time to market the key to competitiveness in the new economy, if companies have to wait longer to get approval for a new building than they take to develop the new product, they will look elsewhere.

Bandwidth for Technology-Oriented Companies

Companies are working across multiple sites and communicating internationally. Every work site in every building should be linked to high-speed data networks.

Technology Transfer for Precision Agriculture

Adoption of new technologies, especially communication technologies, is well documented by Everett Rogers¹⁸. Early adopters consist of larger, more highly capitalized firms that are innovative and not risk averse. To develop the precision agriculture industry, the demand for the technologies will need to be developed. This development will require a program of technology transfer activities similar to those applied by the UC Cooperative Extension . University of California-Davis, College of Agriculture and Environmental Sciences, Department of Pomology, is conducting research related to precision agriculture. A need exists to increase the amount of research being conducted and to disseminate the findings of that research and to conduct training with farm managers on implementing precision agriculture practices.

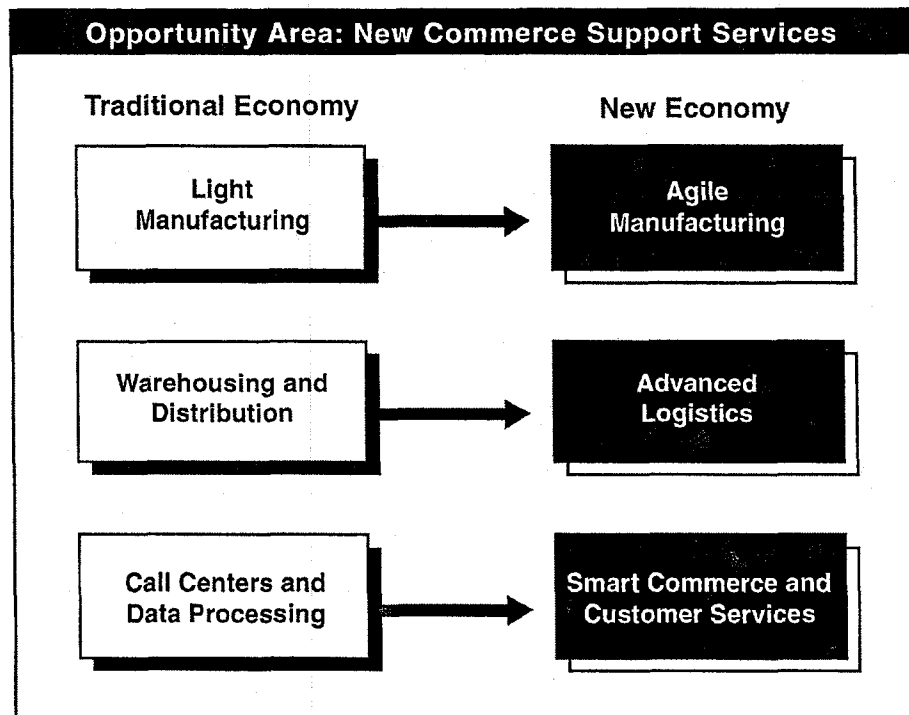
Venture Capital

The formation and growth of innovative agricultural and environmental technology companies will require access to venture capital.

PART III: OPPORTUNITY AREAS IN NEW COMMERCE SUPPORT SERVICES

A Base to Build On

The San Joaquin Valley has assets and a growing industry mix that, if strategically cultivated, could make the region a competitive player in supporting electronic commerce and new forms of commerce emphasizing speed and customization. From the current base of call and data processing centers, warehousing and distribution, and light manufacturing could grow smart commerce and customer services, advanced logistics, and agile industrial manufacturing. These new specialties might start by serving local industry activity, but should aim to evolve into export specialties. This evolution will require the development of an entrepreneurial environment.



The distinctive history, industry evolution, and culture of the San Joaquin Valley create a unique opportunity to leverage and cultivate the following ingredients for new economy activity:

- Increasing presence of customer-services centers that could evolve into Internet order fulfillment and complex information processing centers or “smart commerce and customer services”
- Growing warehousing, distribution, and export infrastructure that could become an advanced logistics nerve center

- Growing workforce with good transferable skills for a just-in-time electronic economy, given agricultural work experience and its culture of perishability
- Increased building of advanced communications infrastructure
- Presence of export-oriented agriculture, food products, and non-food-related manufacturing, which has the ability to become agile and advanced.

Together, these items suggest an opportunity to be competitive in providing important “back-end” services for the electronic economy. The hype of electronic commerce has focused mainly on purchasing products online. However, a vital and complex series of activities lies between the processing of that order and its ultimate delivery to the customer. These activities involve customer services, supply-chain management, and advanced logistics, in addition to customized manufacturing.

What Is Creating This Opportunity?

The growth of the Internet and other digital networks is transforming the way commerce is conducted, both between businesses and between businesses and consumers. Estimates suggest that by 2003, business-to-business e-commerce (e-business) will reach \$1.3 trillion and business-to-consumer e-commerce (e-tail) will reach \$108 billion.¹⁹ This change does not take into account all the new and hybrid industry specialties that will emerge from this transformation of commerce.

Networks and information technology are being used to design, produce, market, buy, sell, and deliver products and services throughout the world electronically. Internet-based networks accessible to all are opening doors where proprietary networks had precluded smaller companies from business opportunities. This change has created a need for all types of business-related software that operates in an open systems environment. The drive is to develop these systems and link them together to increase efficiency across the value chain. This chain begins with a raw material and ends with a customer. Whether it is the design of software that allows a person to order a product online or the warehouse management systems (WMS) that maintain inventory controls and more sophisticated supply chain functions, the demand is to develop and integrate these systems.

Importantly, e-commerce and information technologies are driving industries and markets to be increasingly customer driven. A customer-driven economy is increasing the need for:

- Real-time response to the customer
- Flexibility to meet changing customer demands
- Customization to meet customer specifications.

E-commerce is creating unique value-added opportunities in industries from agriculture and manufacturing to insurance and banking. It enables speed, flexibility, and specialization, and it is scalable for big as well as small operations. The Computer Systems Policy Project (CSPP) writes in its 1998 guide to Global Electronic Commerce Readiness that “the explosive growth of information networks, and increasing consumer confidence in technology, open the door for commercial pioneers to develop new businesses, and revitalize existing businesses.”²⁰

The following sections explore three specific technology-based economic development opportunities that exist along an e-commerce enabled value chain—from raw asset to consumer. They look at the impact of advanced communications—the foundation for e-commerce—on commerce and customer services and the other main clusters that this cluster could help to transform: warehousing/distribution and manufacturing.

Agile Industrial Manufacturing

Agile manufacturing is a primary example of new economy principles and practices. This customer-focused approach to manufacturing is building competitive advantage for manufacturing businesses in advanced economies. Agile manufacturing plays a key role in supply chain activity, and the more integrated this activity at the regional level, the more competitive and prosperous the region.

From Traditional Industrial Manufacturing to Agile Manufacturing

The San Joaquin Valley's manufacturing base, initially oriented to supporting agriculture, has diversified over time to support specialized markets as varied as medical equipment and golf course irrigation systems. The San Joaquin Valley has an opportunity to develop and diversify this already specialized base into an agile manufacturing cluster, which supports diverse markets in and outside the region.

Job opportunities in agile manufacturing require good technical skills that need to be upgraded through continuous training. These skills create a strong base for career mobility in the new economy. In addition, the agile approach to manufacturing is entrepreneurial and encourages such business skills in employees at agile manufacturing firms. "Agile competition is based on the ability to thrive on change and uncertainty." Companies use entrepreneurial organizational strategies, to respond more quickly to changing conditions than a hierarchical structure to changing conditions.²¹

What Is Creating This Opportunity?

As the scope of competition among manufacturers becomes more global, manufacturing defined by "mass production" is giving way to customer-defined "mass customization." Signs of this new economy shift in manufacturing include shorter product life cycles, increasing use of technology in manufacturing process, and simulation modeling for new-product development. These changes are being fostered by the convergence of networked computing, advanced communications, and process technologies used in manufacturing goods. In this environment, agility is the key to survival.

New Economy Industry Snapshot

Agile manufacturing applies to industrial manufacturing across a range of industries, from plastics to textiles. This snapshot looks at metals-based manufacturing because of the prominence of this form of manufacturing in the San Joaquin Valley. In general, metals-based manufacturing is an evolving and diverse industry, ranging from sheet metal fabricators and fabricated structural metal manufacturers to tool-and-die makers and orthopedic appliance manufacturers. With multiple applications, an important focus for metals-based manufacturers is process and approach.

To gain a business advantage, manufacturers have made important shifts in their operating models:

- From product to solution
- From vertical integration to flatter organizations with lateral integration
- From managers to leaders
- From sales to continuous transactions
- From suppliers to associates.²²

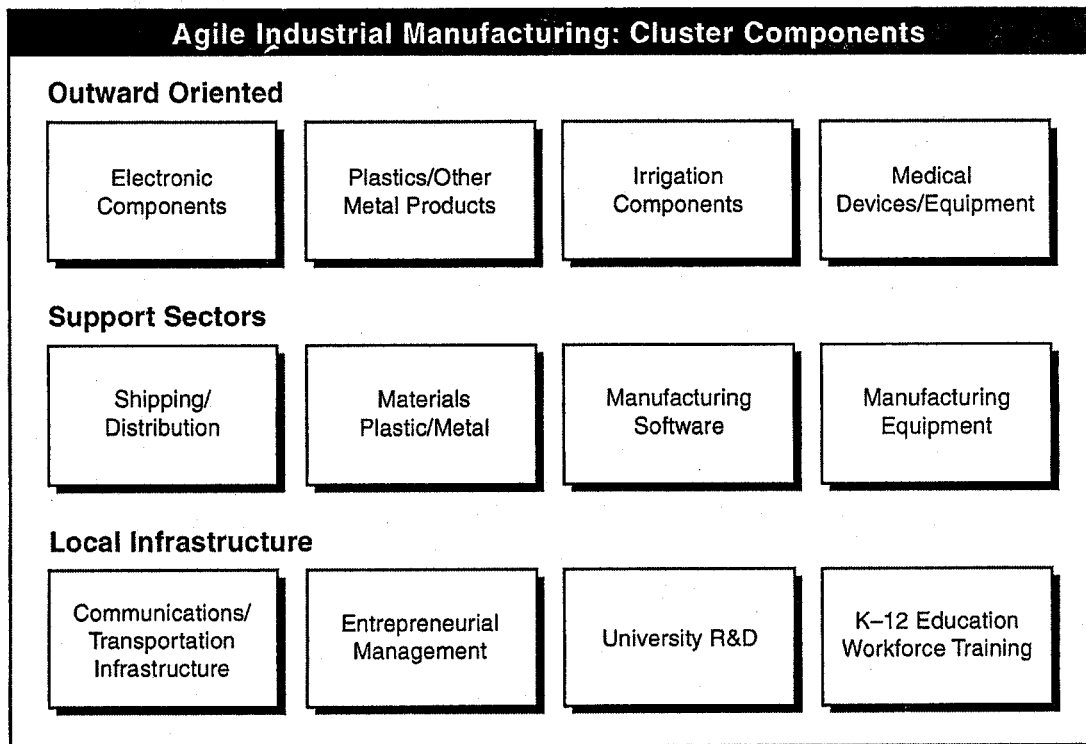
The agile approach creates competitive companies in manufacturing in the new economy.

The Growth of Manufacturing in the San Joaquin Valley

The San Joaquin Valley has an opportunity to drive its traditional light-manufacturing base onto an agile manufacturing path. Metals-based manufacturing is showing solid growth in the San Joaquin Valley. Employment growth has been increasing at rates similar to those of the nation. This industry area shows a slightly less than average concentration relative to the nation. Employment in metals-based manufacturing grew by 16%, from a little more than 5,200 to more than 6,000 between 1993 and 1998. The average annual pay in this cluster was approximately \$38,000 in 1998, a 32% increase from annual pay in 1993.

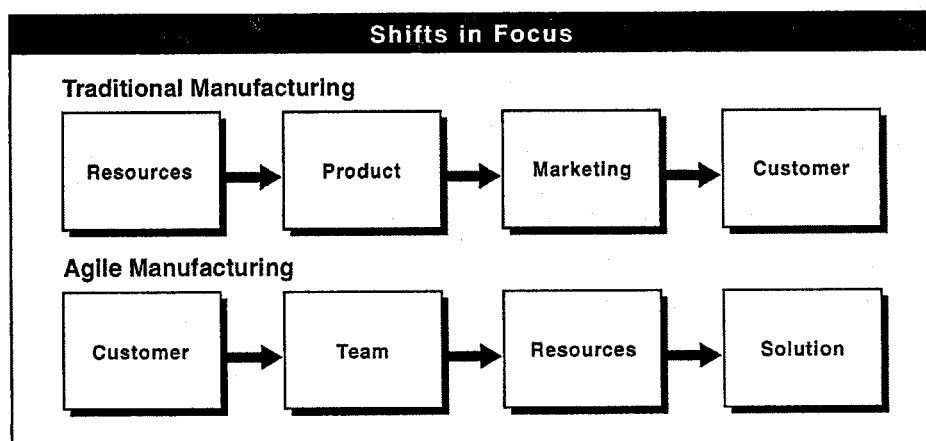
In some cases, specialized San Joaquin Valley metalwork outfits are engaged in building the interiors of military vehicles or developing and applying special coatings to metals for use in the aerospace industry. In others, they are businesses supplying value-added materials to clients making products that range from movie sets to oil filters. Not surprisingly, some are active in creating the building materials and systems for new high-tech logistics facilities in the San Joaquin Valley. Others are developing tools and machinery for agriculture. Apparently a good level of local producer-supplier relationships could form the basis for an agile manufacturing network.

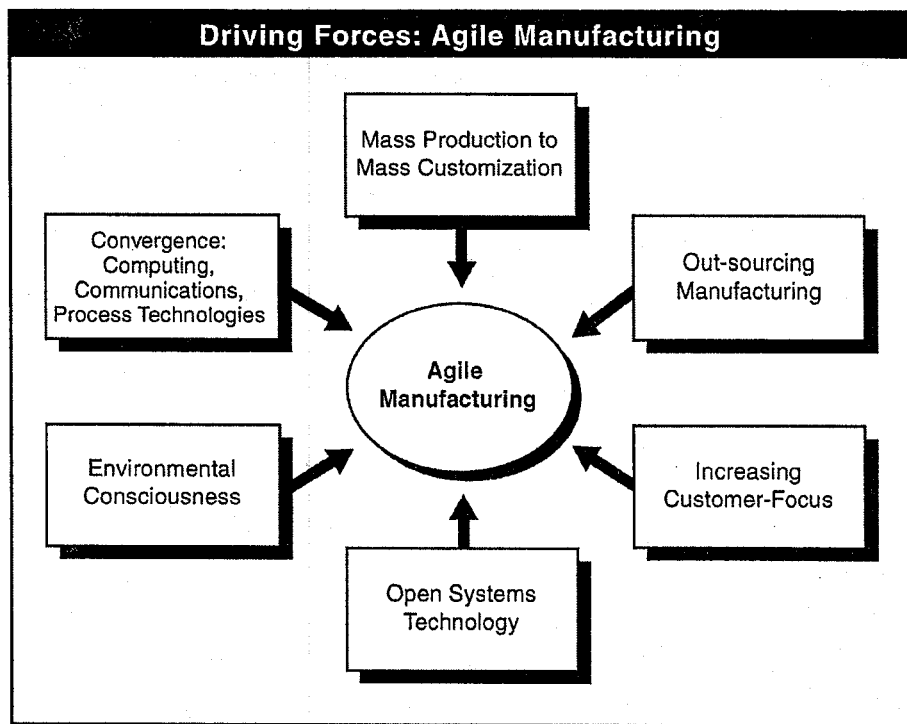
Importantly, San Joaquin Valley metals-based manufacturing activity shows important signs of new economy activity. It tends to be specialized, and it is growing—able to respond to hanging customer needs. It is also small in scale.



From Generic Product to Total Solutions

In the agile manufacturing model, companies are customer focused rather than manufacturing process driven, as they seek to provide solutions that add value to their customer. Solutions can be products, processes, or services but are generated with the customer's specific needs in mind. Relationship building, information sharing, and a team approach are essential to making this work. In the new economy, manufacturers need to bundle products with value added services. This integration of the two helps to build the responsive relationship necessary between producer and customer. It also enables manufacturers to ensure profitability better in product lines where margins are thin.





Environmental Consciousness and High Performance

New economy agile manufacturing is concerned with environmentally conscious manufacturing; it can increase production efficiencies and reduce environmental waste.²³ R&D is leading to advances in reducing the fluids necessary for manufacturing, particularly cutting and drilling processes. Efforts to achieve dry or nearly dry machining are under way. Innovative R&D is transferring the properties of the cutting fluid to the tool material with the use of special coatings. Other efforts include experimentation with dry machining, mist collectors, and cutting fluid evaluation. This type of process improvement through R&D achieves greater efficiencies in the production process necessary for new economy competitiveness and region environmental health.

New Computer Tools and Databases

Technical and managerial tools are necessary to respond to the new economy manufacturing environment, characterized by smaller lot sizes, a larger product mix, and short part life cycles. Manufacturers are now using machining process models that act as useful tools for machining process design and analysis. These software tools reduce the need for trial and error and experimentation using actual production equipment. "Simulation of a machining process can provide an effective means of reducing lead time in process and product development. Simulation allows one to predict machining performance for given machining conditions without going through the expensive and time-consuming experiments with actual machines which must be used for production."²⁴ Manufacturers that have the ability to adopt such technology simulation tools will be well placed to compete in the new economy, where shortened product life cycles require rapid innovation.

Similar to the software tools being developed for electronic commerce, advanced communications, and logistics, agile manufacturing is also moving toward open architecture control systems, so that upgrading and interaction with other systems in a network are possible.

Agile Manufacturing Partnerships and Networks

In the new economy, collaboration is essential for technology commercialization and transfer to manufacturing businesses. Companies that cannot respond to unique customer requirements will lose significant market share to others who can. Moving simulation methods and other process technologies into a real-time product-development process requires expertise from many different areas. For the small to mid-sized company, this requirement presents significant challenges.

Collaborative models that create virtual learning partnerships for the introduction of new technology can work effectively to bridge gaps created by size. Successful projects involve cross-disciplinary teams made of up participants from industry, research institutions (e.g., universities), and bridging institutions such as university-industry research centers. This configuration involves the industry, the developers of the enabling technology, researchers, engineers, and technicians. It requires networked computing and Internet access in order to transfer informal and formal knowledge via e-mail and large electronic transfer files. If the partnering were done long distance, teleconferencing would be also be critical to technical meetings and training sessions.²⁵

Agile networks are also being created to help create a seamless interface between suppliers and producers in the provision of total solutions to large-scale producers. For small to mid-sized companies in the supply chain, this interface represents an opportunity to aggregate supply to be competitive in the bidding for larger-scale demand. Internet access is a prerequisite for leveraging such opportunities.

Regional Assets

The evolution of the San Joaquin Valley's Agile Manufacturing cluster will be facilitated by investments in or enhancements to the Valley's existing regional assets.

Signs of Technology Transfer in Manufacturing

Technology transfer in manufacturing processes is occurring as companies collaborate with government facilities like Edwards Air Force Base, in Kern County. In some instances, the partnering is around industry access to lab facilities.

Specialized Manufacturing Base Already Present

The San Joaquin Valley has a small, diverse, and specialized manufacturing base. This nascent critical requires facilitation to maximize opportunities for itself within and outside the region.

Requirements

The San Joaquin Valley's emerging Agile Manufacturing cluster will require the creation of or additional investments in a number of areas, including collaboration, technology, workforce development, and marketing.

An Industry-Driven Mechanism for Collaboration in Meeting Large-Scale Producer Demands

The San Joaquin Valley manufacturing base needs to aggregate up suppliers to be competitive in gaining contracts from large producers. It can accomplish this goal through the use of information technology and the Internet.

New Technology Adoption to Stay Competitive

The San Joaquin Valley needs to develop incentives and opportunities for companies to adopt new technologies. Many companies do not have the resources or access to information to remain competitive or enter larger markets.

The San Joaquin Valley needs a computer-integrated-manufacturing laboratory to serve the R&D needs of the manufacturing base. Market demands will require manufacturers to be on the cutting edge, but smaller manufacturers (which predominate in the San Joaquin Valley) will be unable to do so, without a partner.

Lessons and Resources for Implementing Agile Manufacturing Processes

Companies need resources that help them to become more entrepreneurial and agile.

The growth and development of the specialized manufacturing base will require financial capital.

Greater Visibility for the Diverse Specialized Manufacturing Base

The San Joaquin Valley needs to take stock of the level of skill and specialization of its manufacturing base. It needs to create greater visibility both within and outside the region for this best-kept secret.

Industry-Defined Workforce Development and Training Programs

Strong community college continuous learning programs for technical skills training are necessary in CNC operations and beyond. Also necessary is a manufacturing base survey.

Advanced Logistics

Where Bytes Turn Back into Bits: Customized Ware-facturing and Logistics

As electronic commerce and communications-based information technology become more pervasive, the San Joaquin Valley could become a leader in another value-added area—turning bytes back into bits in a customer-driven, rather than manufacturer-defined environment. The current call center, warehousing, and transport sectors could evolve into Internet order-fulfillment centers and warehousing and distribution logistics networks. E-commerce will become more cost-sensitive as customers seek lower prices with the same level of convenience. This demand-driven inevitability will shine a spotlight on warehousing and distribution, which will provide the opportunities to achieve important cost advantages in fiercely competitive markets.

What Is Creating This Opportunity?

“Logistics is where tomorrow’s strategic advantage will be created. Companies like Dell, Wal-Mart, and Procter & Gamble are already leading the way in creating strategic business advantage through their logistics and supply chain operations,” explains internationally respected logistics expert, Yossi Sheffi of the Massachusetts Institute of Technology (MIT).²⁶ Logistics professionals increasingly have an opportunity to position themselves to “drive value chain integration and customer fulfillment.”

Advanced Logistics: A Growth Industry

Warehousing and distribution is a growth industry in the new economy. The impact of advanced transportation systems and information technology has been so great that the industry is being increasingly defined as a “logistics” specialty. Logistics involves “the process of planning, implementing, and controlling the efficient, effective flow and storage of raw materials, in process inventory, finished goods, services and related information from the point of origin to the point of consumption for the purposes of conforming to customer requirements.”²⁷

Logistics is a \$900 billion industry, which is growing at 20% annually, according to the International Warehouse Logistics Association. This total represents a larger share of the U.S. gross domestic product than that of health care. If online sales reach an estimated \$100 billion by 2003, an additional 60 million to 100 million square feet of warehouse space would be necessary.²⁸

The growth of logistics is creating demand for related specialty services. According to MIT’s Center for Transportation, “As recently as ten years ago, there was virtually no such thing as a contract logistics company, but today there are hundreds of them in business and a whole new industry has developed to supply them with software.” The challenge of Internet fulfillment and delivery is increasingly recognized as a whole new career path within logistics management and will add additional dimensions to the transformation of this industry.

As a strategically located region for distribution to major population centers in the western part of the United States, the San Joaquin Valley needs to be more active in logistics R&D

and innovation, given the amount of warehousing and distribution activity already in the region. At minimum, regional industry players need to adopt information technology to be competitive. They can also apply to be pioneers in developing models for efficient and service-oriented e-commerce at the place where bytes turn back into bits. This wide-open field will continue to grow in importance in the new economy because of electronic commerce market demands, and the San Joaquin Valley should become the strategic as well as physical nerve center for logistics innovations in the West.

The Growth of Warehousing and Distribution in the San Joaquin Valley

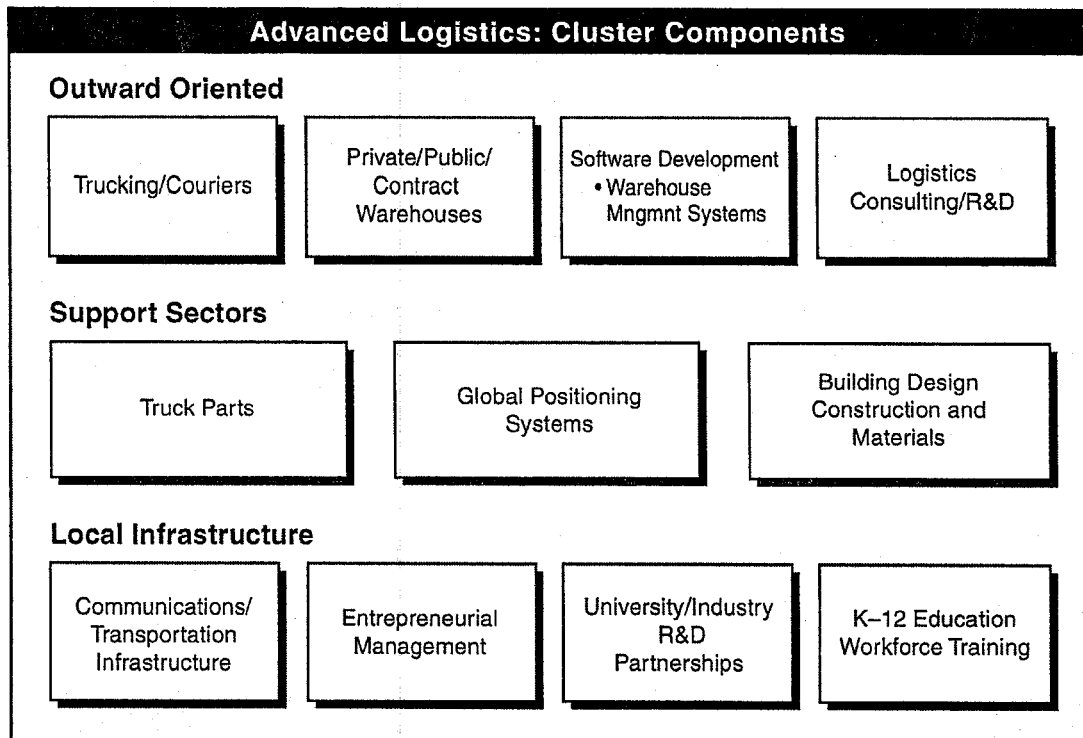
In a recent study of logistics growth in the United States, California ranked third, behind first-ranked Texas and second-place Florida.²⁹ The San Joaquin Valley is home to logistics operations of some larger corporations, including Wal-Mart in Porterville, the Gap in Fresno, Best Buy in Dinuba, and Lever Brothers in Stockton.

Overall, the San Joaquin Valley's warehousing and distribution cluster employed 32,350 people in 1998, adding more than 5,000 jobs since 1993. The average annual pay in this cluster was \$32,000 in 1998, an 11% increase from 1993. Value added per employee declined between 1993 and 1998, suggesting the need to increase productivity in this cluster.

Warehousing and distribution in the San Joaquin Valley shows significant growth in areas suggestive of new economy trends, particularly in public warehousing and courier establishments. Public warehousing caters to multiple customers, a variety of products, and short-term commitments and offers flexible services. Employment growth in public warehousing alone in the San Joaquin Valley has been increasing at rates faster than those of the nation and is more concentrated in the San Joaquin Valley than in the nation.

Growth in the number of trucking and courier establishments has nearly doubled, with employment increasing by about 20% between 1993 and 1998. The number of establishments related to airport and airport terminal facilities has doubled between 1993 and 1998. This sign of courier hub growth is an indicator of new economy growth, in which the trend is toward thousands of smaller shipments, rather than fewer, larger ones.

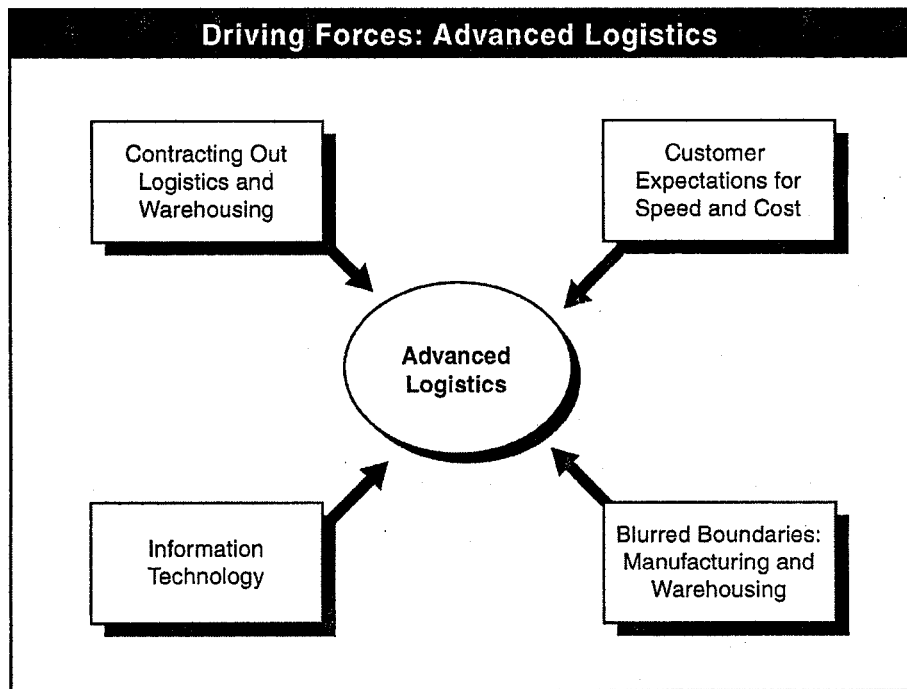
Some experts suggest that regional reach may figure more prominently into retail e-commerce, as retailers seek to reduce costs by bringing stocks closer to consumers to reduce distribution costs. In this regard, the San Joaquin Valley is strategically located vis-à-vis the rest of California, as well as Mexico, the Pacific Rim, and western Canada.



Information Technology

Using information technology in warehousing and distribution is not merely a value-added proposition, it “is the price of admission to the marketplace.” If, for example, “a carrier can’t do business electronically, it can’t do business with many industries.” This case is particularly true in retail.³⁰ The cost of sending an invoice by mail averages \$1.25. The costs drops below 10¢ per transactions via electronic data interchange (EDI) and is likely to get even less expensive if the Internet can be used to conduct such transactions.³¹ Real-time inventory made possible with warehouse management systems (WMS), for example, “minimizes the potential of having the right part in the wrong location” and is another important information technology advantage.³²

The need for value-added activity applies as much to warehousing and distribution services, as it does to the development of any other new economy industry. Warehouses that offer more than empty space for the storage of goods are likely to be more attractive to customers looking for additional services, particularly when those companies are small to medium-sized businesses, trying to enter new markets.³³



Colocation: Closer to the Customer

Value added can enter into many different aspects of logistics. Companies are increasingly looking to colocate functions traditionally associated with management activities and manufacturing. Facilities need to be designed to host these functions, and a prerequisite is to be “wired.” These business functions include accounting, customer services, repair, and other business management activities that benefit from the information that logistics creates about customers. The efficiencies that can be achieved through supply chain planning and management are essential in highly competitive markets, and logistics is at the center of this strategic planning. It is the repository of supply chain data and close customer relationships.

Ware-Facturing

New economy warehouses are sometimes “product transformation centers.” Warehouses can provide value-added final-stage manufacturing for product customization. In the new generation, customized warehousing “lies in the storage of generic product until receipt of a customer demand.” Value-added services range from special palette configurations to packaging, labeling, pricing, assembly, and manufacture. This customization blurs the lines between manufacturing and warehousing, and it has applications in industries from computer and plastics to grocery and juice production. One manufacturer of fasteners for prefabricated buildings uses customized warehousing to fill customer orders. Product is pulled from generic stock made in a manufacturing facility. It is then shipped to one of eight strategically located warehouses, where the product is painted, assembled, bagged, and packed only after an order is placed by a customer.

Optimizing Distribution

The technology leap for warehousing and distribution involves linking orders, inventory control, and process integration. This link makes the supply chain the most efficient it can

be. Texas-based GAF, one of the world's largest manufacturers of asphalt-based roofing materials in the US, took a first step toward optimizing its supply chain processes with a focus on distribution management. This attempt to rationalize the haulage process through the use of technology resulted in a \$500,000 savings in freight costs annually. This experiment in one area of the supply chain was a test for further use of technology. GAF will open a manufacturing facility in Shafter, across the way from its technologically advanced competitor, ELK, shortly.

Cross-docking is another value-added activity, which entails moving products from the supplier's dock through the distribution center without warehousing it at all. This process reduces company inventory stuck in the pipeline, and speeds up the flow of products to the customer.³⁴ Sophisticated cross-docking would include information technology systems that used the Internet or a value-added network to send advanced shipment notices among other things, before a trailer arrives at a loading dock. Again, information technology makes this newer approach feasible, and Web-enabled technology makes linking more aspects of the supply chain more transparent and potentially less costly, because a per transaction fee is not levied.

Regional Assets

The evolution of the San Joaquin Valley's Advanced Logistics cluster will be facilitated by investments in or enhancements to the Valley's existing regional assets, especially transportation and distribution infrastructure.

Location, Location, Location

The San Joaquin Valley is strategically located, with access to markets in the western US, the Pacific Rim, and Mexico.

Developed Physical Infrastructure

The San Joaquin Valley has a well-developed intermodal transportation infrastructure. It has a highly developed rail and road system, with an improving air infrastructure.

The International Trade and Transport Center (ITTC) in Shafter will provide direct rail service to and from the ports of Los Angeles and Long Beach, enhancing the San Joaquin Valley's strategic location in the western United States as a center of trade and international commerce. California shipped.

Requirements

The San Joaquin Valley's emerging Advanced Logistics cluster will require the creation of or additional investments in a number of areas, including research, smart facilities, and airport capacity.

"Warehouse" Facilities Equipped to Respond Flexibly to New Economy Requirements

Facilities have to be flexible to accommodate changing customer desires, including being able to partner with other facilities and services to provide fuller services to more sophisticated customers.

Facilities need to be developed that can provide customized manufacturing function; this development is an important value-added area in the new economy, where mass customization is demanded.

Facilities need to be information technology friendly. They need to be “wired.”

The logistics workforce will require an enhanced skills set and increased levels of flexibility.

Technical Expertise and R&D: It's More Than Just Moving Boxes

A cadre of warehouse management systems and other information and communications technology experts will be in demand to service and evolve supply chain integration functions.

Logistics operations will increasingly require more professional service persons to meet demands for increased colocation of certain business functions at the logistics facility, including accountants, customer services.

Airport Infrastructure Improvements

The commercial and passenger air infrastructure needs to improve in order to meet requirements for air freight-related distribution strategies.

Smart Commerce and Customer Services

One new economy industry cluster is Smart Commerce and Customer Services. This emerging cluster represents new opportunities for the portfolio of current industries in the San Joaquin Valley as well as those that have yet to emerge from the transformation of more traditional forms of commerce.

From Call Centers to Comprehensive Customer-Services Centers

Electronic commerce raises customer-services demands to new levels. Companies able to meet these levels of customer services will create reputations for reliability and security invaluable in this pioneering new form of commerce. Whether it is a foul-up arising from a personal computer's locking up, a Web browser error, Web server time-outs, or credit-card-authorization failures, customer services is in demand. Customers expect speedy response, a new economy value, whether they are awaiting response to an e-mail query or grievance or calling for assistance.

Smart call centers will provide sophisticated customer support in the new economy. This next generation of efficiently provided customer services will have access to detailed information about the customer's account, historical data, and all relevant information to respond to the customer's needs in real time.

Customer Support: A Growth Industry in the New Economy

Sophisticated customer-services centers represent a growth industry. The demand for next-generation call centers is driven by information technology and the use of the Internet. In the United States, the information services industries more than doubled in employment from less than one-half million workers to more than 1 million workers between 1985 and 1996.³⁵ The Bureau of Labor Statistics expects this figure to double again by the year 2006. Data processing and network services is the second-largest information services subsector, and it accounts for nearly 25% of total U.S. revenues in this area.³⁶

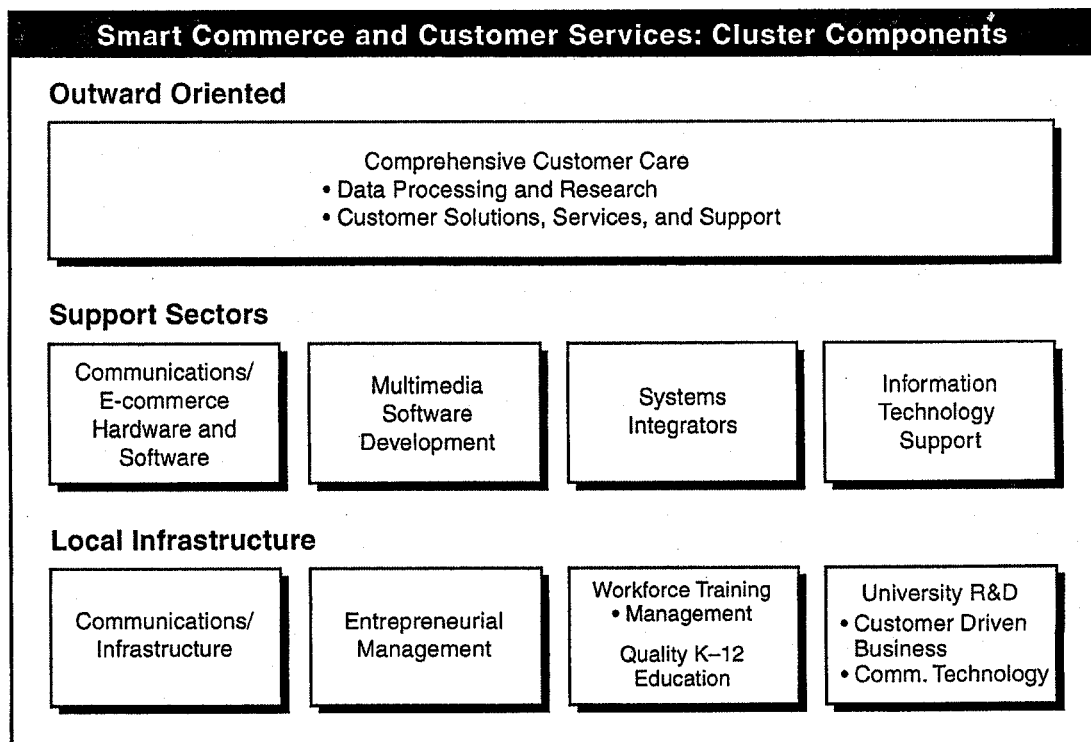
The Internet will continue to create significant demand for customer services. A recent Yankee group survey of 100 large companies found that although 60% use the Web for incoming customer support, less than 10% currently use the Web to provide customer-services responses. The Internet currently acts as another way for customers to contact companies, but not for the businesses to respond effectively to those communications. Nearly 70% of businesses anticipate providing 25% or more of customer-services responses on the Web in two years.

The Growth of Customer-Services Centers and Communications in the San Joaquin Valley

The San Joaquin Valley has grown its base of computer/data processing and telephone customer-services centers and other related communications services in the past five years. Employment in these clusters grew by 43% between 1993 and 1998. The average annual growth rate of establishments in this cluster was a little more than 7%, the second-highest average establishment growth rate of the clusters focused on in this report. The average annual pay in this cluster was a little more than \$57,000 in 1998, a 42% increase in the

average annual wage from 1993. Importantly, the cluster in the San Joaquin Valley showed greater productivity, with a higher valued added per employee than in the United States in the same period.

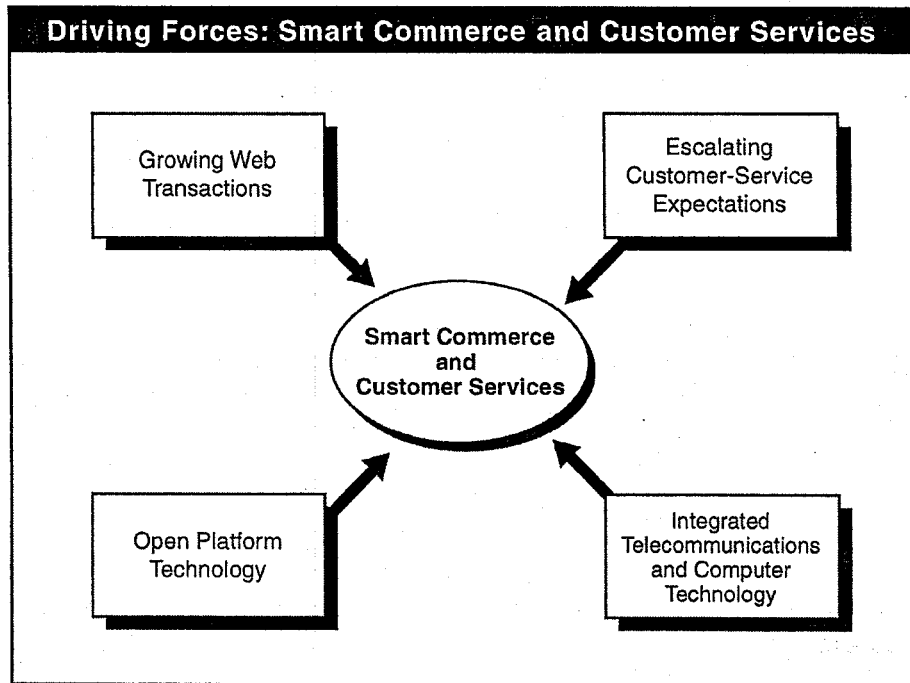
Companies as diverse as AFSA and PacBell have sited facilities in the San Joaquin Valley; they have generated large numbers of jobs from Bakersfield to Fresno. This proliferation of high-productivity call centers in the region is contributing to a flexible customer- and information-services infrastructure that could be leveraged for more sophisticated Internet order fulfillment and other information services. With its loyal, available, and trainable workforce, in combination with fewer, older telephone systems in its facilities, the San Joaquin Valley is potentially well positioned for growth in relation to other regions.



Changing Technology: The San Joaquin Valley and the Online World

The San Joaquin Valley's emerging customer-services center cluster, having to deal with fewer older telephone systems, could become a competitive next-generation 1-800 capitol of the e-commerce world—the 1-800 capitol of the online world.

Until recently, all telephone equipment for call centers and business telephone systems came bundled in one hardware/software package. To add a feature or function, a customer-services center had to wait for its vendor to develop the feature or an interface that enabled use of another manufacturer's equipment. Providing access to databases outside the call center was also complicated. Essentially, the call center was locked in, unless it wanted to start from scratch. In response to demand, vendors are developing call-center equipment based on open system platforms. These systems are interchangeable and easier to evolve to meet rapidly changing market and technology opportunities.



Next-Generation Smart Commerce and Customer Services

Next-generation call centers—“smart” centers—integrate telecommunications and computer technology, so that centers can handle a range of tasks involving e-mail, fax, and Web interactions, as well as voice services. New information systems equipment helps centers to achieve greater efficiencies and offers more value-added services through call routing and detailed customer account information now accessible from different databases. For some companies, the new technology is turning the call center into a valuable source of real-time market research information. This improvement is important in a new economy where customization is key.

Sophisticated call centers are also evolving into “customer interaction centers,” where, in addition to calling, customers can send e-mail, do videoconferences, or chat online from a Web site. Video-enabled commerce is an important part of this next-generation technology. Some customer-services centers are also using case-based reasoning and artificial intelligence software.

Telecommuting: Flexible, Feasible, and Environmentally Friendly

Moreover, some of the most sophisticated call centers are discovering that telecommuting makes sense for this type of customer services. The Internet is making this flexible work option a cost-effective reality. Call center projections for 1996–2001 predict that the number of call centers will double in the next five years and that at least 25% of all call-center agents will work from home as telecommuters. Companies that already have telecommuting call-center programs include America West Airlines, J C Penney, and Hilton Hotels.³⁷

The San Joaquin Valley has an opportunity to develop this more sophisticated customer-services cluster to support many different types of clients, from valued-added agribusiness to retail consumer goods, going well beyond traditional call-center roles and job responsibilities. Positions in these call centers will increasingly demand analytical and technical computer abilities that represent important skills for the new economy. The skills will garner higher wages than those in traditional call centers and will provide individuals in the San Joaquin Valley with greater career mobility.

Regional Assets

The evolution of the San Joaquin Valley's Smart Commerce and Customer Services cluster will be facilitated by investing in and making better use of the Valley's existing regional assets.

An Available and Dedicated Workforce

The San Joaquin Valley has an available workforce with transferable skills from lower-end service positions—in fast-food restaurants, for example—in which similar customer-services skills are necessary. The ability to expand to foreign markets via the Internet makes the diversity of languages spoken in the San Joaquin Valley a real asset.

Cutting-Edge Industry-Driven Education and Training

The Center for Advanced Research and Technology (CART), scheduled to open in September 2000, is an innovation in learning and training that befits the San Joaquin Valley, where at the turn of the twentieth century the first community college in the United States was founded. CART is “a state-of-the-art research and technology center in which students work on projects designed by the local, national, and international business community.” CART will have 11 laboratory environments, one of which is telecommunications.

Entrepreneurial Incubation and E-Commerce Boot Camps

California State University-Fresno e-commerce “boot camp” is a ten-week course for developing entrepreneurial business skills for starting an e-commerce venture. It will be offered for the first time this year. Closely connected with this venture is the Central Valley Business Incubator, a collaborative effort between California State University-Fresno, the Fresno Business Council, the Center for Advanced Research & Technology, and the Fresno Workforce Development Board. The Incubator houses start-up businesses and provides them business and technical expertise to help ensure their growth and success. The Incubator is currently home to nine entrepreneurial firms, six of which are technology businesses, and is looking to expand its facilities to accommodate additional entrepreneurs.

Growing an Advanced Communications Infrastructure

An advanced communications infrastructure is being built in the San Joaquin Valley. Currently, fiber-optic cables run along Highways 5 and 99, forming part of the advanced communications infrastructure that connects major urban centers within the San Joaquin Valley to Los Angeles, Sacramento, and San Francisco. In the more rural areas, the

infrastructure is less developed, though some exciting developments foretell a new economy story for the San Joaquin Valley.

Williams Companies is making a major investment in the San Joaquin Valley to create a fiber-optic backbone that provides access to major north, south, east, and west fiber-optic networks across the United States. Williams will sell bandwidth to Internet service providers (ISPs). This sale will help to drive Internet service costs for consumers down while providing them with improved access.

The growth of electronic commerce could make strategically located San Joaquin Valley a virtual and/or actual port in the millennium. Its unusual combination of warehousing and distribution, customer-services call centers, data processing, and just-in-time culture/training, influenced by the perishability of agriculture, provides critical ingredients for the electronic economy.

Requirements

The San Joaquin Valley's Smart Commerce and Customer Services cluster will require the creation of or additional investments in a number of areas, including infrastructure, workforce development, and research.

Technically Skilled Workers: Necessary for Next-Generation Call Centers

Leading-edge customer-services centers will require increasingly advanced technical, analytical, and organizational skills. Workers will need a good base on which to build through a process of ongoing learning and training.

More Midlevel Managers and Supervisors

Highly trained midlevel supervisors are necessary to manage complex operations in advanced customer-services settings. The San Joaquin Valley needs mechanisms for ongoing training as well as workforce development in this area.

R&D in Communications Technology

University and industry need to partner in the creation of communications technology development to meet industry needs for innovative growth.

Demand-Driven Growth for Advanced Communications Infrastructure

The San Joaquin Valley needs demanding customers for advanced communications infrastructure that can spur the development of that infrastructure.

Critical Mass of Customer-Services Companies

The selective attraction of anchor next-generation smart customer-services companies is important to creating a critical mass of customer-services companies.

PART IV: RECOMMENDATIONS

This Chapter includes two kinds of recommendations for achieving the vision:

Strategic Recommendations. Seven strategic recommendations should form the centerpiece of a regional action strategy. Focusing on these seven strategic areas will benefit all the six opportunity areas described in this report.

Potential Action Initiatives. More than 30 specific actions, organized by opportunity area, should be considered to support evolution of each of the six opportunity areas.

Broad Cross-Cluster Recommendations

Build a Regional Leadership Team

Develop “networks of responsables” across the San Joaquin Valley region that will drive the testing, refining, promotion, and implementation of the new economy vision.

This regional leadership team should include opinion leaders from the business, government, education, and civic sectors. It should include people acting as stewards of the overall regional vision, as well as key people championing each of the six opportunity areas (see Cluster Networks section below).

The Regional Leadership Team should play the following roles:

- *Stewards:* The Leadership Team members should serve as stewards of the vision. Team members should create the vision, declare their commitment to it, and serve as ambassadors for it.
- *Educators/Promoters:* The team should develop and launch a strategy for widespread education of leaders and citizens about the new economy vision.
- *Catalysts:* The Regional Leadership Team should catalyze specific actions to support movement toward the vision. This task includes identifying and supporting champions to advance strategic goals, as well as to refine and prioritize specific action initiatives.

Foster Cluster Networks

Create intermediary institutions, personal connections, and electronic networks that expedite collaborative partnerships among cluster companies, educational institutions, and other organizations.

By collaborating, the small and medium-sized companies so predominant in the Valley can create the scale effects necessary to improve their efficiency and innovation and to serve national and global markets. They will also be able to communicate more effectively with education institutions, training providers, and governments in the region.

In the new economy, regions collaborate to compete. The new economy is about moving from the vertical integration and isolation of business and industry to integration of an economic region through horizontal relationships and partnerships among businesses, research institutes labs, academia, and government. It is not uncommon for competitors in

the same industry to collaborate in order to compete successfully in larger markets. Given the generally smaller scale of industry clusters and business specialties in the San Joaquin Valley and the vast geographic distances, the region must develop institutions and networks that enable collaboration in particular cluster areas.

The starting point is to engage the companies and institutions constituting the six opportunity areas around the vision and recommendations. Cluster companies need to review this report, comment on its validity to their industry, and evaluate and prioritize the action recommendations. Key to this process will be identifying “civic entrepreneurs” who are willing to champion the implementation of specific action initiatives to help their cluster move forward.

The Regional Leadership Team could select two to three clusters to start the cluster engagement process. These selections should be clusters in which companies have demonstrated interest in working together, several potential civic entrepreneurs can be identified, and opportunities for mutually beneficial collaboration seem to exist. Applying these criteria, we recommend starting with:

- Precision Irrigation Technology
- Flexible Food Manufacturing
- Agile Industrial Manufacturing and Advanced Logistics.

The cluster engagement process would include three meetings over a four-month period. The first meeting would focus on reviewing and prioritizing opportunities for collaborative action. The second meeting would focus on developing “business plans” for action. The third meeting would focus on reviewing and refining those business plans. Through the process, civic entrepreneurs would emerge and build commitment to implementation.

Examples of Cluster Networks Already Under Way

The agriculture, food, and industrial manufacturing sectors provide examples of the power of cluster collaboration.

Connecting Suppliers to Manufacturers. Large-scale, export-oriented producers in food- and non-food-related industries that were interviewed often said that they had “outgrown” the suppliers of the San Joaquin Valley. These suppliers have two choices: grow their own businesses significantly or partner to aggregate supply and meet large-scale producer demand. The latter requires cluster collaboration. A new e-commerce server run by California State University-Fresno’s University Business Center at the Central Valley Business Incubator will link suppliers with each other and with producers, acting as an “infomediary.” The “Outsourcing Data Bank” program has proved to be a valuable tool for enhancing buyer-supplier relationships and seeks to have an important impact on the more than 35% of noncritical supplies available from local suppliers but currently purchased outside the San Joaquin Valley. The program will also advise suppliers on how to interact successfully with large-scale producers, seeking to reduce the risk to larger-scale producers and the benefits to smaller-scale suppliers. Additional benefits to local firms include cost reductions as a result of lower transportation and inventory costs, greater ability to work with the supplier on customizing supplies, use of just-in-time systems, and increased opportunities to borrow start-up capital. www.odbonline.com.

Build an Innovation Workforce

Increase collaboration between cluster companies in the six opportunity areas and the high schools, community colleges, and technical colleges in the San Joaquin Valley. These institutions must play a more significant, interactive role in moving the region toward an innovation-based economy.

Create mechanisms for cluster companies to communicate to educators as a group their current and future workforce requirements. This communication includes information about:

- *New Ways of Working in the New Economy*—The kinds of basic skills and orientation required of all workers in the new economy. Given the interviews for this project, these options include basic numeracy, computer literacy, project orientation, and the ability to participate effectively in a team.
- *Occupational Skills Needed by Growing Clusters*—The kinds of occupation-specific skills in demand by cluster companies. Given the interviews for this project, these options include manufacturing technicians who can trouble-shoot computer controlled machinery (e.g., computer numerically controlled machinery operators) and midlevel managers and supervisors across all the opportunity areas.

Ensure from the highest levels that educators are responsive to cluster perspectives and held accountable for ongoing change and dialogue. In the interviews, some companies mentioned being asked for their opinions and participating in initiatives, but then not seeing their investment of time, energy, and resources result in productive change.

The region needs to spotlight successful results from reconnecting educators and the regional economy, to hold up the examples that exist as models, and to share their lessons learned. Doing so will build the foundation for the San Joaquin Valley to capture and generate quality middle-class jobs in its industry clusters over time.

Example of Aligning Education and the Regional Economy

Center for Applied Research and Technology (CART). CART has been designed through a “backward mapping” approach to a career paths curriculum from industry standards. Its business-based learning model is built around 11 high-tech labs in which academic rigor is also a priority. The labs include telecommunication technology, engineering/design technology, biotechnology, agricultural technology, manufacturing technology, and logistics and spatial technology.

Grow a Technology Innovation Community

Shape the basic research activities at University of California-Merced and the applied R&D activities at California State University-Fresno to meet the needs of the industry clusters. In the process, develop a community of applied research professionals in companies and universities that are tightly oriented to the cluster industries (technology innovators).

The creation of University of California-Merced presents a potentially catalytic opportunity to develop comparative advantage for the regional economy in several key research fields. The research agenda and course offerings at University of California-Merced must be aligned with the long-term strategic direction of the San Joaquin Valley economy, or the new university will be an economic island with minimal strategic or multiplying impact on its home region.

University of California-Merced should seize the opportunity to define several industry-driven overlapping research agendas with neighboring California State Universities in the San Joaquin Valley in order to create synergy between innovators and implementers. The applications-focused, business community-connected California State University system could act as an important facilitator of the integration of the university into the region.

Given the interviews for this project, important areas for university research to support the economy include industrial engineering, advanced communications and software engineering, logistics sciences, agricultural biotechnology, food engineering, and precision agriculture, including irrigation.

Stimulate New Economy Entrepreneurship

Cultivate innovation-economy entrepreneurs and next-generation business leadership. Create the places, the support resources, and the culture that encourage people, especially young talent, to recognize business opportunity and exploit it.

The cultivation of homegrown industry is central to the new economy vision of the San Joaquin Valley. Entrepreneurs need both to recognize opportunity and to have the capacity to exploit it. As management guru Peter Drucker explains, “The Entrepreneur searches for change, responds to it, and exploits it as an opportunity.”³⁸ The San Joaquin region needs to take seriously the challenge of stimulating entrepreneurial behavior in its current workforce and encouraging the next generation of business entrepreneurs.

The region should focus on the following strategic areas:

- *Connect Entrepreneurs to Each Other.* Being an entrepreneur in the San Joaquin Valley can be lonely. The entrepreneurs are relatively few, geographic distances are wide, and entrepreneurs often feel misunderstood—a particular problem for those engaged in applying innovations in technology. Create a San Joaquin Valley Entrepreneurs Network to connect entrepreneurs to each other. The network could have regional and community-based components; it could emphasize both in-person and on-line communication and support activities.
- *Build Financial Support.* Develop sources of venture capital and financing. Educate the local banking and investment communities about the value of technology-based companies. Develop a program that provides financing and advising to already existing companies that want to adopt new technologies but lack the resources and information to do so.
- *Develop Other Support.* Develop programs and initiatives that help people to develop entrepreneurial capacity (business plan development, etc.) and the ability to recognize opportunity. Make new economy infrastructure, such as advanced communications, available and affordable to small and young companies.
- *Create Places That Foster Entrepreneurship.* Provide facilities for businesses to incubate, interact, and grow. Create neighborhoods and districts attractive to young people (i.e., “hot ideas” often come from “cool places”). View livability issues from the perspective of young talent. (See Urban Vitality recommendations below.)

Develop New Economy Regional Identity

Develop and communicate a new economy regional identity for the San Joaquin Valley both within and outside the region. Perception matters for prosperity. How the region views itself will go a long way to shaping how others view it.

The Regional Leadership Group should launch a Civic Engagement Campaign around the new economic vision. Engage both opinion leaders and ordinary citizens about the potential of the San Joaquin Valley economy and the changes in mind-set and behavior necessary to achieve the vision. This campaign could include a Speaker's Bureau, Community Forums, and the use of videos, television, and other media.

In addition, develop a campaign to communicate the message of the new San Joaquin Valley to the rest of California. The critical need is to overcome the misperception of limited economic opportunity. Take advantage of meetings and conferences that bring outsiders to the San Joaquin Valley to communicate the new message. Be proactive in cultivating positive stories in urban media. Develop exhibits about the historic and future importance of the San Joaquin Valley at key institutions in urban centers, such as the Metreon in San Francisco and The Tech Museum of Innovation in San Jose.

Examples of Required Mind-Set Shifts

- From *isolation* of companies in the region to *integration* of companies across the region
- From serving *local markets* to serving *global markets*
- From quality of life as residual to quality of life as economic development requirement
- From *attraction* of companies to home-grown *entrepreneurship*
- From *low educational attainment* to *high educational aspirations*
- From land as *unlimited* resource to land as *limited* resource
- From *community* leadership to *regional* leadership
- From public leadership to *private and public* leadership
- From innovation as *business practice* to innovation as *a culture*

Safeguard the Regional Landscape and Improve Urban Vitality

As an economic development tool, consciously create a high-quality living environment for knowledge workers, including vital downtowns, protected open space, and landscapes, improving air quality and preserving the distinctive landmarks and physical character of the rural West. This task matters because attracting and retaining young talent and midlevel professionals are crucial to achieving the vision.

A first priority is to revitalize downtown centers, creating those shops, restaurants, civic buildings, and public spaces that attract people and build community. Evidence is mounting that the people and companies that drive the new economy are attracted to places with distinctive quality of life and places that promote sociability. As a strategic gateway and important population center, revitalizing Fresno's downtown should be a top regional priority.

A second strategic imperative is to remain vigilant about preserving open space and a distinctive edge between urban and rural areas in the region. The more rural feel of the San Joaquin Valley and its large undeveloped open spaces and farmlands offer an increasingly attractive alternative to living and working in the state's urban centers. The San Joaquin Valley must not destroy this unique advantage. Leaders must recognize that how the region

chooses to use it land will have significant consequences for the region's economic evolution.

A final recognition is that the kind of agriculture production and manufacturing envisioned in this report is more compatible with environmental quality than traditional commodity agriculture has been.

Cluster Initiatives

This report identified six cluster areas that represent opportunities to grow and diversify new economy activity in the San Joaquin Valley. This section identifies specific action initiatives that could be implemented to support evolution toward each opportunity area. These potential action initiatives should be tested, refined, and prioritized by the companies in each cluster.

New Economy Cluster	Objective	Initiatives
Flexible Food Manufacturing	<ul style="list-style-type: none"> • Become leading flexible food manufacturing region, with a specialization in natural foods. • Become a center for flexible food manufacturing innovation. 	<ul style="list-style-type: none"> • Establish university-industry-government initiatives and programs focused on flexible food manufacturing, similar to the one at Penn State University. • Increase access to start-up financing for new food manufacturers. • Establish technical training program in conjunction with the three California State Universities in the Valley, community colleges, and or CART to train production workers in flexible food manufacturing. • Build regional capacity of Efficient Customer Response (ECR) operations, otherwise known as logistics. Doing so will enable smaller food manufacturers to compete effectively. • Build on the International Agri-Center's AgZone to increase the capability of food manufacturers to obtain the supplies they need and develop relationships with growers, especially organic growers. • Create Agricultural Buffer Zones between existing farm and ranch operations and urban development.
Precision Water Application	<ul style="list-style-type: none"> • Become the world leader in agricultural, landscape, and turf irrigation. 	<ul style="list-style-type: none"> • Develop industry-government initiatives to expand international trade, establish cluster based export services and support, and cluster-based training in international trade. • Establish an irrigation network of manufacturers, agricultural producers, turf irrigators, federal and state water agencies and universities. • Establish peer-to-peer technology transfer program, encouraging innovative growers to educate other growers on water-efficient irrigation practices.

		<ul style="list-style-type: none"> • Institute tax credits for irrigation capital expenditures to motivate growers to switch to more water-efficient water-application systems. • Change legislation to allow sale of conserved water for other uses as incentive to use water more efficiently. • Establish an agile manufacturing learning center to facilitate movement of irrigation manufacturers to contract manufacturing. (See also agile manufacturing initiatives.) • Improve Fresno airport to allow irrigation sales reps and executives to travel more easily to global customers.
Agricultural Technology	<ul style="list-style-type: none"> • Leverage university-based research in precision agriculture and agricultural biotechnology to become world's leading source of agricultural technology expertise and services. 	<ul style="list-style-type: none"> • Establish a Regional Agricultural Biotechnology Network of university, industry, and government partners that funds research and development activities. • Create a bio-industry cluster organization to facilitate networking, professional development, and entrepreneurship development. • Establish a peer-to-peer technology transfer program to transfer precision agriculture technology from universities and farm managers who are using it to those who aren't. • Establish consistent land-use and building-construction regulations regionwide that expedite community decision making about construction.
Agile Manufacturing	<ul style="list-style-type: none"> • Become an agile manufacturing cluster that can meet rapidly changing customer demands, while remaining profitable and competitive. 	<ul style="list-style-type: none"> ▪ Create an agile manufacturing network that can act as a broker between producers and suppliers and improve the competitiveness of small and medium-sized manufacturers in the San Joaquin Valley. ▪ Develop university-industry-government initiatives and programs focused on metals-based agile manufacturing. Examples of successful programs include Computer Integrated Manufacturing Laboratory (CIM Lab) at Lehigh University and MTAMRI at the Computer and Systems Research Laboratory, University of Illinois Urbana-Champaign. ▪ Create flexible and funded partnerships on skills training between community and technical colleges and manufacturers.

		<ul style="list-style-type: none"> ▪ Create partnerships between local manufacturers and logistics industry to grow warehousing capacity.
Advanced Logistics	<ul style="list-style-type: none"> • Become a leader in defining and providing services in the rapidly evolving field of logistics. • Be innovators and implementers. 	<ul style="list-style-type: none"> ▪ Create certificate and degree programs in logistics, including in logistics software design (e.g., WMS and next-generation systems that further integrate the “value chain”), logistics engineering and management, and logistics consulting. ▪ Create an executive business program for logistics managers (introducing them to the state of the art in their field). ▪ Invest in and develop advanced logistics infrastructure (e.g., International Trade and Transport Center).
Smart Commerce and Customer Services	<ul style="list-style-type: none"> • Become the 1-800 capitol of the on-line world. • Create critical mass of select next-generation customer services companies. • Develop a specialized customer-services–driven communications knowledge base by building R&D capacity. 	<ul style="list-style-type: none"> ▪ Attract next-generation anchor companies. ▪ Create an industry cluster association that provides industry information, market intelligence, and new industry innovations. ▪ Sustain and grow workforce development and training programs in IT-based customer services offered through community and technical colleges in partnership with companies. ▪ Develop a university-industry research center in advanced customer services communications technologies. ▪ Build advanced communications infrastructure through partnerships with local economic development groups, resellers, and backbone providers.

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- ¹ The section on drivers is partly informed by a piece prepared for the New Valley Connexions project by Willard Bishop Consulting.
- ² Natural Food Merchandiser, SPINS.
- ³ "Food companies reassess engineering competencies," Charles Morris, *Food Engineering*.
- ⁴ "The outsourcing edge," Maria Ferrante, *Food Engineering*.
- ⁵ "Logistics: the new competitive edge," Leticia Mancini, *Food Engineering*.
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- ⁷ "Media and Mainstream Push Organics Industry Growth," Catherine Barnard, *Natural Foods Merchandiser*, June, 1999.
- ⁸ "Pollution solution," Steve Berne, *Food Engineering*, June 1998.
- ⁹ *Irrigation Business and Technology*, Irrigation Association, Washington, D.C., April 1996.
- ¹⁰ Because irrigation is not an industry easily tracked by SIC codes, and it is made up of a portion of many different industries, data on employment and establishment are estimates.
- ¹¹ Rain Bird is not located in the San Joaquin Valley, but very close in Glendora, California.
- ¹² *A New Era for Irrigation*, National Academy of Sciences, Washington, D.C., 1996.
- ¹³ *Farm and Ranch Irrigation Survey, 1994*, U.S. Department of Commerce, Census Bureau, 1996. The US in 1994 had 46.4 million acres of irrigated agriculture; California has 7.2 million acres of irrigated agriculture, 16% of the total in the US.
- ¹⁴ Martina McGloughlin, UC Davis, interview, 9/99.
- ¹⁵ BIO's Guide to Biotechnology.
- ¹⁶ *Bioindustry*, a description of California's bioindustry and summary of the public issues affecting its development, by Gus Koehler, California Research Bureau, California State Library.
- ¹⁷ Clive James, "Global Review of Commercialized Transgenic Crops: 1998," *ISAAA Briefs*, No. 8. ISAAA: Ithaca, NY.
- ¹⁸ Rogers, Everett M., *Diffusion of Innovations*, The Free Press, New York, 1995.
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- ²⁰ CSPP, 1998
- ²¹ "The Four Principal Dimensions of Agility," The Agility Forum, 1995.
- ²² "Models for Industry, Academia, and Government Cooperation in an Agile Manufacturing Environment," Emory Zimmers et al., 1996
- ²³ See, for example, the Machine Tool Agile Manufacturing Research Institute at the University of Illinois Urbana-Champaign campus.
- ²⁴ "Machine Process Modeling," the Machine Tool Agile Manufacturing Research Institute at the University of Illinois Urbana-Champaign campus.
- ²⁵ For examples of the virtual learning model and how they have helped smaller companies to adopt new technologies critical to their competitiveness, see "Models for Industry, academia and Government Cooperation in an Agile Manufacturing Environment," Emory Zimmers, Jr., et al., Pennsylvania Agile, 1996
- ²⁶ Yoshi Sheffi, "Why study Logistics," MIT Center for Transportation Studies.
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- ³⁰ "Cyber Carriers," *Logistics Management & Distribution Report*, April 1, 1999.
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- ³⁶ *U.S. Industry and Trade Outlook*, 1999, p. 26-11.
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