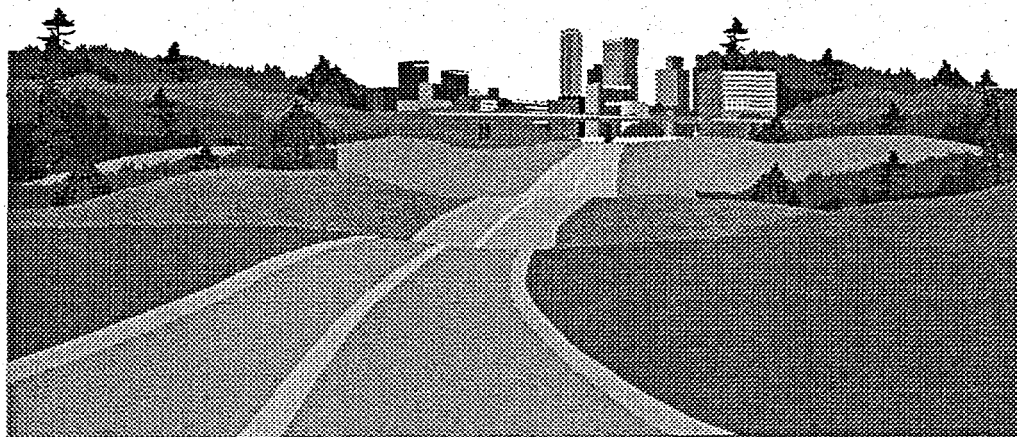


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# *21st Century Jobs Initiative*

**Building the Foundations for a 21st  
Century Economy**

## **Final Main Report**



November 1995

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**21st Century Jobs Initiative**  
**Building the Foundations for a 21st Century Economy**

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## APPENDIX A: CLUSTER WORKING GROUP INITIATIVE BUSINESS PLANS

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## About This Report

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The 21st Century Jobs Initiative has been launched in the context of new realities in Washington, D.C., rapid restructuring of the US economy and accelerating changes in the makeup of the East Tennessee economy driven by these and other external economic forces. Continuing downward pressure on Federal budgets for programs that support three key institutions in the region—DOE's Oak Ridge complex, the Tennessee Valley Authority and research programs of the University of Tennessee—are especially threatening to the region. With a large part of its economy dependent on Federal spending, the area is at risk of troublesome impacts that could ripple out from the Oak Ridge and Knoxville home of these institutions throughout the entire 15-county "Resource Valley."

As these economic forces play out in the region's economy, important questions arise. How will East Tennessee "earn its living" in the future if the Federal government role in the economy shrinks? What kind of new industries will be formed to replace those at risk due to Federal cutbacks and economic restructuring? Where will the jobs come from for the next generation of job seekers? These are among the questions driving the 21st Century Jobs Initiative, an action-oriented program designed and implemented by local leaders in response to the economic challenges facing East Tennessee.

Fortunately, the region's economy is strong today. Unemployment is at near record lows in most counties. Moreover, leaders are increasingly aware of the threats on the horizon and are already moving to action. And the impacts from the forces at work on the economy will probably come slowly, over the next decade or so. Thus, there is time to implement new policies and programs designed to make the most of the region's many economic advantages.

Based on economic research and input from local leaders knowledgeable about the economy, the 21st Century Jobs Initiative has set forth a strategic economic development plan for the region. The plan is designed to help guide policy makers and private sector leaders in their decisions about how and where to invest time and financial resources over the next several years in order to build an economy less dependent on the Federal government and more competitive in the global marketplace.

But the Jobs Initiative is more than simply a plan. With the early consultant reports serving as a wake-up call, more than 1,000 leaders have been involved in an array of forums over the past 10 months reacting to the project team's research findings and contributing directly to its recommendations. By drawing into the process local leaders from the private and public sectors, the Jobs Initiative has begun to forge a new degree of economic leadership in the region. As a result, the project has built a "constituency for action" as well as early momentum for implementing concrete initiatives to enhance the economy.

Department of Energy funds have supported the initiative and Tennessee's Resource Valley, the region's premier marketing and promotion organization, has spearheaded the project. Consulting assistance has been provided by a team led by DRI/McGraw-Hill's Economic Competitiveness Group and IC<sup>2</sup>, Dr. George Kozmetsky's organization affiliated with the University of Texas at Austin.

With this project, leaders in East Tennessee have, in effect, "chosen the future" and are beginning to use the strategic plan to build new foundations for a 21st Century economy. Already several of the action initiatives recommended in this report are being implemented through mechanisms developed in the project. Over the next several years the 21st Century Jobs Initiative can serve East Tennessee as a roadmap to an economy that will be far less dependent on the Federal government and far more entrepreneurial in global markets than is the case today. By implementing the recommendations contained in this report, leaders in the region will have powerful tools for generating economic wealth and good jobs in the future. Key among the recommendations are ways to begin to turn Federal investments in science and technology into strong forces for local economic development.

### **For More Information**

There are several reports and other kinds of information available from the first year of the project. And because the project was designed to be action-oriented, there are several ways that individuals can participate directly in the second year of the project. For more information please contact:

Tennessee's Resource Valley  
Allen Neel, President  
10915 Hardin Valley Road  
PO Box 22990  
Knoxville, TN 37933  
Tel: 423- 694-6772  
Fax: 423- 694-6429

## I. East Tennessee's Economic Challenge

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### ***New Economic Realities: Job Growth in the Future will be Harder to Come by than in the Past***

After 50 years of economic growth and prosperity driven in large part by Federal government spending, East Tennessee finds itself today in a new economic environment. No longer will government spending play the driving force for economic growth and job creation as was the case in the past. Policy initiatives and budget cutbacks in Washington have rippled down to all regions in the country highly dependent on government spending and East Tennessee has not escaped the impacts. Whether at TVA, or at the DOE facilities in Oak Ridge or within the research programs of the University of Tennessee, the region finds itself today faced with a potentially troublesome economic situation.

The good news is that the downturns in Federal spending come at a time when the East Tennessee economy is robust. Unemployment is a near record lows in urban counties and no less than average in rural areas where unemployment is historically high. Strong growth in sectors such as auto parts and accessories, environmental services, tourism and in several other sectors have, for the most part, offset recent job losses in the Federal sector at TVA and the Oak Ridge complex.

However, job growth in several sectors of the region's traditional manufacturing economy is likely to slow over the next ten years and capacities at key institutions could weaken under the pressure of budget cuts and shifts in the mission of key Federal agencies. As a result, the region's ability to create new jobs to offset the job losses likely yet to come will be weaker in the near future than it was not so many years ago.

*The bottom line: After many years of economic growth and prosperity East Tennessee faces a new economic reality. This report finds that cutbacks in Federal spending, structural changes in the economy and the impact of other factors will make it far more difficult to achieve job growth in the future than it was in the past. With this report, East Tennessee is getting a wake-up call.*

Fortunately, the forecasts suggest only a slow down in the rate of job creation, and in no way a precipitous collapse of the economy. Nevertheless, it is clear that the old economic drivers of the economy (Federal programs and traditional manufacturing) are weakening. In this context, it can be argued that the economic logic that shaped East Tennessee's economy in the past is no longer as strong as it was and must be replaced by a new economic logic that reflects better today's realities.

This means that the old economy which was made strong by massive Federal spending must be transformed into a different kind of economy. A new economic vision is needed, one that explicitly takes into account the changing economic environment and the inherent assets in the region, particularly the unique science and technology capacity developed with government investment. Dividends from these assets were once realized during a period of cold war. Today, in a period of cold peace, new dividends are possible in the form of a much more technologically-

intensive regional economy built around core competencies in the institutions that serve as the foundations for the economy. This vision can be achieved by focusing leaders and institutions on the potential for a more technologically advanced economy. And guided by this vision, it can be achieved by implementing new strategies and new tactics for building the kind of economy that can provide jobs for people at risk of losing theirs as well as jobs for the next generation of job seekers.

### ***New Approaches are Needed: Achieving a Paradigm Shift for Economic Development***

Faced with these economic challenges, it can be argued that the old paradigm for economic development in East Tennessee shown in Table I-1 must be replaced by a new paradigm. While traditional industrial recruiting and lobbying for new Federal programs will no doubt be important in some way in the future, these traditional approaches alone are not likely to be the best way to generate jobs and economic wealth in the future.

The new paradigm must focus on building a more competitive economy in East Tennessee, sector-by-sector. This means using public policy in new ways in order to achieve more specialized and responsive institutions that provide worker skills, technology and physical infrastructure. It means focusing private initiative on achieving specific kinds of economic outcomes. And, because the answers to the region's economic challenges are not likely to be found in Washington D.C. (or in Nashville) it means working more collaboratively within the region and across political and institutional boundaries to bring all of East Tennessee's resources to bear on overcoming the challenges.

**Table I-1**  
**Paradigm Shift: Replacing Traditional Approaches with**  
**New Approaches to Economic Development**

Old Approach	New Approach
<p>Heavy orientation to:</p> <ul style="list-style-type: none"> <li>• Promotion, traditional marketing</li> <li>• Industry recruitment</li> <li>• Lobbying for Federal programs</li> <li>• Traditional economic development programs</li> </ul>	<p>Some of the old, but a new focus on:</p> <ul style="list-style-type: none"> <li>• Building a competitive region</li> <li>• Strengthening the region's "economic drivers"</li> <li>• More specialized, responsive economic infrastructure</li> <li>• Regional collaboration for job and wealth creation</li> </ul>

### ***The 21st Century Jobs Initiative: Building the Foundations for a 21st Century Economy***

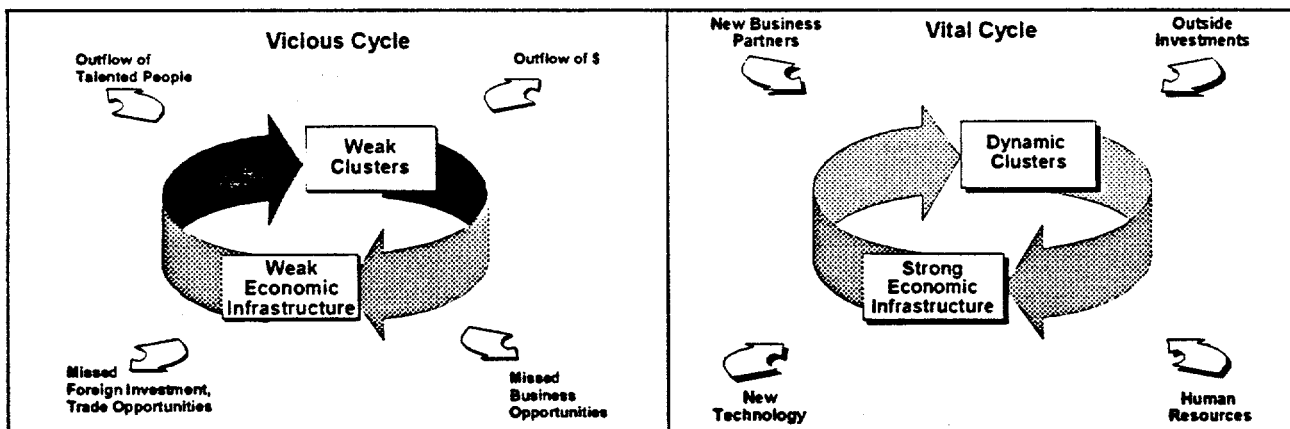
In the face of low unemployment and a general sense of economic prosperity, it would be easy for leaders to ignore the threats on the horizon. But just as they did more than a decade ago when a national recession threatened the economy and opportunities for new infrastructure beckoned (the

Pellissippi Parkway extension to the airport was launched, among other major initiatives), leaders have stepped forward today to face the economic challenges head-on. The 21st Century Jobs Initiative has been launched as a response to today's economic realities.

Unlike other regions whose leaders were lulled into complacency by a once strong but slowly eroding economy (e.g., Detroit in the 1960s, Southern California more recently), East Tennessee's leaders are using the 21st Century Jobs Initiative as a way to intervene in the region's economic destiny. In effect, they have said that East Tennessee can choose its economic future and not get caught in a negative cycle of economic decline like those that have caught other government-dependent regions by surprise (e.g., Los Angeles).

Figure I-1 illustrates how a slowly weakening private sector can, in turn, weaken a region's fundamental economic infrastructure—the very foundations on which the economy depends. If firms in the region's driving "industrial clusters" do not have the skilled workers needed with which to be competitive, or the technology, or the specialized physical infrastructure typically provided by the public sector, they will lose market share and reduce employment. They also will be unable to make the tax contributions needed by the public sector who provide the inputs firms need in order to be competitive (e.g., educated workers, highways, airports). A vicious economic cycle of declining jobs and lower standards of living can ensue. Talented people will leave the area seeking better employment opportunities. Capital will leave seeking better investment opportunities. And business opportunities will be missed because the region will not have the capacity to take advantage of the opportunities.

**Figure I-1**  
**The Vital Cycle Concept**



In contrast to a vicious cycle of economic decline, a strong private sector comprised of dynamic clusters of economic activity able to make tax contributions to the public institutions that make up the economic infrastructure of the region, who in turn provide the worker skills, technology and other inputs needed by firms can result in a vital cycle of growth and prosperity. Instead of a slowly deteriorating situation because of negative economic factors, a positive economic dynamic in the region draws into the economy capital, talented people, technology and other inputs to the vital cycle. Firms create more jobs and grow more prosperous. They are able to support the

public sector better, which in turn can support the private sector better with appropriately educated and skilled workers, with better access to technology and better physical amenities like highways and airports. A vital cycle brings to a region more jobs, more economic wealth and, overall, higher standards of living.

If East Tennessee's economic base is allowed to erode in the face of diminishing Federal spending and other threats on the horizon (e.g., structural changes in the economy that result in lower wages and lower per-capita income), the region could get caught in a negative, vicious cycle. But the 21st Century Jobs Initiative serves as the intervention. With this project, leaders can use public policy to strengthen the economic infrastructure in the region and help make the publicly-supported institutions stronger, more specialized and more responsive to the changing needs of the economy.

Changes in public policy are one way forward but so is sharply focused, strategic private sector initiative. Private investment, if focused on economic opportunity that can leverage changes in the economic structure of the region, can have profound positive effects on the economy. Investment in specific areas of the economy where payoffs are likely to be high (e.g., in industries of the future such as environmental services, and to fill gaps in the supply chain that supports key sectors) is equally important. Finally, although new public policy and private sector initiatives will be needed, these efforts will miss opportunities if taken separately. It will be important for leaders of both sectors to work together in new public-private partnerships in order to achieve the interventions needed. The challenge facing the region is too large to expect all the energy for solutions to problems to come from the public sector or the private sector alone. By working together and combining resources, public-private initiative can leverage the available resources and achieve a more competitive economy.

### ***Can East Tennessee's Leaders Expect Success by Intervening in the Region's Economy?: Lessons From Other Regions***

Why should East Tennessee's leaders expect to be successful by intervening in the trends shaping the economy? Because more than two decades of experience in economic strategy development and implementation have shown that leaders can, in effect, "choose their economic future." By taking action to intervene in troublesome trends or to capitalize on exciting opportunities, leaders in other region's have proven that significant changes in regional economic performance can be achieved in relatively short periods of time.

The turnaround seen in Cleveland's economy in less than 10 years is a good example. Cleveland once known as the "city where the river caught fire" is now celebrated for its economic rebirth. Leaders focused on economic problems and built the capacity for a new kind of economy, a regional center for business services and advanced light manufacturing. Closer to home, Chattanooga is another good example of leaders focusing on building new economic capacity in only a few years. Austin provides another, although different example. Once an economy based mostly on the state government, Austin's private sector leaders took advantage a strong science and technology and R&D capacity and systematically pursued a strategy to build an information and knowledge-based economy. Their efforts have brought thousands of new, high quality jobs

to the region in only a few years. Many other examples can be cited—Jacksonville, Charlotte, even Atlanta have all seen significant improvements in their economies stemming from local vision and initiative.

East Tennessee, of course is not Chattanooga or Jacksonville. It has its own traditions and its own economic structure as a starting point. And like other regions, leaders have already shown that they can take steps to build a new kind of economy. Consider the efforts of a few in the early 1980s to build the Pellissippi Parkway, the Technology Corridor, and other steps to link the region's technological resources to the economy. But many leaders today would say that those efforts failed to have the ultimate impact, that the economy is no more entrepreneurial, innovative or connected to key sources of technology and information know-how than it was 10 or 12 years ago. (In fact, this report supports some of this thinking.) What is different today is that the 21st Century Jobs Initiative has served to systematically move the region to new levels of economic performance. The Jobs Initiative is a strategic planning process, just what was missing during the 1980s. With the vision of this project and its strategies, leaders today have something to guide the change process in a more systematic way than was the case earlier.

Overall, this report finds that East Tennessee has both the traditions of leadership in economic development as well as important capacities in its technology centers to achieve an economic transformation. What is needed now is sustained leadership and a commitment to follow this roadmap to a new economy, a trip that could take 10 years or so to complete. This report can help guide the myriad decisions that will be made during this period, that in combination will shape the region's economic destiny.



## II. East Tennessee's Economy Today: An Overview

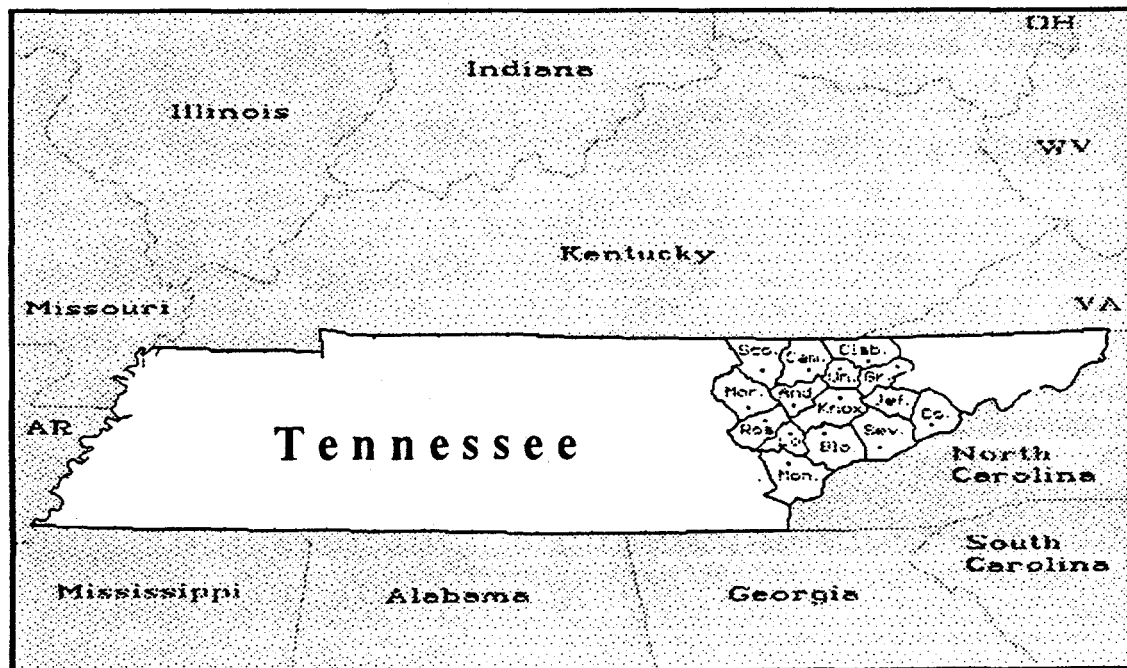
### Overview

The 21st Century Jobs Initiative is, as its name implies, about jobs—about the type and quantity of jobs that are available now and that will be available in the future. Such an initiative must begin with an analysis of the changing structure of the economy and the use of analytic tools to determine how that structure can be changed in ways that will contribute to higher levels of competitiveness and to job creation. Without going into numbing detail, this section looks briefly at the changing structure of the East Tennessee economy and then focuses on the current performance, forecasts and development perspectives for key economic sectors.

### 15-County Region

The starting point for understanding the dynamics within the economy is looking at trends as they relate to the "economic region." Thus, important to this analysis is the definition of the Tennessee Resource Valley region itself. The 21st Century Jobs Initiative analysis includes the 15-county area including the counties of Anderson, Blount, Campbell, Claiborne, Cocke, Grainger, Jefferson, Knox, Loudon, Morgan, Monroe, Roane, Scott, Sevier, and Union (see Figure II-1). While it is not possible to empirically prove that this set of 15 counties best defines an economic region, there is considerable anecdotal evidence (e.g., commute patterns, geographic scope of buyer-supplier inter-relationships) that the region does, in fact, operate as an economic unit.

Figure II-1  
Map of 15-County Region Analyzed



By taking a broader regional perspective, the analysis also illuminates potential for economies of scale and allows for consideration of economic development strategies and tactics to bring to bear all of the region's assets on economic opportunities. For instance, instead of having to consider the economic potential of rather small city or county populations, by taking a 15-county region into account, the area represents an economic potential of nearly 900,000 East Tennesseans.

### ***Unemployment in the Region***

The combined, 15-county analysis also illustrates disparities in the region which may have consequences for growth, both positive and negative. For instance, unemployment in the region ranges from a low 2.9% in urban Knox county to a high 13.2% in rural Scott county (see Table II-1). Clearly, the region comprises an array of economic situations. Nevertheless, the regional perspective taken here is appropriate. It focuses attention on a part of the state that many believe *can* work together more closely as an economic unit.

**Table II-1**  
**East Tennessee**  
**Jobless Rates, July 1995**

County	July %
Anderson	3.5
Blount	7.6
Campbell	6.6
Claiborne	4.8
Cocke	8.7
Grainger	7.3
Jefferson	5.7
Knox	2.9

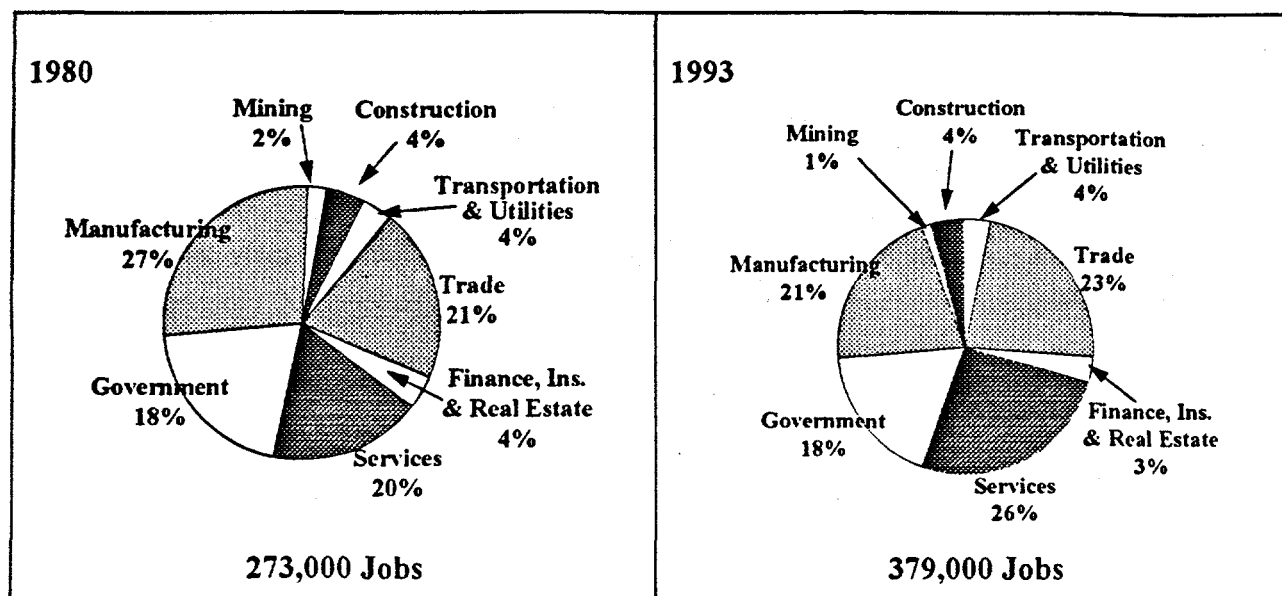
County	July %
Loudon	3.7
Morgan	9.5
Monroe	10.1
Roane	5.9
Scott	13.2s
Sevier	7.1
Union	4.2

Source: Employment Security Department

### ***Changing Structure of East Tennessee Economy***

Over the last decade, the 15-county Resource Valley region has seen significant changes in the type of economic activity present. For example, as Figure II-2 shows, the economy is shifting quickly from manufacturing to services. Like the rest of the country, the region's economy is quickly shifting from a manufacturing base to a services base. Note too, that the economy has been growing—from 273,000 jobs in 1980 to 379,000 in 1993.

**Figure II-2**  
**Changing Structure of the East Tennessee Economy**



Except for the large Federal presence in Oak Ridge and with TVA, East Tennessee's economy looks like most other economies in the Southeast and other parts of the US as well. For example, the shift from manufacturing to services is happening fast, in East Tennessee as it is across the country. And yet, past experience has shown that even structurally similar, neighboring economies can develop in radically different directions due to the differences in the basic economic capacity of different regions (e.g., Nashville and Memphis are developing in different ways because of differences in the underlying competitive advantages of each). Looking at the broad make up of the economy and the economic statistics of the place are not enough. Analysts need a tool for understanding the forces driving regional structural change.

### ***East Tennessee's Economic Clusters: A New Way of Looking at the Economy***

Understanding what is happening in the economy is not easy. For example, knowing that unemployment varies a lot from one county to another is not particularly helpful. Knowing that the economic structure is shifting from manufacturing to services is helpful, but unless more is known about where and how those shifts are occurring little is really known about the implications of the shifts. What is needed is a way of looking at which sectors of the economy are really driving the region and what is happening to those sectors.

With others, DRI is pioneering new ways of examining regional economies. This approach is referred to as *cluster-based economic development*, or cluster analysis. Cluster-based economic development helps analysts understand how the economy operates and what parts of the economy are strong as well as the parts that need fortification.

## **Clusters Ignore Political Boundaries**

Although political boundaries are used in defining regions for cluster analysis, they are used more as a result of spheres of influence (such as for state policy) and realities of data (reported by county) than by anything inherent to clusters themselves. In fact, clusters often ignore political boundaries in their operations. Economic regions are better defined by the buyer supplier linkages of the area's portfolio of economic clusters, and the location of resources which the related sectors share in order to be competitive. The interdependence of the region with the economic clusters, and the interdependence of firms within clusters, is more illustrative of the workings of the economy than is the study of industrial sectors independently within a narrowly defined geographic region.

## **Clusters Drive Their Economies Through Exporting**

Clusters for a region are determined by a variety of measurements and characteristics including employment, output, number of establishments, and the traditional and unique buyer-supplier linkages as shown in studies of input-output (I/O) models and field work in the economy. But perhaps the most important characteristic of a cluster is its export activity. Through exporting its good or service, a cluster generates wealth for the region. (In this sense, exporting refers not necessarily out of the state or the country, but rather to anywhere outside the immediate area so that it brings in money from outside.) A good indicator of export activity is the cluster's concentration level. Concentration levels compare a region's employment levels per capita in a particular industry to the U.S. average per capita for that industry. Having a higher than average concentration denotes special competency, expertise, and export activity.

## **The Economic Infrastructure is the Regional Support of Clusters**

Another characteristic of clusters is the existence of other businesses and providers of soft and hard economic infrastructure which allow the exporting businesses to prosper. Among the most critical components of economic infrastructure are human resources, technology, capital, physical infrastructure, and a competitive tax and regulatory environment. How or whether or not the region provides the appropriate resources to its clusters is a major policy arena of cluster-based economic development. It is the economic infrastructure that gives the cluster its geographic roots.<sup>1</sup>

Cluster analysis, used in this project, stresses four major points which are useful to economic development in East Tennessee:

- Clusters are not defined by political boundaries, but rather by economic demands.
- Clusters, the inter-industry dynamic, is a better focus for understanding the health and evolution of the economy than independent sectors.

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<sup>1</sup> An analysis of East Tennessee's economic infrastructure was undertaken by comparing the region to 14 similar regions using approximately 50 indicators. That report, titled "Benchmarking East Tennessee's Economic Capacity" is available from Tennessee Resource Valley.

- Clusters generate wealth in the economy through exporting. In that sense, they are the drivers of the economy.
- Cluster competitiveness in terms of regional development lies in sustaining quality economic infrastructure or foundations (human resources, technology, capital, physical infrastructure, competitive business climate) responsive to each regional cluster's needs.

### ***East Tennessee's Potential Clusters***

DRI's analysis has pointed to the presence of 8 potential clusters of economic activity in East Tennessee (see Table II-2). Some of these clusters have traditionally been a major portion of the manufacturing base of the region, such as the Forest and Wood Products, Mining and Materials, Textile and Apparel, and Food Products sectors. Others, namely the service clusters of Tourism and Business and Financial Services, have been present in the region for some time but have seen dramatic growth and increased economic importance in the past decade due to an array of macro factors (e.g., higher disposable income is driving tourism, industry changes and economic restructuring are driving the growth of services). Automotive and Transportation Equipment has also grown fast and is evolving into a major economic force in the region. Lastly, with the presence of technical talent in the area and growth in a few key sectors, East Tennessee may be witnessing the birth of several Technology Intensive Products and Services industries. There is strong evidence that East Tennessee is building concentrations of employment in "seed" clusters within this group in areas including environmental services and devices, information services and products, instruments and electronic components of a wide variety.

**Table II-2**  
**Summary Data for East Tennessee's Potential Clusters**

Emerging Clusters	Employment Level		Share of Economy		Relative Concentration		% Growth 1989-1994		% Growth 1994-2004	
	1984	1994	1984	1994	1984	1994	Region	Nation	Region	Nation
Auto/Transportation	9,241	17,492	3.1	4.6	136.1	220.9	2.5	-0.7	-0.6	-0.8
Metals & Materials	23,282	18,635	7.9	4.9	357.6	270.4	-0.9	-1.1	-1.4	-1.2
Forest Products	7,200	9,298	2.5	2.4	264.7	312.8	1.2	-1.3	-1.2	-1.4
Apparel & Textiles	19,500	18,026	6.6	4.7	348.1	343.0	-0.8	-1.7	-2.3	-2.5
Technology Intensive Products & Svcs.	4,985	8,785	1.7	2.3	79.5	105.3	5.8	0.4	2.1	2.1
Business & Financial Services	11,987	18,133	4.1	4.7	62.4	60.3	3.4	1.9	2.6	2.6
Agriculture & Food Products	2,313	3,233	0.8	0.8	183.1	268.0	1.5	-0.9	-1.1	-1.1
Tourism	13,254	22,309	4.5	5.8	101.3	104.6	6.3	2.9	2.6	2.8
Cluster Total in 15-County TRV Region	91,012	114,982	31.0	30.0	--	--	2.2	1.1	0.4	1.6
Rest of 15-County TRV Region Economy	202,574	268,687	69.0	70.0	--	--	2.6	0.9	1.6	1.4
15-County %TRV Region	293,585	383,669	100.0	100.0	--	--	2.5	0.9	1.3	1.4

Sources: DRI/McGraw-Hill; U.S. Department of Labor, Bureau of Labor Statistics; U.S. Department of Commerce, Bureau of Economic Analysis

Although the term "cluster" is used to describe these drivers of the region's economy, there are many indicators suggesting that the industry agglomerations in East Tennessee are not full-fledged clusters (e.g., significant "supply gaps" have been identified, industry experts report weak horizontal and vertical linkages). Unlike Silicon Valley or other regions where the economy is driven by extensive exporting and is deeply endowed with suppliers and strong linkages between buyers and suppliers and where public institutions that provide factor inputs (e.g., uniquely skilled

workers, appropriate technology, specialized physical infrastructure), this report finds that East Tennessee has the *potential for economic clustering in the eight areas highlighted in Table II-2*.

The following sections are descriptions and discussions of the cluster analyses conducted for East Tennessee. These sections provide the basic statistics for each cluster, the 1994 DRI/McGraw-Hill forecast<sup>2</sup> for employment growth (based on national indicators adjusted for regional characteristics), the results of a supply gap analysis in the region, and a summary market assessment for some strategic cluster products. The results of these analyses combined with an assessment of technical competencies at Oak Ridge as well as issues and aspirations reported by regional business leaders, have shaped recommendations for the appropriate development focus for each cluster. The information below provides a "snapshot" of cluster characteristics in sufficient detail for developing strategy and for prioritizing action initiatives.

### **Automotive and Transportation Equipment Cluster**

#### ***Description***

Newer by comparison to East Tennessee's economy than the more traditional manufacturing sectors (e.g., metals, textiles) is the region's Automotive and Transportation Equipment Cluster, although it is built on a long history in a few key sectors. As shown in Figure II-3, the cluster employed 17,500 in 1994 making it one of the larger industries in the region. Employment is concentrated in several sectors, including: motor vehicle parts and accessories, aircraft parts and equipment, plating and polishing, travel trailers and campers, boatbuilding and repairing, refrigeration and heating equipment, transport equipment, and carburetors, pistons, and rings. It is a high wage cluster with the average salary in the cluster at \$24,900, slightly below the national average for the cluster of \$28,580. Real output for the year 1994 was \$2,418 million. The Automotive and Transportation Equipment Cluster has a concentration of 221 (U.S.=100) which means that the automotive industry is two and a quarter times more concentrated in East Tennessee than the average in the country.

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<sup>2</sup> Because the analysis began in Jan. 1995, 1994 forecast was used. Employment forecasts for 1995 are presented in the final section of the report.

**Table II-3**  
**Growth of Auto/Transportation Industries in**  
**15-County Tennessee Resource Valley Region**

Component Industries	Employment				Real Output			Productivity	
	Level (actual) 1994	Relative Conc. 1994 (US=100)	Annual % Change 1989-1994	Annual % Change 1994-2004	Level (Millions) 1994	Annual % Change 1989-1994	Annual % Change 1994-2004	Annual % Change 1989-1994	Annual % Change 1994-2004
<b>Auto/Transportation</b>	17,492	220.9	2.5	-0.6	2,418	2.9	3.0	1.6	3.6
350. Motor Vehicle Parts & Access.	4,598	284.9	4.7	-0.2	732	4.9	3.3	0.2	3.5
355. Boatbuilding & Repairing	1,832	1,112.9	-7.1	0.5	192	-13.1	4.3	-6.5	3.8
205. Glass & Prod Ex Containers	1,594	462.1	9.3	-1.2	218	12.0	2.4	2.4	3.6
359. Mobile Homes	1,552	813.6	6.2	-3.8	197	8.1	-0.4	1.8	3.5
197. Misc. Plastic Products	1,226	53.9	-2.8	1.4	148	-1.0	4.4	1.8	3.0
196. Fab. Rubber Products, NEC	949	248.2	15.9	-0.5	92	16.0	2.5	0.2	3.0
353. Aircraft Parts & Equip., NEC	910	179.3	-4.8	0.7	162	0.4	6.2	5.5	5.4
193. Tires & Inner Tubes	686	258.8	27.3	-2.1	123	27.2	1.3	-0.1	3.6
263. Hardware, NEC	652	263.8	2.0	-2.2	82	3.1	0.9	1.1	3.1
258. Automotive Stampings	645	180.6	1.1	-0.4	109	3.2	2.5	2.1	3.0
309. Refrigeration & Heating Equipment	593	136.7	2.8	-1.8	94	5.5	2.7	2.6	4.6
328. Lighting Fixtures	448	186.3	1.7	-0.8	59	3.8	2.9	2.1	3.7
347. Truck Trailers	365	316.4	33.8	-1.9	57	35.8	1.6	1.5	3.6
295. Ball & Roller Bearings	299	248.5	-1.8	-1.8	36	-2.2	1.2	-0.4	3.0
264. Plating & Polishing	277	131.8	-2.1	1.8	20	-2.7	2.4	-0.6	0.6
360. Transport. Eq., NEC	261	267.0	1.3	0.5	33	4.4	4.6	3.0	4.2
218. Asbestos Prod & Seal. Devices	237	218.2	-1.2	-2.3	25	0.0	0.1	1.2	2.5
198. Hose & Belting	161	201.9	3.0	-2.2	18	1.5	0.2	-1.5	2.5
358. Travel Trailers & Campers	116	119.9	7.3	-1.0	12	7.2	3.2	0.0	4.3
301. Carb. Pistons, Rings	90	133.8	NC	-2.2	11	NC	1.8	3.5	4.1

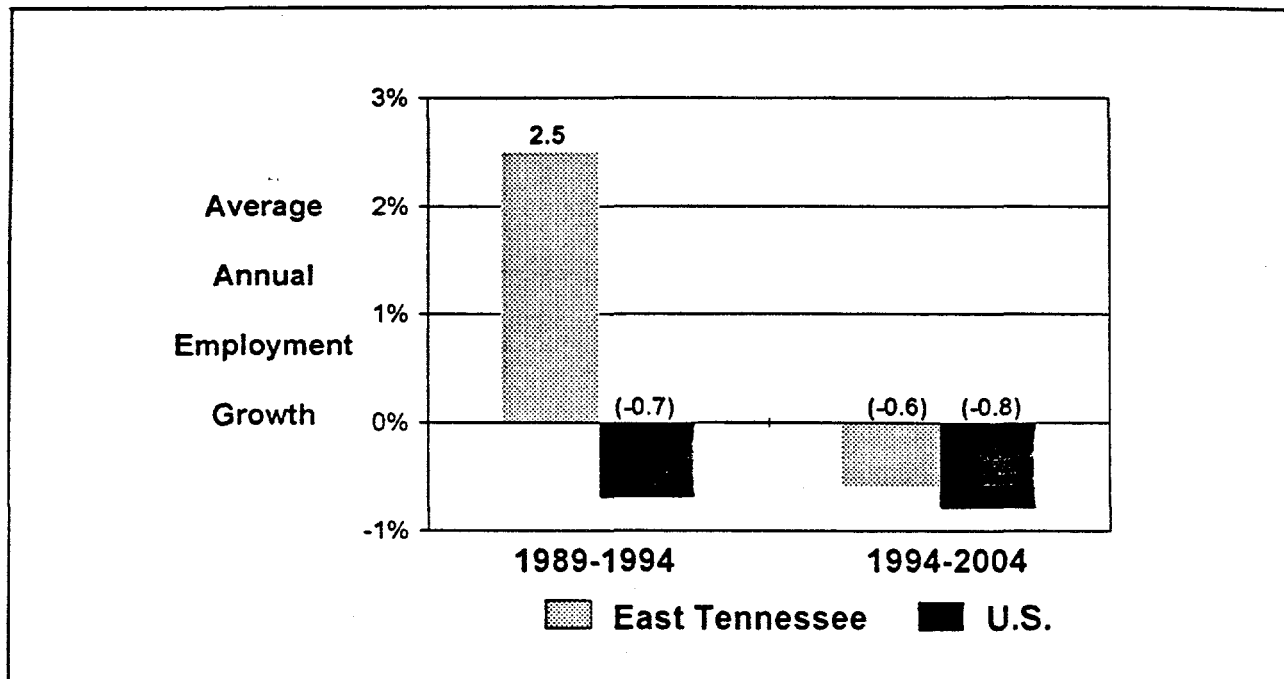
Note: nec = not elsewhere classified

Sources: DRI/McGraw-Hill; U.S. Department of Labor, Bureau of Labor Statistics;  
U.S. Department of Commerce, Bureau of Economic Analysis

### *The Cluster's Future: Forecast and Possible Interventions*

The 1994 DRI/McGraw-Hill forecast for the Automotive and Transportation Equipment cluster in East Tennessee, and in the nation as a whole, shows a slight decline in average annual employment growth over the next ten years. As shown in Figure II-3, over the last five years employment in the cluster has expanded rapidly, at a rate of 2.5%. Growth in the next ten years, however, is projected to fall to -0.6%—slightly better than the national rate of -0.8%. There are several reasons for this expected decline, including cyclical downturns in the production of new automobiles, the increasing problem of high cost of new autos, and productivity increases through technology use and higher skill levels of workers. For example, between 1989 and 1994, productivity in the cluster grew at a rate of 1.8%. Between 1994 and 2004, productivity is expected to increase at increasingly high rates to 3.7% per year. As with all the forecasts in these analyses, these forecast numbers are from a baseline forecast that do not take into account the variety of interventions the local industry could take to increase (or decrease) the cluster's competitiveness.

**Figure II-3**  
**Actual and Forecasted Employment Growth,**  
**Automotive and Transportation Equipment Cluster**

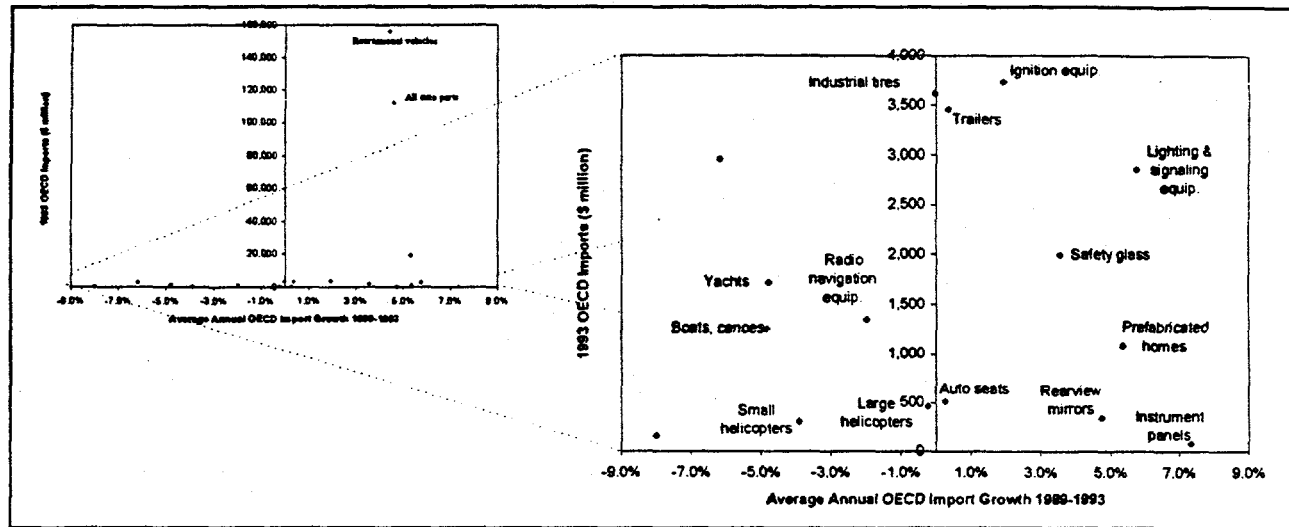


The cluster analysis provides a good first look at what some of the development priorities may be for each cluster. The “supply gap” analysis (reported on in a separate memo) shows that in a two hundred mile radius of the region there is extensive demand but little supply of several automotive and transportation equipment cluster products including: aircraft parts and equipment, screw machine products and iron and steel forgings. Business opportunities may also lie in fast growing international markets. A selected market study of 14 key automotive and transportation and equipment products found that OECD<sup>3</sup> imports for these products totalled \$290 billion in 1993 with a median average growth rate of 2.8% from 1989 to 1993. Some of these faster growing markets are for ignition equipment, lighting and signalling equipment, rear-view mirrors, prefabricated homes, trailers, and auto seats (see Figure II-4).

<sup>3</sup> Organization for Economic Cooperation and Development—a Paris-based international repository of data on world trade.



**Figure II-4**  
**Automotive/Transportation Cluster Products**  
**Size and Growth of the OECD Market**



Transportation related research is a key area of activity at Oak Ridge thus it is especially likely that technology found in the Oak Ridge complex could be valuable to the cluster's future. An analysis of automotive product-related technologies in the laboratories found 73 possible technology applications for the cluster, as summarized in Table II-4. Besides access to technology, business leaders in the cluster also expressed needs for better communication and influence in curricula development at skills training institutions and access to capital.

**Table II-4**  
**Oak Ridge Competencies and Possible Industrial Applications**  
**Automotive/Transportation Cluster**

Biotechnologies	Possible Cluster Application
Biomass	<ul style="list-style-type: none"> <li>Trees and grasses genetically engineered to produce more energy containing cellulose</li> </ul>
Bioreactors	<ul style="list-style-type: none"> <li>Efficiently converting cellulose to fuel alcohol</li> <li>Treating waste streams by passing them through bioreactor systems</li> </ul>
Bacteria	<ul style="list-style-type: none"> <li>Removal of heavy metals and certain chlorinated solvents from waste streams</li> <li>Removal of sulfur and other contaminants from fuels</li> </ul>
Biosensors	<ul style="list-style-type: none"> <li>Sensing of hazardous particulates and fumes in the workplace</li> </ul>

Manufacturing Technologies	Possible Cluster Application
Ultraprecision Machining	<ul style="list-style-type: none"> <li>Capability of producing large, intricately machined parts</li> <li>Multi-axis and micromachining capabilities</li> </ul>
Stereolithography	<ul style="list-style-type: none"> <li>Rapid creation of prototypes</li> </ul>
Controls and Simulators	<ul style="list-style-type: none"> <li>Develop remotely operated manufacturing projects</li> <li>Develop process simulators and trainers</li> </ul>
Environmentally Conscious Manufacturing	<ul style="list-style-type: none"> <li>Recovery of valuable materials from waste streams for process reuse</li> <li>Minimization of waste streams through efficient use of raw materials</li> <li>Energy efficient manufacturing processes, using signature analysis technology for motors and research to regulate energy usage on shop floor</li> </ul>

<b>Materials Technologies</b>	<b>Possible Cluster Application</b>
<b>Catalysts</b>	<ul style="list-style-type: none"> <li>Remove nitrogen pollutants from exhaust gas</li> <li>Develop clean, high efficiency (55%) diesels</li> <li>Catalysts to enable the use of methanol, natural gas, and alcohol vehicles</li> </ul>
<b>Alloys</b>	<ul style="list-style-type: none"> <li>Lighter specialty alloys for engine components</li> <li>Nickel aluminide with properties similar to metals and ceramics that is five times stronger than stainless steel at (600°C) and is corrosive resistant</li> <li>Intermetallic titanium alloys for durable, lightweight valves</li> </ul>
<b>Ceramics</b>	<ul style="list-style-type: none"> <li>Advanced ceramic composites for diesel piston rings, fuel-injector push rods, cam roller followers, and high-performance turbocharger rotors</li> <li>Whisker-reinforced alumina for engine parts that are lightweight and durable</li> </ul>
<b>Ceramics Processing</b>	<ul style="list-style-type: none"> <li>Gel-casting to minimize machining</li> <li>Chemical vapor deposition to infuse ceramic throughout fiber mats or other reinforcing matrices</li> <li>Microwave sintering to fire parts faster and more uniformly</li> </ul>
<b>Composites</b>	<ul style="list-style-type: none"> <li>Carbon-fiber composites used for flywheel technology</li> </ul>
<b>Polymers</b>	<ul style="list-style-type: none"> <li>Specialty polymers to replace glass and metal parts</li> <li>Ion beam curing of polymers</li> </ul>
<b>Chemistry</b>	<ul style="list-style-type: none"> <li>Alter combustion and pollutant formation at the molecular level</li> <li>Alternative solvents</li> </ul>
<b>Materials Joining, Forming &amp; Proc.</b>	<ul style="list-style-type: none"> <li>Methods to join many different materials allowing greater variety of materials of construction</li> </ul>
<b>Plating and Cleaning</b>	<ul style="list-style-type: none"> <li>Capability to provide unique coating services for special materials, which would reduce waste and expand materials of construction capability</li> <li>Enhanced plating materials for cost efficiency and increased wear</li> </ul>
<b>Coatings and Finishes</b>	<ul style="list-style-type: none"> <li>Coatings and finishes that provide excellent corrosion and erosion resistant components to increase material of construction potential</li> <li>New paints, adhesives, and organics coating that perform better and are environmentally friendly</li> </ul>

<b>Instrumentation Technology</b>	<b>Possible Cluster Application</b>
<b>Sensors</b>	<ul style="list-style-type: none"> <li>Fiber optics used to continually assess strain on infrastructure</li> <li>Fiber optics (coupled with computer systems) to monitor traffic flow and reroute traffic</li> <li>Automated safety inspections</li> <li>Sensors that are hardened for operation in harsh environments</li> </ul>
<b>System Integration</b>	<ul style="list-style-type: none"> <li>Integrate electronics, photonics &amp; signal processing to assist with development of the smart car</li> <li>Control/simulator technologies to enhance pre-prototype design</li> </ul>
<b>Custom Electronics</b>	<ul style="list-style-type: none"> <li>Electronic design drafting for faster prototype development</li> <li>Design of analog, digital, and mixed signal ASICs for electronic components</li> <li>Design of electronics for specific use in harsh environments</li> </ul>
<b>Signal Processing</b>	<ul style="list-style-type: none"> <li>Instruments for remote and noninvasive diagnosis of solenoid valves</li> <li>Use of neural nets to analyze the composition of fuels at the pump</li> </ul>

<b>Computing and Information Technologies</b>	<b>Possible Cluster Application</b>
<b>Supercomputing</b>	<ul style="list-style-type: none"> <li>Modeling of the microstructure and properties of materials of construction</li> <li>Rapid modeling of crash simulations for component design</li> <li>Reduce time required to bring new models to manufacturing</li> <li>Modeling of the superplastic deformation of alloys</li> </ul>
<b>Modeling</b>	<ul style="list-style-type: none"> <li>Software expertise in developing risk-based analysis of manufacturing or road use scenarios</li> <li>Tracking systems and route-planning models to ensure transportation efficiency and monitor hazardous waste shipments</li> </ul>
<b>Simulations</b>	<ul style="list-style-type: none"> <li>Simulation of an eight-axis numerically controlled milling machine</li> <li>Prototype highway lanes and on-board systems for vehicle navigation</li> </ul>
<b>Software</b>	<ul style="list-style-type: none"> <li>Logistics software to assist in JIT shipments of raw materials, intermediate parts, &amp; finished prod.</li> <li>Computer Aided Design and Manufacturing to speed design of prototypes</li> <li>Program and inspection plan generation for parts to streamline manufacturing process</li> </ul>
<b>Information Technology</b>	<ul style="list-style-type: none"> <li>Advanced database management to assist with more complex supplier/buyer chains and JIT mfg.</li> <li>Computer and communications security systems</li> </ul>

Environmental Technology	Possible Cluster Application
Environmental Compliance	<ul style="list-style-type: none"> <li>• Assist US manufacturers meet environmental standards intelligently and affordably</li> </ul>
Resource Recovery	<ul style="list-style-type: none"> <li>• Assist in designing manufacturing processes that re-use resources without leaving hazardous wastes</li> <li>• Development of technologies to enhance the recyclability of autos</li> <li>• Development of low-spare manufacturing processes</li> </ul>
Monitoring	<ul style="list-style-type: none"> <li>• Measurements of the impact of waste streams on groundwaters</li> <li>• Measurements of air and soil pollution</li> <li>• Monitoring systems for vehicles</li> </ul>
Waste Minimization	<ul style="list-style-type: none"> <li>• Replacement of hazardous solvents with non-hazardous ones</li> <li>• Alternate coolants, refrigerants, and paints to decrease the inventory of hazardous wastes</li> <li>• Replacements for fluids in vehicles that are more environmentally friendly</li> </ul>
Wastewater Treatment	<ul style="list-style-type: none"> <li>• Water testing techniques to verify water quality</li> </ul>
Environmental Restoration	<ul style="list-style-type: none"> <li>• Destruction of in-place contaminants at a manufacturing site</li> <li>• Fixation of contaminants at a pre-existing site, including solids destruction and fixation</li> </ul>

### *Industry Leader's Vision of Competitiveness*

Regional leaders of this cluster developed a five part vision of requirements for a more competitive cluster during the 21st Century Jobs Initiative working group process. The concepts they focused on included the following:

- East Tennessee's auto and transportation cluster needs to be better networked to the technologies shaping the industry and the technology resources of the region. The benefits include: lower production costs thus reducing the cost of automobiles and rejuvenating demand for new cars, more successful business attraction and supplier development, creation of spin-offs and suppliers for a more complex, dynamic cluster, and a reputation for a leading edge center for transportation technologies.
- The Cluster will be pro-active in developing ways to improve the region's industry-to-education communication processes. The benefits will include: improved productivity, and a renewable workforce with a better basic education, training and retraining opportunities. In particular, East Tennessee will have an advantage in trained maintenance workers.
- The Cluster will grow by maintaining (increasing) the region's low energy cost comparative advantage.
- The industry will work towards creating more financing options for cluster start-ups, which will create a pipeline for new enterprises.
- Companies will be prepared for the future by becoming leaders in meeting environmental standards (QS9000).

### *Summary*

Overall, the Auto/Transportation cluster is poised to play an increasingly important role in East Tennessee's economy. Development strategies should focus on filling the supply gaps through targeted recruitment, expansions and new business formations. Strategies should also be implemented to improving access to product and process technologies in the region and improved buyer-supplier linkage with other clusters (e.g., textile and metal producers making seat belts).

## Metals and Materials Cluster

### Description

The Metals and Materials Cluster is a traditional cluster which grew from East Tennessee's long relationship with Alcoa, mining traditions and as a support industry to the area's traditional manufacturing sectors. As shown in Table II-5 below, the cluster employs 18,600 people in the 15 counties, making it one of the largest concentrations of employment in the region. The cluster is comprised of the following sectors: coal mining, inorganic and organic chemicals, stone/clay mining and quarrying, primary aluminum, aluminum rolling and drawing, hardware, fabricated structural metal, and lime, among others. The average salary in this cluster, \$33,250, higher than the national average of \$31,650. (This is the only cluster where the average salary is higher in the region than in the nation.) In 1994, the Metals and Materials Cluster produced \$4,374 million in real output—more than any other cluster in East Tennessee. The cluster has a concentration of 270 (U.S.=100) which means that the metals and materials industry is two and three quarters times more concentrated in East Tennessee than the average in the country.

**Table II-5**  
**Growth of Metals & Materials Industries**  
**in 15-County Tennessee Resource Valley Region**

Component Industries	Employment				Real Output			Productivity	
	Level (actual) 1994	Relative Conc. 1994 (US=100)	Annual % Change 1989-1994	Annual % Change 1994-2004	Level (Millions) 1994	Annual % Change 1989-1994	Annual % Change 1994-2004	Annual % Change 1989-1994	Annual % Change 1994-2004
<b>Metals &amp; Materials</b>	18,635	270.4	-0.2	-1.4	4,374	2.0	1.6	2.7	3.1
168. Inorganic & Organic Chemicals	5,157	593.4	0.2	-0.6	1,908	2.1	2.1	1.9	2.7
239. Aluminum Rolling & Drawing	2,595	1,446.3	-1.7	-2.4	794	1.7	1.7	3.5	4.2
18. Coal Mining	946	241.9	-11.4	-4.8	218	-4.6	-0.6	7.7	4.4
235. Primary Aluminum	798	1,387.7	-0.4	-4.8	261	2.3	-1.3	2.7	3.7
253. Fab Plate Work (Boilershop)	745	299.1	-3.1	-0.8	94	-2.9	1.5	0.3	2.2
17. Metal Ores Mining, NEC	673	718.5	-3.8	-4.4	75	2.5	0.0	6.6	4.6
263. Hardware, NEC	652	263.8	2.0	-2.2	82	3.1	0.9	1.1	3.1
21. Stone/Clay Mining & Quarrying	639	191.3	-4.3	-0.1	75	-1.2	2.2	3.3	2.3
284. Special Dies, Tolls, Accessories	610	100.9	13.6	-1.8	52	16.2	2.7	2.3	4.5
254. Sheet Metal Work	457	148.4	-1.5	0.1	53	-0.6	1.4	0.9	1.3
251. Fab Structural Metal	455	195.5	2.2	-1.6	64	4.7	1.4	2.4	3.1
270. Fab Metal Prod, NEC	449	169.5	-2.1	0.4	39	-3.3	2.4	-1.2	2.0
256. Misc. Metal Work	434	286.8	10.0	0.6	61	9.1	3.1	-0.8	2.5
293. Special Industry Machine, NEC	426	131.9	12.9	-2.5	58	15.9	2.3	2.7	4.9
210. Porcelain Plumbing & Elec. Supp.	353	539.1	9.0	-0.4	31	8.4	2.6	-0.6	3.0
178. Plastic Materials & Resins	284	112.7	3.5	-0.6	115	3.7	1.8	0.2	2.4
242. Aluminum Casting	281	162.7	8.1	-4.4	28	9.0	0.5	0.9	5.2
264. Plating & Polishing	277	131.8	-2.1	1.8	20	-2.7	2.4	-0.6	0.6
266. Misc. Fab Wire Products	243	132.7	9.3	-0.1	25	10.4	2.1	1.0	2.2
252. Metal Doors, Sash & Trims	236	114.3	25.7	-1.0	27	27.0	0.5	1.1	1.5
214. Lime	210	1,232.2	10.1	-2.2	32	8.9	1.1	-1.0	3.4
248. Metal Sanitary Ware	204	747.2	-5.8	0.0	25	-6.2	2.7	-0.4	2.7
222. Nonmetallic Mineral Prod., NEC	171	523.4	7.6	-1.3	12	6.6	1.2	-0.9	2.5
182. Drugs	150	18.3	20.8	-0.6	42	23.9	3.0	2.6	3.6
255. Architectural Metal Work	143	187.2	-8.2	-0.4	17	-4.7	2.7	3.8	3.1

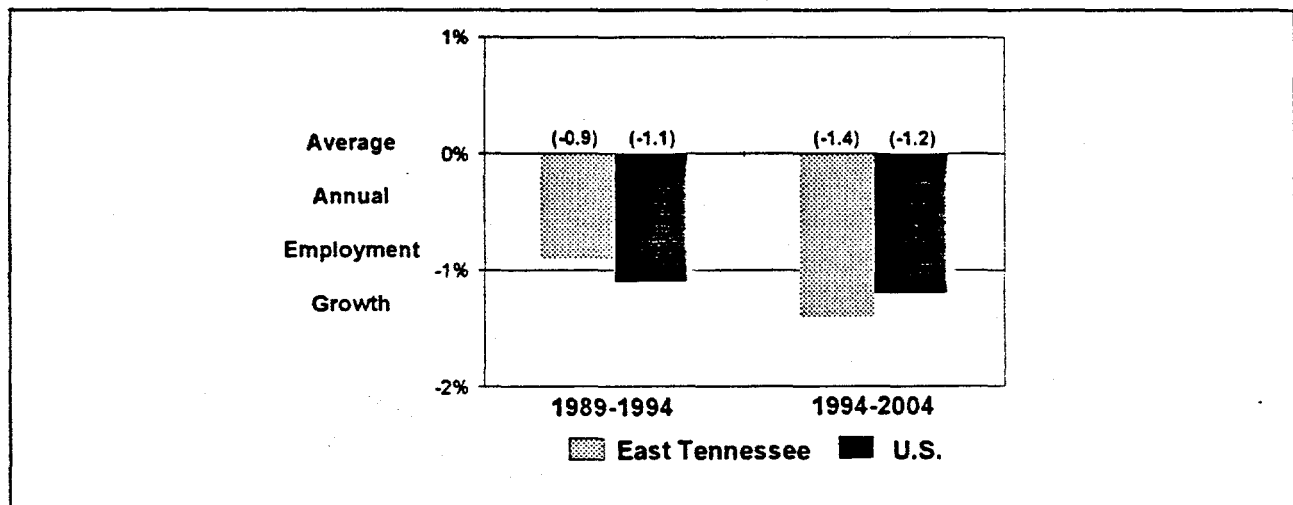
Note: nec = not elsewhere classified

Sources: DRI/McGraw-Hill; U.S. Department of Labor, Bureau of Labor Statistics;  
U.S. Department of Commerce, Bureau of Economic Analysis

### *The Cluster's Future: Forecast and Possible Interventions*

The 1994 DRI/McGraw-Hill forecast for the Metals and Materials cluster in East Tennessee, and in the nation as a whole, show a significant decline in average annual employment growth over the next ten years. As shown in Figure II-5, over the last five years employment in the cluster declined at a rate of  $-0.9\%$  per year. Growth in the next ten years is projected to fall to  $-1.4\%$  per year—slightly worse than the national rate of  $-1.2\%$ . Among the reasons for the decreases in employment are market saturation for many metal commodities, a high cost environment in the region (e.g. wages), and significant productivity increases. For example, between 1989 and 1994, productivity in the cluster grew at a rate of  $2.7\%$ . Between 1994 and 2004, productivity is expected to increase to a rate of  $3.1\%$ .

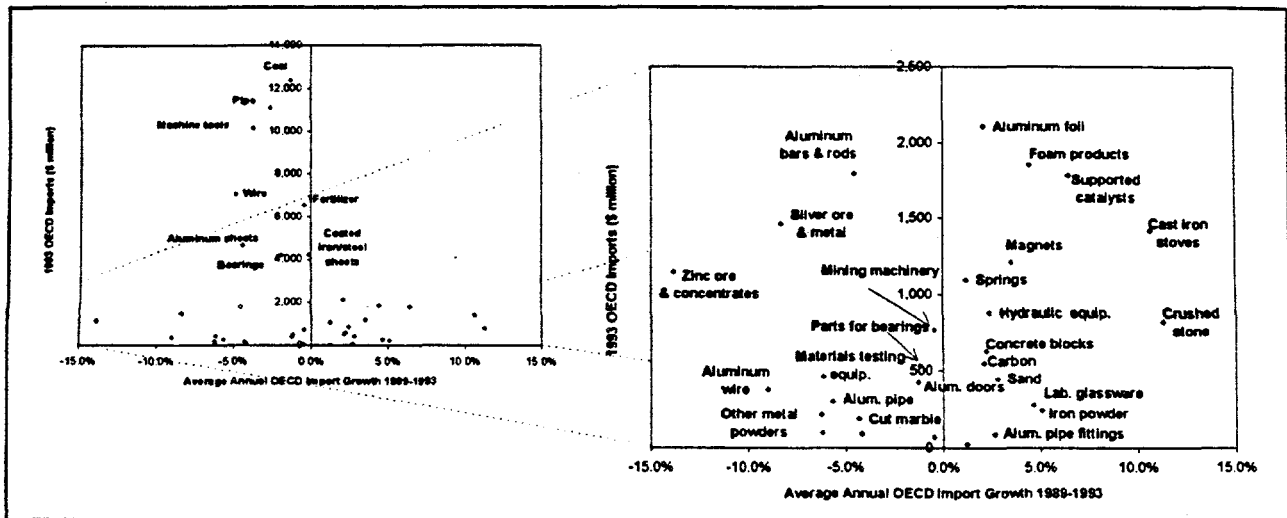
**Figure II-5**  
**Actual and Forecasted Employment Growth,**  
**Metals and Materials Cluster**



As with the other clusters, the cluster analysis provides a good first look at what some of the development priorities could be. The supply gap analysis reported in a separate memo shows that within a two hundred mile radius of the region there is demand for, but little supply of several metals and materials cluster products and services including: special industry machines and some inorganic and organic chemicals.

Business opportunities may also lie in fast growing international markets. A market study of 37 key metals and materials products found that OECD imports for these products totalled \$82 billion in 1993 (although the median average annual growth rate was  $-0.5\%$  from 1989 to 1993). Some of these products included aluminum bars and rods, foam products, magnets, and aluminum wire (see Figure II-6).

**Figure II-6**  
**Metals & Materials Cluster Products**  
**Size and Growth of the OECD Market**



As with the other clusters, there may be technological advantages at the Oak Ridge complex that could be important to the future growth and development of the cluster. An analysis of material product-related technologies in the laboratories found 58 possible technology applications for the cluster. Table II-6 shows some of the core competencies and possible industrial applications in the cluster. Besides improved access to technology, business leaders in the cluster also pointed out the need for employee skill development, start-up and expansion capital, and streamlining of regulation.

**Table II-6**  
**Oak Ridge Competencies and Possible Industrial Applications**  
**Metals and Materials Cluster**

Biotechnologies	Possible Cluster Application
Bioreactors	• Biotreatment of manufacturing wastes
Bacteria	• Use of bacteria to remove heavy metal contamination from aqueous waste streams
Biosensors	• Use of biosensors for detection of workplace hazards, such as particulates and fumes

Instrumentation Technology	Possible Cluster Application
Sensors	<ul style="list-style-type: none"> <li>• Pyrometer scanners for furnace environments</li> <li>• Heat loss, moisture, and flow rate detection</li> </ul>
System Integration	<ul style="list-style-type: none"> <li>• Process control and diagnostics of manufacturing systems</li> <li>• Integration of sensors, electronics, signal processing, and control and simulator technologies in a manufacturing environment</li> </ul>
Custom Electronics	<ul style="list-style-type: none"> <li>• Electronic drafting for design applications</li> <li>• Analog, digital, and mixed signal ASICs</li> <li>• Electronics designed for harsh environments</li> </ul>
Signal Processing	<ul style="list-style-type: none"> <li>• Neural networks for manufacturing assistance</li> <li>• Mechanical system monitoring</li> <li>• Neural networks for in-line, real time fault detection</li> </ul>

<b>Materials Technologies</b>	<b>Possible Cluster Application</b>
<b>Catalysts</b>	<ul style="list-style-type: none"> <li>• Catalysts for waste treatment</li> </ul>
<b>Alloys</b>	<ul style="list-style-type: none"> <li>• Development of new alloys</li> <li>• Alloy properties testing</li> </ul>
<b>Ceramics</b>	<ul style="list-style-type: none"> <li>• Development of new ceramic materials</li> <li>• Ceramic properties testing</li> </ul>
<b>Ceramics Processing</b>	<ul style="list-style-type: none"> <li>• Microwave processing of ceramic materials</li> <li>• Near net shape forming</li> </ul>
<b>Composites</b>	<ul style="list-style-type: none"> <li>• Graphite and carbon-carbon composites</li> </ul>
<b>Polymers</b>	<ul style="list-style-type: none"> <li>• Development of new polymers</li> <li>• Polymer curing techniques</li> <li>• Waste treatment of polymer by-products</li> </ul>
<b>Chemistry</b>	<ul style="list-style-type: none"> <li>• Environmentally friendly coolants</li> <li>• New solvents</li> </ul>
<b>Materials Joining and Forming</b>	<ul style="list-style-type: none"> <li>• Near net shape casting, forming, and rolling</li> <li>• Powder metallurgy</li> </ul>
<b>Processing</b>	<ul style="list-style-type: none"> <li>• Computer modeling of manufacturing process</li> </ul>
<b>Plating and Cleaning</b>	<ul style="list-style-type: none"> <li>• Cleaning and surface preparation techniques</li> <li>• Advanced electroplating capabilities</li> <li>• Chemical vapor deposition capabilities</li> </ul>
<b>Coatings and Finishes</b>	<ul style="list-style-type: none"> <li>• Specialty coatings for metals, alloys, ceramics, polymers, composites, and graphite structures</li> </ul>

<b>Computing and Information Technologies</b>	<b>Possible Cluster Application</b>
<b>Supercomputing</b>	<ul style="list-style-type: none"> <li>• Environmental information management</li> <li>• Research on groundwater contaminant transport</li> </ul>
<b>Modeling</b>	<ul style="list-style-type: none"> <li>• Development of enhanced process characterization</li> </ul>
<b>Simulations</b>	<ul style="list-style-type: none"> <li>• Advanced estimates of flow rates</li> <li>• Remotely operated manufacturing</li> <li>• Simulators and trainers for production personnel</li> </ul>
<b>Software</b>	<ul style="list-style-type: none"> <li>• CAD/CAM for advanced engineering design</li> <li>• Development of inspection plans</li> <li>• Generation of part program plans</li> </ul>
<b>Information Technology</b>	<ul style="list-style-type: none"> <li>• Security systems for computers and communications systems</li> <li>• Advanced database management</li> <li>• Information system development including access to data dictionaries and repositories</li> </ul>

<b>Environmental Technology</b>	<b>Possible Cluster Application</b>
<b>Environmental Compliance</b>	<ul style="list-style-type: none"> <li>• Experience with regulatory agencies with reporting requirements, etc.</li> </ul>
<b>Resource Recovery</b>	<ul style="list-style-type: none"> <li>• Recovery and reuse of byproducts</li> <li>• Techniques of energy conservation</li> <li>• Alternate building methods for energy conservation</li> </ul>
<b>Monitoring</b>	<ul style="list-style-type: none"> <li>• Analytical testing of waste streams</li> <li>• Waste water testing and monitoring</li> </ul>
<b>Waste Minimization</b>	<ul style="list-style-type: none"> <li>• Replacement of chlorinated and other solvents</li> <li>• Development of more efficient manufacturing processes to reduce byproducts and wastes</li> </ul>
<b>Wastewater Treatment</b>	<ul style="list-style-type: none"> <li>• Use of bacteria to treat waste water streams</li> <li>• Techniques to remove heavy metals from waste streams</li> </ul>
<b>Environmental Restoration</b>	<ul style="list-style-type: none"> <li>• Destruction of contaminants at pre-existing sites</li> <li>• Fixing and capping pre-existing sites</li> <li>• Solids destruction and fixation</li> </ul>

### ***Industry Leader's Vision of Competitiveness***

During the course of the Jobs Initiative, regional business leaders crafted a four-part vision of competitiveness for the cluster:

- East Tennessee's metals and materials cluster will be better connected to the emerging Environmental Technology industry—contributing to the success of both by creating new business opportunities and creating mutually profitable environmental protection solutions.
- The industry will benefit from growing East Tennessee's JIT training capacity—a new integrated approach to the region's training resources. The industry will become involved in guiding worker development in recruitment (high school outreach), new entrant training (expanding long-term, certification programs in desired skills), and retraining (making better use of the flexible training resources at the Centers for Manufacturing/Y-12).
- The cluster will be better networked to the region's technological resources which will allow it to reduce costs and increase productivity and to penetrate new markets through product development.
- The pipeline of new companies in the cluster will improve with the cultivation of new sources of capital.

### *Summary*

As with the other clusters, these concepts of the future metals and materials cluster, based on analysis of economic data and industry leader's understanding of the marketplace, are the basis for the recommendations at the end of the report. Although employment may continue to decline in the region, it is apparent that new business and market opportunities exist. Overall, two primary development strategies are suggested. First, efforts should focus on commercialization of Oak Ridge technologies (especially new materials such as ceramics and catalysts for waste treatment). Secondly, steps should be taken to improve cluster linkage (e.g. metals producers supplying the auto/transportation cluster). Recommendations for implementing both strategies are made in Section V, "Moving to Action."

## **Forest Products Cluster**

### *Description*

With its long history in the Smoky Mountains, the Forest and Wood Products Cluster is one of the region's traditional natural resource clusters and today employs 9,300 workers. The average salary in the cluster is \$17,780, substantially below the national average for the cluster of \$22,230. Although the cluster does include lumber and basic wood products, many value-added sectors are present in the region such as: hardwood dimension and flooring, stationery and miscellaneous paper products, wood household furniture, upholstered household furniture, paperboard containers and boxes, wood kitchen cabinets, and prefabricated wood structures. In 1994, these activities resulted in \$912 million in real output. The Forest Products Cluster has a concentration of 313 (U.S.=100) which roughly means that the forestry industry is three times more concentrated in East Tennessee than the average in the country.



**Table II-7**  
**Growth of Forest Products Industries in**  
**15-County Tennessee Resource Valley Region**

Component Industries	Employment				Real Output			Productivity	
	Level (actual) 1994	Relative Conc. 1994 (US=100)	Annual % Change 1989-1994	Annual % Change 1994-2004	Level (Millions) 1994	Annual % Change 1989-1994	Annual % Change 1994-2004	Annual % Change 1989-1994	Annual % Change 1994-2004
<b>Forest Products</b>	9,298	312.8	2.5	-1.2	912	3.6	2.7	2.6	4.0
134. Upholstered HH Furniture	2,806	1,025.7	9.9	-1.1	235	12.8	3.1	2.6	4.2
131. Wood HH Furniture	1,401	330.5	3.6	0.4	101	4.2	3.6	0.6	3.2
119. Hardwood Dimension & Flooring	966	994.5	-4.7	-2.4	74	-2.1	2.8	2.8	5.4
133. Wood TV and Radio Cabinets	850	6,727.6	7.8	-4.4	62	6.2	0.3	-1.5	4.9
155. Paperboard Containers & Boxes	596	83.0	6.5	-0.4	95	9.1	2.7	2.4	3.1
143. Furniture & Fixtures, NEC	508	503.3	11.1	-0.6	49	17.0	3.8	5.4	4.5
154. Stationery & Misc. Paper Products	421	298.4	6.7	-0.8	54	7.8	1.9	1.1	2.7
139. Public Building Furniture	410	472.4	3.2	-1.2	47	2.3	2.9	-0.9	4.1
122. Wood Kitchen Cabinets	335	147.1	-2.5	-0.6	25	-2.6	2.9	-0.2	3.5
118. Sawmills & Planing Mills, Gen	313	69.6	-2.2	-2.4	64	1.7	2.0	4.0	4.5
125. Prefab Wood Structures	197	306.9	-11.8	-0.4	27	-9.4	2.7	2.8	3.1
12. Forestry Products	189	129.8	-19.1	-0.8	36	-14.1	3.2	6.2	4.0
162. Manifold Business Forms	181	119.5	0.8	-2.3	29	2.6	1.4	1.8	3.8
124. Struct. Wood Members, NEC	125	157.8	-0.4	-1.5	14	-0.1	3.1	0.3	4.6

Note: nec = not elsewhere classified

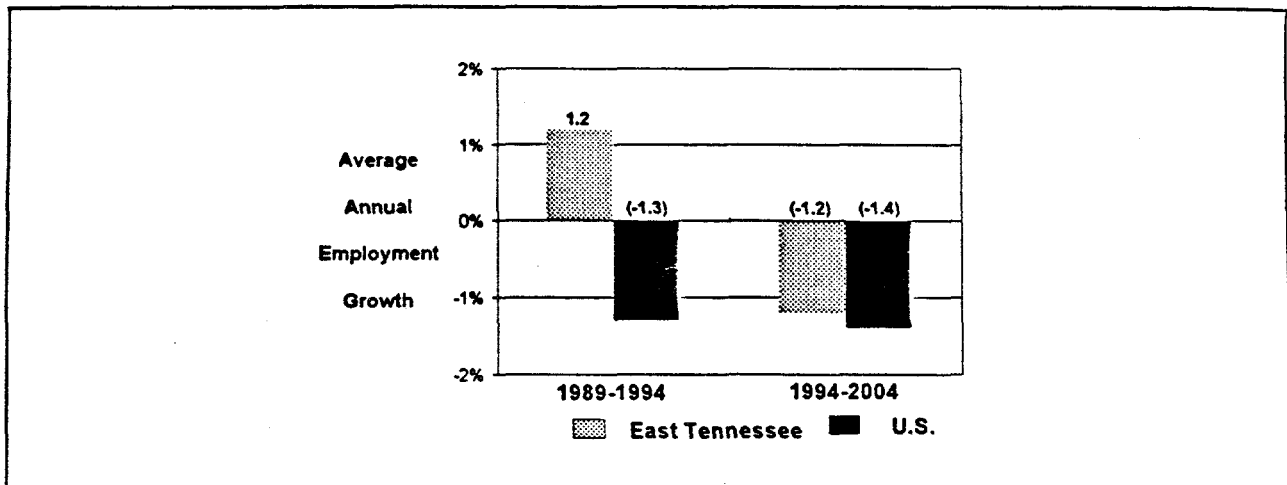
Sources: DRI/McGraw-Hill; U.S. Department of Labor, Bureau of Labor Statistics;  
U.S. Department of Commerce, Bureau of Economic Analysis

### *The Cluster's Future: Forecast and Possible Interventions*

The 1994 DRI/McGraw-Hill forecast for the Forest Products cluster in East Tennessee, and in the nation as a whole, suggest a significant decline in average annual employment growth over the next ten years (see Figure II-7). After enjoying 1.2% growth per year over the last ten years, employment is projected to decline at 1.2% per year—slightly better performance overall than the forecast national average decline of 1.4% per year.

Environmental concerns have forced changes on the industry with regulatory compliance cited as a major hardship for wood product manufacturers. Another reason for the decline in employment in the cluster is increased productivity—simply being able to produce more output with fewer employees. Between 1989 and 1994, productivity in the cluster grew at a rate of 2.6%. Between 1994 and 2004, productivity is expected to increase to 4.0%. These forecast numbers are from a baseline forecast which do not take into account the variety of interventions the local industry could take to increase (or decrease) its competitiveness.

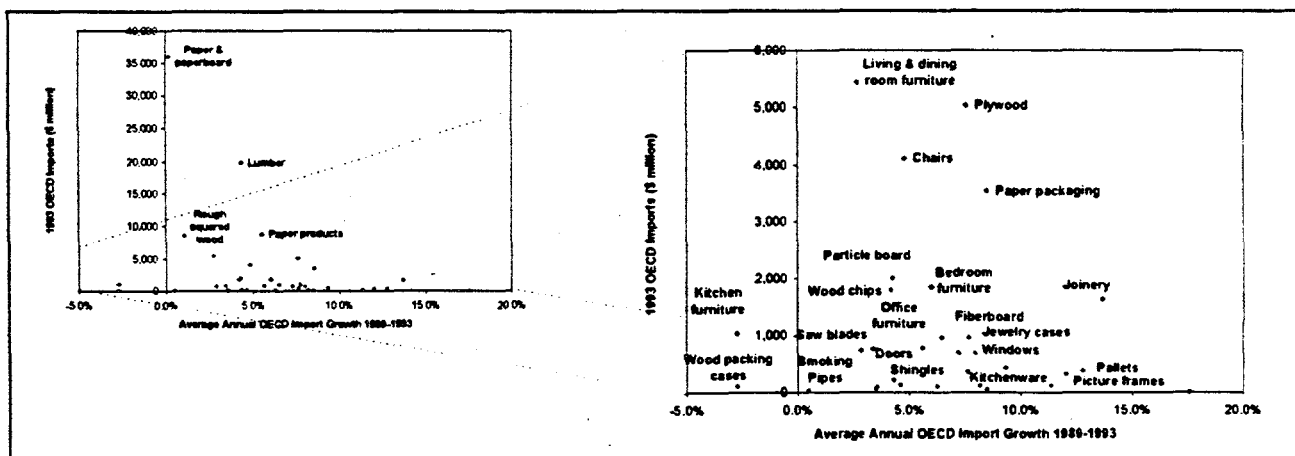
**Figure II-7**  
**Actual and Forecasted Job Growth, Forest Products Cluster**



This analysis provides a “snapshot” of what kind of economic development strategies are needed. For example, the supply gap analysis (see separate memo report) shows that in a two hundred mile radius of the region there is extensive demand but little supply of some wood products that could potentially be produced in the region including veneer and plywood, paperboard, and particleboard.

Business opportunities may also lie in fast growing international markets. A market study of 35 selected forest products found that OECD imports for these products totalled \$108 billion in 1993 with a median average annual growth rate of 5.6% from 1989 to 1993. Some of the products having especially fast growing markets include chairs, paper packaging, bedroom furniture, joinery, and kitchenware (see Figure II-8).

**Figure II-8**  
**Size and Growth of the OECD Market, Selected Forest Products Cluster**



Collective, regional intervention in the development of the forest products cluster includes steps such as creating vital new links between the industry and the economic infrastructure providers in the region. For example, technology found in the Oak Ridge complex could be valuable to the cluster's future. An analysis of forest product-related technologies in the laboratories found 58 possible technology applications for the cluster. Table II-8 lists the core competencies identified at the Oak Ridge complex and selected industrial applications in East Tennessee.

**Table II-8**  
**Oak Ridge Competencies and Possible Industrial Applications**  
**Forest Products Cluster**

<b>Biotechnologies</b>	<b>Possible Cluster Application</b>
<b>Biomass</b>	<ul style="list-style-type: none"> <li>• Development of genetically transformed trees that are more disease resistant</li> <li>• Genetically transformed trees that are more productive</li> </ul>
<b>Bioreactors</b>	<ul style="list-style-type: none"> <li>• Feedstock pretreatment for pulp and paper manufacturing</li> <li>• Use of bioreactors to treat waste waters</li> <li>• Separation of biochemicals for reuse or easier disposal</li> </ul>
<b>Bacteria</b>	<ul style="list-style-type: none"> <li>• Use of bacteria to treat waste streams</li> <li>• Use of bacteria to remove heavy metal contamination from aqueous waste streams</li> </ul>
<b>Biosensors</b>	<ul style="list-style-type: none"> <li>• Use of biosensors to detect fume and particulate hazards in the workplace</li> </ul>
<b>Genetic Engineering</b>	<ul style="list-style-type: none"> <li>• Extend the life and health of the forest by reducing the effects of greenhouse gases</li> </ul>

<b>Manufacturing Technologies</b>	<b>Possible Cluster Application</b>
<b>Ultraprecision Machining</b>	<ul style="list-style-type: none"> <li>• Advanced and specialized development of machine tooling of manufacturing equipment</li> </ul>
<b>Stereolithography</b>	<ul style="list-style-type: none"> <li>• Rapid development of prototypes for design applications</li> </ul>
<b>Controls and Simulators</b>	<ul style="list-style-type: none"> <li>• Remotely operated manufacturing processes</li> <li>• Improved estimates of manufacturing flow rates</li> <li>• Manufacturing process simulators and trainers</li> </ul>
<b>Environmentally Conscious Manufacturing</b>	<ul style="list-style-type: none"> <li>• Assistance with the development of manufacturing processes with reduced waste streams</li> <li>• Development of manufacturing process that utilize recycled materials</li> </ul>

<b>Materials Technologies</b>	<b>Possible Cluster Application</b>
<b>Catalysts</b>	<ul style="list-style-type: none"> <li>• New catalysts to help with pulping process</li> </ul>
<b>Alloys</b>	<ul style="list-style-type: none"> <li>• Digester components made of special metals to enhance corrosion resistance, wear, and strength</li> <li>• Lightweight, strong manufacturing components</li> </ul>
<b>Ceramics</b>	<ul style="list-style-type: none"> <li>• High strength cutting knives for paper/pulp manufacturing</li> <li>• Materials for manufacturing equipment for high temperature or harsh environments</li> </ul>
<b>Ceramics Processing</b>	<ul style="list-style-type: none"> <li>• None identified</li> </ul>
<b>Composites</b>	<ul style="list-style-type: none"> <li>• Paper processing equipment constructed of composites such as carbon-carbon</li> </ul>
<b>Polymers</b>	<ul style="list-style-type: none"> <li>• Corrosion resistant manufacturing equipment</li> <li>• Specialty filtration equipment constructed of polymers</li> </ul>
<b>Chemistry</b>	<ul style="list-style-type: none"> <li>• Coolants that are environmentally friendly</li> <li>• Assistance with development of non-hazardous chemical replacements</li> </ul>
<b>Materials Joining and Forming</b>	<ul style="list-style-type: none"> <li>• Development of manufacturing equipment that exhibits corrosion resistance and increased wear strength, using joining and forming techniques to create polymers bonded to metals, etc.</li> </ul>
<b>Processing</b>	<ul style="list-style-type: none"> <li>• New process control methods</li> </ul>
<b>Processing</b>	<ul style="list-style-type: none"> <li>• New process control methods</li> </ul>
<b>Plating and Cleaning</b>	<ul style="list-style-type: none"> <li>• Corrosion resistant manufacturing equipment</li> <li>• Abrasion resistant manufacturing equipment</li> </ul>
<b>Coatings and Finishes</b>	<ul style="list-style-type: none"> <li>• Corrosion resistant mixer blades</li> <li>• Development of advanced thermal barriers for manufacturing environments</li> </ul>

<b>Instrumentation Technology</b>	<b>Possible Cluster Application</b>
<b>Sensors</b>	<ul style="list-style-type: none"> <li>• Monitoring for heat loss in piping</li> <li>• Moisture monitoring</li> <li>• Automated, in-situ, temperature sensing and calibration</li> </ul>
<b>System Integration</b>	<ul style="list-style-type: none"> <li>• Process control and diagnostics of manufacturing systems</li> <li>• Integration of electronics, photonics, signal processing, and control/simulator technology in manufacturing systems</li> </ul>
<b>Custom Electronics</b>	<ul style="list-style-type: none"> <li>• Electronic design drafting for new manufacturing processes</li> <li>• Design and fabrication of specialty ASICs</li> <li>• Electronics for use in harsh environments</li> </ul>
<b>Signal Processing</b>	<ul style="list-style-type: none"> <li>• Neural networks for real time flaw detection</li> <li>• Monitoring of mechanical systems</li> </ul>

<b>Computing and Information Technologies</b>	<b>Possible Cluster Application</b>
<b>Supercomputing</b>	<ul style="list-style-type: none"> <li>• Modeling three-dimensional pictures of effluent streams to assist in waste treatment activities</li> </ul>
<b>Modeling</b>	<ul style="list-style-type: none"> <li>• Models of climate changes can help determine the future viability of forest lands</li> </ul>
<b>Simulations</b>	<ul style="list-style-type: none"> <li>• Use of simulation models would streamline manufacturing process</li> <li>• CAD/CAM capabilities would assist with new process design</li> </ul>
<b>Software</b>	<ul style="list-style-type: none"> <li>• System integration software to streamline manufacturing process</li> </ul>
<b>Information Technology</b>	<ul style="list-style-type: none"> <li>• Development of database systems</li> </ul>

<b>Environmental Technology</b>	<b>Possible Cluster Application</b>
<b>Environmental Compliance</b>	<ul style="list-style-type: none"> <li>• Studies on the effects of global warming, acid rain, and other environmental issues assist in assuring timberlands for the future</li> <li>• Studies on the effects of logging also assist in the long-term viability of forest lands</li> </ul>
<b>Resource Recovery</b>	<ul style="list-style-type: none"> <li>• Past studies on the recovery of waste streams could benefit efforts to process waste streams for reuse</li> <li>• Past research could assist in more energy efficient manufacturing practices</li> </ul>
<b>Monitoring</b>	<ul style="list-style-type: none"> <li>• In-line, advanced monitoring systems allow for real time assessment of env't'l. compliance measures</li> <li>• Sophisticated analytical capabilities can provide information on effluent pollution</li> </ul>
<b>Waste Minimization</b>	<ul style="list-style-type: none"> <li>• Research in the efficient use of raw materials would minimize chemical waste streams</li> <li>• Computerized process control also would streamline mfg. process and minimize effluent streams</li> </ul>
<b>Wastewater Treatment</b>	<ul style="list-style-type: none"> <li>• Bacteria can be used to treat effluent streams</li> </ul>
<b>Environmental Restoration</b>	<ul style="list-style-type: none"> <li>• Bacteria used to digest chlorinated wastes can help with existing problem waste sites</li> <li>• Experience with stabilizing and capping waste sites could be used to remediate old sites</li> </ul>

Besides technology, business leaders in the cluster also pointed to other kinds of interventions in the forecasts, including enhanced public education regarding issues facing the industry, better access to "best forestry practices" information, and better linkages between the cluster and local educational institutions.

### ***Industry Leader's Vision of Competitiveness***

Considering their internal and external threats and opportunities, regional business leaders set forth a three part vision of competitiveness for the cluster, stated as follows:

- East Tennessee will provide and have access to better industry information about the industry and its opportunities in the region, which will lead to more successful investment attraction and better industry decision making.
- East Tennessee will become a region known for its sustainable use of the forest. Using the forest in a sustainable manner will help improve public perception of the industry (changing,

too, the political implications of the negative image), create opportunities to produce a higher quality products and create jobs, and will improve the health of the forest.

- The Cluster will be better networked for technology transfer and commercialization of existing technologies.

These industry perspectives on the cluster and its future have been the basis for the action initiatives recommended at the end of the report.

### *Summary*

East Tennessee's Forest Products Cluster faces a difficult future for a variety of reasons, environmental compliance being perhaps the most important. In this regard, the analysis suggests that environmental technologies at Oak Ridge may be applicable to the cluster. Development strategies should focus on improved access to Oak Ridge technologies with the aim of making the cluster a model for sustainable forestry. Strategies should also be pursued for linking the cluster to others in the region (e.g., production of fibers for use in the Auto/Transportation Cluster—for sound proofing, soft internal panels in autos). Recommendations are made in Section V, "Moving to Action."

## **Textile and Apparel Cluster**

### *Description*

Like other traditional manufacturing sectors, the Textile and Apparel cluster has been a mainstay of the East Tennessee economy. Although the structure of the industry is such that most employment is found in small and mid-sized businesses, the cluster represents one of the largest concentrations of employment in the region. It employs 18,000 people. The average wage in East Tennessee is \$15,880, substantially below the national average for the industry of \$17,460. As shown in Table II-9, sectors included in the cluster analysis and found in East Tennessee include: apparel from purchased material, fabricated textile products, yarn mills and textile finishing, narrow fabric mills, textile machinery, hosiery and knit goods, broadwoven fabric plants, leather goods, knit fabric mills, and leather gloves and mittens. In 1994, these sectors produced \$1,478 million in real output. The Textile and Apparel cluster has a concentration of 343 (U.S.=100) which roughly means that the apparel and textile industry is three and a half times more concentrated in East Tennessee than the average in the country.

**Table II-9**  
**Growth of Textile and Apparel Industries in**  
**15-County Tennessee Resource Valley Region**

Component Industries	Employment				Real Output			Productivity	
	Level (actual) 1994	Relative Conc. 1994 (US=100)	Annual % Change 1989-1994	Annual % Change 1994-2004	Level (Millions) 1994	Annual % Change 1989-1994	Annual % Change 1994-2004	Annual % Change 1989-1994	Annual % Change 1994-2004
<b>Apparel &amp; Textiles</b>	18,026	343.0	-2.6	-2.3	1,478	0.4	1.6	2.6	4.0
114. Apparel from Purchased Materials	9,909	400.3	-2.0	-2.7	669	-0.8	0.9	1.2	3.6
112. Hosiery & Knit Goods	2,557	527.8	-11.6	-2.4	164	-8.8	0.8	3.2	3.3
364. Surgical Appliances & Supplies	1,955	639.1	11.4	-2.5	300	13.8	2.5	2.1	5.2
116. Fab. Textile Products, NEC	1,734	328.4	0.4	0.2	137	0.2	3.8	-0.2	3.6
104. Broadwoven Fabric Plants	614	89.4	1.9	-2.9	96	3.5	1.1	1.5	4.1
106. Yarn Mills & Textile Finishing	377	100.6	0.1	-2.3	40	2.8	1.8	2.7	4.2
204. Leather Goods, NEC	220	288.3	65.6	-3.7	16	66.6	-0.3	0.6	3.6
105. Narrow Fabric Mills	214	336.7	-4.6	-2.3	14	-5.1	2.2	-0.6	4.6
113. Knit Fabric Mills	195	100.8	-13.9	-2.4	23	-11.7	1.9	2.6	4.5
289. Textile Machinery	169	305.0	73.3	-1.8	15	71.8	1.9	-0.9	3.8
202. Leather Gloves & Mittens	82	749.7	4.5	-5.1	2	-2.4	-0.2	-6.6	5.2

Note: nec = not elsewhere classified

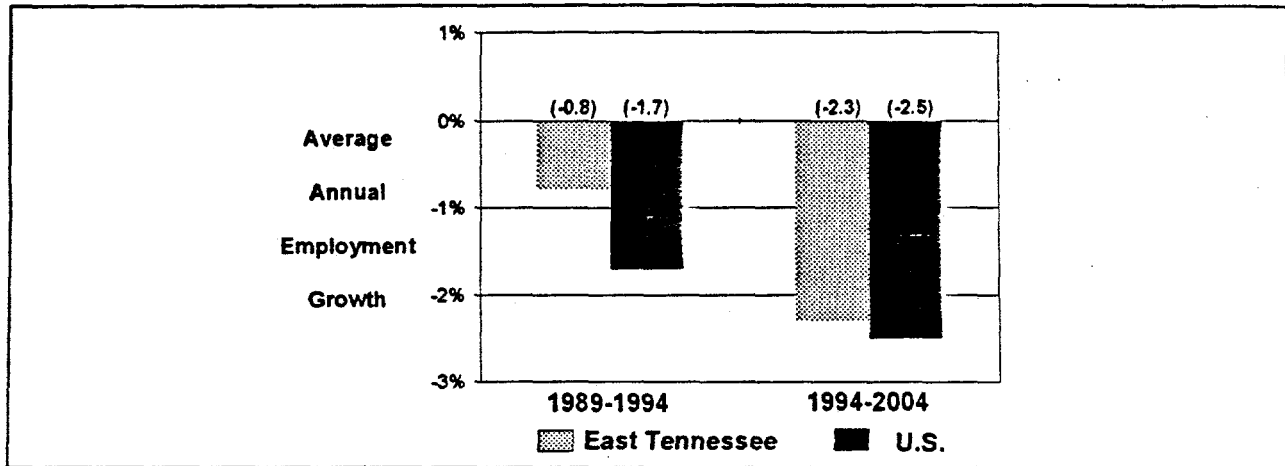
Sources: DRI/McGraw-Hill; U.S. Department of Labor, Bureau of Labor Statistics;  
U.S. Department of Commerce, Bureau of Economic Analysis

### *The Cluster's Future: Forecast and Possible Interventions*

The 1994 DRI/McGraw-Hill forecast for the Textile and Apparel Cluster in East Tennessee, and in the nation as a whole, shows a significant decline in average annual employment growth over the next ten years. As shown in Figure II-9, after five years at -0.8% growth per year growth is projected to be -2.3% for the next ten—slightly better than the national average of decline of 2.5% per year.

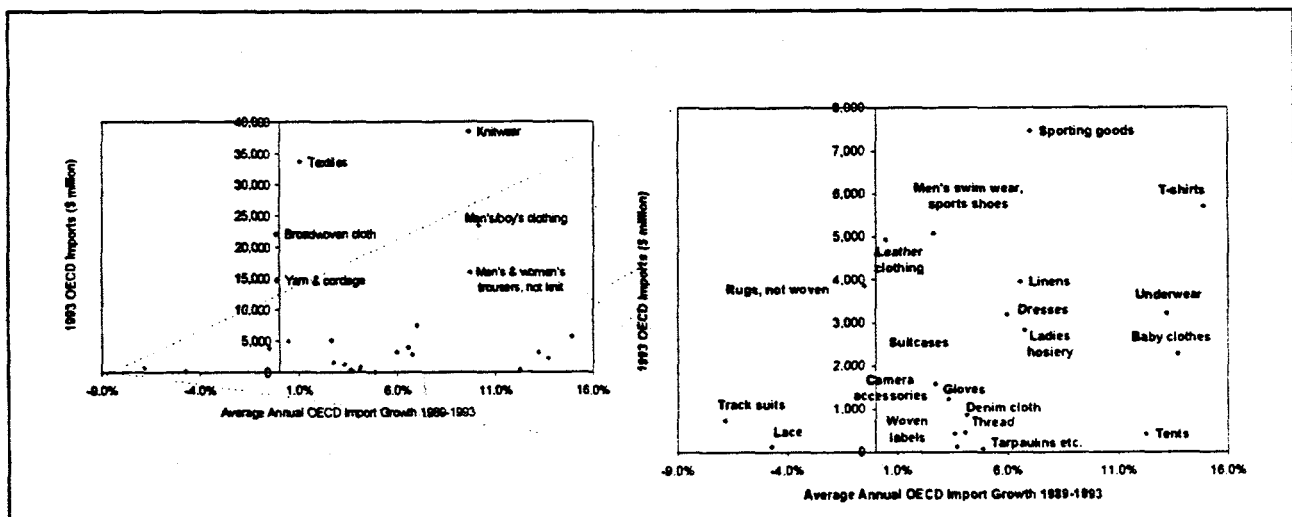
The textile and apparel industry has always been vulnerable to off-shore production, and is more so today with the passage of NAFTA. As protectionist barriers are dropped and infrastructure is developed in countries with cheap labor, the competition will only become more fierce. Another reason for the decline in employment in the cluster is increased productivity—simply being able to produce more output with fewer employees. Between 1989 and 1994, productivity in the cluster grew at a rate of 2.6%. Between 1994 and 2004, productivity is expected to increase to 4.0%. As with the other forecasts reported here, these numbers are from a baseline forecast which do not take into account the variety of interventions the local industry could take to increase (or decrease) its competitiveness.

**Figure II-9**  
**Actual and Forecasted Employment Growth**  
**Textile and Apparel Cluster**



The analysis provides a look at what some of the development priorities may be for each cluster. For example, the supply gap analysis (reported in a separate memo) shows that in a two hundred mile radius of the region there is extensive demand but little supply of some apparel and textile products including: fabricated textile products, narrow fabric mills, leather tanning and finishing, and apparel from purchased materials. Business opportunities may also lie in fast growing international markets. A market study of 26 key textile and apparel products found that OECD imports for these products totalled \$197 billion in 1993 with a median average annual growth rate of 4.1% from 1989 to 1993. Some of these products included linens, men's swim wear, underwear, baby clothes, and T-shirts (see Figure II-10).

**Figure II-10**  
**Apparel & Textiles Cluster Products**  
**Size and Growth of the OECD Market**



The analysis has shown that technology found in the Oak Ridge complex could be valuable to the cluster's future. For example, an analysis of apparel and textile product-related technologies in the laboratories found 64 possible technology applications for the cluster. Table II-10 lists the core competencies of the Oak Ridge complex and selected industrial applications to the cluster. Besides improved access to technology, business leaders in the cluster also pointed to the need for better linkages to educational institutions and ways to bring down barriers for small operations to work together in flexible manufacturing-type operations.

**Table II-10**  
**Oak Ridge Competencies and Possible Industrial Applications**  
**Apparel & Textiles Cluster**

<b>Biotechnologies</b>	<b>Possible Cluster Application</b>
<b>Biomass</b>	<ul style="list-style-type: none"> <li>• New feedstock materials</li> </ul>
<b>Bioreactors</b>	<ul style="list-style-type: none"> <li>• Biochemical separation of chemicals from byproducts</li> <li>• Pretreatment of certain feedstocks</li> <li>• Use of bioreactors to treat waste streams</li> </ul>
<b>Bacteria</b>	<ul style="list-style-type: none"> <li>• Bacteria used for waste water treatment</li> <li>• Bacteria used to remove heavy metals from aqueous waste streams</li> </ul>
<b>Biosensors</b>	<ul style="list-style-type: none"> <li>• Sensors used to detect work place hazards, such as fumes and particulates</li> <li>• Sensors to detect ground contamination</li> </ul>
<b>Genetic Engineering</b>	<ul style="list-style-type: none"> <li>• Increased raw material crop yields</li> </ul>

<b>Manufacturing Technologies</b>	<b>Possible Cluster Application</b>
<b>Ultraprecision Machining</b>	<ul style="list-style-type: none"> <li>• Machining and tooling of manufacturing equipment</li> </ul>
<b>Stereolithography</b>	<ul style="list-style-type: none"> <li>• Rapid prototyping of design models</li> </ul>
<b>Environmentally Conscious Manufacturing</b>	<ul style="list-style-type: none"> <li>• Recovery and recycle of materials from waste streams</li> <li>• Energy conscious manufacturing systems</li> </ul>

<b>Materials Technologies</b>	<b>Possible Cluster Application</b>
<b>Catalysts</b>	<ul style="list-style-type: none"> <li>• Advanced catalysts for feedstocks</li> </ul>
<b>Alloys</b>	<ul style="list-style-type: none"> <li>• New materials for manufacturing equipment for longer wear and life</li> </ul>
<b>Ceramics</b>	<ul style="list-style-type: none"> <li>• New material of construction for equipment tooling</li> </ul>
<b>Ceramics Processing</b>	<ul style="list-style-type: none"> <li>• None identified</li> </ul>
<b>Composites</b>	<ul style="list-style-type: none"> <li>• New materials for manufacturing equipment for longer wear and life</li> </ul>
<b>Polymers</b>	<ul style="list-style-type: none"> <li>• Advanced polymers for new fibers</li> <li>• Advanced polymers for new feedstocks</li> <li>• Advanced polymers for filtration systems</li> </ul>
<b>Chemistry</b>	<ul style="list-style-type: none"> <li>• Environmentally friendly coolants and feedstocks</li> <li>• New solvents</li> </ul>
<b>Materials Joining and Forming</b>	<ul style="list-style-type: none"> <li>• Advanced materials for manufacturing equipment</li> </ul>
<b>Processing</b>	<ul style="list-style-type: none"> <li>• Process control systems</li> <li>• Harsh environment processing techniques</li> </ul>
<b>Plating and Cleaning</b>	<ul style="list-style-type: none"> <li>• Abrasion and corrosion resistance for manufacturing equipment</li> <li>• Improved lubricity of manufacturing equipment</li> </ul>
<b>Coatings and Finishes</b>	<ul style="list-style-type: none"> <li>• Erosion resistant manufacturing equipment</li> <li>• Thermal barriers</li> <li>• Corrosion resistant manufacturing equipment</li> </ul>



<b>Instrumentation Technology</b>	<b>Possible Cluster Application</b>
<b>Sensors</b>	<ul style="list-style-type: none"> <li>• Piping heat loss and moisture monitoring</li> <li>• Automated in-situ temperature sensor and calibration</li> </ul>
<b>System Integration</b>	<ul style="list-style-type: none"> <li>• Process control diagnostics</li> <li>• Integration of electronic, signal processing, sensors, and control and simulator technologies</li> </ul>
<b>Custom Electronics</b>	<ul style="list-style-type: none"> <li>• Electron drafting for design applications</li> <li>• Analog, digital, and mixed signal ASICs</li> <li>• Harsh environment electronics</li> </ul>
<b>Signal Processing</b>	<ul style="list-style-type: none"> <li>• Neural networks for manufacturing assistance</li> <li>• Neural networks for real-time, in-line flaw detection</li> <li>• Mechanical systems monitoring</li> </ul>

<b>Computing and Information Technologies</b>	<b>Possible Cluster Application</b>
<b>Supercomputing</b>	<ul style="list-style-type: none"> <li>• Environmental information management systems</li> <li>• Groundwater contaminant transport characterization</li> </ul>
<b>Modeling</b>	<ul style="list-style-type: none"> <li>• Development of new manufacturing systems</li> </ul>
<b>Simulations</b>	<ul style="list-style-type: none"> <li>• Improved estimates of flow rates</li> <li>• Remotely operated manufacturing</li> <li>• Simulators and trainers for process operators</li> </ul>
<b>Software</b>	<ul style="list-style-type: none"> <li>• CAD/CAM for new production and manufacturing design</li> <li>• Development of inspection plans</li> <li>• Generation of part program plans</li> </ul>
<b>Information Technology</b>	<ul style="list-style-type: none"> <li>• Security systems for computers and communications systems</li> <li>• Advanced database development and management</li> <li>• Data administration, including data dictionaries and repositories</li> </ul>

<b>Environmental Technology</b>	<b>Possible Cluster Application</b>
<b>Environmental Compliance</b>	<ul style="list-style-type: none"> <li>• Assistance with regulatory requirements</li> </ul>
<b>Resource Recovery</b>	<ul style="list-style-type: none"> <li>• Alternate fuels and building methods</li> <li>• Energy conservation methods</li> </ul>
<b>Monitoring</b>	<ul style="list-style-type: none"> <li>• Advanced waste stream analysis</li> <li>• Advanced waste water analysis</li> </ul>
<b>Waste Minimization</b>	<ul style="list-style-type: none"> <li>• Replacement of hazardous chemicals, such as dyes</li> <li>• Recovery and reuse of byproducts</li> <li>• Reductions in the amount of landfill usage</li> </ul>
<b>Wastewater Treatment</b>	<ul style="list-style-type: none"> <li>• Bacteria-based treatment of waste waters</li> </ul>
<b>Environmental Restoration</b>	<ul style="list-style-type: none"> <li>• Destruction of contaminants in existing sites</li> <li>• Fixation and capping of existing files</li> <li>• Destruction and fixation of solids</li> </ul>

### *Industry Leader's Vision of Competitiveness*

Based on the analysis and considering their knowledge of the marketplace, regional business leaders set forth a two part vision of competitiveness for the cluster, stated as follows:

- East Tennessee will have a well-organized industry which can: a) develop the critical mass to access and create a technological competitive advantage b) do a better job of tapping into regional and national associations for political clout and industry development investment, and c) communicate a positive image of the industry to the community, workforce, and economic development professionals.

- To ward off threats and to take advantage of opportunities as global markets change, the East Tennessee Apparel and Textile industry will pursue strategic partnerships, find growth niche markets, and take advantage of the GATT window.

### Summary

Facing severe foreign competition, the Textiles and Apparel Cluster will need to reduce costs, meaning that innovations in manufacturing equipment and processes will be required. It appears that technology of this kind is available at the Oak Ridge complex. Therefore, one key development strategy should be to link much closer to Oak Ridge and work hard to identify appropriate technology for commercialization by cluster firms. Several recommendations in this regard are made in Section V, "Moving to Action."

### Food Products Cluster

#### Description

The Food Products Cluster is one more traditional cluster in the sense that it has historically been a part of the East Tennessee economic landscape. The cluster is, and has been for some time, focused on the processing of agriculture commodities into food products. Sectors in this cluster found in East Tennessee include: bottled and canned soft drinks, canned specialties, roasted coffee, flour and other grain mill products, fertilizers, bread and related products, wet corn milling, fishery products, and animal and marine fats and oils, among others. Together these sectors employ 3,200 people in East Tennessee, making the smallest employment concentration among the eight clusters identified. The cluster accounted for \$849 million in real output in 1994. The average salary in this cluster is below the national average for the industry, \$25,110 as compared to \$26,760. The Food Products Cluster has a concentration of 268 (U.S.=100) which roughly means that the food products industry is two and three quarters more concentrated in East Tennessee than the average in the country.

**Table II-11**  
**Growth of Agriculture & Food Products Industries in**  
**15-County Tennessee Resource Valley Region**

Component Industries	Employment				Real Output			Productivity	
	Level (actual) 1994	Relative Conc. 1994 (US=100)	Annual % Change 1989-1994	Annual % Change 1994-2004	Level (Millions) 1994	Annual % Change 1989-1994	Annual % Change 1994-2004	Annual % Change 1989-1994	Annual % Change 1994-2004
<b>Agriculture &amp; Food Products</b>	3,233	268.0	-0.7	-1.1	849	1.9	1.0	2.1	2.2
89. Bottled & Canned Soft Drinks	1,071	364.6	-3.0	-1.5	290	0.7	0.9	3.7	2.4
79. Bread, Cake & Related Products	803	141.3	-4.9	-0.7	95	-5.1	0.1	-0.2	0.8
66. Canned Specialties	641	731.9	9.6	-1.3	173	11.9	1.2	2.0	2.5
78. Wet Corn Milling	203	669.0	-2.4	0.3	140	2.5	2.4	5.1	2.1
95. Roasted Coffee	168	423.3	1.9	-0.4	75	1.8	-0.3	-0.1	0.1
13. Fishery Products	150	197.8	NC	-2.2	23	NC	0.6	-1.4	2.8
72. Flour & Other Grain Mill Products	89	181.6	-11.6	-1.6	34	-10.0	0.9	1.8	2.4
94. Animal & Marine Fats & Oils	71	222.9	15.5	-1.5	13	22.0	1.7	5.6	3.3
170. Fertilizers, Mixing Only	37	121.1	-1.4	-1.4	5	2.4	2.3	3.9	3.8

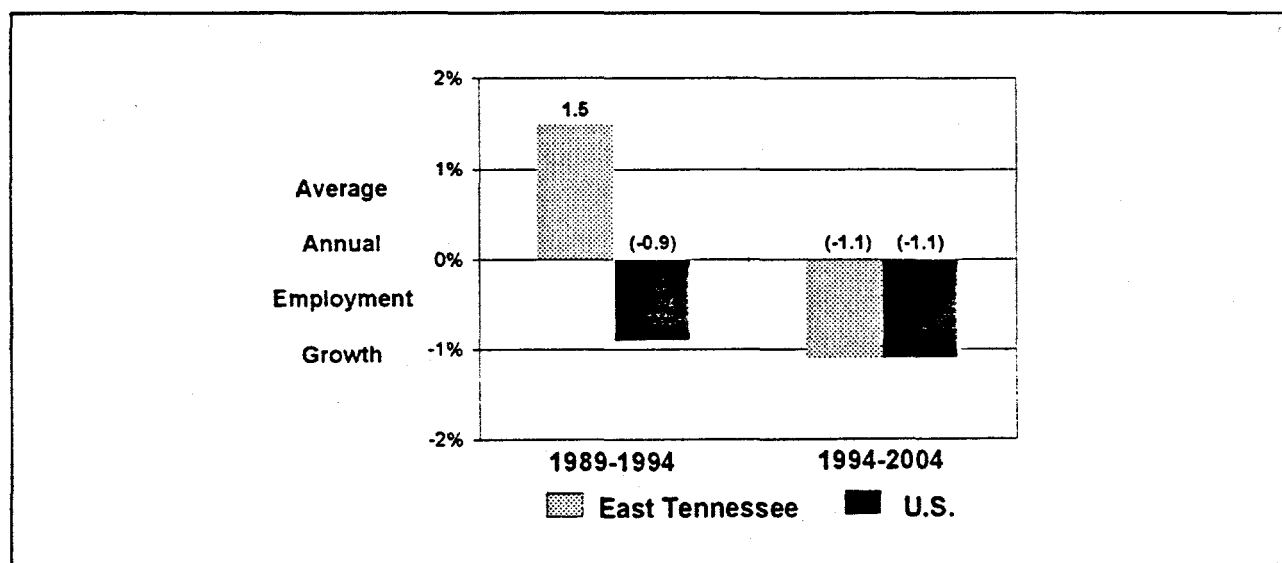
Note: nec = not elsewhere classified

Sources: DRI/McGraw-Hill; U.S. Department of Labor, Bureau of Labor Statistics;  
U.S. Department of Commerce, Bureau of Economic Analysis

### *The Cluster's Future: Forecast and Possible Interventions*

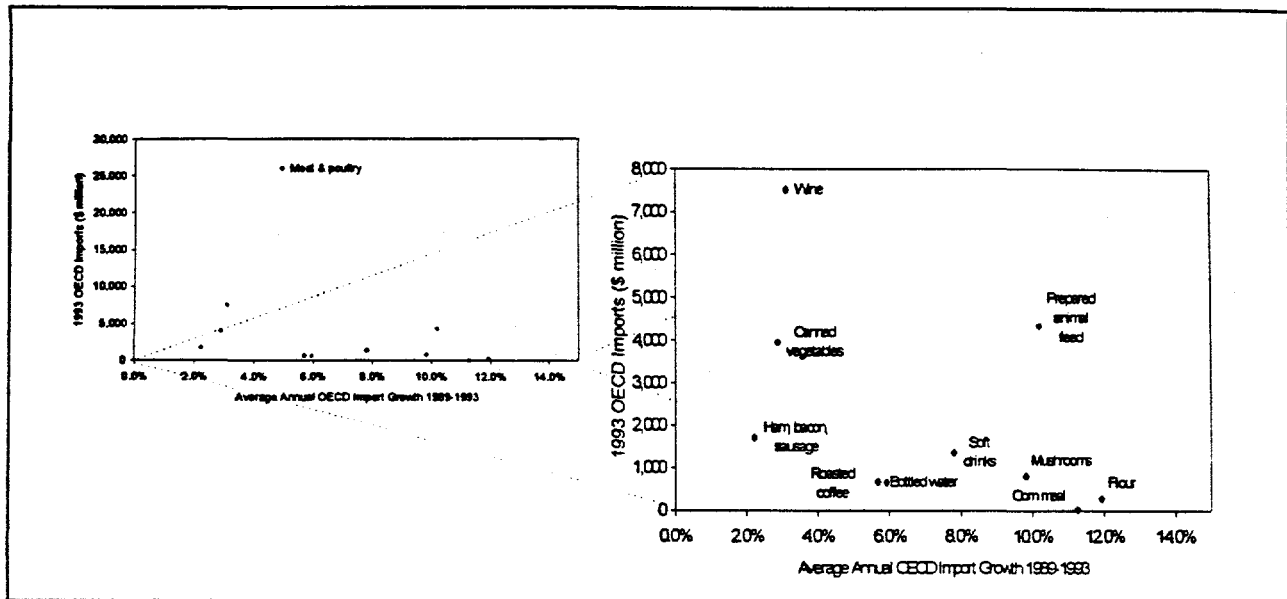
The 1994 DRI/McGraw-Hill forecast for the Agriculture and Food Products cluster in East Tennessee, and in the nation as a whole, show a significant decline in average annual employment growth over the next ten years. As shown in Figure II-11, after enjoying 1.5% growth per year for the last five years, growth is projected to be a negative 1.1% for the next ten years—as forecast for the nation as a whole. Among a variety of reasons, productivity increases through technology use and manufacturing re-engineering is one reason for the forecasted decline in employment. Between 1989 and 1994, productivity in the cluster grew at a rate of 2.1%. Between 1994 and 2004, productivity is expected to increase to 2.2% per year. As with all forecasts, these numbers are from a baseline forecast which does not take into account the variety of interventions the local industry could take to increase (or decrease) its competitiveness.

**Figure II-11**  
**Actual and Forecasted Employment Growth, Food Products Cluster**



This analysis undertaken for this cluster provides a good first look at what some of the development priorities could be. For example, a supply gap analysis (provided in a separate memo) shows that in a two hundred mile radius of the region there is extensive demand but little supply of some food cluster products and services including: dehydrated food products, canned fruits and vegetables, meat packing plants, flour and other grain mill products, and flavorings and syrups. As with the other clusters, business opportunities may also lie in fast growing international markets. A limited market study of 19 key food products found that OECD imports for these products totalled \$40 billion in 1993 with a median average annual growth rate of 6.9% from 1989 to 1993. Some of these fast growing markets were for canned vegetables, animal feed, mushrooms, and bottled water (see Figure II-12).

**Figure II-12**  
**Food Products Cluster, Size and Growth of the OECD Market**



As with other clusters, technology found in the Oak Ridge complex could be valuable to the cluster's future. An analysis of food product-related technologies in the laboratories found 69 possible technology applications for the cluster. Table II-12 lists some of the relevant core competencies and possible industrial applications of them to the Food Products Cluster. Besides technology, business leaders in the cluster also have pointed out the need for better linkages to financial capital institutions and for finding solutions to some key transportation, warehousing, and distribution problems of the industry.

**Table II-12**  
**Oak Ridge Competencies and Possible Industrial Applications**  
**Food Products Cluster**

Biotechnologies	Possible Cluster Application
<b>Biomass</b>	<ul style="list-style-type: none"> <li>• New feedstock materials</li> </ul>
<b>Bioreactors</b>	<ul style="list-style-type: none"> <li>• Biochemical separations of waste streams</li> <li>• Advanced bioreactors for manufacturing processes</li> <li>• Pretreatment of feedstocks</li> </ul>
<b>Bacteria</b>	<ul style="list-style-type: none"> <li>• Treatment of bi-products and waste streams</li> </ul>
<b>Biosensors</b>	<ul style="list-style-type: none"> <li>• Sensors to detect work place hazards such as fumes and airborne particulates</li> <li>• Sensors to detect ground contamination</li> </ul>
<b>Genetic Engineering</b>	<ul style="list-style-type: none"> <li>• Use of genetic engineering to increase feedstock crop yields</li> </ul>

Manufacturing Technologies	Possible Cluster Application
<b>Ultraprecision Machining</b>	<ul style="list-style-type: none"> <li>• Advanced machining and tooling of manufacturing equipment</li> </ul>
<b>Stereolithography</b>	<ul style="list-style-type: none"> <li>• Advanced rapid prototyping of models</li> </ul>
<b>Environmentally Conscious Manufacturing</b>	<ul style="list-style-type: none"> <li>• Recovery and recycle of materials from waste streams</li> <li>• Increased energy efficiency of manufacturing processes</li> </ul>

Materials Technologies	Possible Cluster Application
Catalysts	<ul style="list-style-type: none"> <li>Advanced catalysts for production processes</li> </ul>
Alloys	<ul style="list-style-type: none"> <li>New materials of construction for manufacturing equipment</li> <li>High strength materials for harsh environments</li> </ul>
Ceramics	<ul style="list-style-type: none"> <li>New materials of construction for manufacturing equipment</li> <li>Materials for high temperature, corrosive environments</li> </ul>
Ceramics Processing	<ul style="list-style-type: none"> <li>None identified</li> </ul>
Composites	<ul style="list-style-type: none"> <li>Corrosion and wear resistant manufacturing equipment</li> </ul>
Polymers	<ul style="list-style-type: none"> <li>Advanced filtration equipment</li> <li>New packaging materials</li> </ul>
Chemistry	<ul style="list-style-type: none"> <li>Environmentally friendly coolants</li> </ul>
Materials Joining and Forming	<ul style="list-style-type: none"> <li>Joining and forming technologies for advanced materials for manufacturing equipment</li> </ul>
Processing	<ul style="list-style-type: none"> <li>Glovebox and closed environment manufacturing processes</li> <li>Process control techniques</li> </ul>
Plating and Cleaning	<ul style="list-style-type: none"> <li>Advanced techniques to improve equipment lubricity</li> <li>Abrasion and corrosion resistance for equipment</li> </ul>
Coatings and Finishes	<ul style="list-style-type: none"> <li>Advanced techniques to ensure thermal barriers in manufacturing equipment</li> <li>Corrosion and erosion resistant manufacturing equipment</li> </ul>

Instrumentation Technology	Possible Cluster Application
Sensors	<ul style="list-style-type: none"> <li>Loss of heat in process piping</li> <li>Moisture monitoring</li> </ul>
System Integration	<ul style="list-style-type: none"> <li>Process control and diagnostics</li> <li>Integration of electronics, processing sensors, and control simulator technologies</li> </ul>
Custom Electronics	<ul style="list-style-type: none"> <li>Electronics designed to withstand harsh environments</li> <li>Electronic design drafting</li> <li>Analog, digital, and mixed ASICs</li> </ul>
Signal Processing	<ul style="list-style-type: none"> <li>Manufacturing using neural networks for process control</li> <li>Neural networks for real time defect detection</li> </ul>

Computing and Information Technologies	Possible Cluster Application
Supercomputing	<ul style="list-style-type: none"> <li>Characterization of groundwater contaminant spread</li> </ul>
Modeling	<ul style="list-style-type: none"> <li>Development of production and manufacturing models</li> </ul>
Simulations	<ul style="list-style-type: none"> <li>Improved estimates of flow rates in process systems</li> <li>Remotely operated manufacturing</li> <li>Simulators and trainers for manufacturing processes</li> </ul>
Software	<ul style="list-style-type: none"> <li>CAD/CAM for advanced process design</li> <li>Development of manufacturing or production inspection plans</li> </ul>
Information Technology	<ul style="list-style-type: none"> <li>Security systems for computers and communication systems</li> <li>Advanced database management systems, including dictionaries</li> <li>Information system development</li> </ul>

Environmental Technology	Possible Cluster Application
Environmental Compliance	<ul style="list-style-type: none"> <li>Experience with regulatory bodies on environmental regulations and record keeping</li> </ul>
Resource Recovery	<ul style="list-style-type: none"> <li>Alternate fuels technology</li> <li>Energy conservation techniques and equipment</li> <li>Alternative building techniques</li> </ul>
Monitoring	<ul style="list-style-type: none"> <li>Advanced analytical testing of waste streams</li> <li>Specialized waste water testing techniques</li> </ul>
Waste Minimization	<ul style="list-style-type: none"> <li>Recovery and reuse of byproducts</li> <li>Techniques to minimize waste streams by more efficient manufacturing and production processes</li> <li>Reduction of solid wastes for landfilling</li> </ul>
Wastewater Treatment	<ul style="list-style-type: none"> <li>Use of bacteria to treat waste waters</li> </ul>
Environmental Restoration	<ul style="list-style-type: none"> <li>Destruction of contaminants in pre-existing sites</li> <li>Fixation and capping of pre-existing sites</li> <li>Solids destruction</li> </ul>

## *Industry Leader's Vision of Competitiveness*

Based on the analysis and considering their knowledge of the markets, regional business leaders developed a three part vision of competitiveness for the cluster:

- Cluster leaders will build on the industry's historical presence and the region's quality of life to become a national leader in value-added food processing. The cluster will become more complete with the attraction of missing suppliers, better connections to food company headquarters which exist elsewhere, and the development of the physical infrastructure to meet the industry's special needs in product warehousing and distribution.
- The cluster will become better networked with the technology capacities of the region—allowing the regional industry to become a leader in production efficiencies and in employing leading-edge technologies (e.g., irradiation, aseptic packaging).
- The Food Processing industry will become more valuable to the region by increasing its role as solution to rural (inner city) employment problems. The cluster will play an active role in cultivating the skills the industry demands (automation, food safety) from this workforce.

## *Summary*

The Food Products Cluster will need to remain competitive by moving fast to identify niche markets in the fast-changing processed foods business. Innovations in product and process technologies will be required. The analysis shows that some of these innovations seem possible by drawing on technologies at the Oak Ridge complex. One development strategy that makes sense for this cluster is to seek closer working relationships between industry and Oak Ridge-based researchers. An array of technology transfer and commercialization recommendations are made in Section V, "Moving to Action."

## **Technology-Intensive Products and Services Cluster**

### *Description*

Of the eight potential clusters of East Tennessee, the least formed is a group of small, promising businesses (and supportive institutions, e.g., Oak Ridge) which could become the seeds of new industry in the region-- the Technology Intensive Products and Services Cluster. Because of its early stage development, employment numbers in commercial enterprises do not really reflect its potential in the area. Much of this potential is linked to the presence of people with know-how in the Oak Ridge complex and other regional technical institutions. Nonetheless, the unusually high employment concentrations that can be identified for this industry include those in the sectors of environmental services, computer and data processing, electronic components, measuring and dispensing pumps, engineering/ architecture/surveying, measuring and controlling instruments, electron tubes, and resistors for electrical applications. As shown in Table II-13, these sectors combined employ 8,800 people in East Tennessee. The average salary in the group is \$32,100, the highest among the eight clusters identified. Nevertheless, the wages for this cluster are lower than the national average for these sectors of \$36,050. Real output for the cluster was \$2,513 million in 1994.

**Table II-13**  
**Growth of Technology Intensive Products & Services Industries in**  
**15-County Tennessee Resource Valley Region**

Component Industries	Employment				Real Output			Productivity	
	Level (actual) 1994	Relative Conc. 1994 (US=100)	Annual % Change 1989-1994	Annual % Change 1994-2004	Level (Millions) 1994	Annual % Change 1989-1994	Annual % Change 1994-2004	Annual % Change 1989-1994	Annual % Change 1994-2004
<b>Technology Intensive Prod. &amp; Svcs.</b>	<b>8,785</b>	<b>105.3</b>	<b>7.5</b>	<b>2.1</b>	<b>1,036</b>	<b>9.9</b>	<b>3.9</b>	<b>2.3</b>	<b>1.8</b>
413. Engineering, Arch. & Surveying	4,065	150.9	6.8	3.4	425	6.5	3.5	-0.3	0.1
403. Computer & Data Processing	2,168	74.3	20.0	3.8	231	20.3	3.6	0.3	-0.3
362. Measuring & Control Instruments	819	231.3	2.9	-3.0	113	9.4	2.9	6.3	6.1
340. Elec. Components, NEC	660	74.9	0.9	-1.9	108	10.4	7.0	9.5	9.1
334. Electron Tubes	312	381.0	11.3	-5.1	37	15.8	2.9	4.0	8.4
343. X-Ray Apparatus & Tubes	193	135.0	3.9	-0.7	46	12.6	5.5	8.4	6.2
310. Measuring & Dispensing Pumps	122	470.8	25.1	-2.9	19	25.3	1.1	0.2	4.1
368. Ophthalmic Goods	74	79.1	-3.8	-2.6	7	-0.7	1.7	3.3	4.4
363. Surgical & Medical Instruments	71	23.4	NC	-1.8	9	NC	4.1	5.7	6.0
345. Elec Equipment, NEC	64	83.7	-0.1	-2.4	6	3.4	2.4	3.5	4.9
361. Engineering & Scientific Inst.	59	61.6	-18.4	-2.0	8	-14.0	1.9	5.4	4.0
337. Resistors, for Elec. Applic.	56	134.3	-7.7	-4.2	4	1.4	6.7	9.9	11.3
367. Optical Instruments & Lenses	42	23.7	2.5	-2.1	6	9.3	2.0	6.7	4.2
312. Electric Measuring Instruments	39	18.9	34.9	-1.7	5	43.4	2.3	6.3	4.0
369. Photographic Equip. & Supplies	39	15.5	-5.8	-3.1	11	-2.2	1.1	3.9	4.3

Note: nec = not elsewhere classified

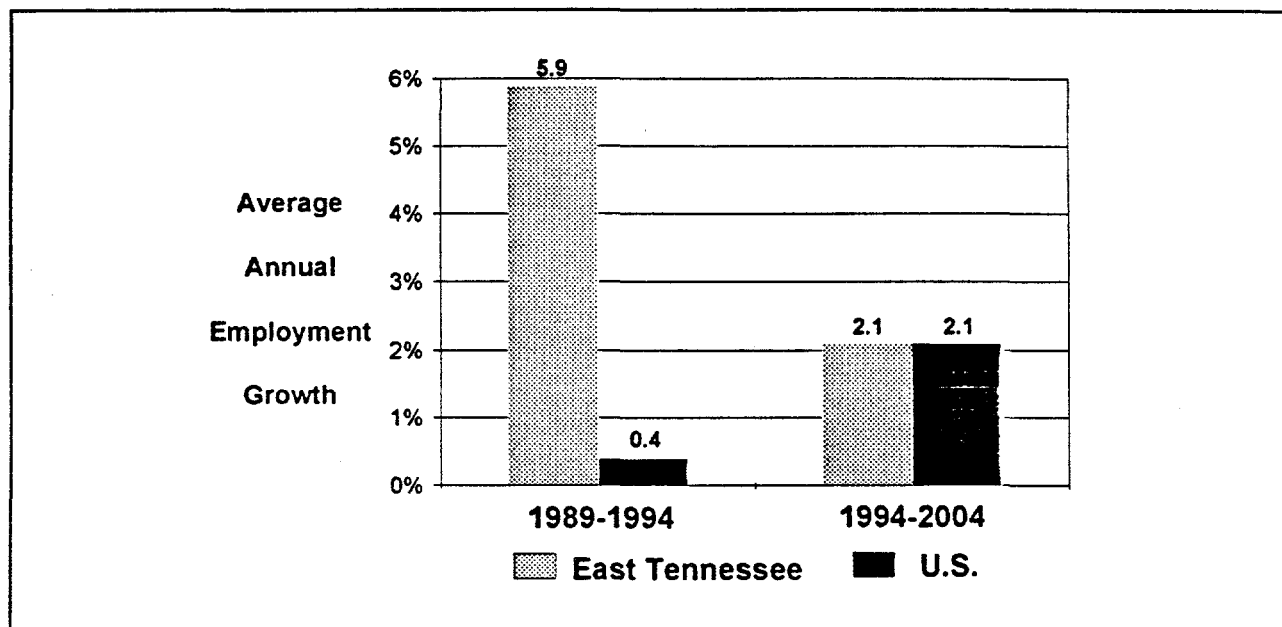
Sources: DRI/McGraw-Hill; U.S. Department of Labor, Bureau of Labor Statistics;  
U.S. Department of Commerce, Bureau of Economic Analysis

### *The Cluster's Future: Forecast and Possible Interventions*

The 1994 DRI/McGraw-Hill forecast for the cluster in East Tennessee, and in the nation as a whole, shows an increase in average annual employment growth in this cluster over the next ten years. As shown in Figure II-12, over the last five years, employment in the cluster has expanded rapidly, at a rate of 5.9% per year—much higher than the national growth rate of 0.4%. Growth in the next ten years is projected to slow to 2.1%—the same rate of growth as the nation. As a supplier of inputs to many other industries, it is difficult to say which competitive forces are working for and against sustained high rates of employment in these sectors. Moreover, characterized by small, start-up businesses employing fast-changing technologies in shifting markets, businesses in this cluster may never grow large.

Productivity growth is actually expected to decline for these sectors, a function of the expected rapid rate of technological advance of manufacturing processes (rapid change making it difficult to realize stability in production processes). Between 1989 and 1994, productivity in the cluster grew at a rate of 2.3%. Between 1994 and 2004, productivity is expected to decrease to 1.8%. These forecast numbers are from a baseline forecast which do not take into account the variety of interventions the local industry could take to increase (or decrease) its competitiveness.

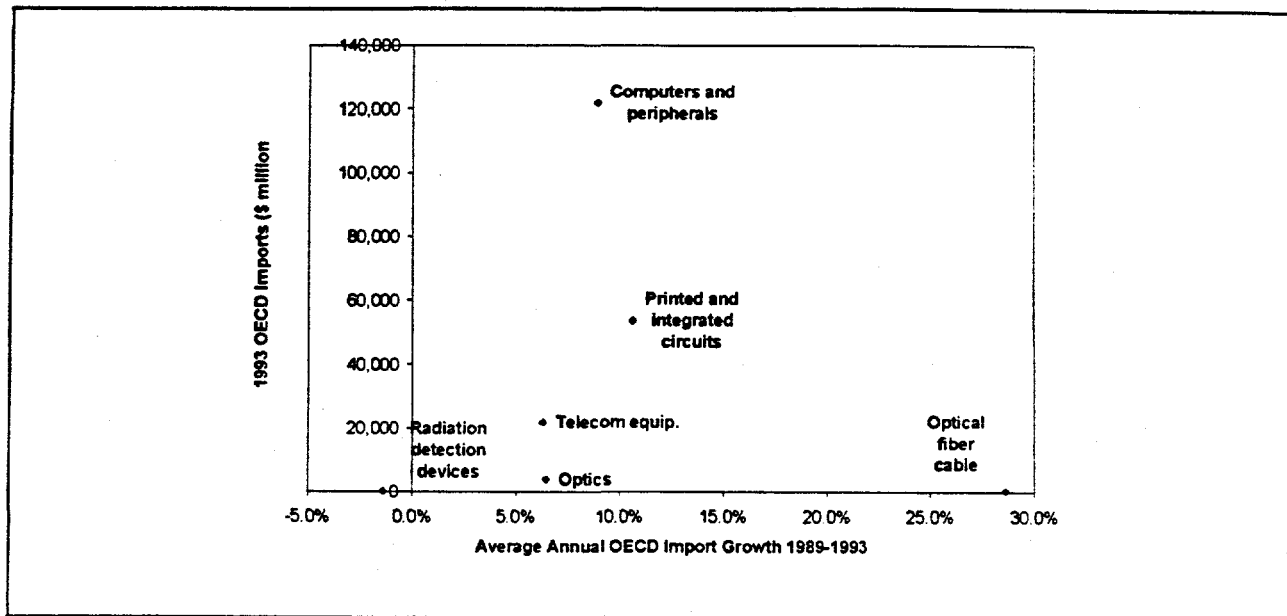
**Figure II-12**  
**Actual and Forecasted Employment Growth,**  
**Technology Intensive Products and Services**



As was the case for each cluster, a working group of technologists and business leaders met through the course of the 21st Century Jobs Initiative to contemplate the future of the technology seed industries. Their thoughts combined with analysis, showed that the technology cluster group could be viewed in terms of four “mini seed” clusters (i.e. potential future driving forces in the region’s economy): information technology, health technology, manufacturing technology, and environmental technology and services. A limited market study of 6 representative technology intensive products (i.e., to illustrate world market dynamics rather than to identify specific market opportunities) found that OECD imports for these products totalled \$202 billion in 1993 with a median average growth rate of 7.7% from 1989 to 1993. Some of these products included telecommunication equipment, optical fiber cable, optics, and radiation detection devices (see Figure II-13 below).



**Figure II-13**  
**Technology Intensive Products & Services Cluster**  
**Size and Growth of the OECD Market**



Industry leaders representing the four technical areas stressed that East Tennessee's significant science and technology resources, especially those present at the Oak Ridge complex will be valuable to the cluster's future. Table II-14 below draws information from the core competency tables developed for each of the other seven clusters and notes the range of technical competencies at Oak Ridge that could support business development in this cluster.

**Table II-14**  
**Summary of Core Competencies at Oak Ridge Complex that could Support**  
**Business Development By Cluster Area**

Competencies of the Oak Ridge Complex	Medical	Manufacturing	Information Technology	Environmental
Telecommunications	X	X	XX	X
Encryption Technology	XX		XX	
Software Development	XX	XX	XX	XX
Massively Parallel Computing	X		XXX	
Bioreactors	X			XX
Bioprocessing	X			XX
Waste Minimization		XX		XX
Recycling Technologies		XX		XX
Composites	XX	XXX		
Polymers	X	XX		

**Qualitative Rating:**  
 X = some capacity  
 XX = fairly extensive capacity  
 XXX = world class strengths

cont'd...

Competencies of the Oak Ridge Complex	Medical	Manufacturing	Information Technology	Environmental
Ceramics		XXX		
Alloys	X	XX		
Micromanufacturing	XX	XXX		
Education		XX		
Concurrent Engineering		XX		
Agile Manufacturing		XXX		
Instrumentation	XX	XX		XX
Controls	XX	XX		XX
IC Design		XX		XX
Environmentally Conscious Manufacturing		XX		XX
Waste Stream Characterization, Minimization, and Control			XX	XX
Wastewater Treatment		XX		
Environmental Conservation				XX
Environmental Restoration				XX
Bioremediation				XX
Bacteria				XX
Biomass				XX
Genetic Engineering	XXX			XX
Biosensors	XX	XX		XX
Sensors	XX	XX		XX
Catalysts				XX
Ceramic Processing		XXX		
Chemistry	X			
Materials Joining & Forming		XX		XX
Plating & Cleaning		XXX		
Coatings & Finishes	XX	XXX		
Stereolithography	XX	XX		
Modeling	XX	XX	XX	XX
Simulations	XX	XX	XX	XX

**Qualitative Rating:**

X = some capacity  
 XX = fairly extensive capacity  
 XXX = world class strengths

### *Industry Leader's Visions of Competitiveness*

As a part of the Cluster Working Group process, four sub-working groups developed vision statements for the four main technology areas identified in the analysis. Listed below, these concepts of future conditions in this cluster usefully start to define what industry leaders feel is possible in East Tennessee:

#### *Vision for Manufacturing Technology*

- This cluster will be a leading exporter of manufacturing technology for multiple industries, enabled by establishment of new manufacturing entities in the region.

- The cluster will increase the region's overall level of manufacturing employment to 25% of non-agricultural jobs, emphasizing high-value added employment. .
- The cluster would produce manufacturing technologies in machining, measurement, predictive maintenance and ceramic technologies.
- This cluster would serve all manufacturing sectors worldwide.
- This cluster would derive its competitive advantage from access to the Oak Ridge complex (ORC), enabled by a manufacturers user group that identified market-pull for ORC capabilities.
- It would derive competitive power from proximity to the University of Tennessee.
- The number of qualified technical workers in the employment pool would be high, assisted by access to laboratory technology.
- This growing new manufacturing technology cluster will play a key role in reducing costs, reducing the cycle time to market for products.
- It will create a market advantage for user industries and will support all East Tennessee cluster groups.

### *Vision for Environmental Technology*

- The region will have developed a national/world-wide image of East Tennessee's environmental technology businesses, changing the region's image from a government town to a private-sector driven economy.
- The region will be a key exporter of environmental *services* to European markets, not simply products.
- Environmental resources (i.e., information) will be accessible and through a one-stop shop.
- The region will have shaped its growing position in environmental technology through a developmental process that links key factors over time.
- Geography: Moving capabilities from Oak Ridge Complex into the region, the nation and international markets.
- Customers: Growing from serving DOE, to other agencies (DOD) and the private sector.
- Process: Expanding from studies, to clean-up demonstrations and businesses to prevention businesses.
- Companies: Evolving from desegregated capabilities to a consolidated environmental industry cluster.

### *Vision for Information Technology*

- The cluster will comprise both small and large firms, including at least one \$1 billion information technology company.
- East Tennessee will have a reputation as an Information Technology (IT) region, with an established image of success.
- In addition to large information technology businesses the region will also attract financial institutions that are major users of IT.
- This cluster will have accelerated the growth of the regions' information technology businesses by having established an IT association in affiliation with Tech 2020 that will have

provided market research, outreach between innovators and markets, as well as financial resources to a growing number information technology entrepreneurs and expanding companies.

- The information technology cluster will comprise an extensive business community with the ability to produce, sell and distribute information technology worldwide, through both firm capabilities and regional information infrastructure.
- The information technology cluster will become an integrated business community with a strong identity (e.g., as is the case in Huntsville, Alabama).
- The region's entrepreneurs will be able to operate creatively and more freely because their employee's benefits are not dependent on belonging to large companies, thus, have established a network to provide benefits.

### *Vision for Health Technology*

- The region will grow jobs based on application of technologies to a variety of health care markets and leveraging of existing capabilities among leading firms.
- The region would be known as a center of excellence in products emphasizing cost effective innovations for health care deriving from both private innovation and high access (ORC) capabilities in many fields applicable to bio-medicine.
- The region would be known for its cost-effective diagnostic technologies, such as new modes of PET scan imaging, among other technologies, enabled by a more flexible regulatory environment at the national level (regarding health reimbursement).
- Regional growth would arise through new market-focused innovations in care, such as a cancer treatment center based on a privatized boron nuclear reactor which could treat upwards of 3000 persons annually, which would be enabled by a more flexible environment in DOE regarding privatization of facilities.
- In particular, the region would have grown its position by reaching out and partnering with the health services complex in Nashville, as well as national markets.
- The innovative cost-focused health technology cluster would grow through the efforts of a regional "virtual organization" that rapidly linked technical, business and financial resources into new firms or rapid product development efforts for existing firms.

### *Summary*

The analysis suggests that there are significant growth opportunities in this cluster. Not only are there growing employment concentrations in several high technology industries, but strong technological capacities in the region. The key to accelerated growth will be found in strategies to close the gap between the Oak Ridge complex and the region's private sector. An array of recommendations for doing so are found in Section V, "Moving to Action."

## Business and Financial Services Cluster

### Description

The Business Services Cluster in East Tennessee, like business services clusters in other regions, has grown from the increased professional service needs of businesses and entrepreneurs (e.g., for specialized knowledge and information) and the increased use of technology in the office. Sectors included in the analysis of this cluster include: banking, insurance carriers and agents, accounting and auditing, personnel services, credit agencies and securities brokers, legal services, and advertising. The average salary in the cluster is considerably lower than the national average, \$25,700 compared to \$32,200. As shown in Table II-15, the various sectors of the cluster employ 18,100 East Tennesseans and accounted for \$1,857 million of the region's real output in 1994.

**Table II-15**  
**Growth of Business & Financial Services Industries in**  
**15-County Tennessee Resource Valley Region**

Component Industries	Employment				Real Output			Productivity	
	Level (actual) 1994	Relative Conc. 1994 (US=100)	Annual % Change 1989-1994	Annual % Change 1994-2004	Level (Millions) 1994	Annual % Change 1989-1994	Annual % Change 1994-2004	Annual % Change 1989-1994	Annual % Change 1994-2004
<b>Business &amp; Financial Services</b>	18,133	60.3	3.8	2.6	1,857	3.4	2.8	-0.9	0.1
394 Banking	3,787	65.8	1.9	1.7	439	1.8	2.5	-0.1	0.8
402 Personnel Supply Services	3,250	54.8	7.3	5.8	79	6.7	5.9	-0.6	0.1
395 Credit Agencies & Sec. Brokers	3,158	60.8	2.8	-1.1	280	9.3	2.9	6.4	4.1
396 Insurance Carriers & Agents	2,988	42.4	-0.1	2.2	353	0.5	2.4	0.5	0.1
412 Legal Services	2,353	70.9	8.3	2.9	309	7.3	2.3	-0.9	-0.6
414 Acctg., Auditing & Misc. Prof.	1,607	60.6	6.6	2.9	160	4.9	1.8	-1.6	-1.1
411 Other Adv. (inc. signs, dir. mail)	990	600.0	3.9	4.2	237	-0.4	3.7	-4.1	-0.5

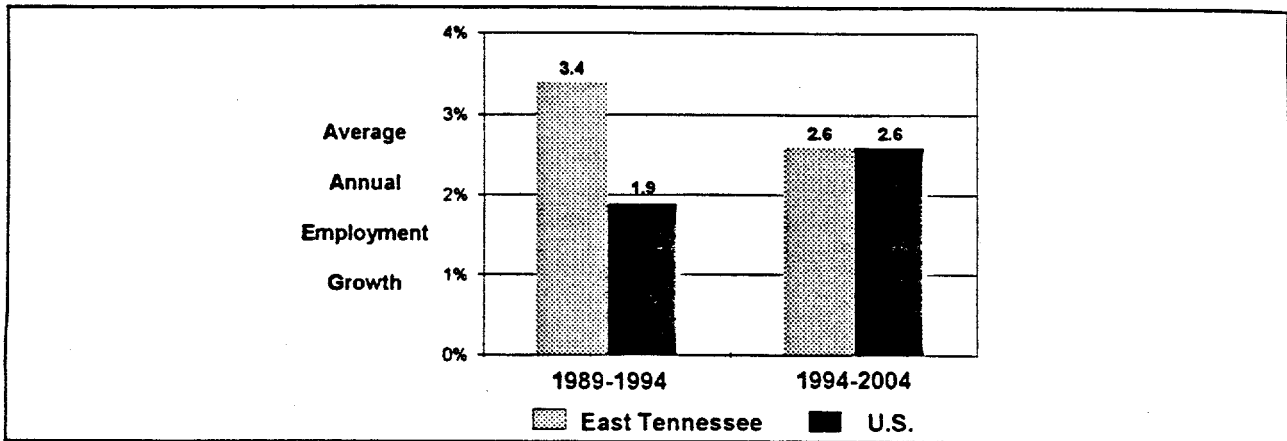
Note: nec = not elsewhere classified

Sources: DRI/McGraw-Hill; U.S. Department of Labor, Bureau of Labor Statistics;  
U.S. Department of Commerce, Bureau of Economic Analysis

### *The Cluster's Future: Forecasts and Possible Interventions*

As shown in Figure II-14, the 1994 DRI/McGraw-Hill forecast for the Business and Financial Services cluster in East Tennessee, and in the nation as a whole, shows an increase in average annual employment growth over the next ten years. Over the last five years employment in the cluster expanded at a rate of 3.4%—much higher than the national growth rate of 1.9%. Growth in the next ten years is projected to slow to 2.6%—the same as the nation. Highly dependent on the growth of other clusters in the region, the slowing of growth in those industries would tend to account for some of the growth rate decline in business services. Between 1989 and 1994, productivity in the cluster grew at a negative rate of -0.4%. Between 1994 and 2004, productivity is expected to increase slightly to a rate of 0.8%.

**Figure II-14**  
**Actual and Forecasted Employment Growth,**  
**Business and Financial Services Cluster**



Unlike the other seven clusters, Business and Financial Services has a relatively low concentration factor of 60 (US=100). This means that East Tennessee only has sixty percent of the business and financial services employment of other regions. Although no OECD market analysis was possible for this cluster (i.e., OECD does not track traded services), this low concentration factor suggests that there are business and financial service needs going unmet in the community, thus, that there are local business opportunities for the cluster.

As is the case for other clusters, the science and technology resources present at the Oak Ridge complex could be valuable to the cluster's future. An analysis of business services product-related technologies at ORC found 8 possible technology applications for the cluster (see Table II-16). Besides technology, business leaders in the cluster have pointed to the need for improved employee skill development, venture capital, and consolidation of government.

**Table II-16**  
**Oak Ridge Competencies and Possible Industrial Applications**  
**Business and Financial Services Cluster**

Manufacturing Technologies	Possible Cluster Application
Manufacturing Skills Campus	<ul style="list-style-type: none"> <li>Hands-on manufacturing skills enhancement programs for high schools</li> <li>User facilities for continuing education of regional workforce</li> <li>Resource for expanded interaction between Community Colleges and UT and the private sector for continuing education</li> </ul>

Computing and Information Technologies	Possible Cluster Application
Modeling	<ul style="list-style-type: none"> <li>Modeling of transportation systems to increase efficiency and access</li> </ul>
Software	<ul style="list-style-type: none"> <li>Development of business logistics software</li> </ul>
Information Technology	<ul style="list-style-type: none"> <li>Security systems on computers and communication equipment to protect customer information</li> <li>Advanced database management to enhance customer and new client information</li> <li>Information systems development to enhance communication among businesses</li> </ul>

### *Industry Leader's Vision for Competitiveness*

The Cluster Working Group process was the basis for the vision statement below that begin to show how leaders in this industry see the future of the cluster:

- The cluster will offer a full spectrum of financial services, including:
  - traditional lending services (e.g., debt financing)
  - non-traditional financial sources (e.g., equity financing)
  - sources of information about business financing
- The region will become pro-business with efficient government services and a fair tax and regulatory environment.
- Companies will have access to appropriately skilled workers and the ability to retrain workers rapidly in local institutions as needs changes.
- The physical environment (e.g., downtown improvement) will support the growth and development of the business and financial services cluster.
- Technological capabilities in the region (e.g., at Oak Ridge) will be well understood and accessible.

### *Summary*

The Business and Financial Services Cluster will grow as a result of two factors. First, because it is linked as a supplier to the other clusters it will grow along with their growth. However, the data (e.g., low concentration rate) suggests that there may yet be unmet business opportunities with existing clusters. Second, it will grow as a result of expanding out from the region as its primary market to neighboring regions. East Tennessee's business service providers should seek opportunities in a much broader geographic region. The key will be to develop specialized service products, some of which could be based on Oak Ridge technologies (e.g., business logistics software). In Section V, "Moving to Action" an array of recommendations are made for improving linkages between cluster firms and sources of technology in the area.

### **Tourism Cluster**

#### *Description*

The evolution of Tourism Cluster is an interesting case of cluster growth. With the Great Smoky Mountain National Park, mountain and ecological tourism have long been a part of the local economy. In the last fifteen years, however, the region has capitalized on its location and natural beauty by developing man-made tourist amenities to expand the region's tourism attractions. The businesses in this cluster include those in the sectors of amusement and recreation services, auto rental and leasing, hotels and lodging places, motion pictures, and portions of the sectors of retail trade and eating and drinking places. As shown in Table II-17, tourism employs 22,300 people in East Tennessee and accounted for \$1,122 million in real output in 1994. The average salary in the

cluster is \$9,530, the lowest by far of the eight clusters present in the region. The national average salary for tourism is \$10,480.

**Table II-17**  
**Growth of Tourism Industries in 15-County Tennessee Resource Valley Region**

Component Industries	Employment				Real Output			Productivity	
	Level (actual) 1994	Relative Conc. 1994 (US=100)	Annual % Change 1989-1994	Annual % Change 1994-2004	Level (Millions) 1994	Annual % Change 1989-1994	Annual % Change 1994-2004	Annual % Change 1989-1994	Annual % Change 1994-2004
Tourism	22,309	104.6	5.9	2.6	1,122	5.5	2.5	-0.8	-0.1
393. Retail Trade	4,031	100.7	7.4	1.8	205	9.7	2.4	2.2	0.9
415. Eating & Drinking Places	6,698	110.8	3.7	2.1	287	3.0	2.0	-0.7	-0.1
399. Hotels & Lodging Places	6,347	119.3	5.7	2.9	216	4.0	1.9	-1.6	-1.0
419. Amusement & Recreation Services	3,559	96.2	8.9	3.3	199	8.0	3.3	-0.8	0.0
418. Motion Pictures	1,266	91.3	10.9	2.9	116	12.0	2.6	0.9	-0.3
416. Auto Rental & Leasing	409	83.5	-1.8	3.4	98	-0.4	2.7	1.5	-0.6

Note: nec = not elsewhere classified

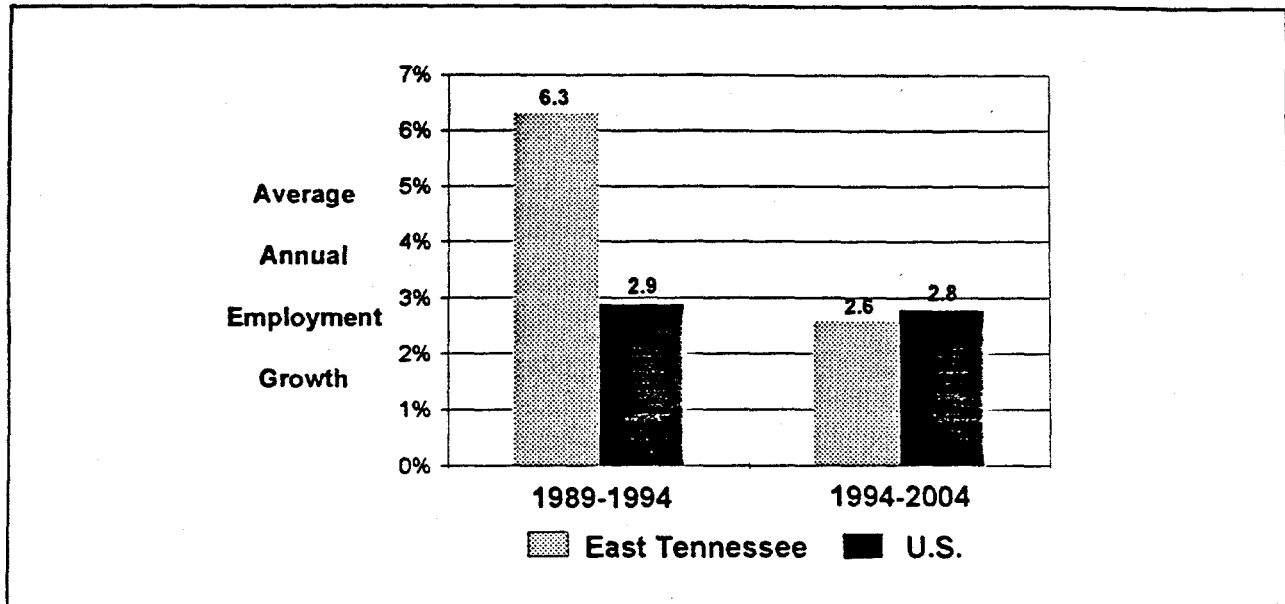
Sources: DRI/McGraw-Hill; U.S. Department of Labor, Bureau of Labor Statistics; U.S. Department of Commerce, Bureau of Economic Analysis

### *The Cluster's Future: Forecast and Possible Interventions*

DRI's 1994 forecast for the Tourism cluster in East Tennessee, and in the nation as a whole, shows an increase in average annual employment growth over the next ten years. As illustrated in Figure II-15, over the last five years employment in the cluster has expanded rapidly at a rate of 6.3% per year—much higher than the national growth rate of 2.9%. Growth in the next ten years is projected to slow to a rate of 2.6%—just slightly below the national average of 2.8%. In the analysis (and computer model) fast growth is viewed as a natural reaction to a boom cycle, thus is compensated for in the forecast. The forecast simply makes the point that the region may not be able to maintain the exceptionally fast growth rates seen over the last five years. Between 1989 and 1994, productivity in the cluster grew at a rate of 1.5%. Between 1994 and 2004, productivity is expected to slip to a rate of 0.3%. These forecast numbers are from a baseline forecast which do not take into account the variety of interventions the local industry could take to increase (or decrease) its competitiveness.



**Figure II-15**  
**Actual and Forecasted Employment Growth, Tourism Cluster**



With such burgeoning growth, leaders in the Tourism cluster are not having difficulty finding new business opportunities. The markets for growth are expanding rapidly as disposable income grows in the U.S. and other developed countries. Foreign markets are growing fast for another reason, strong currency value relative to the dollar. Some of the tourism markets that are growing the fastest are in the area of "experiential tourism," including activities such as river rafting and kayaking, rock and mountain climbing, backpacking and trekking, and golf.

The major concerns expressed in the working group process focus on better coordination, communication, and partnering across and throughout the cluster, especially across the entire geographic region of the Resource Valley. The economic infrastructure concerns raised by Tourism business leaders focused on skill training and career development for young people, lack of public transit and proper physical infrastructure to connect the Tourism employment opportunities with the region's pockets of high unemployment, and protection of the natural resources and beauty of the region. Although access to technology was not noted as a major concern, an analysis of Oak Ridge competencies shows some opportunities for transfer and commercialization (see Table II-17).

**Table II-17**  
**Oak Ridge Competencies and Possible Industrial Applications**  
**Tourism Cluster**

Biotechnologies	Possible Cluster Application
Bacteria	• Treatment of scenic waterways
Biosensors	• Sensors to detect potentially hazardous dusts or fumes

Instrumentation Technology	Possible Cluster Application
Sensors	• Security devices
System Integration	• Integration of reservation systems across several groups or businesses
Custom Electronics	• Traffic pattern sensors
Signal Processing	• Neural networks to characterize visitor concentrations and use patterns

Computing and Information Technologies	Possible Cluster Application
Modeling	• Development of prediction tools to help with strategic planning for future expansions
Simulations	• Development of use patterns to assist with traffic flow control
Software	• Software to enhance reservations and interactions between sites and/or businesses • Development of software for use on a regional tourism WWW page
Information Technology	• Security systems on computers and communication equipment to protect guest and mailing list information • Advanced database management to enhance guest information and new client information • Information systems development to enhance communication among businesses

Environmental Technology	Possible Cluster Application
Environmental Compliance	• Extensive experience to be used to help places such as state and Federal parks monitor compliance issues
Resource Recovery	• User friendly recycle activities
Monitoring	• Testing of recreational waterways
Waste Minimization	• Recycle technologies to reduce solid waste volumes
Wastewater Treatment	• Bacteria based treatment of drinking water supplies
Environmental Restoration	• Destruction of contaminants in pre-existing sites • Fixation and capping of pre-existing sites

### *Industry Leader's Vision for Competitiveness*

Within the Cluster Working Group process, regional tourism leaders set forth a four part vision of competitiveness for the cluster:

- The industry will be better organized across the region and, as an industry, dedicated to maintaining growth, solving problems collaboratively, facilitating the tourists' stay, protecting the region's natural resources, reducing costs for individual tourism businesses, and completing the cluster with a convention center. Through a new industry organization, the cluster will better communicate and speak with an industry voice, and move forward with a well-conceptualized regional plan.
- In five years or less, East Tennessee will become a true tourist destination—with longer average tourist visits and increased mobility through the area. A major component of this concept of the industry in the future is the communication of a unifying theme for tourism in the region.
- The region's tourism industry will work collaboratively to find creative, local solutions to natural resource protection.
- East Tennessee Tourism will be proactive in developing its regional tourism workforce through mass transit development, affordable housing solutions, high school and other training outreach programs.

## ***Summary***

The overall challenge for the Tourism Cluster is to manage the growth to ensure that the fundamental quality of the region's attractions remains high. In order to develop the region into a stronger "final destination," a regional approach will be required. While Sevier County will no doubt remain the strongest tourism attraction, other attractions can be linked to Sevier County in order to strengthen the attraction overall (e.g., Knoxville Zoo, Riverfront attractions, museums). In this context the best development strategy to pursue is one having regionwide scope. Section V, "Moving to Action" suggests several ways that a broader tourism marketing campaign could strengthen the industry.

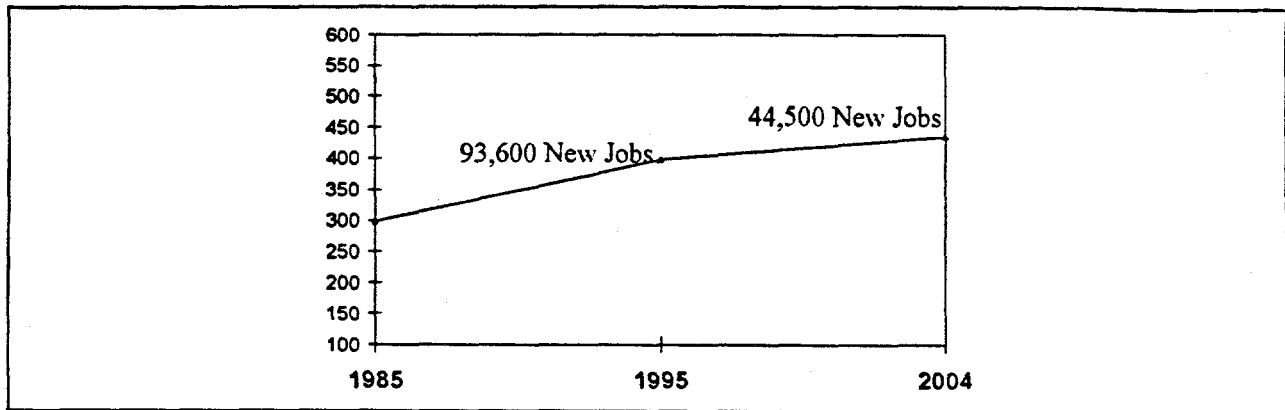
## ***Conclusion***

What does the foregoing analysis say about East Tennessee's economy? Simply said, the economy is changing. The analysis suggests that East Tennessee will be a manufacturing and services based economy well into the future. However, the balance between manufacturing and services will continue to shift, with an increasing share of the economy based on tourism and business services. Tourism, by itself, will clearly make up a very large part of East Tennessee's 21st Century economy. Manufacturing will shift from traditional sectors such as textiles and apparel, agriculture and food and metals to less traditional (more advanced) sectors including auto/transportation and technology-intensive products. Finally, it appears likely that environmental services (and devices), information technology products, medical products and others like instruments and sensors will make up a significantly larger part of the economy.

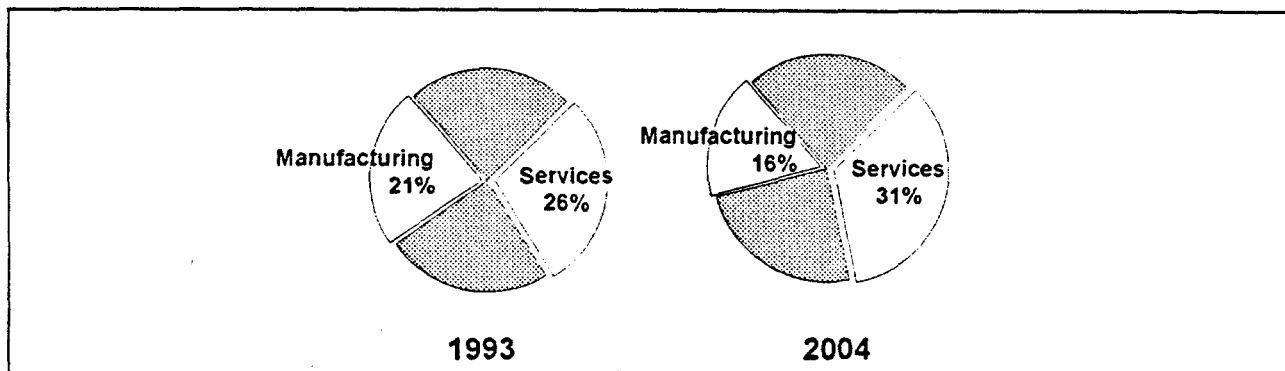
However, there are many external economic factors that could come into play to shape the region's economic evolution. For example, a significant slowdown in the US economy would reduce the disposable income of people that drives the tourism industry. New technology not adopted in the region could help other regions capture markets in technology-intensive sectors that East Tennessee could otherwise claim. Foreign competition, such as Mexico emerging as a world center for the production of auto parts and accessories, could significantly impact that sector.

Based on the DRI forecasts, it is possible that East Tennessee's rate of employment increase seen in the period 1985-1995 could slip significantly over the next decade. During the last 10 year period, the 15-county region created approximately 93,600 new jobs. The forecast suggests that over the next 10 years, only 44,500 new jobs will be created, about half of the job creation rate during the past 10 years (see Figure II-16). Moreover, because of the shift from generally higher paying manufacturing jobs to generally lower paying services jobs (see Figure II-17), the forecasts suggest that per capita income for the region could fall from slightly more than 12% in the early 1980s to about 8% over the next several years (see Figure II-18). The forecast does suggest an upturn in per capita income in the period 1998-2004, based on assumptions about job growth in higher paying jobs in growing technology and services areas.

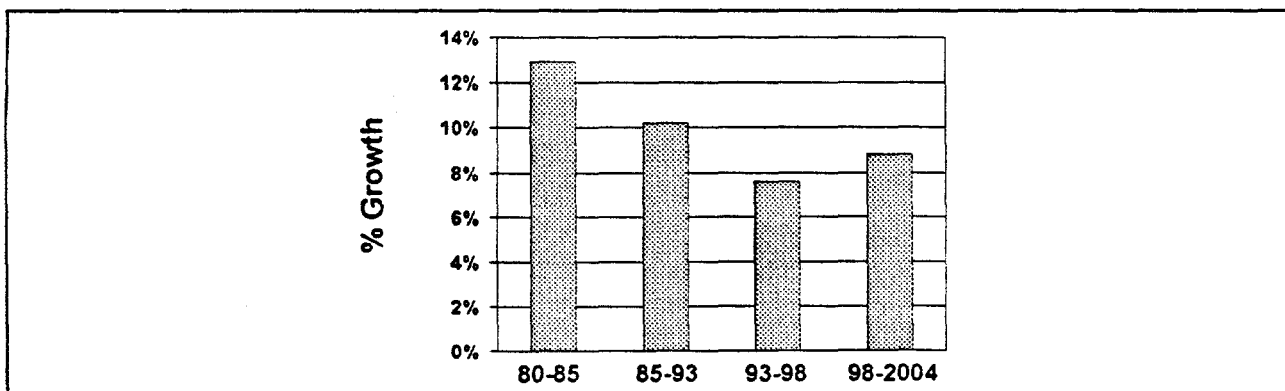
**Figure II-16**  
**Forecast Job Growth**



**Figure II-17**  
**Forecast Shift from Manufacturing to Services**



**Figure II-18**  
**Per Capita Income**



In this context, it is important to point out that these forecasts are based on macro factors subject to change. Furthermore, they do not take into account local interventions in the economy that could be expected to have impact on the region's ability to create jobs. Nevertheless, the best available information suggests that unless the region takes steps to enhance its ability to create jobs, the future could be one of a employment shortfall. In such a situation, local job seekers would find limited employment opportunities and could be forced to seek employment outside the region.

Will these forecasts actually become reality? As suggested above, probably not. But having this information provides leaders with sound evidence that increased attention to the region's economic development is needed.

As East Tennessee's leaders look to the future and take steps to develop the economy, they must continuously take into account the external environment (e.g., macro forces, markets and competition), work constantly at the margin within their own economy to make it as competitive as possible (using public policy and private sector initiative) and monitor economic performance closely. In later sections, the report points to a new, yet plausible economic vision and logic and recommends strategies and tactics for achieving what is termed an advanced 21st Century economy. Success, the report argues, will depend in large part on the region's capacity to take advantage of the science and technology resources in Oak Ridge and at the University. The next section takes a close look at those capacities today and points out some problems that must be addressed in order for a more technologically advanced economy to evolve.

### III. East Tennessee's Capacity for Entrepreneurship Based on Technology Commercialization

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#### **Overview**

Section II provided an analysis of East Tennessee's economy as it exists today, based on a cluster perspective. For the analysis, both economic data and input from local industry experts have been used to show how the economy is changing economy as well as to suggest plausible visions of a future economy, if local interventions are made. For each cluster, the importance of technology was highlighted and evidence provided showing that the region has substantial technological competencies that could drive future cluster development. For technology to play a larger role in the region's economy, however, East Tennessee will need to be especially adept at entrepreneurial-driven technology commercialization—the process of bringing together technology, risk capital and business acumen in ways that new businesses can be formed and be managed for rapid growth. This section of the report provides an assessment of the region's capacity for entrepreneurship and enterprise formation based on one of East Tennessee's strongest economic assets - its technology.<sup>4</sup>

#### **Approach**

The research to address the region's capacities of these kinds comprised three parts—1) a community survey, 2) an assessment of the region's R&D budgets, technology capacity and related data, and 3) an analysis of East Tennessee's history of entrepreneurship and new business formation. The first part of the research, the survey, provides findings about economic issues and priorities and supports the conclusion that the region needs to be guided by a new economic vision and that leaders need to use new approaches to enhance technology-based entrepreneurship. However, the second part of the research, assessments of budgets and core competencies of the R&D community relative to similar communities and regions across the country, provides findings suggesting that the region may lack a degree of institutional capacity for successful entrepreneurship and technology transfer. The third part of the research, development of a "genealogy" of the region's enterprise development history provides additional findings about the region's capacity for entrepreneurship and development of technology-intensive industries.

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<sup>4</sup>This section is based on an extensive report prepared by IC<sup>2</sup> which is available separately from Tennessee's Resource Valley. The full report includes data based on 600+ survey responses, analysis of the region's research/technology base and competitive analysis of similar regions in the US. In a separate report, produced by DRI/McGraw-Hill, East Tennessee is compared to 14 other regions in several categories of economic competitiveness (e.g., human resources, capital, technology) using more than 50 indicators. This report, "Benchmarking East Tennessee's Economy," is also available from Tennessee Resource Valley.

## ***The Survey: General Community Opinion and Direction Regarding the Economy, Economic Development and Technology***

More than 600 individuals in the region responded to a survey which details their opinions about today's economy and the economic development directions needed to meet the challenges of the 21st century. A 35% response rate to the survey, high by any measure, reflects the degree of importance that leaders give to economic issues in the region.

Most relevant to the 21st Century Jobs Initiative is the consensus view among respondents of the overall directions to take, and actions needed for successful economic development. For example, when asked about how best to realize a prosperous economic future, East Tennessean's are very much focused on approaches to economic development based on leveraging and developing local assets - human, financial and technological - for economic development across the region. By their response, leaders also recognize that where there are short-comings in the region's capacity for economic development, there are also opportunities for implementing new approaches to economic development based on collaboration and coordination of public *and* private sector resources. Just as important, respondents have identified in the survey, perceived factors inhibiting economic growth in the region—areas that should be targeted for attention as part of the 21st Century Jobs Initiative.

The consensus evident among public and private sector leaders makes several points very clear: East Tennessean's believe cooperation is the paramount requisite for success. They also believe that private sector leadership is imperative for increased cooperation and economic success. And, they believe that new approaches to close gaps in the regional economic infrastructure are a necessary although difficult requirement to meet in overcoming the challenges of economic development.

Specifically, survey respondents ranked the following positive factors for the region's economic future:

1. Stable Wage Levels
2. Technology Base and Strong Scientific Competency
3. Existing Manufacturing Base/Strong Inventory of Facilities
4. Available, Competitive Priced Land & Utilities
5. Access to Mountains & Lakes: Quality of Life

However, their perceptions about the future included questions about the region's ability to:

1. Preserve the region's natural assets
2. Facilitate public/private use of advanced technology
3. Provide innovative financing of infrastructure/privatization
4. Support of the region's cultural assets
5. Enable rural counties to have access to business opportunity/technology
6. Establish more direct air flights and transportation services

Survey respondents commenting on factors facilitating job growth vs. factors inhibiting job growth in the region noted the following:

Factors Perceived as Conducive to Job Growth	Factors Perceived as Inhibiting Growth
<ul style="list-style-type: none"> <li>• Regional cooperation &amp; partnerships</li> <li>• Technology transfer linkage: UT/ORNL/industry</li> <li>• Other observations: <ul style="list-style-type: none"> <li>• Federal government: privatization of assets</li> <li>• Regional government: taxes, infrastructure, quality of life</li> <li>• Local government: support of technology-based companies</li> <li>• Leverage technical expertise for economic development</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Education (weak)</li> <li>• Lack of cooperation between economic development organizations</li> <li>• No regional strategy, shared vision</li> <li>• Govt. response to business climate</li> <li>• Lack of risk capital</li> <li>• No business management and entrepreneurial training</li> </ul>

East Tennessean's responding to the survey have strong opinions about the general approaches needed to meet economic development objectives. For instance, respondents associated successful economic development in the future with several areas needing attention today. The priorities of sector respondents is as follows:

Perceived Requirements for Successful Economic Development in East Tennessee	Public Sector Rank	Private Sector Rank
Move entrepreneurial energy away from Federal sector	2	1
More proficient access/development of new national markets	1	2
Provide access for entrepreneurs to East Tennessee's business expertise	3	3
More proficient access/development of new international markets	4	5
Provide entrepreneurial networking and teambuilding	5	6
Entrepreneurial training in high school/college	5	4

Finally, when asked to rank the critical technology-intensive products and services for the 21st century, East Tennessean's responding to the survey felt that R&D programs should link to, and support the eight economic clusters identified in Section II. Although differing in the priority rank, both the public and private sectors sense the importance of these eight clusters and identify with their potential for job creation and wealth-generation. However, respondents from both the public and private sectors reported concerns about the problems in accessing and enhancing the region's technology resources, and worry about the region's ability to develop and transfer appropriate technologies to the eight clusters. Perceived importance of industry clusters to the region's economy ranked by respondents are as follows:



Key Clusters <sup>5</sup> for the Future	Public Sector Rank	Private Sector Rank
Tourism	1	1
Automotive/Transportation	2	2
Business & Financial Services	3	3
Metals & Materials	4	4
Food Products	5 (tie)	5
Forest Products	5 (tie)	6
Apparel & Textile	5 (tie)	7

### **Assessing East Tennessee's R&D Funding and Selected Commercialization Outcomes**

As shown in Table III-1, the current annualized budget of the region for technology-oriented research and development programs is nearly \$510 million, most of that at Oak Ridge National Laboratory. Nearly \$80 million of the total is for technology-oriented research at the University of Tennessee (Knoxville). More than \$31 million of the total flowed into the region through the Federal SBIR (Small Business Innovation Research) program and by way of CRADAs (Co-operative Research and Development Agreements) signed with firms located in the region. Additionally, as the Figure shows, the region has a significant record of success in winning SBIRs, in licensing technology from ORNL and in patents based on research activities at ORNL and the University.

**Table III-1**  
**Summary of R&D Funding, SBIRs, Patents and Licensing**

Annual Regional Research Funds (1994)	SBIRs, Patents, Licenses Since 1983*
<ul style="list-style-type: none"> <li>• ORNL = \$400 million</li> <li>• UT/K = \$78 million</li> <li>• SBIRs = \$1.84 million</li> <li>• CRADA = \$29.5 million</li> </ul> <p><b>Total - \$509.34 million</b></p>	<ul style="list-style-type: none"> <li>• 235 SBIR Partners</li> <li>• 217 Patents issued at ORNL</li> <li>• 572 Patent rights from DOE</li> <li>• 59 Patents issued at UT/K</li> <li>• 121 Patents filed at UT/K</li> </ul> <p>*approximate; based on best available information</p>

It is clear from the analyses, however, that the East Tennessee region will need to work harder towards attracting greater research sponsorship from industry through strategic partnerships as Federal R&D budgets remain under pressure. Increased effort to market the region's technological capacities and core technical competencies should provide opportunities to take advantage of increasing industry demands for cost effective, value-added research relationships.

<sup>5</sup>Note: Technology-intensive cluster was evaluated positively, separately.

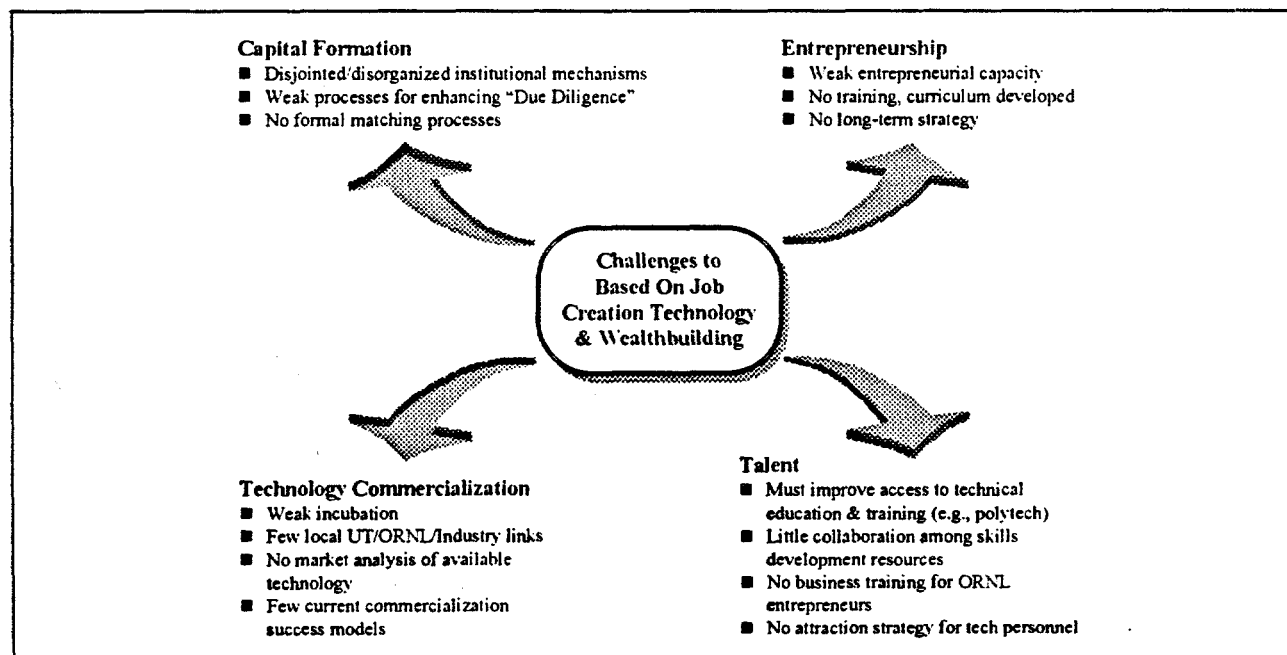
## Assessing East Tennessee's Capital Formation and Wealthbuilding Capacity

Based on the survey results, as well as a series of focus groups and individual interviews, it seems clear that although the region has many of the essential ingredients for successful entrepreneurship, there are some gaps in East Tennessee's infrastructure for capital formation and technology commercialization.

Figure III-2 illustrates some of the key challenges facing the region. In the area of capital formation, for example, there are few community-based initiatives aimed at strengthening the region's capacity to pool specialized capital (e.g., early stage seed capital and traditional venture capital). Where they do exist, there is little coordination between efforts to pool capital and efforts to strengthen entrepreneurship overall. In particular, there is currently no system in place to identify sources of non-traditional capital, sources of entrepreneurial capacity, and match the two. Other regions, notably Austin, Silicon Valley and Boston have formal mechanisms for doing so.

In the area of technology commercialization, the region has administrative capacity for enabling commercialization through LMES and at the University, but lacks other requisites for successful commercialization such as business incubation capacity, market analysis of available technology and well publicized commercialization success models. As it relates to developing entrepreneurial skills, the region lacks formal training programs on entrepreneurship and other formalized education and training related to the development of future technically trained entrepreneurs.

**Figure III-2**  
**Challenges to Job Creation Based on Technology and Wealthbuilding**



The survey findings, below, also support the conclusion that East Tennessee lacks some of the critical capacities necessary for successful capital formation and technology development. Listed

are five "needs" expressed by survey respondents as they relate to the issue of capital formation. Note that public sector and private sector respondents ranked the needs in the same order.

Critical Needs for Improving Capital Formation and Economic Wealthbuilding	Public Sector Ranking	Private Sector Ranking
Attract venture/business expansion capital	1	1
Attract more 'seed' capital	2	2
Establish new, creative funding mechanisms	3	3
Explore risk reduction mechanisms for local bankers to encourage more lending	4	4
Educate local bankers on small, medium size business needs	5	5

Clearly, however, East Tennessee is not devoid of entrepreneurial spirit. Anecdotal evidence indicates a strong sense of the importance, and a desire for more entrepreneurial activity in the region among private and public leaders alike. Nevertheless, there is also plenty of evidence suggesting that the region lacks key prerequisites for more entrepreneurial activity. In order to build a more supportive, nurturing environment, the region will need to work hard to put in place an array of mechanisms for improving the process of capital formation and for technology commercialization.

### ***Assessing East Tennessee's Technology Capacity***

Because of Federal government investments in programs which attracted highly educated personnel with scientific knowledge, the region has long been one of the country's leading centers in array of technical competencies including energy, environmental, metals and materials, instruments, and information technologies. However, it was not until the late 1970s and early 1980s that research and development activities began to include a private sector, industry dimension. In those years, informal contacts and conferences outside "the fence," resulting in interactions between the ORNL, for instance, and the private sector, was considered "innovative." During this period there were few, if any, formal mechanisms for fostering these relationships.

The establishment of the CRADA program and the SBIR program started the process of building stronger industry and private sector links with the region's research institutions. And, as mentioned, increasing numbers of patents and license arrangements signalled the emergence of an array of new linkages between public institutions and the private sector.

Most importantly, the research shows that more than 245 companies were launched (or expanded locally with entrepreneurial initiative), in the region from 1979 through early 1995 (see Table III-2 that follows).

The potential for licensing, for receiving royalties, and for realizing the benefits of access to growing research dollars in a region have always attracted industry and entrepreneurial leaders. And while new business formation is only one benchmark of successful technology commercialization, there is little doubt that increased access to intellectual properties is linked to

greater potential for product development, higher returns on investment, and the successful transfer of applied research.

From a historical perspective, it would appear that the University has taken an approach to commercialization different than that taken at the Oak Ridge complex. For example, concentrated efforts to license University developed technology has been the primary approach to commercialization, while the Laboratory has emphasized CRADAs over licensing. Neither strategy is wrong, but neither strategy alone hastens commercialization nor entrepreneurial spin-offs.

Significantly, this report finds that by 1989-1990, the rate of technology-based business formation seen in the preceding ten years had slowed to a trickle in all but two industries, Information Technology, and Environmental Services (see Table III-2 that follows). A slow down in the rate of business formation suggests that more attention be paid to developing, leveraging and commercializing opportunities in all areas, but especially where there is a good record of success.

This pattern of growth could either mean that new markets have begun to emerge for these industries or that innovative research in the region is having better commercial results in these industries than in others. Another reason for the success of these industries is that Federal grants and contracts locally could be driving uses of these technologies for specific Federal needs at the Oak Ridge complex. Whatever the reason, it is clear that the most recent growth of new technology-based businesses are in a few specific areas that should be supported by complementary economic development initiatives.

In the context of uncertainty in the future of national science policy, and especially the future mission of the national laboratories, the 21st Century Jobs Initiative seeks to address the potential and likelihood of increasing the economic impact of technology-intensive industries, products and services that reside in the region from the 50 year Federal government investment in intellectual and human resources. However, in their response to the survey, both public and private sector leaders expressed concerns about regional R&D strategies and policies. Leaders identified several ways to improve the region's capacity for technology commercialization and ranked them as follows:

Ways to Improve Technology Commercialization	Public Sector Ranking	Private Sector Ranking
Improve access to UT technical resources and professional expertise	1	1
Determine commercial potential of ORNL, UT, TVA technologies and R&D	2	2
Improve linkages with national resources and markets for technology commercialization	3	3
Improve access to ORNL technical resources and professional expertise	4	4
Establish regional technology demo/application centers - "Industry Incubators"	5	5

Unlike some technology-based economies narrowly grounded in just a few technical fields, East Tennessee has a choice of directions to take in deciding its future because of the breadth of technical competencies in the region. As highlighted in Section II, the analysis of core competencies in both the ORNL and the University offers evidence that opportunities exist for more technology commercialization in the region and for the establishment of regional strategic alliances and research consortia to sustain improved commercialization processes.

When asked to rank the most likely technologies to lead East Tennessee's economic development early in the 21st century, respondents noted the following:

Most Likely Technologies to Lead Region's Economic Development	Public Sector Ranking	Private Sector Ranking
Environmental Services, Waste Management	1	3
Health Care (Medical Technologies)	2	1
Information Technology	3	4
Energy	4	5
Telecommunications	5	2
Electronics/Components	6	6

For the most part, survey respondents ranked highest the technology fields where there is good evidence that commercial activity is increasing rapidly (e.g., see Section II where the data shows rapid growth in environmental, information and other technical fields noted above).

### ***Genealogy of Enterprise Formation***

For a region to know how, and toward what ends, it must develop its economy it must first understand its historical record in various aspects of economic development. Research on the pattern and methodology of new business formation can serve as a starting point for understanding the requirements for achieving a new kind of economy. Moreover, an analysis of new technology-based business formation can serve to benchmark the results of future technology commercialization endeavors.

As mentioned earlier, the research has shown that from 1979 to early 1995, 245 new companies were established in the region (see Table III-2). An analysis of employment in seven selected technology fields indicates that, for the most part, the technology-based firms that have been established remain small. Yet, the research shows that there are a few firms that have grown fast which indicates that the requisites for fast growth (e.g., entrepreneurial management talent) are not completely absent.

**Table III-2**  
**New Business Formation, by Technical Field (1979-1994)**

	<b>Pre-1979</b>	<b>1980-1984</b>	<b>1985-1989</b>	<b>1990-1994</b>	<b>Total Firm 1979-1994</b>
Bio-Medical	3	0	2	1	6
Manufacturing	2	6	5	0	13
Materials	3	4	6	7	20
Electronics	4	9	18	5	36
Instruments	12	11	13	5	41
Information	6	17	18	13	54
Environment	14	8	21	32	75
<b>Total</b>	<b>44</b>	<b>55</b>	<b>83</b>	<b>63</b>	<b>245</b>

'80-'94: Information technology & environmental on average = 50%+ of firm formation

In 50% of environmental startups, in '90-'94, firms have less than 10 employees

In 80% information startups, in '90-'94, firms have less than 10 employees

The underlying trend, however, is troubling. This report finds that technology-based firm formation in key fields (e.g., Electronics, Instruments, and Information) has waned over the past few years. And for those fields that have grown, for example the environmental firms formed in the period of 1990-1994, many are small, having less than ten employees.

An analysis of these findings suggests that there may be three possibilities for why many of the start-ups have remained small:

- 1) Many of the enterprises launched in the early 1980s were actually consultancies rather than entrepreneur/company-builders, thus it is unlikely that significant growth would occur .
- 2) The new enterprises could be reflecting the national trend towards 'virtual' teams of experts who come together around a specific project and then re-form on another project in another realm; or
- 3) The new enterprises have formed under the "small is better" notion, where, because regulatory and bureaucratic policies are perceived to be significant challenges for larger companies dealing with the Federal laboratory or state university, the decision was made to start and remain small.

This report finds that East Tennessee needs to do a much better job of building new companies based on its technological capacities. The record to date is not bad, just disappointing. Total employment today in these 245 firms is probably no more than 5,000, far less than the job losses in the region due to cutbacks in Federal government-supported institutions and negative growth in some traditional sectors (e.g., metals, textiles/apparel).

This report finds that new, technology-based business formation in East Tennessee is both required and possible. Required because the analysis is compelling—cutbacks in government spending, economic restructuring and other factors (e.g., growing foreign competition such as NAFTA impacts on textiles/apparel industry) will hurt the East Tennessee economy. Possible

because the R&D capacity of the region will be strong well into the future and because the region has demonstrated that it can create new business by commercializing locally available technologies.

## ***Conclusions***

Overall, the research has found that although there are substantial technological resources in the region, the nurturing and incubation processes needed for fostering growth and development of technology-based companies may be lacking in the region. Access to risk capital to grow technology-based companies is difficult, at best. Further, the kind of entrepreneurial management required to build firms around the technological competencies either does not exist or there are few ways of developing it. And finally, the process of commercializing technology in the region is problematic for many reasons, some relevant only to the region and others universal problems requiring new policies and initiatives from Washington, DC.

As assets at the Oak Ridge complex become available for acquisition or partnership, opportunities to convert the facilities to programs such as "teaching factories" (e.g., Y-12) or "technology commercialization test-beds" (e.g., K-25) will provide new ways to commercialize technologies. New ideas and innovative approaches to the challenges of technology commercialization and transfer will be necessary as the region works through the impacts of changes coming from Washington, DC. At a minimum, it is clear that an array of linking mechanisms is required to improve the flow of information about commercialization opportunities between local firms, potential entrepreneurs and technology institution. Over the next several months and years, there must be much more discussion between those having the technology capacity and those in the private sector who must, in the end, take the risks to create more vibrant, growing businesses. Linkage, in whatever way it is achieved, will be critical for responding to, and offering new alliances between industry, entrepreneurs, and wealthbuilders.

East Tennessee must focus its economic development strategies on building off its competitive advantages, especially its technology base. The challenge is to build a technology-intensive economy having strong private sector capabilities that can lead to continued job generation and economic growth. Doing so will require setting a course to the 21st century based on a new vision with a new strategy. The next Section sets forth a plausible economic vision for the region and recommends the strategies for to pursue achieving a next generation economy.

## IV. A New Economic Vision

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### **Situation Assessment**

Although the region faces significant challenges to its economy (Section II), and may lack some of the institutional capacity for entrepreneurial, technology-based economic development (Section III), this report nevertheless concludes that *East Tennessee has the potential to overcome threats on the horizon and take advantage of opportunities to become a more dynamic, more technology intensive economy.* Why? Because the basic ingredients for building a more competitive economy are in place. First, the region has a tradition of community leadership with a good record of implementing large scale, strategic interventions aimed at improving the region's economy (e.g., Pellissippi Parkway, formation of Tennessee's Resource Valley and development of the Technology Corridor). Strong economic leadership of the kind shown before is critical because it will be East Tennessee's leaders that will move the 21st Century Jobs Initiative's strategic action program forward. Without energized leaders there would be little interest in undertaking the hard work of implementing the strategies and action plans outlined in this report.

Second, the region is at a good starting point for moving forward to achieving a more competitive economy. Unemployment is low thus there is no need for making precipitous, risky interventions. Moreover, unlike many region's whose economies are concentrated in a few areas, East Tennessee's economy is relatively well-grounded in several manufacturing and services sectors. Comprised of eight early stage clusters of economic activity—four having potential for growth (e.g., auto/transportation, technology-intensive, business services and tourism) and four others able to at least remain as a stabilizing force and source of jobs in the future (e.g., metals/materials, textiles/ apparel, food processing, forest products). These clusters, when more fully developed, can be powerful engines for generating jobs and economic growth in the region well into the 21st Century.

Third, in addition to a strong manufacturing and services base, East Tennessee also has relatively strong economic foundations on which to build a new kind of economy. Especially important is the fact that region is home to large institutions at Oak Ridge that provide an unusually large base of scientists, engineers and technicians. TVA is also a strong force in energy-related, applied research. The region has an excellent research university as well as several increasingly entrepreneurial colleges. This science, technology and information base comprise distinctive economic features—economic characteristics that will increasingly define the region's competitive advantages.

Finally, and increasingly important as a factor in economic development, the region enjoys an unusually good "quality of life." East Tennessee is unusually well-endowed with scenic mountains, lakes, rivers, and array of manmade amenities (e.g., theaters, museums, amusement centers) that support recreation and make pleasant the leisure time of residents. Observers of economic development trends are making a strong point that "lifestyle amenities" are contributing to the development of economies. With advanced telecommunications increasingly important to



commerce, people in business can live anywhere where there is access to telecommunications systems and airport services. Increasingly, observers of demographic changes point out that so called "gold collar workers," the knowledge workers who will especially be the entrepreneurs and managers of tomorrow, will seek out places to live and invest in that have strong lifestyle amenities..

This report concludes that East Tennessee has the essential ingredients for building an advanced, technologically-intensive economy. It has an existing economy with growth potential. It has a strong institutional base in science, technology and information. It has a lifestyle attractive to residents, as it will be to talented people that could be attracted from other regions. And finally, it has energized leadership to make the most of these advantages.

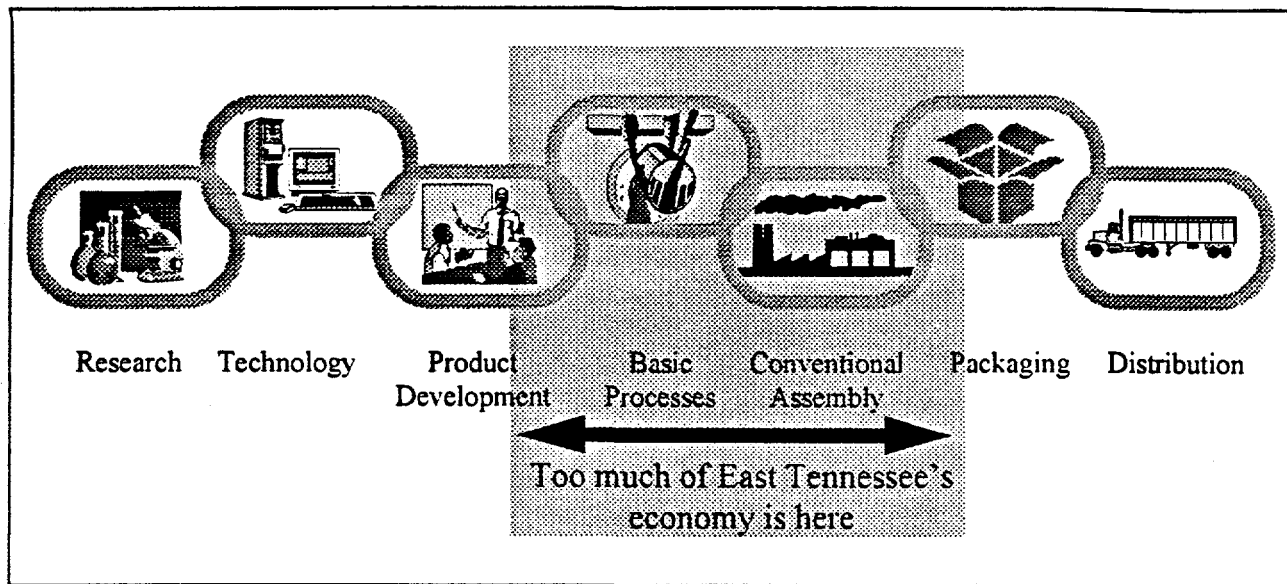
What is needed now is an exciting vision of a economy "on the move"—one that is evolving from traditional kinds of economic activity to one that is better integrated, and better supported with technology. East Tennessee needs an economic vision that can further galvanize leaders and the general public alike, one that can help forge a regionwide consensus for moving the economy forward with coordinated, strategic action taken in both the public and private sectors.

### ***A Plausible Vision: Becoming a Technologically-Intensive 21st Century Economy***

What is an achievable vision for the region? This report finds that East Tennessee can become an advanced 21st Century economy, one made distinctive by its ability to adapt quickly to global opportunities, by its manufacturing and services cluster structure, by its specialized economic foundations (especially its science and technological base) and by the ability of its leaders to work together to solve problems and take advantage of opportunities.

For any region the key to sustaining economic growth lies in the ability to continuously add value to goods and services produced (or shipped through) the region. In a simple formulation, this means having the capacity to add innovation or information (e.g., technology) to a product or service making it more valuable in the marketplace. Figure IV-1 illustrates a value-added chain having basic science and technology at one end and finished products, distributed to end users at the other end. While it is unlikely that a regional economy will be strong across the entire value added spectrum, the challenge for any economy is to add as much value as possible along the chain and, as a result, reap the economic rewards stemming from wide-ranging economic activity.

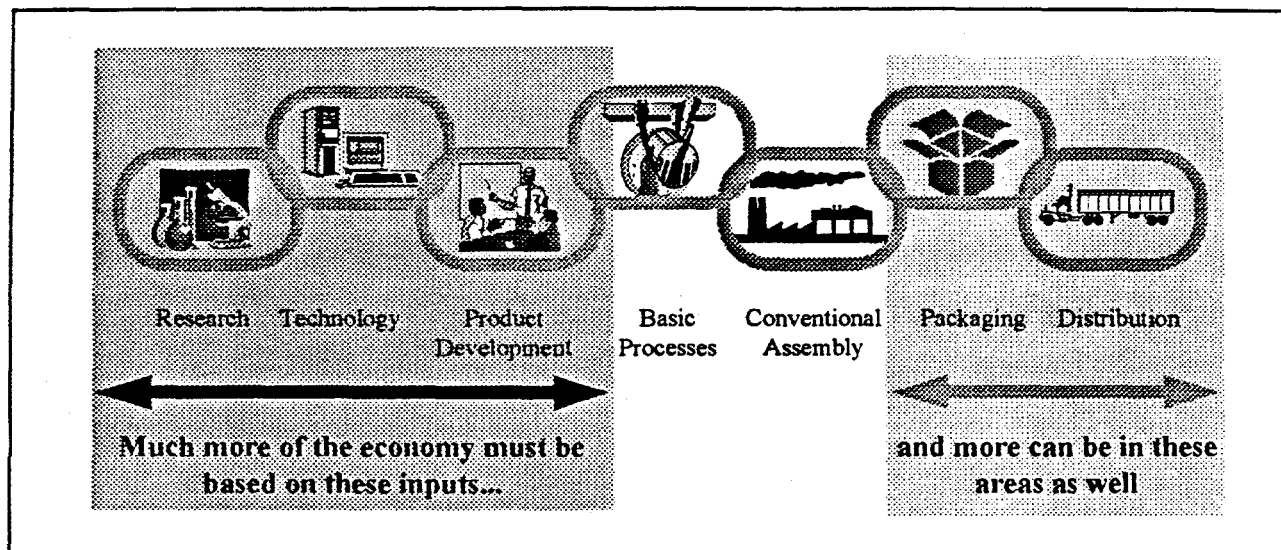
**Figure IV-1  
Value Added Chain**



The shading in the figure illustrates the area of the value added chain that much of East Tennessee's economy commands. For the most part, the region's traditional manufacturing economy produces at the middle. Some new product development occurs, in the technology-intensive cluster and others as well, and plenty of basic processing (e.g., textiles, metals, food) and assembly (e.g., auto parts) occurs throughout the economy in other clusters. Overall, however, this report finds that too little of the region's economy is built on, or linked to the significant scientific and technological resources illustrated in the value added chain, even though the region is as richly endowed with 20,000 scientists, engineers and technicians employed at the Oak Ridge complex, within the University and at TVA and other sources of R&D.

Figure IV-2 shows the area of the value added chain that, if built on and linked to the East Tennessee economy, would pay huge dividends in the form of more technologically advanced processing and assembly. Because most of East Tennessee's science base has been focused on national security (e.g., Oak Ridge) and energy missions (e.g., TVA) the region has been mostly unable to capitalize on these assets and diffuse them into the rest of the economy. Certainly, East Tennessee's 21st Century economy will need to capture more value added at both ends of the chain, but especially by diffusing science and technology throughout the economy. With the changes now affecting Oak Ridge, TVA and the University's research agenda, now is the time for leaders to take the steps possible to capture more value added by linking sources of science and technology to the region's clusters.

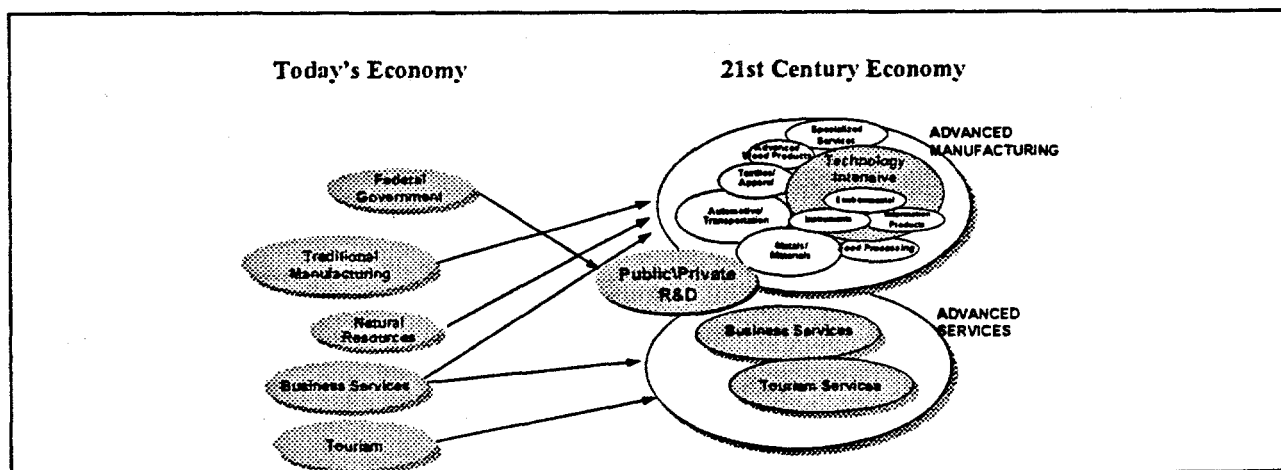
**Figure IV-2**  
**Value Added Chain Illustrating Opportunity For East Tennessee Development**



***What Could the Next East Tennessee Economy Look Like?***

Figure IV-3 illustrates the concept of building a more technology-intensive economy by leveraging the Federal government research base in ways that can change the structure of East Tennessee's economy. This report argues that for the economy to become more competitive and more technologically advanced, Federal scientific and technological "enterprises" represented mostly by the Oak Ridge complex (but also TVA and government supported research at the University) must evolve from its historic mostly *independent role* and become more diffused throughout the region's economy.

**Figure IV-3**  
**A Plausible Vision of East Tennessee's 21st Century Economy**



The time is ripe to build public-private R&D linkage mechanisms to speed the diffusion of technology into the local economy. Already there are signs of change, especially with the establishment of user groups such as the Centers for Manufacturing Technologies( and its Skills Campus). Of course, there are also the activities of the LMES Office of Technology Transfer that are focused, in part, on diffusing technologies into the region's economy. DOE has also recently made a large tract of land available in Oak Ridge for an industrial park. And the University has several mechanisms for diffusing technology into the region.

But these efforts are all on *the supply side of the supply-demand equation*. To date, most technology transfer efforts in the region have been designed to "push" technology into the economy (e.g., both the University and Oak Ridge have attempted to communicate technology availability to local firms). In the context of today's challenges, instead of continuing to try to push technology into the economy where there may be little capacity to take advantage of it, a better approach is to enhance both "technology push" (where most efforts have been focused to date) and especially "technology pull." Among East Tennessee's challenges for the future is to significantly strengthen the demand side (e.g., technology pull) of the equation.

For technology transfer to be successful, a market-based approach is required. By strengthening the marketplace for technology in East Tennessee, enhancing the capacity of clusters and entrepreneurs to use technology, the pull of the marketplace would accelerate the process of technology transfer and commercialization and strengthen the economy overall. Doing so will require more entrepreneurship, more risk capital, and more information about technology-intensive business opportunities throughout the economy,

Figure IV-3 illustrates how today's economy, comprised of five largely independent kinds of economic activity, can transform into a more technology-intensive economy, comprised of more complete clusters than exist today and new clusters that can grow from the technology base of the region. Leverage for this transformation can come from market forces, especially if the sources of technology supply (e.g., public R&D centers) and sources of technology demand (e.g., existing and future clusters) are linked through new public-private R&D mechanisms designed for more effective technology commercialization.

Although the structure of the region's future economy cannot be predicted with great accuracy, it is reasonable to assume that, with strategic actions, more cluster integration and more technology diffusion into the economy is possible. Efforts to integrate the economy through clustering and linking of clusters (e.g., textile/apparel producers making seat belts and airbags for the autos/transportation cluster) can be achieved by strategic industrial recruiting, business expansions/spin-offs, and new business formation. More diffusion of technology into the economy can be achieved through efforts to help the Federal government part of the economy both provide and help apply technology and know-how to clusters. Potentially, spin-off user groups or parts of user groups from the Federal sector could also be done in ways that could add value to existing and fledgling clusters (e.g., spinning off ORCMT resources and linking them to clusters as intermediaries, between the public and private sectors). Spin-offs could also include individuals from the laboratory environment who, with proper support, could establish

entrepreneurial start-up companies based on technologies developed in the region (or brought into the region from outside sources).

As illustrated in Figure IV-4, a new vision for East Tennessee's economy is one comprised of two main parts, advanced manufacturing and advanced services. Advanced manufacturing envisions enhancements to today's traditional clusters, using technology and information to produce higher value added products (e.g., food producers developing and entering markets with "higher processed" food products, metals producers developing and selling new metal/composite materials). Advanced manufacturing also envisions several of the fledgling clusters (e.g., environmental services/devices, information products) growing and developing into strong clusters in their own right.

Advanced services envisions two components, business services and tourism. Business services are the way cluster firms get access to specialized inputs and information (e.g., accounting, legal, temporary personnel). Like advanced manufacturing, it is envisioned that the services cluster can move up the value added chain and become more both more technologically advanced (e.g., more use of computer power, telecommunications) and better linked to markets outside of East Tennessee (e.g., providing specialized services to firms in Chattanooga, Nashville and beyond the state's borders). Tourism can grow in the same way, by tapping into the region's technology capacities and putting the technology to work (e.g., using computer power for more sophisticated reservation systems, sensor technology for security purposes, telecommunications for marketing). The region's tourism attractions also need to be linked together themselves in order to achieve the economic synergies of complementarity (e.g., visitors attracted by outlet malls also taking advantage of urban attractions, all in the same visit). This means recognizing the historical and continuing importance of the attractions of Sevier County, for example, but also the complementary attractions of Knoxville and the broader urban region (e.g., Knoxville Zoo, Oak Ridge Museum of Atomic Energy).

The vision of a better integrated, more technology-intensive economy for East Tennessee is plausible for all of the reasons touched on above. With strategic action, using public policy and private initiative focused on achieving the outcomes suggested above, the region can expect to become one of the country's few economies achieving success and generating new jobs by the application of information and technology to local enterprise in a region highly attractive to investors and talented people because of its strong lifestyle (e.g., quality of life) advantages.

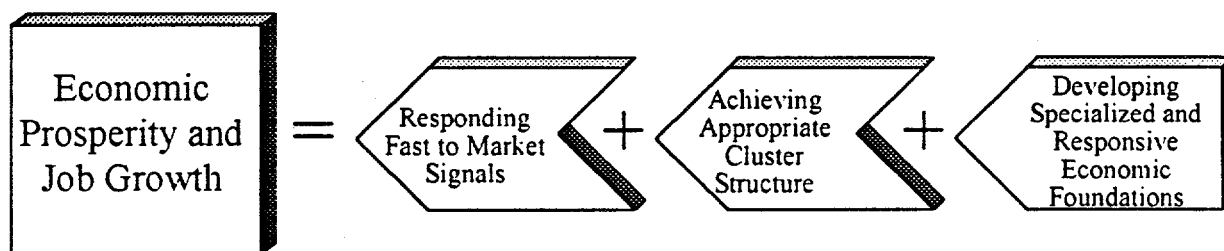
## V. Strategies for Achieving an Advanced 21st Century Economy

This section of the report builds on the findings and conclusions in Sections II and III and sets forth key strategies for moving the economy toward the vision of a technology-intensive, 21st Century Economy outlined in Section IV.

### ***Ensuring Economic Prosperity and Job Growth: A Simple Formula for Economic Success***

For East Tennessee, the formula for economic success over the next several years is not complex. Although external economic forces will always be present and will have strong impact on the region's economy in the future (as the new realities in Washington DC are having today), East Tennessee's leaders will be able to take local action to position and shape the economy "on the margin." This means that no matter what forces are affecting the economy from the outside, local initiative can make the most of the situation. Figure V-1 illustrates, by way of a simple "formula," the elements of a strategic approach for achieving economic prosperity and job creation in East Tennessee.

**Figure V-1**  
**Strategies for Achieving Economic Prosperity and Job Growth**



### ***A 3-Part Strategy for Building an Advanced 21st Century Economy***

The "formula" illustrated in Figure V-1 provides a strategic framework for building a 21st Century economy in the region. Each component of the formula can be made action-oriented by linking public and private sector initiatives to the strategy. In this section, a three-part strategy is recommended for guiding East Tennessee toward a better integrated, more technology-intensive economy.

***Strategy 1: Build capacity to respond fast to market signals. Accelerate the shift from significant dependence on Federal spending to more entrepreneurial, demand-driven economic activity.*** Fast changing technology and foreign competition has made the market environment

faced by companies more dynamic than ever before. Some region's have become unusually agile in this environment and able to respond quickly to market shifts (e.g., high tech centers like, Boulder, Salt Lake City, Austin, Raleigh/Durham). East Tennessee, this report finds, is perhaps not as entrepreneurial as it could be. Maybe 50 years of Federal dependence has built a culture of risk avoidance. Whatever the case, the region is clearly waking to the new realities in WDC. Leaders will need to continue to use the leverage available in DOE and other Federal agencies as the transition continues but will also need to develop new kinds of economic activity to offset what is likely to diminish. East Tennessee must start the process of breaking its dependence on Washington and building the capacity for entrepreneurial response to opportunities in the non-government marketplace.

***Strategy 2: Achieve Appropriate Cluster Structure.*** Leaders must focus economic development activity on those parts of the economy that will drive the region in the future. This means focusing on the 8 clusters by filling in the supply gaps through targeted industrial recruiting, strategic efforts to expand and spin off companies within the clusters, and new business formation within the clusters. It also means using private sector initiative to link together those clusters where the potential exists (e.g., textiles producers linking to metal manufacturers to make seat belts to support the auto/transportation cluster) and building up those clusters where growth is likely (e.g., environmental services, tourism). This strategy will require new approaches to economic development, especially to more sharply focused industrial recruiting. It will also mean providing new kinds of assistance to existing firms wanting to seize market opportunities locally, as well as in the global economy.

***Strategy 3: Build more specialized and appropriate economic foundations.*** The major institutions that provide inputs to the clusters (e.g., the University, the Regent's institutions, the Oak Ridge complex, cities and counties) will need to build new kinds of capacity to support the economy with inputs designed specifically with the regional economy in mind. The University, for example, can become better linked to the region's economy through strategic partnerships with local firms (e.g., sponsored research and internships for students). The Regent's institutions can, for example, establish "rapid response" training programs to meet the needs of firms for short, intensive job skill training. The Oak Ridge complex can reach out more to local firms, both helping them understand the technological advantages of the complex and helping to put those advantages to work in firms. Cities, counties and public utilities can build advanced transportation and telecommunications systems to link together the region and link the region to the global economy.

### ***Using the Strategies to Build Consensus and Improve Coordination***

From an economic development standpoint, regional strategies for development can be helpful because they articulate overall approaches for achieving economic development in a region. When communicated, and when they become well-understood in the region, economic development strategies are a good tool for building consensus and starting the process of coordination among different organizations (e.g., local chambers of commerce) that represent different constituencies.

The 3-part strategy recommended above can guide leaders toward the vision of a technology-intensive 21st Century economy. Each strategy can take the East Tennessee economy in the directions outlined in Section IV, A New Economic Vision. The strategies will also be useful as a way to classify specific action initiatives, which are discussed in the next section.



## VI. Moving to Action: Flagship Initiatives to Achieve an Advanced 21st Century Economy

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Building on the findings and conclusions before, this section of the report sets forth several "Flagship Initiatives"—they have been referred to as "big ideas"—that, when implemented, could have profound mid- and long-term impacts on the region's economy and ability to generate jobs.

The Flagship Initiatives have emerged over the past several months, shaped by the economic analysis, by input from 8 Cluster Working Groups as well as by "best practices" and program models from other communities. Information and ideas gathered in interviews, small group meetings and working sessions of the Tennessee's Resource Valley Board of Directors have also contributed to the process that has culminated in the formation and shaping of the Flagship Initiatives.

The Flagship Initiatives recommended for immediate action leading to implementation are as follows:

1. *21st Century Workforce Initiative*: Make East Tennessee's Workforce Worldclass
2. *Entrepreneurial Valley Initiative*: Steps to Enhance the Climate for Entrepreneurship
3. *Technology Start-ups*: An Initiative to Establish the Resource Valley Capital Network
4. *Market-driven Technology Development*: Steps to Accelerate the Commercialization of Resource Valley Technologies
5. *Resource Valley Connections*: Actions to Move People, Goods, and Information Rapidly Through the Valley and Beyond
6. *Market the Region*: Promote the Next Generation East Tennessee Economy

## ***Flagship Initiative #1. 21st Century Workforce Initiative: Make East Tennessee's Job Skills World Class***

### **Key Components:**

- Enhance School-to-Work Transition
- Establish Education/Employment Standards
- Develop "Rapid Response" Training Mechanisms
- Explore the Establishment of "Teaching Factories" at Underutilized Federal Facilities
- Create Cluster Consortia for Workforce Development

### ***Critical Issue: Developing Workers for a Competitive Region***

Across the US economy workforce issues are emerging as one of the most critical factors in firm competitiveness, industrial development and overall job creation. As markets shift and new competition emerges, the pressures on workers grow. Skills suitable for one set of requirements become quickly out of date as new skill requirements come into play. Employers are looking for new abilities in their employees, in fact, for new levels of adaptability to fast-changing job requirements. For new entrants into the job market, both high school and college graduates, employers seek basic levels of education and technical skills that sometimes are lacking either because of shortcomings in the education system or in what the individual learned in school.

In East Tennessee, no issue is more prominent among business leaders than the question of workforce skills and worker adaptability to changing employment needs. In every Cluster Working Group concerns were expressed about the region's workforce. Is it competitive today, and will it be tomorrow? In some clusters (e.g., technology intensive) the issues had more to do with changing skill sets among technically trained workers such as engineers and technicians. In other clusters (e.g., tourism) the problem was simply access to new workers. Some clusters (e.g., auto/transportation) expressed concern over the basic work ethic of recent hires. These new hire decisions were made in the face of tight labor markets where available workers lack many of the requisites for employment. Certainly, these questions are increasingly asked by business leaders across the country. For East Tennessee to have a competitive economy, it must have a competitive workforce.

### ***How Can the Region Respond? Four Specific Needs***

In order to successfully transition from today's economy to the concept of a better integrated, more technology intensive 21st Century economy over the next several years, the region will need to sharply focus efforts on improving the skills and adaptability of the workforce. Of course, much is already being done to address the issue. School officials at all levels are aware that the challenges and the realities of the situation will require constant attention, not only within the traditional learning environment but at home and by employers. Creative solutions will be required to develop new ways of teaching and training and, perhaps, new ways of funding education. The entire region, but especially business will need to support K-12, higher education

and continuing education in significant ways (e.g., financial support, use of facilities) as efforts are taken to move the economy toward the 21st Century.

There are three workforce issues having high priority in the context of the 21st Century Jobs Initiative. The first is the issue of *school-to-work transition*. Business leaders and educators alike recognize the growing problem of preparing students to a level so that when they enter the workforce they are able to quickly adapt to the requirements without a steep learning curve. However, "the workplace" simply is too specialized an environment to educate students for and the learning environment is simply too broadly-based for preparing students for specific employment requirements. Closing the gap between school graduation requirements (especially secondary education) and the actual requirement of the workplace is a significant challenge for the region.

The second issue is more specific, having to do with the level and kind of education and skills actually achieved by students when they graduate from the K-12 system. Educators seek input from business leaders about the changing requirements in the workplace in order to shape curriculum. Business leaders want to be assured that graduates have achieved a level of education and have developed skills within some range of competency that meets their needs. Closing this gap will require developing the means for improved dialogue between the private sector and the education and training community along with, in this context, the establishment of some kind of "*employability standards*" for the education community to meet with their graduates.

Third, rapid changes in skills needs due to fast-paced technological advances and other factors place a premium on the ability of training institutions to quickly ramp-up and develop *just-in-time training programs* that might require a few weeks rather than months to complete.

Fourth, educators and trainers simply must be better connected to the business community if they are to respond to the needs of the private sector. New mechanisms for linking demand (business needs) to supply (the capacity of the education and training community) must be established.

#### **Recommended Initiative: Launch a Comprehensive 21st Century Workforce Initiative**

East Tennessee should immediately launch a comprehensive initiative to ensure that employers have access to a skilled and adaptable workforce as the economy moves into the 21st Century. While the initiative should have broad objectives, including supporting the array of existing education reforms, it should focus on specific areas where regional public/private partnerships could make East Tennessee a leader in workforce development. Over the next two to three years, and with positive outcomes expected within five years, leaders in East Tennessee should take ambitious steps to:

1. **Enhance School-to-Work Transition**—Leaders in the public and private sector are already talking and taking some early steps toward this end. The initiative, however, envisions new and more ambitious efforts. Private sector leaders of the 21st Century Jobs Initiative have placed a high priority on having access to recent graduates who are at a high state of readiness for employment. Under this initiative, private sector leaders would take steps to help the

education community prepare students for the world of work. This could mean internships to high school seniors, mentoring of students in K-12 or the 2-year institutions about to enter the workforce or providing space and other support to classrooms at the work site. (Efforts in this regard are currently moving forward at Pellissippi State.)

2. ***Establish Education/Employment Standards***—Faced with workforce issues, business leaders are increasingly ready to take the steps necessary to identify the specific education level and skill sets needed for different job classifications and make this information available to the education community. In effect, the process would establish “employability standards” which would help educators implement changes in both curriculum and graduation standards. This initiative would start the process of developing, cluster-by-cluster, standards for employment. The process will involve the establishment of cluster/education partnerships whose purpose would be to put together business leaders with the education community to define both the standards to be met and the roles to be played by both the private and public sectors to ensure that graduates meet specific standards for employment.
3. ***Develop “Rapid Response” Training Mechanisms***—Fast-changing manufacturing process technologies and other dynamics in the workplace are increasingly placing new pressure on skill training institutions to provide “relevant” training. As job skill needs change, training institutions must respond more quickly with changes in training programs. The concept of “just-in-time training” involves the ability of training institutions to respond rapidly to near-term needs of employers (e.g., an employer winning a contract requiring 20 people skilled in a particular set of component assembly skills). Just-in-time refers to the ability of training institutions moving quickly to shift gears and both implement new training programs in a short period of time and make the programs themselves short). This initiative would kick-start the process of developing among East Tennessee training institutions (e.g., Roane State, Pellissippi State, Walters State as well as other training centers such as the Oak Ridge Centers for Manufacturing Technology Skills Campus) the ability to anticipate training needs and respond quickly with short-term, flexible training programs.
4. ***Explore the Establishment of “Teaching Factories” at Underutilized Federal Facilities***—As the process for examining reuse of DOE/ORNL and other Federal facilities continues, an opportunity emerges for an innovative use of these facilities as a part of the region’s education and training infrastructure. The high cost of new teaching/training facilities and the imperative for more collaboration between scientists, technicians and the business sector in the education process argues for the exploration of a “teaching factory” concept as used in Germany and Japan. Oak Ridge’s Centers for Manufacturing Technology has implemented a “skills campus” concept that can be expanded to include both more widespread use in the region and more specialized teaching and training linked to the needs of the region’s clusters. Workforce development in real world settings using “cutting-edge” equipment and highly-skilled trainers will help ensure that the region has a competitive 21st Century workforce.
5. ***Create Cluster Consortia for Workforce Development***—During the first year of the 21st Century Jobs Initiative, eight cluster working groups were formed to help the consultants understand cluster needs and to participate in the shaping of action initiatives. By most accounts, the participants in these groups saw significant value in the process and many felt that the working groups should be continued. East Tennessee should take this opportunity to institutionalize the eight working groups by keeping them administratively supported and

helping them form into specialized consortia for developing new capacities in the region. For example, all eight working groups should evolve so that they form "cluster consortia for workforce development." These loosely knit consortia (i.e., non-bureaucratic) can serve as industry focus points for articulating needs in education and training and other areas (see technology-related initiatives) and serving as sounding boards for the education and training community.

#### **Sources of Leadership: *Who Drives the Initiative?***

- **Overall leadership:** This Initiative can be driven toward implementation by the Board of Directors of Tennessee's Resource Valley, working in partnership with the region's education community including the recommended Cluster Consortia for Workforce Development.
- **Other sources of leadership:** Local school boards and their superintendents, the Board of Regents, UT College of Education, ORCMT, and qualified volunteers from the community.

#### **Launching the Initiative: *Key Action Steps and Milestones***

1. Secure the commitment of one business-leader to be the "champion" in the region and take responsibility for spearheading the effort working with a small TRV support team. (ASAP)
2. Convene a meeting of committed business leaders and top officials of the education community (e.g., K-12 superintendents, Board of Regents, UT College of Education) to discuss the need for the initiative and the recommended approaches outlined above.
3. Establish an Initiative Action Team comprised of business leaders and key educators to work with the champion toward implementation (by the end of 1995)
4. Develop a detailed Action Plan for each element of the Initiative above including resource requirements (rely on a loaned executive or specialized consultants to draft the detailed plan).
5. Identify a champion for each element of the plan. Establish the Cluster Consortia for Workforce Development (by February 1996)
6. Move each element of the Initiative ahead as quickly as possible (demonstrable progress should be evident by June 1996)

#### **Related Initiatives Developed by Cluster Working Groups**

Most of the eight Cluster Working Groups placed a high priority on workforce issues and several groups developed business plans for cluster-specific workforce initiatives. Many of these initiatives fall within the parameters of this Flagship Initiative. Where this is the case, the cluster-specific initiatives could be implemented through a coordinated effort (e.g., the approach outlined above could be modified so that the activities directly address the needs of specific clusters). Below are the Cluster Working Group initiatives (and reference number) that are similar to this Flagship Initiative:

##### ***Automotive/Transportation Cluster***

- Industrial Outreach to Primary and Secondary Education (A-4)

- Automotive Curriculum Development (A-2)
- Just-in-Time Training Availability (A-3)
- Skill Needs Assessment (A-1)

*Technology-Intensive Cluster*

- Information Technology Education Partnerships (T-4)
- Manufacturing Technology 6-12 Education Outreach (T-5)

*Business and Financial Services Cluster*

- Business Services Skills Training (BS-1)

*Food Products Cluster*

- Food Industry Education Outreach (AF-1)

## ***Flagship Initiative #2. Entrepreneurial Valley Initiative: Steps to Enhance the Climate for Entrepreneurship***

### **Key Components:**

- Enhance entrepreneurial education and training
- Provide mechanisms for mentoring and counseling
- Establish a forum for exchange of ideas, concerns and to provide peer support

### ***Critical Issue: Improve the Environment that Supports Entrepreneurial Business Development***

As the East Tennessee region accelerates the transformation from a Federal government-driven business climate to one driven more by private enterprise, the need to build a stronger capacity to support entrepreneurship is clear. The concept of an advanced 21st Century economy includes not just world-class technology-based companies, but a continuously developing pool of entrepreneurs to build the next generation of companies and generate new jobs within those companies. Those regions that have emerged as entrepreneurial "hosts" (e.g., Austin, Silicon Valley, Phoenix, Salt Lake City) have done so with a clear set of entrepreneurship-related objectives and tools—education and training, mentoring, infrastructure support from suppliers (legal, financial, accounting), and methods to link fledgling entrepreneurs with other entrepreneurs as "sounding boards."

Although it can be argued that East Tennessee's reliance on Federal government spending has minimized the natural occurrence of entrepreneurship, there is good evidence of entrepreneurial spirit and prior success in the region. Nevertheless, current programs which assist entrepreneurial activities are disjointed and in most cases informal. And yet, the knowledge and foundations exist in the region to support an initiative which targets resources and energies towards becoming a 21st Century entrepreneurial region.

Critical issues being addressed in this project include identification of infrastructure gaps (capital, human resources and basic skill sets, entrepreneurial management, need for incubation) and innovative solutions (see below). The 21st Century Jobs Initiative has focused, in part, on growth characteristics of entrepreneurial companies, potential alternatives for capital resources and further development of the environment for educating and mentoring young entrepreneurs. Overall, the conclusion is that the region must work at two levels: nurturing the current generation of entrepreneurs, which is in transition from corporate or Federal senior positions to the private sector, and developing the next generation of entrepreneurs. The parallel opportunities to educate and train these individuals from both generations on the principles of entrepreneurial management and marketing is unique. Since there may be few differences in the learning curve, the environment could exist for launching a number of enterprises from the educational experience that brings these two generations together.

However, under conditions found in the analysis of the region, the lack of entrepreneurial management in the region is causing well-financed, start-up enterprises to "import"

entrepreneurial talent into the region rather than develop available local talent. The positive side of importing such talent is that the region is marketing its opportunities across the U.S. by approaching individuals that would not have considered East Tennessee as a location to build companies. The down side of importing talent is that eventually the demand could outstrip the pool of talented entrepreneurs ready to relocate.

In addition to developing new talent from scratch, mentoring of new entrepreneurs beyond the initial education and training is critical. Even if entrepreneurs know the region is capable of supporting their infrastructure needs through the best legal, financial and accounting experience, the ability to rely on private counsel from individuals who have gone through the experience of launching a company is vital. Mentoring comes from local success case histories and/or from peer-to-peer relationships.

The current mentoring activities in East Tennessee often are provided by consultants or, when time permits, from individuals with a track record of starting companies regardless of past successes or failures. This base of regional know-how, though limited, suggests a solid foundation on which to build a more structured mentoring process.

Relevant exposure to success models at the regional, state and national levels has proven to be helpful not only to entrepreneurs seeking advice and counsel, but also to the ongoing promotion of the region as an attractive entrepreneurial region. In East Tennessee, periodic exposure to such models is just that, periodic. The greater the need to meet demand for infrastructure support to entrepreneurs, the more important a formal entrepreneurial organization becomes to those examining self-developed employment opportunities.

In the course of this project, business leaders, investors and the financial community have expressed a concern that the entrepreneurial base in East Tennessee is either low as compared to other regions, or non-existent. More importantly, these same individuals have expressed deeper concern that the current class of entrepreneurs presents two challenges. The first challenge is the case where an individual has prior knowledge of a commercial product or service, but little understanding of how to construct an enterprise around the idea. The second challenge is the case where an individual has launched a company on the basis of a good idea and sound business plan, but has little experience in taking the company to the next stage of growth.

Influencing some of these observations are past interactions with the scientific community in and around the Oak Ridge National Laboratory. Whereas the world-class knowledge and intellectual base at ORNL is recognized by the business community at large, a weakness exists where ORNL staff desire to step from the "safe" laboratory setting into the far riskier entrepreneurial environment. Lack of formal training for scientists and technicians in basic business and entrepreneurial management may cause potential mentors, advisors and investors to become frustrated with the process.

East Tennessee can learn a lesson from other regions. For example, some communities in transition have utilized a one-stop clearinghouse concept or other mechanisms that bring together expertise with those in need of advice, counsel or an environment conducive for exchanging ideas



with regard to their future. While entrepreneurship is always an alternative, not every individual transitioning from the public sector to the private sector is ready to take the necessary risk. Some individuals are willing to become a part of the management team or to choose other routes to an economically stable future. And still others are willing to use some of their retirement funds to develop business opportunities directly.

The U.S. Small Business Administration (SBA) calls these mechanisms "business information centers" (BICs). SBA has helped support more than a dozen of them throughout the country in regions experiencing corporate downsizing, defense base closure or industry transition. In some cases, after the SBA exhausted its funding, four or five major corporations took it upon themselves to establish BICs on their corporate campuses.

East Tennessee must take steps to enhance the climate for entrepreneurship in the region. New jobs can come from several development processes in an economy. Such processes include firms that decide to move to the region, firms that decide to expand in the region and new business startups. Although many of the ingredients are in place to create jobs from new business startups, there is too little institutional support.

### **How Can the Region Respond? *Take Steps to Improve the Climate for Entrepreneurship***

Several specific needs have emerged in this regard from the Cluster Working Group meetings, from special focus group activities of the project, and from the analysis/benchmark of the region:

1. ***Enhance entrepreneurial education and training***—While some say that entrepreneurs are "born, not taught" it is clear that elements of the dynamic of entrepreneurship can be taught and that individuals with the drive to take calculated business risks can be trained in some of the lessons of successful entrepreneurship.
2. ***Provide mechanisms for mentoring and counseling***—Entrepreneurs can benefit from the processes of mentoring and counseling. Individuals who have successfully started businesses can provide both insight and lessons to others in ways that can help improve the confidence level of "entrepreneurs to be."
3. ***Establish a forum for exchange of ideas, concerns and provide peer support***—In order to bring together the resources represented by ideas, capital, role models, information and other inputs to the formula for entrepreneurship, new forums and mechanisms are needed. While there are pockets of public and private support to entrepreneurs, the region must take steps to formalize and institutionalize the entrepreneurial development mechanisms in the region. Informality of the process has caused potential entrepreneurs to leave the region, while others have persevered without formal infrastructure.

Even with the shortcomings noted above, the region has a unique foundation on which to build a strong entrepreneurial base. First, it has an excellent higher education and community college system. Second, it has access to world-class technology and R&D facilities for prototype and test-bed activities. Third, it has successful entrepreneurs who have demonstrated an understanding of the process. Fourth, it has a business climate and infrastructure supportive of

entrepreneurial activities. Finally, East Tennessee has growth opportunities in domestic and international markets. Yet these comparative advantages have not been woven together in ways that a strong supporting environment for entrepreneurs exists.

**Recommended Initiative: *Launch the East Tennessee Entrepreneurial Council***

East Tennessee immediately should launch the East Tennessee Entrepreneurial Council to serve as the forum for enhancing entrepreneurship in the region. The Council would provide the support and administrative infrastructure to encourage the development of new entrepreneurs, mentor existing entrepreneurs while these individuals build their companies, and counsel other institutions in the region—both public and private—in responding to the needs of an “Entrepreneurial Valley” concept.

The Entrepreneurial Council Initiative should move forward with the following steps:

1. ***Creation of a Steering Committee and programmatic committees***—The Council should seek to bring together all elements of existing regional entrepreneurial activities into an ongoing steering committee which governs and maintains the Council's agenda and programs. In turn, the Council should establish committees which provide a forum for mentoring and counseling, an environment for CEO peer review sessions, an agenda for monthly programs and sessions with regional and national entrepreneurial figures, and a method for linking cross-cutting regional assets and talents to improve constantly the Council's benefits to the Entrepreneurial Valley concept.
2. ***Organize roundtable discussions with regional leadership***—The Council could serve as the conduit for benchmarking the region's entrepreneurial environment by hosting a series of roundtable discussions among CEOs, community and political leadership, and emerging entrepreneurs.
3. ***Develop a 12-18 month educational program in entrepreneurship***—In cooperation with the higher education and 2-year college institutions, a concentrated educational curriculum should be developed to offer classes to undergraduate and graduate students on the principles of entrepreneurship, to provide real learning experiences and internships, and to access to the region's base of entrepreneurial talent as “hosts” for exposing ideas and talents within a corporate or public entity.
4. ***Examine the feasibility of a formal mechanism functioning as an SBA-like Business Information Center***—This could serve as the host entity of the Council and provide the services for entrepreneurs and those in transition from the public to the private arena. A BIC-like mechanism could be established in cooperation with LMES, DOE and the University of Tennessee.

**Sources of Leadership: *Who Drives the Initiative?***

***Overall leadership:*** The Entrepreneurial Valley Initiative, made up of the four elements above, should be first and foremost supported by the board of Tennessee's Resource Valley in alliance

with the region's existing entrepreneurial infrastructure (e.g., recognized entrepreneurs). The board should take the lead in pulling together the key sources of support for the concept.

**Other sources of leadership:** A working group from the 21st Century Jobs Initiative project already exists to analyze this Initiative as well as other similar initiatives from the Cluster Working Group sessions. Regional entrepreneurs and entrepreneurial advocates already have begun to examine the initiative's principals and sustaining mechanisms. Others that could be included in the leadership of the initiative are the Small Business Development Center, city and county offices, representatives of the UT School of Business, Pellissippi State Technical Community College, and the region's key chambers of commerce.

### **Launching the Initiative: Key Action Steps and Milestones**

1. Secure the commitment of one business leader to be the "champion" in the region and take responsibility for spearheading the initiative by forming and working with a TRV support team (ASAP).
2. Convene meeting of key individuals and organizations to form an Initiative Action Plan(s) focusing on each of the elements discussed above (meeting by November 1995, form Council by January 1996).
3. Develop a detailed Action Plan and Work Statement for each element of the initiative, including resource requirements, determination of "host" organization, roles and duties, and long-term, self-sustaining objectives.
4. Identify Steering Committee and key champions for each element.
5. Move the establishment and maintenance of the Council's activities forward commensurate with resource availability, institutional and community support, and ongoing measurement of impact. Early activities could include: benchmark and inventory of current programs, creation of a council tailored to needs of region, organize and institutionalize council activities, establish long-term project implementation in cooperation with regional assets.

### **Related Initiatives Developed by Cluster Working Groups**

In nearly all of the industry cluster working groups entrepreneurial activities were a priority, including the identification of entrepreneurial resources (management education and training) and capital (access to capital, capital funding mechanisms). Just as important, the concern about access to technology and commercialization of technology was considered by the working groups to be an ongoing concern for maintaining a stream of available opportunities for enterprise-building. The cluster working group business plans similar to this Flagship Initiative include the following:

#### ***Automotive/Transportation Cluster***

- Automotive Industry Information Clearinghouse (A-8)
- Database of Funding Sources for Early Stage Businesses (A-6)

*Technology Intensive Cluster*

- Environmental Technology Web Site and Information System (T-7)
- Health Technology Network (T-9)

### ***Flagship Initiative #3. Technology Startups Initiative: An Initiative to Establish the East Tennessee Capital Network***

#### **Key Components:**

- Establish a mechanism for teaching potential entrepreneurs how to write business and financial plans
- Establish a set of community investment criteria and communicate them widely throughout the region
- Establish a process of periodic forums to enhance the due diligence process
- Provide an efficient process of matching entrepreneurial opportunities with investor interests

#### **Critical Issue: *Access to Risk Capital***

Entrepreneurs and business leaders in East Tennessee have stated in nearly every project forum that the region has a capital shortage—that there are not the “right kinds of capital to make this region grow.” The issue of capital access is worth exploring because seldom do two individuals in need of capital define “capital” in the same terms. Is the region’s perceived shortfall in the area of start-up capital, working capital, inventory capital, R&D capital, or acquisition capital? All uses are different and come from different sources. From the discussions, it appears that the region has adequate sources of traditional capital, meaning capital lending based on collateralized assets, inventories, or cashflow. It also appears that there are adequate sources of public sector capital of the kind that supports economic activity through entities such as the U.S. Small Business Administration and the State of Tennessee’s economic development programs.

The issue of capital access relates mostly to early stage financing of research and development, product “proof of concept,” prototype and testing, initial marketing and promotion—the kinds of capital common to the entrepreneur at the start-up stage of an enterprise. Often, access to capital for these purposes is difficult to find unless the entrepreneur meets certain criteria in which a match is so evident that the investing community responds with little difficulty. From the East Tennessee entrepreneur’s point-of-view, access to capital takes far too long and eventual success is perhaps too problematic to even start the process.

From the project team’s analysis of the East Tennessee wealthbuilding community, there appears to be enough private investment and “business angel” resources to ensure a stable supply of entrepreneurial companies. What is missing is a process—a mechanism—that matches otherwise well-prepared entrepreneurs to sources of capital on the basis of investor criteria. While some individuals in the region desire to know the amount of available capital, this may be the wrong question. The correct inquiry should derive answers to the following questions: Which private investors and business angels are prepared to step forward to make more investments in regional opportunities? What are their criteria for such investment? What is the preparation required to meet those criteria? And, what is the process for identifying business opportunities and securing investment for those opportunities?

Other regions around the U.S. have relied on a variety of programs to encourage greater regional investment by private investors and business angels in early stage start-up ventures. From the well-known Ben Franklin fund in Pennsylvania to Michigan's Capital Access Program, states and communities have determined that riskier ventures are often overlooked by conservative investors in both the public and private sectors, and therefore sought to form public-private partnerships to fill the capital gap. Further analysis of the U.S. investment community found that in 1994 only 1,400 investments were made by venture capital firms for a total of \$3 billion, while in the same period over 100,000 investments were made by private investors and business angels for a total of \$30 billion. It is obvious that the investment culture has changed dramatically over the years and that early stage financing is more and more derived from individuals that are willing to take greater risks than from traditional venture capital firms.

In the past year, two significant efforts in this regard have emerged in East Tennessee. First, Lockheed Martin Energy Systems (LMES) has funded and supported the Innovation Venture Corporation to assist in launching entrepreneurial ventures founded on ORNL-based technologies. Second, a group of businessmen with past experiences in forming and managing entrepreneurial ventures have established several investment vehicles funded by regional wealthbuilders. These activities signal a change in the environment for East Tennessee capital formation. Yet, to meet the challenges the near term, the region must enhance its capital environment even further.

#### ***How Can the Region Respond? Develop New Mechanisms to Enhance the Investment Process***

Achieving the qualities of an advanced 21st Century economy requires bold new action in the area of capital formation and access. Steps are required in several areas including more information and communication about capital issues as they relate to entrepreneurial activity, enhancing the process for matching entrepreneurs and investors, and developing a formal process for efficient and confidential investment by regional wealthbuilders. Of course, nothing can replace a round of successful investments which brings more jobs and more wealth to the region. Such success must be recognized in and around the region for two reasons. First, successes will bring more regional investment capital to the process and second, these successes will communicate to a national audience the attractiveness of East Tennessee's investment opportunities. Regardless of whether the region has \$4 million or \$400 million in available capital (two figures that have been suggested by knowledgeable people as East Tennessee's local investor investment potential), increasing the "deal-flow" and the attraction of more entrepreneurial opportunities must be a high priority for the 21st Century Jobs Initiative.

The region should begin to take appropriate steps towards improving the capital formation and access process by addressing a set of issues and concerns raised by East Tennessee investors and financial service representatives.

1. ***Establish a forum for teaching potential entrepreneurs a method of writing clear, concise, and complete business and financial plans***—From recent graduates of the University of Tennessee to Oak Ridge National Laboratory scientists, skills are lacking for developing business and financial plans. Currently, the region has a plethora of consultants and other

advisors that provide advice and services of this kind for a fee. However, at the stage in which overhead and cost are a critical factor, such services are too costly for many fledgling entrepreneurs. Instead of paying for the service, they will attempt to find answers to their questions in inefficient ways, such as months of letter writing, telephone calls, etc. This is an inefficient process that can be vastly improved simply by providing a way for entrepreneurs to learn the principals of business plan development in a teaching/learning environment.

2. ***Establish a set of community investment criteria and communicate them widely throughout the region***—Common concerns among East Tennessee investors include ill-prepared business and financial plans, entrepreneurs' failure to understand the markets and/or the technology opportunities, lack of realistic expectations for generating an investment opportunity, and the need to bridge entrepreneurial ideas with the correct management talent to ensure success. For instance, many wealthbuilders in the region have recounted their experiences with ORNL scientists cum entrepreneurs in which the negotiations ended over the '100/20' issue - "where these intelligent individuals end up owning 100% of nothing rather than 20% of something". Therefore, in order for the regional wealthbuilding process to be more organized and formalized, a specific set of investment criteria must be set out such that entrepreneurs know at the start the investment community's prerequisites for deal-making.
3. ***Establish a process of periodic forums, organized around the region's industry clusters, to enhance the due diligence process***—East Tennessee's abundant technology base should foster greater investment opportunities and entrepreneurial expansion. However, like other regions of the U.S., lack of investor understanding on how to conduct "due diligence" on technologies is an important factor in resolving the capital gap issue. To overcome this problem, other communities have hosted periodic forums for private investors and business angels to learn the due diligence process on a variety of industry investments. These forums bring together service providers (regional accountants and lawyers, technologists and commercialization specialists, experienced venture and financial analysts) with investors and their counselors. East Tennessee should launch a similar kind of activity, perhaps by building off the Cluster Working Groups. Each working group could evolve from its membership a Cluster Consortia on New Investment Development as a way to enhance the process of getting access to non-traditional financing for business spin-offs or expansions.
4. ***Provide an efficient process of matching entrepreneurial opportunities with investor interests in such a way that venture capital firms, bankers, accountants, public sector officials, and private investors and business angels find a collaborative source for "deal-making"***—A number of attempts have been made in East Tennessee to match entrepreneurs with investors—some have been formal processes, others have been informal and episodic. Two concerns regarding this issue have been raised by investors and by entrepreneurs in focus groups and interviews. First, consultants providing matching services in return for a commission or retainer might not have the best interest in reaching a lasting deal. Second, if they fail to attract investors initially, sound business plans are rarely forwarded to investors with matching investment criteria. In other words, matching investors with business plans is a hit-and-miss situation. Currently, there are no neutral, third party organizations which have the experience and capability to guide the entrepreneur through a matching process without expecting a commission. Nor is there a clearinghouse where good business plans can be securely and confidentially shared between investment parties.

### **Recommended Initiative: *Establish the East Tennessee Capital Network***

East Tennessee should establish the East Tennessee Capital Network modeled, at least in part, on IC<sup>2</sup>'s Austin-based The Capital Network and other similar efforts used across the country. By providing a neutral, third party entity for matching capital needs and investment opportunities in an efficient, timely, and confidential manner, the Capital Network can become a driving force in the region for solving gaps in the capital flow process. With information on the current gaps in capital (e.g. the lack of venture capital, the lack of an efficient mechanism for matching needs and interests, and the lack of critical financial acumen for technology investments), the Capital Network can be a resource for both sides of the deal-flow equation.

#### **Sources of Leadership: *Who Drives the Initiative?***

- **Overall leadership:** The Capital Network Initiative should be supported by the Board of the Tennessee's Resource Valley and those individuals on the board who have expressed an interest in fostering greater regional investment opportunities.
- **Other sources of leadership:** A number of organizations around the region have played a role in the past and could be vital to the successful implementation of the Capital Network Initiative such as the Small Business Development Center at Pellissippi State College, the Venture Alliance, the Innovation Venture Corporation/LMES, the Venture Exchange Forum and various regional banking, financial, and accounting service providers.

#### **Launching the Initiative: *Key Action Steps and Milestones***

1. Secure the commitment of one business leader to be the "champion" in the region and take responsibility for spearheading the effort, working with a group of identified interests as a support team (ASAP)
2. Convene a meeting of key individuals and establish an Initiative Action Plan which builds upon prior discussions and an analysis on forms of wealthbuilding and capital formation at the regional level (meeting by end of 1995, Network formed by January 1996)
3. Develop a detailed Action Plan for organizing and implementing the Network, including resource requirements (both financial and human resources) in cooperation with *other sources of leadership* above. Use loaned graduate students and interns to the extent possible, senior community advisors and volunteers where necessary. Action Plan could include: Formation of an East Tennessee Capital Network Steering Committee, expanded research and analysis of regional capital formation issues, definition of necessary service base and activities, establishment of a self-sustainable organization, launching of network on pre-existing successful outcomes (by February 1996).
4. Identify a Regional Advisory Committee for the Initiative (as soon as practical)
5. Move the Network Initiative forward commensurate with resource availability, as well as institutional and community support.



## **Related Initiatives Developed by Cluster Working Groups**

Access to capital and assistance to entrepreneurs was a high priority of several of the Cluster Working Groups, especially the Business and Financial Services group. Each working group identified specific gaps in the region's economic infrastructure related to the lack of appropriate capital, the absence of greater local and regional wealthbuilding initiatives, and the failure to secure capital based on well-written business and financial plans. In the formation of an East Tennessee Capital Network, those individuals who expressed an interest in the initiative should be included in early discussions and planning. Cluster Working Group initiatives similar to this Flagship Initiative include the following:

### *Metals and Materials Cluster*

- Metals and Materials Financing Organization (M-1)

### *Automotive/Transportation Cluster*

- Database of Funding Sources for Early-Stage Businesses (A-6)

### *Business and Financial Services*

- East Tennessee Risk Capital Network (BS-2)

## ***Flagship Initiative #4. Market-driven Technology Development: Steps to Accelerate the Commercialization of Resource Valley Technologies***

### **Key Components**

- Establish a Resource Valley Technology Commercialization "Action Alliance"
- Establish a process of quarterly "Regional Roundtables on Innovation and Technology Partnerships"
- Establish a process for market analyses of existing technologies
- Establish a Knoxville Riverfront "Resource Valley Technologies Pavilion"
- Establish a region-wide "virtual" Innovation Center

### **Critical Issue: *Achieving More Local Economic Impact From Homegrown Technology***

For more than fifty years East Tennessee has played a critical role in America's national security interests, establishing itself in the process as a key element of the country's long-term science and technology capacity. The billions of dollars invested in both physical plant and intellectual property in Oak Ridge is a unique resource for the region, the nation, and the world. Oak Ridge National Laboratory's role and mission in national security has produced not only viable research and development of products for meeting the challenges of the Cold War, but has encouraged collaboration across core competencies and technological disciplines. Today, those roles and missions are changing in light of the transition from Cold War to Cold Peace, by budget actions of the new majority in Congress, and by the Clinton Administration's plans for reinventing government.

The changing course of DOE's laboratory mission, coupled with the encouraging signs of regional transition towards a more market-driven economy, provides a unique opportunity for East Tennessee to become a national model of entrepreneurial technology commercialization. ORNL and its regional R&D markets—namely the University of Tennessee and local industry—offer new potential for collaboration and integrated partnerships.

In the past, CRADAs (cooperative research and development agreements) and SBIRs (small business innovation research grants) have served as key links between ORNL and local industry. While these arrangements have provided access to the intellectual and core competencies of East Tennessee's technological base, some individuals with experience in the process argue that before CRADAs and SBIRs the process was simpler and more efficient. Once the concepts of risk assessment and risk minimization were introduced, the process became more bureaucratic and less entrepreneurial.

Successful technology commercialization in the region in the future may demand more innovative approaches, especially new ways of linking local industry directly to the sources of technology. For example, innovative approaches to utilizing facilities and industry partnerships in new ways will become more critical as facility reuse strategies are developed at the community and Washington D.C. headquarters levels. The region could become a national model for broadening the entire discussion of commercialization through facilities reuse (e.g., using K-25 facilities for

industrial testbeds and private sector incubation as a way of developing the region's environmental industry). Unique opportunities also exist for melding public and private interests into local technology consortia which foster vital links with industry and small business.

The East Tennessee commercialization process as it exists today is problematic for several reasons: First, a region's efforts to commercialize technologies depends, in part, on the process of local incubation which can directly impact long-term entrepreneurial endeavors. Rather than having an array of traditional and non-traditional incubation initiatives underway, East Tennessee has few such initiatives today. Incubation of technologies requires focus and professional support, allowing the technological and managerial talent to not only achieve technological breakthroughs but commercial breakthroughs as well. Incubation is necessary to ensure that technologies with a potential commercialization value can build a business foundation while simultaneously improving the core technological competency of the idea. In East Tennessee, much of this process has been done informally or through the myriad of consultants. The region must follow the example of other technology-based communities and put more emphasis on formalizing the technology incubation process.

Second, the technology transfer or commercialization process is fraught with hurdles, not the least of which is overcoming cultural barriers to commercialization success. This is true for not only East Tennessee but for all communities seeking to enhance their commercialization process. The legal, fiduciary, and administrative challenges are significant for moving research and technologies out of the public sector environment (a government laboratory or university) to either a public-private entity or a fully private, commercial entity.

Questions of ownership through intellectual property concerns, questions regarding fair market value and return on investment for public and private sector participants, and questions on the role of risk management for taxpayer-supported programs, have plagued the commercialization process across the U.S. for years. Additionally, introducing the idea of commercialization into a research facility that has had a higher mission, such as national security, can raise conflicts for a scientist who chose the public sector over the private sector for various reasons. These issues raise a key question: what are the incentives to overcome these hurdles so that both sides of the commercialization process derive benefits?

Third, even with a strong incubation and a supportive commercialization culture, technologies must stand the test of the market and have appropriate management and financial infrastructure. This raises the question of whether there is an entrepreneurial capacity to expand the commercialization process in the region. As discussed in previous initiatives, the issues of entrepreneurship are linked to the question of how to increase the number of commercially viable technologies resulting from ORNL and UT research. Because the existing hurdles for breaking through the maze of technology transfer at these two institutions are complex (and different for each), such entrepreneurship requires specialized knowledge and management talent. Training in these areas is non-existent in East Tennessee.

Finally, while the region may have produced a plethora of commercialization opportunities, minimal market analysis has been conducted on the technologies, thus there is little information

Through this process, the Action Alliance should strive to establish "Consortia for Technology Commercialization" for each cluster. These cluster consortia would provide the lines of communication linking key representatives at the Laboratory and at the University with key representatives of industry.

Another specific objective of the Action Alliance would be to assist LMES in implementing its proposed Entrepreneurial Leave Program. The program seeks to enhance regional technology commercialization through state-of-the art incentives enabling individuals to take leave from under the Federal umbrella, start or join companies to develop new products and, if they choose, go back under the umbrella within two years. The Action Alliance could help LMES by representing the community side of the "leave process" (e.g., help identify opportunities for interested LMES employees). The Entrepreneurial Leave program is an excellent example of using incentives to encourage individuals to participate in the technology commercialization process. This LMES initiative (due to be implemented in October 1995) should be widely advertised throughout the Oak Ridge complex. Its outcomes should be evaluated as soon as possible and expanded, as suggested by the evaluation, by strengthening the incentives.

2. ***Establish a process of quarterly "regional roundtables on innovation and technology partnerships."*** Implemented through the Action Alliance, these forums would bring together the chief research officers of the Oak Ridge National Laboratory, the University of Tennessee, and leaders of Lockheed Martin Energy Systems with industry leaders and entrepreneurs to discuss and support research plans for the future as well as the current base of research and development programs impacting the commercialization process. The roundtables could serve as the forum for analyzing and implementing innovative forms of public-private partnerships.

Additionally, the roundtables could serve as a forum for identifying issues which require regional legal, financial, accounting, and managerial talent, thereby making the commercialization process inclusive of such critical know-how as well as fostering new career opportunities in the areas of intellectual law, finance and capital, accounting, and business and entrepreneurial management. Over time, such business and financial services would provide the basis for expanded regional and national expertise that could pay off in both new business opportunities for firms in the region and by positioning East Tennessee as a good place to do business in these fields, thereby attracting talent to the region.

3. ***Analyze the markets for existing technologies.*** Technology market analysis is currently missing from the commercialization process in East Tennessee. This omission contributes to the criticism by investors and the business community that there is a "disconnect" between the scientific/research arena and the realities of a market-driven economy. A market analysis process, supported by the University and others, could result in a win-win situation. The market assessment process would provide opportunities for students to learn and conduct analysis, enable business leaders to identify greater market access for East Tennessee technologies, and help investors to recognize the immediate markets for technology investments.
4. ***Establish a Knoxville Riverfront "Resource Valley Technologies Pavilion"*** to showcase the best of East Tennessee's technologies and commercialization successes from Oak Ridge, the University of Tennessee and other sources of technology in the area. As the riverfront development moves forward, such a pavilion would add a tourism focus as well as an

be comprised of individuals having expertise in the commercialization process (e.g., successful entrepreneurs, officials of the laboratories). The Action Alliance's primary mission should be to advance the goals of technology commercialization by institutionalizing past successful experiences through the development and implementation of new strategies and tactics. The Action Alliance will provide both a forum for discussing issues and for leading the implementation of new approaches. In doing so, the Alliance will provide focus and continuity to the commercialization process.

Although the priority issues for early attention could change as the organizational shifts now underway at the Oak Ridge complex play out, several issues and potential projects seem ready for immediate discussion:

1. *Opportunities for Privatization*—As the debate about the future of DOE's facilities has evolved, the issue of privatizing parts of the complex is receiving greater attention. This report has concluded that much more needs to be done to diffuse Oak Ridge technologies into the economy. Decoupling parts of the complex from strict government control (e.g., of user groups at Y-12, facilities at K-25), turning them into non-profit applied R&D centers uniquely linked to the region's clusters (as well as to national clusters such as the automotive cluster), would be a bold step. Depending on how the entities were structured, doing so would improve the linkages between local sources of technology supply and private sector demand. Doing so would also no doubt be difficult, and perhaps impossible. At a minimum, the idea should be discussed at high levels in the community at a forum convened by the Action Alliance.
2. *Expanding the Innovation Venture Corporation (IVC)*—This initiative, recently launched by LMES, may well prove to be an excellent mechanism for commercializing Oak Ridge technologies. If evaluated as such by the region's private sector leaders, it may be possible to expand the concept. For example, IVC might take the lead in preparing market assessments a wide spectrum of available Oak Ridge technologies. Moving in another direction, IVC might become more of a technology broker than is the case now. By pro-actively searching out local businesses or entrepreneurs, IVC could become a primary intermediary, linking Oak Ridge to the region's clusters. The key, from an LMES perspective, is clear evidence of demand for the role on the part of the region's private sector. The Action Alliance could provide the forum for developing, and communicating this demand to LMES.
3. *More LMES Community Outreach*—Potentially, LMES could play a much larger role in the economy by just being better connected to it. The Action Alliance could help develop a constituency within the private sector for an array of new outreach initiatives (e.g., an annual "Inventions Fair," to showcase commercialization opportunities). Again, a clear sign of market demand developed by the Alliance could serve as the force to motivate LMES toward these ends.

Other activities of the Action Alliance could be to serve as a force for continuing the dialogue between the 21st Century Jobs Initiative Cluster Working Groups and the technology transfer functions of the Oak Ridge complex. Building on the success of this dialogue, the Action Alliance would advance the strategies jointly agreed upon by LMES cluster representatives (recommended as a part of this initiative) and members of the respective industry clusters.

available on potential downstream products and services. If commercialization is to be successful, greater understanding is required of market realities, including competing technologies and global growth trends.

**How Can the Region Respond? *Build New Bridges Between the Sources of Technology and the Local Economy***

The region's response will require a collaborative effort by the Department of Energy (DOE), Lockheed Martin Energy Systems (LMES), University of Tennessee technology officials, industry and entrepreneurial leaders, as well as the individual scientists, researchers and technologists of East Tennessee. The concerns requiring attention include the following: overcoming the strong perception that technology transfer and commercialization simply is not working in the region (i.e., there are good examples); implementing steps to connect key users of technology (clusters) with key technology providers; implementing steps to develop across the region's R&D institutions a cross-cutting and systematic approach to the commercialization process; reducing barriers to technology access; communicating regional success stories; and developing appropriate mentoring and entrepreneurial assistance to individuals eager for success in the commercialization process.

As East Tennessee makes the transition to a more entrepreneurial, technology intensive economy, there may be a need to rely on strategic alliances and supplier-chain activities. Over the next several years, East Tennessee will need to develop the means to link to international alliances for R&D, for product development and for production. The region's technology resources will prove to be a powerful tool for forging these alliances.

Another factor that could lead to improved East Tennessee commercialization might be found in a broader facility reuse strategy. For example, more innovative uses could be established for Y-12 (e.g., as a teaching factory) and K-25 (e.g., as a technology incubator-type test-bed for enterprises advancing their environmental technologies).

**Recommended Initiative: *Launch the Resource Valley Technology Commercialization Initiative***

A broadly based, regional initiative should be launched to accelerate the commercialization of homegrown technologies. The problem of "disconnects" between companies and the sources of technology (Oak Ridge, the University) have been identified by the Cluster Working Groups, in survey results, as well as in interviews and focus groups. There are too many disincentives facing local firms and individuals to participate in the "pull side" of the technology commercialization process and too few incentives to participate in the "push side" (e.g., incentives to move technology and people out of the lab and into the economy). A comprehensive, holistic approach is needed to improve the process, one that includes industry leaders, entrepreneurs, scientists and researchers. This initiative should have several elements.

1. ***Establish a Resource Valley Technology Commercialization Action Alliance as a focal point in the region for achieving commercialization advances.*** The Action Alliance should

education and training facility for linking the region's technology assets with visitors and residents. In addition, with the technological capacity of Technology 2020, such a pavilion could be an information source, providing access to research, analysis and entrepreneurial activities in and around the Oak Ridge National Lab and the University. The pavilion should be staffed by informed individuals who can actively assist interested visitors by providing information and helping them establish contact with LMES and the University of Tennessee.

5. ***Establish a region-wide "virtual" innovation center***—that serves as a mechanism for linking the East Tennessee Capital Network, the East Tennessee Entrepreneurs' Council and related resources to ensure that the mentoring, analysis, licensing, and similar advisory activities are in place and working to support the innovation process in the region. While there are many models to follow, the Center could be staffed by loaned executives from the private sector, the University's departments of research/ engineering/business, and from the Oak Ridge complex. The Center's primary mission would include bringing together consultants and service providers with individuals seeking a process that meets the "market test," business and financial planning objectives, and management strategies required of regional and national investment interests.

Building on the existing endeavors and future strategies of Y-12 (the Centers for Manufacturing Technologies) and K-25 (the Environmental Testbed concept), such a virtual innovation center approach seeks to catalyze opportunities for commercialization in a real-world "laboratory" setting.

#### **Sources of Leadership: Who Drives the Initiative?**

- ***Overall source of leadership:*** As with the other Flagship Initiatives, the Board of Tennessee's Resource Valley must take the lead in this area, not in an operational sense but by helping the region's institutions come together and realize the benefits of enhanced technology commercialization—high quality jobs and more economic wealth for the region overall.
- ***Other sources of leadership:*** LMES Office of Technology Transfer, the University of Tennessee Office of Research Administration (along with the Department of Engineering and School of Planning), TCRD, Oak Ridge Chamber of Commerce, others.

#### **Launching the Initiative: Key Action Steps and Milestones**

1. Secure the commitment of one business leader to be the "champion" in the region and take the responsibility for spearheading the effort working with interested parties and existing organizations (ASAP).
2. Convene meeting of key individuals and establish the recommended Action Alliance, including the recommended Cluster Consortia ( meeting by end of 1995, Consortia formed by February, 1995).
3. Develop a detailed Action Plan for each element of the initiative, including resource requirements. Identify possible use of loaned graduate students and executive personnel to support planning activities as well as implementation of market analysis and assessment studies.

4. Identify a champion for each element of the Initiative (by end of 1995).
5. Move each element of the Initiative forward commensurate with resource availability, as well as institutional and community support.

#### **Related Initiatives Developed by Cluster Working Groups**

Each of the Cluster Working Groups expressed concern and, in some cases frustration, about accessing information from the knowledge base of the Oak Ridge National Laboratory and the University of Tennessee. In recent weeks, Lockheed Martin Energy Systems has taken steps to bring together cluster working groups, ORNL, and its corresponding technology applications. These new lines of communications and cooperation should be enhanced further through the Initiative. Similar initiatives developed by the Cluster Working Groups are as follows:

##### *Forest Products Cluster*

- Forest Product Industry Technology Consortia (F-3)



## ***Flagship Initiative #5. Resource Valley Connections: Actions to Move People, Goods and Information in the Valley and Beyond***

### **Key Components**

- State-of-the-Art Communications Systems Linking the Region
- Comprehensive transportation planning and a regional "Ring Highway" system
- Airport Development Linked Explicitly to Economic Development Objectives
- A Regional Transportation Research Center

### **Critical Issue: *Challenges to the Region's Transportation Infrastructure***

Several new economic realities are having profound effects on the ability of regions throughout the country to compete. Imperatives such as "just-in-time" delivery of components, business efficiency through consolidation of operations, and the increasing need for rapid access to markets are all trends that put new pressures on the physical infrastructure of a region. While necessary, it is no longer sufficient to simply have ready access to the Interstate Highway System, an airport, or the telephone system. Today, regional road and highway systems must move people from more remote areas where they may have lived for generations to the source of employment, generally a region's urban area. Goods must move quickly to the railheads and interstate systems that connect regional economies to distant markets. Today's "just-in-time" world of commerce requires airports to offer advanced cargo handling services, not just passenger services. Business travelers seek efficient air travel with as few layovers as possible. Where there is a delay, air terminals with specialized business support centers offer more benefits to travelers. Information access, whether by wire or "wireless," is critical since the information era is now a daily reality for businesses.

In its efforts to become an advanced 21st Century economy, East Tennessee's Resource Valley will be pressed to develop transportation systems to move people, goods and information through the region and around the world. The 15-county area once was far more economically disconnected than it is today. Now it increasingly works together as one economy. There is one regional airport, for example, that move residents from throughout the region to more distant destinations and brings in business people and tourists. The urban area, especially downtown Knoxville, is no longer an economy of its own. Instead, it is quickly becoming a regional center for business services, restaurants and entertainment for the entire area. And from strictly an employment perspective, the five counties immediately around Knoxville account for most of the employment for residents of the 15- county area who prefer the rural lifestyle but are forced by economic reality to travel long distances to jobs in urban areas.

There are several specific problems. One is that although advanced fiber optic and wireless communications services are available, at least in the urban areas, the demand for these services is both growing and changing. In this context, keeping up with increasingly specialized demands by providing new applications is difficult. Another problem is that the road and highway system in East Tennessee was built for an earlier economy. It is difficult for residents to get from rural areas to the sources of employment. Businesses growing in rural areas find it difficult to get their goods

into the region's urban transportation and distribution hubs. Travelers to the Great Smokies and other destinations find access routes congested during peak periods. Airport services and flights may be fine for today, but the trends would suggest that both new flights and new facilities are required in the future.

While the infrastructure of this kind may not be pressed to its limits today, demands are growing and the lead time for building transportation systems is long. For East Tennessee to achieve an advanced 21st Century economy over the next few years, long range infrastructure planning is necessary. In the near term, some initiatives need to be launched to quickly improve the ability of the region's infrastructure to connect people, goods and information to markets.

### **How Can the Region Respond? *Comprehensive Strategic Planning for Advanced Systems and Facilities***

East Tennessee must launch today the transportation-related strategic planning processes and action initiatives that will result in specific infrastructure needed to support the kind of dynamic, technologically advanced economy envisioned for tomorrow. Regionwide access to new kinds of telecommunications infrastructure will be increasingly important for economic growth. Planning for these investments must be accelerated and projects launched to develop the communications systems. And because highway infrastructure is expensive, and because needs are changing, strategic planning of new investments is required. For example, if East Tennessee's future economy is to be driven by more technology-intensive manufacturing and tourism/leisure (as is likely), priorities for transportation infrastructure might be higher for major access roads to Oak Ridge and to tourist destinations than is the current case. If workforce issues for these industries, such as access to the unemployed in rural areas, is critical (as is the case), higher priority should be given to roads and transportation systems linking remote areas to future sources of employment. If air freight is increasingly the mode of choice of just-in-time suppliers and business people spend more time in airports, higher priority might be given to specialized airport facilities.

The point is that future planning, whether in the public or private sector, needs to be comprehensive and oriented to expected changes in the fundamental nature of the economy. East Tennessee must take steps today to shape and prepare for the economy of tomorrow. Advanced transportation systems, both the facilities and services as well as the R&D needed to keep abreast of advances, will be a key to economic success in the next few decades.

### **Recommended Initiative: *Comprehensive Planning and Actions to Build an Advanced Transportation System in the Region***

By taking steps to plan and build an advanced transportation system (information, people and goods) in the region, East Tennessee will be positioning itself for a new kind of economy and new levels of economic prosperity in the future. An advanced transportation system will help existing businesses grow, will stimulate the relocation of businesses from the outside whose future depends on transportation and information, and can be the basis for new business start-ups. Economic rewards will come in the form of more prosperous businesses, new jobs and economic wealth for the region if, over the next 2-3 years, the following steps are taken:

***Build a state-of-the-art communications system to link the region electronically***—For East Tennessee to emerge as one of the country's premier centers of technology and information it will need to build a premier telecommunications system. Fortunately, many of the pieces are in place. Telephone companies are making significant investments in advanced infrastructure including fiber optic lines and, to a lesser extent, advanced switching equipment. The University of Tennessee, with local government has recently implemented K-NET, an Internet-based information system serving the urban area. Finally, a regional information technology resource has emerged in the past few months that can drive further development of the region's telecommunication systems. Technology 2020, headquartered in a state-of-the-art facility, is a regional resource for public and private leaders seeking access to information, technology and other kinds of assistance related to telecommunications. The first element of the initiative envisions Technology 2020, in partnership with the University, spearheading efforts to develop an advanced communications systems network in East Tennessee. There are at least two specific areas needing attention:

- *Expand K-NET* throughout the 15-county region to enable the Internet to be used for communication and information exchange between institutions (e.g., colleges and universities) and individuals. As soon as practical, K-NET should become known as Resource Valley Net, *the Information Superhighway* for all of East Tennessee.
- *Implement toll free dialing* throughout the 15-county area (8 counties now enjoy toll-free dialing). This relatively easy step would both symbolically and practically unite the region.

In this area, leaders should rely heavily on Technology 2020 as a market-driven mechanism for advancing a wide range of high speed, high band width, fiber optic and wireless communications-related initiatives. Technology 2020's principal mission should be to implement vastly superior information technologies and far more widespread use of them in organizations and in homes than is the case today. In order to realize its mission, Technology 2020 should seek a range of partnerships with key institutions in the region and take steps to link directly to the private sector through the establishment of partnerships with the Cluster Working Groups that have emerged in this project (e.g., help establish cluster consortia to ensure that telecommunications advances meet the actual needs of firms in the region).

- ***Take steps to complete a regional "ring highway" system***—Some pieces of a ring system (not a circle, but a radius of roads 20-30 miles outside Knoxville and connections to the ring system) are already in place. Now a consensus must be reached among Federal and state agencies and relevant counties for projects, quadrant-by-quadrant, to realize the ring system concept (the concept of "goal coupling" can help drive consensus). To achieve the full economic benefits of the concept, comprehensive planning must also take into account the physical development of centers of economic activity that could be built around the "ring." Cluster concepts, because they are based on geographic concentration of similar kinds of economic activity, should be considered in the planning processes. A specific element of the initiative that has emerged in discussions among regional business leaders is the need to extend the Foothills Parkway through Cocke County and beyond in order to provide improved access to the airport.

- ***Airport Development Linked Explicitly to Economic Development Objectives***—McGhee Tyson Airport is a key element of the region's physical infrastructure. Aside from providing needed services, the airport unites East Tennessee. It is the only full service airport in the 15 county area. In addition to its services and utility as a unifying force for the economy, it is a strong asset for economic development. As the Airport Authority moves forward with expansion plans, economic development and job creation potential should drive consideration of (and priorities for) specific airport projects. For example, expansion of the terminal should include state-of-the-art conference facilities and other business services. Existing buildings at the airport could find a higher and better use. One airport building now used for other purposes could be reused as an "economic development showcase" where business relocation prospects are met and the region's strengths are displayed. Finally, although market demand is the driving force for decisions about adding new flights, targeted efforts to attract more direct flights to key business centers are needed.
- ***Accelerate Actions to Establish a Regional Transportation Research Center***—Early efforts by University, Knox County and Lockheed Martin Energy Systems officials have identified the potential for establishing a market-driven, public-private regional research center that focuses on transportation technologies. More than \$100 million is currently budgeted for transportation-related research in the area, but the research is spread throughout the region. A demand-oriented transportation research institute (i.e., having strong private sector leadership) could be a way of ensuring both research synergy and focus on practical applications of the research in the region. More effort is needed, especially from the private sector, to explore the feasibility of creating this center.

#### **Sources of Leadership: *Who Drives the Initiative?***

- ***Overall leadership:*** This initiative can be driven toward implementation by the Board of Directors of Tennessee's Resource Valley, working in partnership with other private and public sector organizations.
- ***Other sources of leadership:*** For *telecommunications* development—University of Tennessee, TVA, Technology 2020, local/national telephone service providers, chambers of commerce. For *"ring highway" system*—Tennessee Department of Transportation (TDOT), counties, cities, chambers of commerce. For *airport development*—Metropolitan Knoxville Airport Authority, chambers of commerce. For *transportation research center*—University of Tennessee, DOE, LMES, Knox County.

#### **Launching the Initiative: Key Action Steps and Milestones**

1. Secure the commitment of one business leader to be the "champion" in the region and take responsibility for spearheading the overall effort working with a small TRV support team. (ASAP)
2. Convene meetings of key individuals and establish Initiative Action Partnerships (working agreements), one for each of the Initiative elements above (meetings by end of 1995, partnerships by March 1996).

3. Develop a detailed Action Plan for each element including resource requirements. Use loaned executives to extent possible and consultants where necessary (TRV should facilitate but not lead each element).
4. Identify a champion for each element of the initiative (by end of the year).
5. Move each element of the initiative forward commensurate with resource availability, as well as institutional and community support.

### **Related Initiatives Developed by Cluster Working Groups**

Access to information of specific kinds was a high priority for several of the Cluster Working Groups and a number of initiatives designed to meet specific cluster needs have been developed. Some of these initiatives may fall within the broad parameters of this Flagship Initiative. Where this is the case, the cluster-specific initiatives could be implemented through a coordinated effort (e.g., the approach outlined above could be modified so that the activities directly address the needs of specific clusters). Below are the Cluster Working Group initiatives that are similar to this Flagship Initiative.

#### *Automotive/Transportation Cluster*

- Automotive Industry Information Clearinghouse (A-8)

#### *Technology Intensive Cluster*

- Environmental Technology Web Site and Information System (T-7)
- Information Technology: A Regional Broadband Infrastructure (T-2)
- Health Technology Network (T-9)

## **Flagship Initiative #6. Market the Region: Promote the Next Generation East Tennessee Economy**

### **Key Components**

- Develop New Marketing Themes
- Develop Approaches to Fund the Campaign
- Implement Cluster-Based Approach to Economic Development Regionwide

### **Critical Issue: *Communicating an Image of an Advanced 21st Century Economy***

The image of a place is important to its residents as well as to outsiders. Image, as much as reality, tends to define a region. People's perceptions about a region shape their decisions about whether to visit, to seek business opportunities or to relocate. Image development, shaped by marketing and promotion, has been and still is a key part of the economic development formula used by leaders around the world.

Promoting a positive image of East Tennessee has been a high priority for economic development professionals for several reasons. First, East Tennessee (especially Oak Ridge) still is viewed as the "birthplace of the atomic bomb." Undoubtedly, the uninformed outsider's image of East Tennessee has been shaped by the weapons-related work in Oak Ridge. Yet this attribute of the economy is no longer the defining one it once was. Secondly, East Tennessee has unique features which clearly define the region (e.g., strong applied research and technology base, Great Smoky mountains). These features, with creative and ambitious marketing, can positively differentiate the region from others. By weaving together these defining features of the region, East Tennessee can establish its image as an advanced, technologically 21st Century economy supported by a unique lifestyle.

The 21st Century Jobs Initiative has provided the opportunity to revamp the region's marketing and promotional efforts. This report has set forth a vision of an exciting new economy and recommendations for action. The project also has energized key leaders and changed the course of the region's approach to economic development. New themes and approaches can be implemented to achieve both the image and the reality of an economy "on the move."

### **How Can the Region Respond? *New Themes and New Approaches***

Image marketing and promotion, in the context of a changing economy, will be an important tool for East Tennessee's economic development. Successful marketing will draw positive attention to the region and can encourage businesses to relocate in the region. Moreover, promotion can be a tool to encourage existing businesses to remain in the area by developing and implementing initiatives ensuring a positive business climate.

A new economic vision, as well as new ways of developing the economy as set forth in this document, call for new marketing themes and new approaches to promoting East Tennessee.

## New Marketing Theme

East Tennessee should transition its marketing themes from today's general message (e.g., Mountains of Opportunity) to themes driven by the two most important competitive advantages present in the area, technology and tourism and leisure (defined as much by lifestyle as by destination attractions). Why tourism and leisure (i.e., lifestyle)? Because tourism is the largest and fastest growing industry in the country as it is in East Tennessee. Moreover, a new kind of economic logic is emerging which argues that economic growth driven by knowledge and technology can be accelerated when linked to physical attributes like mountains, streams, clean air and water, and pedestrian-friendly cities. Simply put, economic synergy occurs when technology and high quality of life are present in a region. Consider so-called "hi-tech regions" like San Francisco (Silicon Valley), Austin, Colorado Springs, Seattle, Portland, San Diego and Salt Lake City. One common strength of these cities is a unique lifestyle built around physical beauty, recreation and leisure-time attractions, and a "high quality of life."

To further make the case consider the following. The term "gold collar worker" has been used to distinguish knowledge workers from physical workers. Today's economy is undergoing a rapid shift from physical labor to knowledge-based labor. Because of higher levels of education and more life experiences (e.g., through travel), knowledge-based workers often are individuals who have a strong love for and appreciation of the natural environment. They prefer to live in places offering a high quality of life. And today, advanced communications technologies allow knowledge-based workers to *live where they choose*. Region's having a unique lifestyle and a high quality of life will surely accrue the economic benefits of talented people moving to the region for the linked activities of work and leisure.

Linking the region's technology base to the presence of physical attributes that are driving tourism growth into a unified marketing theme can pay large dividends. As the competition for knowledge workers increases, the presence of bright people will become more important than a low cost business environment. Promotional efforts combining the technology (i.e., knowledge sources) and tourism (lifestyle and quality) aspects of East Tennessee can bring talented people, investment, technology-intensive firms and other elements of an advanced 21st Century economy to the region.

## New Approaches to Economic Development

Today, industrial recruiting is the primary strategy employed by economic development organizations. Tactics typically include broad-based advertising, promotion of the region at trade shows, follow-ups with industrial prospects by mail or telephone and eventually personal visits. While success stories abound, success is difficult to achieve when every region is using the same strategy. Rich incentives in the form of tax breaks and public spending are used to attract firms where economic logic fails. Such incentives usually result in a zero-sum situation that decreases public spending that might otherwise be available for education and worker skill development.

East Tennessee, through Tennessee's Resource Valley and other organizations, has successfully followed this strategy and these tactics (without offering wholesale tax incentives) for several

years. However, the region can expand its strategies beyond broad-based industrial recruiting. *And the essence of strategy is focus.* In pursuing firms and investment, some markets will prove better than others. These will be the markets where firms seek the specific competitive advantages of East Tennessee. For example, this project has made the point that international markets offer many opportunities for foreign investment and strategic alliances linking foreign and local firms for strength in rapidly developing international supplier networks.

East Tennessee's marketing and promotional efforts should target selected domestic and international markets and seek not only new manufacturing plants but new strategic alliances which can make existing businesses more competitive. Rather than taking "shotgun" approaches and trying to attract any investment, new marketing approaches should be more strategic and employ tactics to attract "cluster firms" that will complement the existing clusters. Firms which learn about the general character of East Tennessee and supply gaps in economic clusters may find the region to be a more suitable home for their business.

**Recommended Initiative: *Enhance the Region's Marketing Themes and Launch New Approaches to Economic Development***

A theme that builds on the successful "mountains of opportunity" message and captures the synergy inherent in the region's technology and tourism/lifestyle strengths would positively distinguish East Tennessee from competing regions. This theme can work to attract talented people, technology-intensive business investment and higher quality new jobs. Moreover, linking the process and outcomes of the 21st Century Jobs Initiative to the new marketing and promotion approach lets prospects know the region has a vision and is working hard to achieve a new kind of economy.

This theme should be supported by a limited number of sharply focused "tactics". Selected international visits, focusing on both securing new foreign investment as well as developing firm-specific strategic alliances would be a new approach. So too would cluster-based industrial recruiting that aimed primarily to fill the region's supply gaps. Finally, efforts to promote the region "within the region" would begin to communicate to existing businesses that East Tennessee's leaders are working hard to make the business environment strong enough to support expansion as well as new business formation.

The initiative should have several elements:

1. ***Develop new marketing themes***—The technology/tourism theme should have at least two components. First, the message must make the point that the region has for more than 50 years been richly endowed with technology. Knowledge and innovation have long been at the core of the business culture of the Resource Valley. More than 15,000 scientists, engineers and technicians work at the Oak Ridge complex alone and thousands more work at the University, TVA and in the hundreds of technology-intensive companies in the region. This part of the theme must communicate the fact that East Tennessee is one of the country's leading centers of advanced technology. Second, the message must communicate that East Tennessee has a history of diffusing technology into the economy—through technology



transfer processes and successful commercialization—which is expected to be even more successful through the implementation of the 21st Century Jobs Initiative. Finally, no message is stronger than real life examples of technology transfer at work (i.e., mini case studies of success stories).

The tourism/leisure-time part of the theme must make several points as well. First, East Tennessee is richly endowed with mountains, lakes, streams, clear air and water, and livable cities—the basics that contribute to a high quality of life and make for a superior visit. Beyond the basics, the message should communicate the many attractions of the area, beginning with the Great Smoky Mountains National Park. Few outsiders realize that East Tennessee is the primary gateway to the park. In addition, the complete inventory of man-made attractions in the region must be highlighted—attractions to suit every traveler's tastes, from Dollywood and outlet shopping in Sevier County to the zoo and museums of the urban areas). Perhaps most important is the fact that these attractions eventually be linked in ways that build a critical mass of tourism amenities that help make East Tennessee a true "destination." In other words, East Tennessee should be promoted as a place where one can visit a zoo, museum or riverfront attraction, backpack in the mountains, shop at outlet malls, and enjoy the amusements of Dollywood all during one extended visit. Clearly, an important key for attracting visitors for longer stays lies in taking steps to integrate the tourism/leisure attributes of the *entire* region into packages of attractions with promotional mechanisms.

Integrating the two themes, technology and lifestyle, into one will be critical if the complementarity of the combination of both aspects of the region is to be communicated effectively. The combined attributes of technology and tourism give East Tennessee a competitive advantage. East Tennessee is the only region in the country where one can drive from a national laboratory to a national park on 4-lane roads in less than 2 hours. From an economic development perspective, by promoting these strengths—technology and tourism—East Tennessee will be positioning itself as a unique region, one where not only visitors will find interesting attractions but gold collar workers, entrepreneurs, investors and others will find an environment unusually supportive of business success and high quality living.

2. ***Funding the Campaign***—Raising money for a broad-based image campaign could be difficult. Already Tennessee's Resource Valley has a budget of nearly \$300,000. TRV's programs currently do not include tourism promotion. Funding a larger, more ambitious program could require three or four times as much investment. Some of the additional funds needed will come from today's sources, local businesses which realize that a larger investment will pay higher economic development dividends. New sources of funding will be found within the tourism industry where no unified promotional campaign exists. A significant source of new funds can be found at the headquarters of firms that operate branches in East Tennessee. To date, little effort has been made to approach the headquarters of banks operating local branches or to corporate headquarters outside the area operating local manufacturing plants. A major effort is necessary to reach beyond the Resource Valley for contributions through a broader-based marketing and promotional campaign.
3. ***Implementing New Approaches to Economic Development***—The universe of companies to attract to the area is vast. Thousands of companies might be thinking about relocation at any given moment. At a time of scarce resources, economic development professionals in East Tennessee will need to sharply focus their marketing efforts on those markets where there is

reason to believe companies and investors will have sound economic reasons to invest in the area.

Cluster-based economic development can be a tool for focusing attraction efforts on companies that would find the region a good place to do business. The 21st Century Jobs Initiative has identified eight existing or emerging clusters. Gaps in the supply chain for the manufacturing clusters also have been identified. Now is the time for the economic development organizations in the region to transition from traditional "shotgun" approaches to economic development toward a much more focused, cluster-based approach.

This initiative should start the process of educating economic development professionals—those working in chambers of commerce, in development corporations, in local government, at large institutions like TVA and LMES/ORCMT—on the cluster concept of economic development (e.g., specialized training, technical assistance, loan programs). Seminars and workshops can begin the process of bringing more coordination to regional economic development efforts.

#### **Sources of Leadership: *Who Drives the Initiative?***

- **Overall leadership:** This Initiative can be moved ahead by TRV's Board of Directors. TRV must work with other organizations in partnerships to achieve the objectives of the Initiative.
- **Other sources of leadership:** Chambers of commerce, cities, counties, economic development organizations, TVA, LMES/ORCMT, others.

#### **Launching the Initiative: *Key Action Steps and Milestones***

1. Identify the individual who will spearhead the effort and serve as the overall champion for the Initiative as well as individuals who will chair the three main elements of the Initiative. (ASAP)
2. Convene a meeting of lead organizations involved in marketing and promotion to discuss the objectives and general approaches to the effort. Form a small Marketing and Promotion Project Team to work with the champion.
3. Hire a professional communications firm to develop the marketing and promotion campaign (by February 1996). Launch campaign by March 1996.
4. Hire professional fund raising experts to design and help implement the fund raising campaign focused on contributions expected from outside the area (by February 1996). Launch campaign as soon as possible.
5. Hold education and training seminars for local economic development professionals on the concepts of cluster-based economic development and on the appropriate approaches for pursuing focused industrial recruiting, expansion of existing businesses and new business formation (by February 1996).
6. Develop a seminar series to continue to educate, train and coordinate regional approaches to cluster-based economic development, including continued research on supply gaps, and how to fill those gaps with relocating firms, expanding firms or start-up firms (by February 1996)

## **Related Initiatives Developed by Cluster Working Groups**

Some of the Cluster Working Groups placed a high emphasis on marketing and promotion as it relates to their cluster, and developed business plans for cluster-specific initiatives. These initiatives, especially the Tourism initiative, are similar to the one described above. Where there are similarities among initiatives, a coordinated implementation effort is required. Below are the Cluster Working Group initiatives that relate to this Flagship Initiative.

### *Agriculture and Food Cluster*

- New Investment in Freezer/Warehouse Infrastructure (AF-2)

### *Automotive/Transportation Cluster*

- Maintaining the Energy Advantage (Promotion) (A-7)

### *Tourism Cluster*

- Comprehensive Plan for Regional Tourism Development (T0-1)

### *Business and Financial Services Cluster*

- Downtown Knoxville Business Promotion (BS-3)

### *Technology Intensive Cluster*

- Public Relations Mechanism for Environmental Industry (T-8)

## **Strategies Linked to Flagship Initiatives**

Table VI-1 below is a matrix that shows how various elements of the Flagship Initiatives will serve as tactics for implementing the 4-part strategy recommended in Section VI.

**Table VI-1**  
**Flagship Initiatives Support the Recommended 3-Part Strategy**

<b>Flagship Initiatives</b>	<b>Strategy #1 Create Capacity for Rapid Response to Market Signals</b>	<b>Strategy #2 Achieve Appropriate Cluster Structure</b>	<b>Strategy #3 Build Specialized and Responsive Economic Foundations</b>
<b>Flagship #1 21st Century Workforce</b>		<ul style="list-style-type: none"> <li>• Rapid Response Training</li> <li>• Teaching Factories</li> <li>• Cluster Consortia for Workforce Development</li> </ul>	<ul style="list-style-type: none"> <li>• School-to-Work Transition</li> <li>• Education/Employment Standards</li> </ul>
<b>Flagship #2 Entrepreneurial Valley Initiative</b>	<ul style="list-style-type: none"> <li>• Entrepreneurial Education and Training</li> <li>• Mentoring and Counseling</li> <li>• Forum to Exchange Ideas (Entrepreneurs' Council)</li> </ul>		
<b>Flagship #3 Technology Start-ups Initiative</b>	<ul style="list-style-type: none"> <li>• Teach Business and Financial Plan Preparation</li> <li>• Establish Community Investment Criteria</li> <li>• Forums on Due Diligence Process</li> <li>• Matching System (East Tennessee Capital Network)</li> </ul>		
<b>Flagship #4 Market-based Technology Commercialization</b>			<ul style="list-style-type: none"> <li>• Technology Commercialization Action Alliance</li> <li>• Regional Roundtables</li> <li>• Analyze Technology Market Potential</li> <li>• Resource Valley Technologies Pavilion</li> <li>• Virtual Innovation Center</li> </ul>
<b>Flagship #5 Resource Valley Connections</b>		<ul style="list-style-type: none"> <li>• Regional Transportation Research Center</li> </ul>	<ul style="list-style-type: none"> <li>• Regional Communications System</li> <li>• Ring Highway System</li> <li>• Airport Development</li> </ul>
<b>Flagship #6 Targeted Cluster Development and Promotion</b>		<ul style="list-style-type: none"> <li>• Cluster-based Approach to Economic Development</li> <li>• New Marketing Themes</li> <li>• New Funding Mechanisms</li> </ul>	

As shown in the table, by implementing the six Flagship Initiatives, East Tennessee will start the process of strategically moving the economy toward becoming more market-oriented, with an improved cluster structure and better supported by institutions and organizations that are more specialized and responsive to cluster needs.

## VII. Summary of the Cluster Initiatives

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This section summarizes the results of the Cluster Working Group process built into the first year of the 21st Century Jobs Initiative. In order to draw into the project the insights and experiences of leaders whose firms or organizations are a part of the eight clusters, the project implemented a working group process that ultimately involved 20-50 individuals from each cluster. In all, more than 300 leaders from the public and private sectors were involved in the process. Meeting three times for a half-day working sessions, these leaders accomplished several tasks that contributed directly to the project.

In the first meeting, the groups identified priority needs in terms of impediments in East Tennessee to economic growth (e.g., lack of skilled workers). In the second half-day workshop the groups focused on developing vision statements that would help focus cluster initiatives on meeting specific needs facing the cluster. The second meeting also set out the range of initiatives that could be pursued through the efforts of the working group itself or through other organizations. These initiatives were prioritized and the groups then held small sub-committee meetings where business plan outlines were prepared. In the final meeting, these business plans were presented to the entire working group and were evaluated and, in some cases, modified.

Table VII-1 shows the title of all 30 business plans that were developed during this process. The full business plans are found in Appendix Report A, classified in three categories: those plans that are already underway, those that are nearly ready for action but will require some additional work (e.g., identification of a "champion" to lead the effort. The final category of cluster working group business plans are those that may need more thinking and idea development before any action can be taken.

**Table VII-1**  
**Cluster Working Group Business Plans**

**Automotive/Transportation Cluster**

- A-1 - Skills Needs Assessment
- A-2 - Automotive Curriculum Development
- A-3 - "Just In Time" Training Availability
- A-4 - Industrial Outreach To Primary And Secondary Education
- A-5 - Automotive Industry QS9000 Registration Program
- A-6 - Database Of Funding Sources For Early-Stage Business
- A-7 - Maintaining The Energy Advantage
- A-8 - Automotive Industry Information Clearinghouse
- A-9 - East Tennessee Automotive Suppliers Association

**Business And Financial Services Cluster**

- BS-1 - Business Services Skills Training
- BS-2 - East Tennessee Risk Capital Network
- BS-3 - Downtown Knoxville Business Promotion

**Forest Products Cluster**

- F-1 - East Tennessee Forest Products Development Network
- F-2 - Forest Products Action Plan For Sustainable Forest Use
- F-3 - Forest Product Industry Technology Consortia

**Textile And Apparel Cluster**

- TA-1 - Resource Valley Textile And Apparel Association

**Technology Intensive Products And Services Cluster**

- T-1 - Information Technology Industry Association
- T-2 - Information Technology: Implement A Regional Broadband Infrastructure
- T-3 - Information Technology: Shared Benefits Program For Small Business
- T-4 - Information Technology: Education Partnerships
- T-5 - Manufacturing Technology: 6-12 Education Outreach
- T-6 - Manufacturing Technology: Regional Manufacturing Association
- T-7 - Environmental Technology: Environmental Technology Web Site And Information System
- T-8 - Environmental Technology: Public Relations Mechanism For Environmental Industries
- T-9 - Health Technology: Health Technology Network

**Agriculture And Food Products Cluster**

- AF-1 - Industry To Education Outreach
- AF-2 - Freezer Warehouse Infrastructure

**Metals And Materials Cluster**

- M-1 - Metals And Materials Financing Organization
- M-2 - East Tennessee Composite Materials Association

**Tourism Cluster**

- TO-1 - Comprehensive Tourism Development Plan

It is envisioned that most of the initiatives developed during this process will move toward implementation through the efforts of the working groups themselves, each one led by a "champion." In some cases the initiative will move forward as a part of larger "flagship initiatives" discussed in the previous section. In other cases, the plans will move toward implementation through the efforts of specific groups who have been named in the business plans.

Overall, progress toward implementing the cluster working group initiatives will be monitored by Tennessee's Resource Valley, where some implementation assistance will be available. This process is discussed in the final section that follows.

## VIII. Implementation and Monitoring Progress of the 21st Century Jobs Initiative

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### ***Organizational Options for Implementation***

East Tennessee has numerous economic development organizations, many of which could be tapped for specific implementation roles. For example, many counties have a private sector-led chamber of commerce or an economic development corporation that is dedicated, at least in part, to attracting new firms to the area. Many cities and some of the county's have governmental units focused on economic development. The University and some colleges have people working on economic development. Special organizations like the Tennessee Corporation for Research and Development (TCRD) have economic development as part of their mission. TVA is very committed to economic development and has a large economic development unit working to develop the multi-state region the agency serves.

East Tennessee needs to put these organizations to work in the implementation of the Flagship Initiatives, in ways that match their missions and capacities. And while there may be several ways to mobilize these resources for implementing the recommendations of the 21st Century Jobs Initiative, the best way is for the project to simply assign an appropriate implementation role to existing organizations according to how well an initiative fits the mission of the organization and rely on each assigned organization to move the initiative forward. But without some kind of central mechanism to coordinate and monitor implementation, there will be a risk of responsibilities falling through "the cracks."

The concept of "virtual organization" is key to managing a complex implementation requirement that will involve many independent organizations. In this context, virtual refers to loosely knit networks of people and resources (including financial, information, and political). A virtual organization is network-structured, designed to draw together from various sources the resources and people necessary to complete a task. Because a virtual organization is loosely structured it can be flexible and able to respond quickly to changing situations. The concept also has the advantage of linking together several existing organizations through "goal-coupling" as a way of moving many organizations toward achieving common objectives and avoiding turf difficulties.

### ***Key Recommendation: Create the Resource Valley Network***

East Tennessee should begin the process of establishing the Resource Valley Network (RVN) as soon as possible. RVN should be a "virtual organization," meaning that it should be a collaborative effort of existing organizations in the region whose mission is economic development and job creation. RVN should not have cumbersome bureaucratic baggage like its own Board of Directors, budget and offices. Instead, RVN should rely on members of the network to commit to carry the implementation work of the 21st Century Jobs Initiative forward. Members of RVN should include each organizations that has agreed to participate in some way in the implementation of the project's initiatives (each Flagship Initiative section in the report mentions the possible sources of leadership for implementation). Finally, RVN should also



include as members the cluster consortia recommended in the area of workforce development and technology commercialization.

At the outset, Tennessee's Resource Valley will need to serve as the *secretariat* of RVN, at least through the second year of the DOE grant that supports the 21st Century Jobs Initiative. Functions during this period will include overall leadership of the project, coordination of Flagship implementation, provision of clearinghouse activities for the cluster initiatives, monitoring of implementation progress and serving as a continuing source of information about the project.

During the second, implementation year of the grant, further thought can be given to the best mechanism to continue the project. At this point, however, it seems that TRV is best suited to play a continuing catalytic role in the region for wide-ranging economic development initiatives, in particular, the 21st Century Jobs Initiative.

### ***Priorities: A Stepwise Approach to Implementation***

With five flagship initiatives, each having several components, East Tennessee has an ambitious program of work to pursue. Some of the initiatives should be launched immediately while others can wait. Table VIII-1 shows a plausible implementation plan that could be followed.

**Table VIII-1  
Recommended Staged Implementation Plan**

<b>First Stage (Nov. '95-June '96)</b>	<ul style="list-style-type: none"> <li>• Pursue Formation of Entrepreneurs Council</li> <li>• Initiate Planning for Extension of KNET</li> <li>• Hold Innovation/Partnership Roundtables (first roundtable held Nov. 4)</li> <li>• Launch Fundraising for Marketing Campaign</li> <li>• Develop New Marketing Themes</li> <li>• Initiate Resource Valley Network Concept</li> </ul>
<b>Second Stage (June-Dec. 1996)</b>	<ul style="list-style-type: none"> <li>• Implementation Plan for East Tennessee Capital Network</li> <li>• Implement Technology Commercialization Action Alliance</li> <li>• Establish Cluster Consortia for Workforce Development</li> <li>• Develop School-to-Work Transition Pilot Initiative</li> <li>• Establish Cluster Consortia on Technology Commercialization:</li> <li>• Launch First Efforts in Comprehensive Transportation Concept</li> </ul>
<b>Third Stage (Jan-June 1997)</b>	<ul style="list-style-type: none"> <li>• Develop and Launch Rapid Response Training Pilot</li> <li>• Take First Steps Toward Developing Education/Employment Standards</li> <li>• Implement Entrepreneurial Curriculum Project</li> <li>• Hold Entrepreneurship Mentoring Workshops</li> <li>• Hold Due Diligence Workshops for Investors</li> <li>• Develop Technology Market Analysis Mechanism</li> <li>• Launch Virtual Innovation Center concept</li> <li>• Scope Airport Facilities Initiative</li> </ul>
<b>Forth Stage (July-Dec. 1997)</b>	<ul style="list-style-type: none"> <li>• Develop Detailed Plans for Technology Pavilion</li> <li>• Develop Teaching Factory Concept/Pilot</li> <li>• Implement Regional Transportation Research Center</li> </ul>

### **Monitoring Job Creation Progress**

To be useful, the 21st Century Jobs Initiative's strategic action plan must serve not only to guide economic development activities, but serve as a benchmark against which to quantify progress against goals as well. Since the primary goal of the Initiative is job creation, mechanisms must be developed for systematically measuring the region's success (or failure) to create jobs. Of course, the problems of doing so are immense. Definitional problems alone make the task difficult. For example, are part time jobs considered "jobs" nonetheless. Moreover, employment data can be out of date and therefore potentially misleading.

Nevertheless, some system of tracking progress is necessary. Based on the data developed for this report, current employment in the eight clusters and forecast future employment, a basis for monitoring job creation is available. A 1994 DRI/McGraw-Hill forecast was used in this project because it was the only data available in January, 1995 when the economic analysis was started. Now, 10 months later, DRI has produced an updated forecast based on more current economic conditions. One feasible measure to use to assess progress in job creation in the eight clusters on is the most recent forecast of expected annual growth over the next 8 years, sector-by-sector. Where the region actually exceeds the forecast, it could be assumed that good progress toward job creation was being made—more than was forecasted. Where the region fails to meet the forecast, it could be assumed that job creation efforts have come up short.

Table VIII-2 provides the most up-to-date forecast of expected annual growth in employment for each cluster. These figures can be used as a *rough benchmark* against which to measure progress in job creation, but must be used with all the caveats above. Moreover, it must be recognized that the forecasts are a baseline case and do not take into account employment impacts accruing to the region because of the interventions recommended in this report.

**TABLE VIII-2**  
**Forecast Employment Growth in Eight Industry Clusters**  
**in 15-County Tennessee Resource Valley Region**

Key Clusters	Employment Level (Thousand) 1994	Forecast Annual % Change 1994-2004
Auto/Transportation	18.3	0.0
Metals & Materials	19.1	-1.0
Forest Products	9.4	-0.8
Apparel & Textiles	18.1	-1.2
Technology Intensive Products & Services	9.1	2.1
Business & Financial Services	18.3	2.7
Agriculture & Food Products	3.3	-0.5
Tourism	22.3	2.6
Cluster Total in 15-County TRV Region	116.8	0.8

In order to use this data, an effort will be required to develop employment summaries periodically in the sector categories *used in this project* (e.g., combine DES employment data such that the

sectors line up with the sectors used to define the cluster). Ideally, the cluster definitions used in this report will be the "units of analysis" for the monitoring system. If using the cluster definitions is not feasible, traditional sector definitions must be used instead. Doing so will make the forecasts of Table VIII-1 problematic.

## ***Conclusion***

Although East Tennessee enjoys a strong economy today, with especially low unemployment of the 15-county area, the region faces an uncertain future. This report has argued that new economic realities in Washington, DC and economic restructuring in the US and in the region itself suggest that job creation in the future will be harder to come by than was the case in the past. In order for the region to be well-positioned for new job creation, new approaches to economic development are required.

With this strategic plan, East Tennessee has a "road map" to guide decisions in the public and private sector over the next several years. By pursuing the vision of a technology-intensive economy, and following the 3-part strategy set forth in this report, East Tennessee will be taking important steps to intervene in the trends and start the process of building the foundations for a competitive 21st Century economy. The Flagship Initiatives, as well as the Cluster Working Group initiatives, comprise a set of actions that can be taken over the next several months to kick-start the process of change. Over the next 10 years, this plan and approach to economic development is one that should ensure that the region makes the most of its economic opportunities.