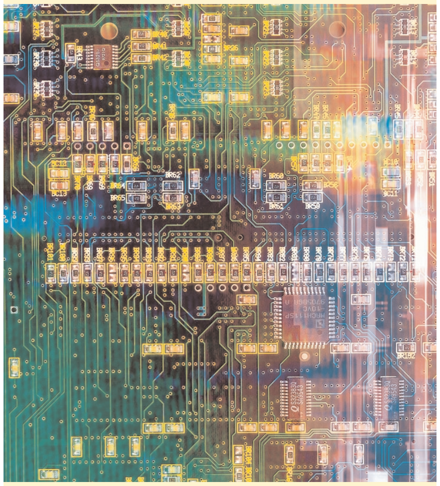

FINAL REPORT:

A TECHNOLOGY STRATEGY FOR NEVADA

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Executive Summary

Nevada **can** diversify its economy by accelerating the already robust growth in its technology sector, and there are persuasive arguments for pursuing this goal with some urgency. Of these, the most telling rationale concerns the need to renew and invigorate the opportunity structure for its best and brightest citizens, particularly in comparison with other states in the Western region. Nevada has always been a place where people can come from afar, and carve out for themselves a meaningful economic, social, and civic life. Consistent with that history and tradition, Nevada now needs to make a place for itself in the global, knowledge-based economy.

A Vision

Based on its analysis of the Nevada economic and technological situation, and in consultation with leaders from all walks of life in the state, the Battelle team has developed the following statement which captures some of the major themes of what could happen in Nevada.

Vision

*Nevada will be the place where great ideas become reality. Nevada's 21st century economy will continue to be founded upon a stable and robust gaming and resort industry, but this will be supplemented by a rapidly growing entrepreneurial technology and knowledge sector. This sector will be composed of both new-to-Nevada technology firms as well as those that have thrived in the state for some time, all delivering high-value products and services that will serve national and global markets. This sector will attract the best and brightest knowledge workers, both homegrown and from afar, who will be well-paid, major contributors to the betterment of Nevada. The state will have a first-class, nationally renowned educational system—from kindergarten through graduate school—and will be in the first rank of states in R&D and innovation. The business infrastructure will be consistent with the new global economy. Nevada's New Economy will support an increasingly rich quality of life and unparalleled educational, cultural, and employment opportunities for all its citizens. For business leaders, young people, retirees, and average citizens, it will be **the** place to live and work.*

Getting to the Vision: Strengths, Weaknesses, Opportunities and Threats

Visions such as this do not become reality in a month or a year. More typically, significant progress will slowly accumulate over a ten to fifteen year period, at the end of which a new technology economy has emerged. This long-term process necessitates sticking to a disciplined plan and implementation approach. Successful progress is also contingent upon strong leadership commitment, and an understanding of the assets and potential liabilities that a state brings to the table.

Two chapters in this report were dedicated to enhancing that understanding among Nevada's private, public, and non-profit leadership community. Based on statistical analysis, structured interviews with members of Nevada's technology and public policy communities, and benchmarking of practices elsewhere in the country, the Battelle Team developed a summary description of Nevada's strengths, weaknesses, opportunities and threats (SWOT), as it moves toward technology-based economic development.

Strengths

Nevada has a number of assets that are consistent with the development of technology-based companies. These strengths tend to attract the highly educated people who lead and staff the companies of the knowledge economy. They include:

- A *high quality of life*, particularly when compared with adjacent and competitor states;
- A lower *cost of doing business*, particularly in the area of taxes;
- Easy and ready *access to government*, and a "can-do" approach to business/government relations;
- A *robust economy, led by a world class gaming and resort industry*;
- An *entrepreneurial culture* that encourages the formation of new enterprises;
- A *physical infrastructure,* including air and surface transportation, as well as Internet access, that is highly competitive;
- A tradition of *partnering* across sectors and regions;
- A highly competitive system of economic development *incentives*;
- A rate of *R&D growth* that is among the highest in the nation;
- A large *federal R&D* presence;
- An *adjacency* to the world-class *technology corridor* of the Pacific coast;

Weaknesses

The above notwithstanding, Nevada also confronts a number of current problems and inadequacies in attaining a technology-intensive economy. They include:

- A *single industry dominance*, in this case gaming and associated resorts;
- *A university* system that has not reached *national prominence* in R&D and industry partnering;
- *A thin technology sector*, with no clearly-defined technology clusters;
- An overstressed K-12 system;
- A chronic issue of *technology workforce shortages;*
- An alarming "*brain drain*" of science and engineering graduates to other states;
- A weak *support and assistance network* for entrepreneurs;

- A weak *university technology transfer* system;
- A less-than-optimal level of inter-unit *cooperation and coordination* within UCCSN;
- An *inflexible* system of state *revenue and spending*;
- An uneven *rural infrastructure*, particularly in the area of telecommunications;
- A slow rate of *government adoption* of technology;
- A continuing issue of *north-south tensions*.

Opportunities

By considering the initial strengths and weaknesses of Nevada, one can identify in broad outline some of the opportunities that the state might quickly exploit and move toward a more robust technology sector. These include:

- Attaining *excellence in research, development, and industry partnering* among the state's universities;
- Leveraging and enhancing Nevada's *quality of life*;
- *Change Nevada's image*, to that of a state that is actively participating in the global knowledge economy;
- Achieving greater *organizational coherence* in how Nevada approaches technology-based economic development;
- Placing greater emphasis and resources on the *people assets* of the knowledge economy, from Kindergarten through graduate school;
- Encouraging *technology entrepreneurship*;
- *Leveraging the significant federal R&D* presence in Nevada into commercial R&D and economic development.

Threats

In addition to the current situation, there are a number of foreseeable events or likely circumstances that may impact the chances for Nevada to build a technology economy. They include:

- The growth of *on-line and Native American gaming*, which could potentially undercut the core industry of the state;
- A *changing national technology sector*, which might expand in ways inconsistent with Nevada's strengths;
- Increasing *competition from other states*, which are moving faster in developing their own technology strategies;
- Increasing *competition from other college and university systems,* which are moving faster in developing novel and responsive approaches to industry partnering;

- A rapidly *growing social agenda* for the state, such as the need for health care for the elderly, which might swamp other public budget priorities (such as technology).

Strategies and Actions

Based on the framework of the SWOT analysis, a Set of Strategies and Actions were developed for Nevada. These are presented in summary fashion in Table 1, and include priority rankings, expected time frames for implementation, lead and partner organizations, and likely start-up and ongoing expenditures for each action. It should be noted that the crafting of these action recommendations and their priority rankings ("critical", "high" or "moderate") were developed with extensive input on the part of a large number of Nevada public and private sector leaders. There is no paragraph in this report, particularly the recommended strategies and actions, which has not been scrutinized by stakeholders in the state.

Table 1: Strategies and Actions

Strategy	Action	Priority	Time Frame	Lead Organization	Key Partners	Resource Requirements
Strategy One: Increase the focus of the state's economic development efforts on technology-based opportunities	Conduct a core technology competencies analysis	Critical	Immediate	Commission on Economic Development and UCCSN	Corporate community, federal technology community, and chief research officers at UNR, UNLV, and DRI	One-time costs of less than $75,000, plus upwards of one person-year of donated time from stakeholders
	Increase public understanding of technology-based economic development and the New Economy	Critical	Immediate	Commission on Economic Development	Regional economic development organizations, Nevada Technology Council, TechAlliance, UCCSN, technology industry associations	Less than $100,000 in out-of-pocket costs, plus 1 to 2 person-years of donated time
	Technology Nevada branding and marketing	High	Immediate	Commission on Economic Development	Regional economic development organizations, Nevada Technology Council, TechAlliance, technology industry associations	One time costs of less than $100,000
	Focus on easy adjacent targets in the Pacific coast technology corridor	High	Long term	Commission on Economic Development	Regional economic development organizations	Annual costs of $100,000 to $200,000
	Increased focus on early stage technology companies	High	Near term	Commission on Economic Development	Regional economic development organizations	Start-up costs of $100,000
	Market and maintain Nevada quality of life	High	Long term	Commission on Economic Development, Governor, Lieutenant Governor	Regional economic development organizations, UCCSN, relevant state agencies, relevant not-for-profit advocacy and analysis organizations	$25,000 start-up costs, and $75,000 annual costs, plus upward of one person-year of donated time
	Re-orient MAP and other business assistance programs toward high-value products	Moderate	Long term	MAP, UCCSN	Corporate community	Planning and start-up costs of $75,000; no incremental steady state costs
	Go for the tech flagships, private and public	High	Long term	Commission on Economic Development	Regional economic development organizations	No additional
	Recruit people as well as companies	High	Near term	Commission on Economic Development	Regional economic development organizations, UCCSN	Annual costs of $75,000–$100,000
	Launch a statewide rural telecommunications initiative	High	Near term	Governor's office	State agencies dealing with telecommunications, companies in IT industry, regional economic development organizations, UCCSN, System Computing Services of UCCSN	One-time costs of $250,000 to support strategic planning in several rural communities

Table 1: Strategies and Actions

Strategy	Action	Priority	Time Frame	Lead Organization	Key Partners	Resource Requirements
Strategy Two: Enhance the research, development, and industry partnering roles of the university system	A renewed mission strategy for UNR and UNLV	Critical	Immediate	UNLV and UNR	UCCSN, corporate community	Modest one-time planning expenses
	An expanded mission for the Desert Research Institute	High	Near term	DRI	UCCSN, corporate community, and federal technology sector	One-time planning costs of $100,000; ongoing costs contingent upon DRI performance
	Launching a Nevada Research Alliance	Critical	Near term	UCCSN	UNLV, UNR, DRI, Governor, legislature, and corporate community	$3-$4 million to endow every Alliance chair, from government, industry, and foundation sources, with anywhere from twenty to thirty chairs established over a ten year period
	Re-engineering the Applied Research Initiative	High	Near term	UCCSN	Chief research officers from UNLV, UNR, and DRI, corporate community	No increase over resources already allocated
	Flexible and non-incremental funding within the University and Community College System	High	Long term	UCCSN	Board of Regents, legislature	No increase over resources already allocated
	Develop an effective statewide university-industry technology transfer function	High	Immediate	UCCSN	Chief research officers at UNR, UNLV, and DRI, corporate community, and economic development organizations	Steady state costs of $800,000 per year plus $250,000 start-up costs. Over 5 years, royalty revenues will counterbalance a significant fraction of this
	Conduct a core technology competencies analysis	Critical	Immediate	Commission on Economic Development and UCCSN	Corporate community, federal technology community, and chief research officers at UNR, UNLV, and DRI	One-time costs of less than $75,000, plus upwards of one person-year of donated time from stakeholders
Strategy Three: Build the Nevada New Economy workforce	Increase technology industry input to higher education programs	Critical	Immediate	UCCSN and Commission on Economic Development	Technology industry community, UNR, and community college leadership	One-time costs of $75,000, plus upwards of one person-year of donated time
	Develop an ongoing capacity to assess the emerging personnel needs of Nevada technology industry	High	Long term	UCCSN, corporate community	Commission on Economic Development	Annual costs of $75,000, and start-up costs of $50,000 plus upwards of several person-months of contributed time
	Expand intern and co-op opportunities across UCCSN	High	Near term	UCCSN, corporate community	Units (departments and colleges) at UNR, UNLV, and community colleges with particular relevancy to New Economy industry	Annual cost of $500,000 across UCCSN, plus start-up effort in donated time
	Attain an order of magnitude increase in information technology graduates by establishing a center for excellence in information technology	High	Near term	UNR, UNLV, and community college leadership, plus 2020 Vision Group	UCCSN, corporate community from IT sector, and from those sectors with major IT applications	$1–$2 million in annual operating costs once fully operational, with majority provided by corporate, foundation, and federal agency grants, plus planning costs of $100,000, much of which will be covered by donated time
	Increase general and targeted support for K-12 to national benchmarks	High	Long term	Governor, State Department of Education	Legislature	Unknown at this time
	Increase the use of educational technology in K-12	High	Long term	Commission on Educational Technology, legislature, and Governor	State Department of Education, corporate community	Unknown at this time
	Expand the scope of the Millennium Scholarship Program	High	Near term	Governor, legislature	UCCSN, State Department of Education	Undefined at this time
	Increase and create incentives for program cooperation within UCCSN	High	Longer term	UCCSN	Campus leadership at the unit level	No additional, steer existing resources

Table 1: Strategies and Actions

Strategy	Action	Priority	Time Frame	Lead Organization	Key Partners	Resource Requirements
Strategy Four: Accelerate the growth of the entrepreneurial technology economy	Expand entrepreneurial education and training	High	Near term	Planning committee with UCCSN	Entrepreneurial companies and service providers, regional economic development organizations	Start-up costs of $50,000, with other costs contingent upon detailed planning outcomes
	Coordinate and strengthen the development of incubation services and programs	High	Near term	Leadership of existing and in-planning incubator programs,	Entrepreneurial companies and service providers, regional economic development organizations, UCCSN	No additional
	Expand the supply of early stage capital for technology enterprises	High	Near term	Incubator association, Commission on Economic Development	Regional economic development organizations, UCCSN	None additional other than to support planning processes, which will involve donated time
	A start-up oriented university technology transfer system	High	Near term	UCCSN	Board of Regents, legislature	No increase over resources currently allocated
	An entrepreneurial-friendly system of statute and constitutional law	Critical	Near term	Governor, legislature	Commission on Economic Development	No additional at this time
Strategy Five: Create a permanent and effective organizational vehicle for implementing the Nevada technology plan	Create a permanent and effective organizational vehicle for implementing the Nevada technology plan	Critical	Immediate	Governor	Legislature, CED, and UCCSN	$25,000 to support operational planning, incorporation, executive search services, and other out-of-pocket costs, plus annual costs of $300,000 to $400,000 to support (on a contract basis) the operations of the Silver State Technology Corporation
Strategy Six: Leverage current and future federal investments in Nevada	A Nevada Federal Technology Institute (NFTI)	High	Near term	Nevada congressional delegation	Governor, legislature, Nevada-based federal technology organizations	$1 million in planning and start-up costs, annual operational costs of $10 to $15 million, and a one-time investment of $25 to $50 million in capital facilities (land, building, and equipment), all of which would presumably come from federal agency funds plus industry cost-sharing
	Industry, lab, university cooperative research centers	High	Near term	Nevada-based federal sector, corporate community, and UCCSN	Commission on Economic Development	$150,000 for a year-long planning project which will determine scope and foci of centers program

The Importance of Leadership

In the opening page of this Executive Summary, we mentioned the importance of leadership commitment and understanding in realizing the promise of *A Technology Strategy for Nevada*. In this closing section, we would like to reiterate and amplify that theme.

First of all, we would like to specify what public and private leadership needs to be in the vanguard of this vision. In the public sector, there needs to be active advocacy and detailed implementation planning on the part of the Governor, Lt. Governor, key legislator leaders, the Board of Regents, Chancellor, and senior administrators from throughout UCCSN, and agency (e.g., DOE) and contractor leadership from within the federal R&D community. From the private and non-profit sector, this plan needs to be championed by leaders from state and local economic development organizations, state technology organizations (e.g., Nevada Technology Council, TechAlliance), technology industry associations, private philanthropic organizations and foundations, and executives from the gaming and resort industry.

Second, we would like to suggest how these various leaders should work **together** to foster the implementation of this plan. Each of the organizations and groups alluded to above will have their own particular take on what ***A Technology Strategy for Nevada*** implies for their world. This is, of course, human nature and organizational self-interest. Nonetheless, it is important to learn from the practices of those states that have climbed from technology obscurity to national prominence (e.g., Georgia). The leaders in such states have learned to transcend—at least for awhile—their own narrow agenda, and to strive for partnering and cooperation in the interest of the larger good. In the case of Nevada, the larger good is a more robust technology economy, greater job opportunities for its citizens, and an improved quality of life.

Finally, it would be useful to comment on the necessary **intensity** of leadership that needs to emerge in order to successfully implement *A Technology Strategy for Nevada*. Not only must the right mix of leadership be at the table, with hopefully all being able to surmount narrow interests and achieve productive cooperation, but a smaller number of those leaders need to have a passionate, single-minded, and long-term commitment to transforming the state. In every region that has become a leader in the New Economy, one will find a small number of individuals, drawn from many sectors and persuasions, all of whom have a "fire in the belly" to carry the change process to success. Nevada needs to identify those individuals, and give them all the resources and support necessary to stay the course.

Chapter 1: Technology-Based Economic Development: Why Now?

Nevada is poised to embark on a challenging adventure as a state and a society. As the first year of the millennium draws to a close, it is obvious that the national economy and its underlying social systems are rapidly moving toward a dominance by knowledge-based industry and commerce. Increasingly, the most successful businesses are those built around great ideas and talented people, which can quickly bring their products and services to the attention of the world. Innovation drives this new economic order, and those states, communities, firms, and individuals that can master its processes will win out.[1] Those who cannot—or will not—change in these directions will decline.

However, Nevada has yet to make a deliberate, far-reaching, comprehensive commitment to becoming a significant player in the "New Economy." Thus far, it has slowly approached technology-based economic development. There is an undercurrent of indecisiveness about whether the state really needs to pursue a technology strategy. After all, Nevada has witnessed decades of unparalleled economic growth, largely as a function of its world class gaming and resort industries, so why bother? In this section we would like to provide some historical context for this question of **why** technology based economic development should be pursued.

History and Economic Geography

How can one translate the 110,000 square miles of Nevada into a context in which a technology economy might be nurtured? After all, about 86 percent of the state's area is encompassed by arid, open space, dominated by basins with no drainage to the Pacific, numerous high mountain ranges, and seemingly limitless desert terrain. We would argue that the land itself has colored and continues to influence the culture, values, and orientation of the state. In effect, well past the American era of frontier conquest, Nevada has many of the characteristics of the frontier. It is perhaps the most western of the western states, and the resultant complex of values and perceptions has implications for its current and future economy.

Walter Prescott Webb[2], the noted historian, has argued that it is the ratio of open land to population that defines the frontier experience. Sparsely populated wild country creates a different psychology among its inhabitants. The following is an eloquent statement of that point:

> *Here were new forests, new soil, and new streams; here was new silence and immensity, too silent and extensive to be broken by a single individual or by any number then available. How small man feels in such presence. But with this consciousness of insignificance goes that of elation which comes when man feels himself blended with nature where his vision is unobstructed and his acts unimpeded by other men. What men had done to him all his life now fell away in a single instant: nowhere was there policeman, priest or overlord to push him around. All the barricades that men had placed*

1. For an excellent readable overview of these developments, the August 21, 2000 double issue of *Business Week*, on the 21st Century Corporation is recommended.
2. Webb, W. P. *The Great Frontier.* Austin, TX: University of Texas Press, 1979.

around him came down, and he stepped forth freer of man than he or any of his fellows had been for a very long time.

This aggressive individualism is what drove the settlement of the west, much of which transected what is now Nevada. This was the impetus for the expeditions[3] of John Fremont, the Bartleson-Bidwell Party, Rowland-Workman, and the ill-fated Donner Party. The individualistic dream of making a fortune quickly, albeit with great toil and hardship, was behind the development of Gold Canyon, the Comstock, and Aurora. The frontier vision, steered by religious commitment, enabled the establishment of the Mormon agriculture communities.

Nonetheless, the frontier history of Nevada diverted significantly from that of much of the rest of the country. In most places, the limitless land filled up, was fenced, and yielded to the plough, the ranch, and organized town government. In Nevada, however, most of the land encompassed by the state was unsuitably arid for farming and animal husbandry. Later on, the federal government acquired a large percentage of the state's area, much of it dedicated to national security applications. In Nevada there is still open, available land.

This history has had several implications for the economy, culture, and values of the state.

For one, it pushed the state toward an economy that rested on a relatively few major industries. In the nineteenth century, and for much of the twentieth, these were railroads and mining. In fact, the two major urban areas rest on traditional east-west transportation corridors.

The economic geography of the state has also perpetuated much of the ethos of frontier individualism. This has manifested itself in a strong entrepreneurial culture and a belief that with pluck and hard work anyone can build a life. In some sense, the growth of the gaming and resort industry is particularly compatible with the history of the state. It has created viable vocational paths for people with modest education but a willingness to work hard. To a significant degree, Nevada is one of the last of the blue-collar states, in terms of this opportunity structure. The robust growth of the gaming industry has made the state a mecca for the restless but ambitious who continue to swell the population, particularly of southern Nevada.

The values and cultural orientation of the state continue to be heavily influenced by the land itself. While Las Vegas and Reno are clearly urban communities, it is not difficult to drive fifteen to twenty minutes and find oneself in an environment not unlike that faced by John Fremont and his peers. The canyons, sagebrush, red rocks, and mountains are as they were thousands of years ago. Depending on how one defines urban, ten to twenty-five percent of Nevada residents still live in rural areas and small towns, right up against the vastness of the terrain.

Renewing the Dream—The Imperative to Diversify

Unfortunately, much of what has been just described ignores some unfortunate realities of the Nevada economy and society, and how it relates to the burgeoning national information economy. In a culture that places a great value on opportunity, pluck, and individual initiative, the state needs to expand its opportunities for a significant portion of its citizens. It needs to significantly diversify its economy in ways that will provide employment options for some of its most talented and ambitious citizens, that is, high-wage primary jobs that are associated with

3. Hulse, J. W. *The Silver State.* Reno, NV: University of Nevada Press, 1998.

high value-adding products and services that are mostly sold outside the state. Many of those options will be found in the New Economy, as it is focused on technology, high skills, global markets, and entrepreneurship. **Unlike the economy of the 60s and 70s, participating and winning in the New Economy depends as much on formal knowledge and skill as it does on entrepreneurial zeal. It is here in particular where Nevada needs to renew its cultural heritage.**

In effect, the opportunity structure for Nevada's young people is incomplete for those with the talents most in demand in the New Economy—advanced education and innovativeness. One result has been a troubling emigration of Nevada's best and brightest, as many of the young seek opportunity in other states.

According to analyses published by the Southern Technology Council,[4] Nevada is in the lowest national quartile in terms of retaining recent BS and MS graduates in science and engineering. In effect, there is a significant negative "brain drain," of just those talented graduates most needed to build this New Economy. Other data suggest that many young people leave right after high school in order to attend college out of state—and never return. The nature of the Nevada economy and its image as a single industry state are two of the obstacles that technology companies in the state must overcome in order to recruit seasoned scientists, engineers, and technical managers.

As part of its analysis Battelle obtained more detailed information on these trends. We asked the alumni offices at UNR and UNLV to identify graduates since 1995, in science, engineering, or business, who were now living in either the San Francisco bay area or Los Angeles/ Orange County. The total was 376; this begs the question of how large the number might be if one broadened the geographic scope and time frame.

Why have they gone? To get a feel for the answer, we wrote a letter to all 376 and asked them to participate in a data-gathering process that would explore their reasons for leaving for Nevada—and equally important, what might have kept them in Nevada or what might encourage their return. We conducted phone interviews with two dozen individuals.

In our interviews, we asked the graduates to rate various factors that made California and Nevada more or less attractive as a place to live and work. Highest on the ratings as positives for California were "best opportunity to use my skills," better salary, and the "quality of colleges and universities in California." Other factors included the possibility of "getting rich" or joining a startup, and the life style attractions of California. In a nutshell, they wanted to expand their opportunities and life chances.

On a positive note, a majority of the graduates also said they would have stayed in Nevada if they had been able to connect with a job consistent with their skills and aspirations, and an encouraging number also indicated that they would return to the state if a suitable job came available. Many indicated that a greater presence of Nevada technology companies in placement and internship activities in their university would help.

4. Tornatzky, L.G., Gray, D., Tarant, S.A., and J.E. Howe, 1998, *Where have all the Students Gone? Interstate Migration of Recent Science and Engineering Graduates.* Research Triangle Park, NC: Southern Growth Policies Board.

The themes articulated by recent graduates were echoed in our interviews with principals of technology-based companies in the state. Human resources is one of their chief concerns. There are not enough experienced tech-oriented people in Nevada, and companies frequently go “over the hill” to California to make key hires. For them, competing with the gaming industry for new hires and for increasing the supply of appropriate graduates is an ongoing challenge.

Finally, adding to this discussion of Nevada’s technology opportunity structure are the voices[5] of those citizens living in the state’s rural areas and small towns. Many are acutely aware of the need to have access to the technologies of the knowledge economy in order to grow their communities and to provide more options for their young people. For them, technology is increasingly seen as a hope for enabling their communities to survive and prosper.

Let us summarize what this report is and is not about:

This is not about science and technology for its own sake, nor an exploration of the intricacies and wonders of the technological world. This is a report on how to use science and technology as **tools** to diversify the Nevada economy and create more high wage primary jobs.

The analyses, strategies, and action recommendations presented here should be seen as vehicles for increasing **opportunities** for Nevada through economic diversification consistent with the history and traditions of the state.

The customers for this report are those thousands of Nevada citizens who see the need for enhancing the technology sector, but who also need a more coherent vision and a set of action strategies they could support.

Outline of the Report

The balance of the report will be organized as follows:

- Chapter 2 will provide an overview of the Nevada economy, particularly the technology sector. This will be drawn from a more expansive Battelle report, developed earlier in the project.[6]
- Chapter 3 will present a SWOT (strengths, weaknesses, opportunities, and threats) analysis of Nevada, in terms of technology-based economic development.
- Chapter 4 will present a series of Strategies, and recommended Actions to implement those Strategies.
- Chapter 5 will present an Implementation Plan for executing the strategies and action steps.

5. Trainor, B. J. *Reaching Out: Telecommunications in Rural Nevada*. Las Vegas, NV: Frontier Trail Inc., 1999. Prepared for the Nevada Commission on Economic Development.
6. Battelle Memorial Institute, Technology Partnership Practice. *Summary Technology Profile for the Nevada Commission on Economic Development.* April 15, 2000.

Chapter 2: An Economic And Technology Profile Of Nevada

Introduction

On March 1, 2000, the Battelle Memorial Institute launched this project for the Office of Science, Engineering, and Technology of the Nevada Commission on Economic Development. Other official participants in the project include the Office of the Governor, the Nevada state legislature, and the university and community college system of Nevada. These organizations were joined by a blue-ribbon Project Advisory Committee, which was carefully selected from the corporate, economic development, and academic communities of the state.

The goal of the Battelle project is to develop a comprehensive analysis of the existing technology economy of Nevada, and to develop action strategies for its expansion. However, before launching into the development of action recommendations, it was deemed important that the various Nevada stakeholders interested in technology-based economic development and diversification reach a shared understanding of where the state currently stands.

Therefore, a key project component involves summarizing and consolidating state and regional economic analyses and reports, particularly as they pertain to the technology sector. This chapter addresses that component, and has the following objectives:

- To familiarize stakeholders with some basic facts concerning the Nevada technology economy, and to enable a common basis for future discussion.
- To frame issues that needed to be addressed by the Battelle team in the balance of this report, particularly in the crafting of recommended strategies and actions.

Method and Approach

A two-pronged approach was employed to address these objectives. First, the Battelle team assembled existing reports addressing Nevada's economic and technology assets and opportunities. This data came from federal agencies, government and non-profit organizations, and several national organizations working in the area of technology-based economic development. The studies were carefully reviewed for relevant data, which in turn are presented in the body of this chapter. In selecting relevant databases, the Battelle team was guided by the insights of the NED-SET planning group. Many of the variables examined and findings reported in this chapter were a result of interactions with veterans of the 1999 NED-SET meetings.

A second approach used by the Battelle team was to perform two secondary analyses of employment data gathered by Dun & Bradstreet and the U.S. Census Bureau. Location quotients measure industry specialization relative to the national economy, particularly in technology-intensive industries. Shift-share analysis examines changes in local employment over time in technology-intensive sectors. The objective is to discern "competitive" shifts in the local economy that go beyond broad national trends, and thus to discover any emerging technology industry clusters.

For much of these analyses, the Battelle team looked at Nevada's data relative to peer states, which were drawn from the Rocky Mountain region on the basis of similarity to Nevada in geography, tradition, and economic history. These peer states are Arizona, Colorado, Idaho, Montana, New Mexico, Utah, and Wyoming.

Overview of the Nevada Economy

In this section, the team will review broad overall indicators about the health of the Nevada economy. These are primarily drawn from federal government sources. The picture that emerges at this level of aggregation is one of robust economic growth for at least the last decade.

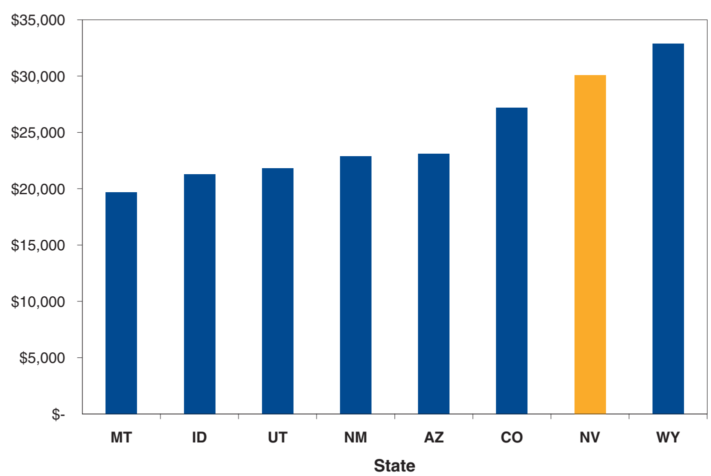
Employment

In October of 1999, according to the Federal Reserve Bank of San Francisco,[1] 989,800 individuals were employed in Nevada, and unemployment stood at 4.4 percent. This represented an annual rate of employment growth of 4.9 percent, which was better than all of the other states in this federal reserve district.[2] This also compared favorably with the national rate of job growth of 2.2 percent.

Output and Income

These recent data mirror longer-term trends in the Nevada economy concerning output and income. For example, if one looks at per capita gross state product[3] as of the mid-1990s (Figure 1), the picture for Nevada is positive, trailing only Wyoming in the region.

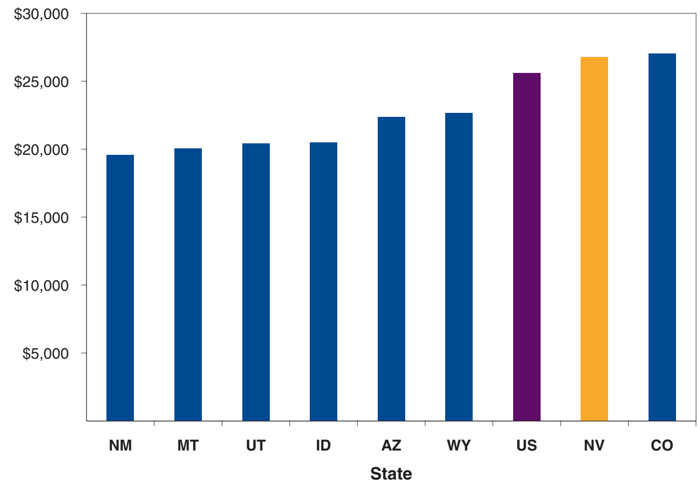
Figure 1: Per Capita GSP



1. Federal Reserve Bank of San Francisco. *Western Economic Developments.* December, 1999.
2. Alaska, Arizona, California, Hawaii, Idaho, Nevada, Oregon, Utah, and Washington.
3. National Science Foundation. *NSF EPSCoR National Almanac*.

Looking at another measurement (Figure 2), Nevada trails only Colorado in personal income per capita as of 1997 in the mountain region.[4] Both states exceed the U.S. average. This suggests, at the aggregate level, a fairly robust economy for Nevada and the region.

Figure 2: Personal Income Per Capita



However, overall economic performance was not without some increase in income disparities, in Nevada as well as peer states. Two ratio indices are worth noting: changes in the ratio between the average income of the top fifth of families and that of the middle fifth of families, and changes in the ratio between average income of the top fifth of families and the bottom fifth. The data[5] in Table 2 are for the period between 1990 and 1998. A larger positive number indicates a greater disparity in income. As can be seen, only Colorado has grown its economy without introducing large disparities in family income.

Table 2: Changes in Ratio of Incomes

Ratio	NV	AZ	CO	ID	MT	NM	UT	WY
Top/Middle	0.5	.09	.03	0.3	0.4	0.2	0.3	0.4
Top/Bottom	1.5	3.9	-0.5	1.3	2.1	2.2	0.9	1.3

4. National Science Foundation. *Science and Engineering State Profiles: 1998 Data Update.* Available only electronically at <www.nsf.gov/sbe/srs/nsf>

5. Bernstein, J., McNichol, E., Mishel, L. and Zahradnik, R. *Pulling Apart. A State-by-State Analysis of Income Trends.* Center on Budget and Policy Priorities, Economic Policy Institute, Washington, D.C., January, 2000.

Population Trends

Economic growth is typically accompanied by population growth. This has characterized the mountainous West as well as the state of Nevada. Table 3 presents state rankings[6] of population growth relative to the rest of the country, for the periods of 1990 to 1999, and 1998 to 1999 respectively. As can be seen from Table 3, Nevada has sustained long-term population growth. The absolute magnitude has been and will continue to be significant as well. For example, during the period between 1992 and 1997 there was a 25.8 percent increase in state population.

Table 3: Population Growth, Benchmarking Set

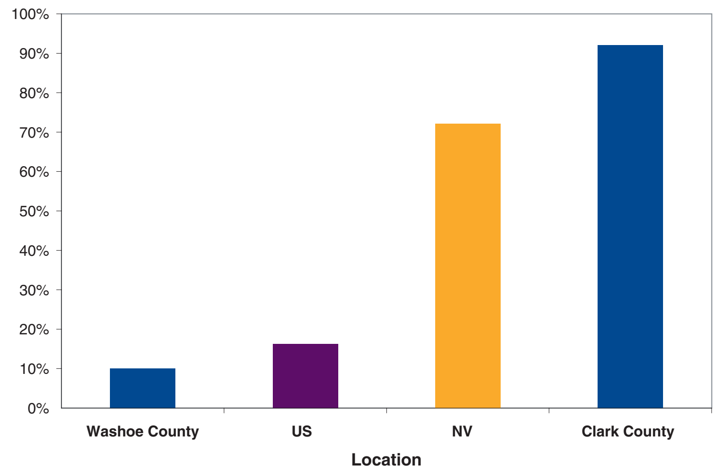
Population Growth	NV	AZ	CO	ID	MT	NM	UT	WY
1990 to 1999, rank	1	2	5	3	19	12	4	35
1998 to 1999, rank	1	2	3	5	36	37	8	47

Based on projections from the Nevada Department of Taxation and the Nevada state demographer[7], between 2000 and 2018 the state's population is projected to increase by 72.1 percent, from 2,034,010 to 3,500,860. The Las Vegas area will grow much faster than the Reno area. Washoe County (Reno) is projected to grow from 325,370 in 2000 to 358,050 in 2018, an increase of ten percent. Over the same time period, Clark County (Las Vegas) is expected to increase from 1,395, 930 to 2,683,260, an increase of 92.2 percent. In comparison, according to the U.S. Census Bureau,[8] the nation's population is projected to grow from 275.3 million in 2000 to 318.9 million in 2018, an increase of 16.2 percent. To summarize current population projections, between now and the year 2018, the state of Nevada will grow at a rate over *four times* that of the U.S., Las Vegas will grow at a rate nearly *six times* that of the U.S., and Reno will grow at a rate that is *less* than the U.S. as a whole. This information is presented in Figure 3.

The primary source of Nevada's population increase has been migration from other states. State data on driver's license applications from new residents are instructive.[9] For example, in 1986 a total of 28,652 out-of-state licenses were turned in as part of a new application process. This increased to 77,822 in 1999. In both 1986 and 1999 the largest fraction consisted of former residents of California, at 27.7 percent and 34.5 percent of all new residents respectively. In order of contribution, the other states that sent relatively large numbers of new residents to Nevada in 1999 include Arizona (5.9 percent of total), Texas (4.4 percent), Illinois (4.3 percent), and Florida (4.2 percent).

6. U.S. Census Bureau, Statistical Information Staff, Population Division. *State Rankings of Population Change and Demographic Components*.
7. There are high, low, and middle forecasts. These are middle forecasts.
8. U.S. Census Bureau, Washington, D.C. *Annual Projections of the Total Resident Population as of July 1: Middle, Lowest, Highest, and Zero International Migration Series, 1999 to 2100.* Revised Release Date: February 14, 2000.
9. Center for Business and Economic Research. *Migration Statistics. 1986-Present.* University of Nevada, Las Vegas, January, 2000.

Figure 3: Projected Population Growth, 2000 to 2018



Industry Structure

Another way of examining the Nevada economy relative to its mountain state neighbors is to break down state GNP into broad industry categories by percentage contribution. These are provided for 1996 data in Table 4 below. As can be seen, the primary distinction between Nevada and its neighbors is the huge fraction of activity devoted to the service economy, a reflection of the gaming and resort industries.

Table 4: Gross State Product, Percentages by Category

Gross State Product, Percentages	NV	AZ	CO	ID	MT	NM	UT	WY	US
Agriculture	1%	2%	2%	6%	5%	2%	1%	2%	2%
Manufacturing, Mining, Construction	17%	22%	19%	27%	17%	28%	23%	41%	23%
Transportation, Communication, Utilities	8%	8%	11%	9%	13%	8%	9%	14%	8%
Wholesale and Retail Trade	14%	17%	16%	16%	16%	13%	16%	10%	16%
Finance, Insurance, Real Estate	18%	19%	17%	12%	13%	14%	16%	10%	19%
Services	32%	20%	22%	16%	19%	17%	20%	10%	20%
Government	10%	13%	13%	13%	16%	18%	15%	13%	12%

Longitudinal Trends and Regional Variations

It is beyond the scope of this analysis to compare in great detail the northern and southern economic regions of Nevada, meaning the metropolitan areas of Las Vegas and Reno. However, some work worth noting has previously been done in that area. As part of a sub-regional analysis[10] of the Reno-Sparks economy, the Policom Corporation presented data on 316 metropolitan areas in the U.S. in an omnibus measure of "economic strength." Their index is derived from 25 years of data that analytically combines a number of measures designed to tap into both "the rate of growth and the consistency of the growth." Eighteen categories of data are included in the model, primarily in the areas of employment, earnings, and income.

Following these procedures, the Policom report provides data on both the Las Vegas Metropolitan Statistical Area (MSA) and the Reno MSA. Both major metropolitan areas in the state had an enviable record of economic advance. Of the 316 metropolitan areas, Las Vegas ranked sixth on the 1999 Index of Economic Strength and Reno placed a respectable forty-sixth. In subsequent sections of this report, the Battelle team will begin to unravel these differences, particularly as they pertain to technology.

Overview of the Nevada Technology Economy

In this section, the team will begin to pull apart the highly generalized information presented above, and look in more detail at some of the indicators that have been used to characterize the technology-based "new economy" in contrast to the "old economy." Ignoring for a minute the debate about whether such broad terminologies enlighten or inform understanding, we should pause for a minute and present some of those distinctions. Borrowing heavily from Progressive Policy Institute[11] work, the New Economy is characterized by networked entrepreneurial companies which serve global dynamic markets. Those companies place a greater reliance on innovation and research knowledge, tend to be highly mobile, are involved in alliances and collaboration with other firms, use flexible production, and digitize many aspects of their operations. Their workforce is paid more, has greater skills and knowledge, is likely to be involved in constant upgrading of skills via lifelong learning, and is more amenable to a collaborative model of labor-management relations. Employment tends to be less stable, but with more professional and financial opportunities. These working definitions suggest a number of useful comparisons.

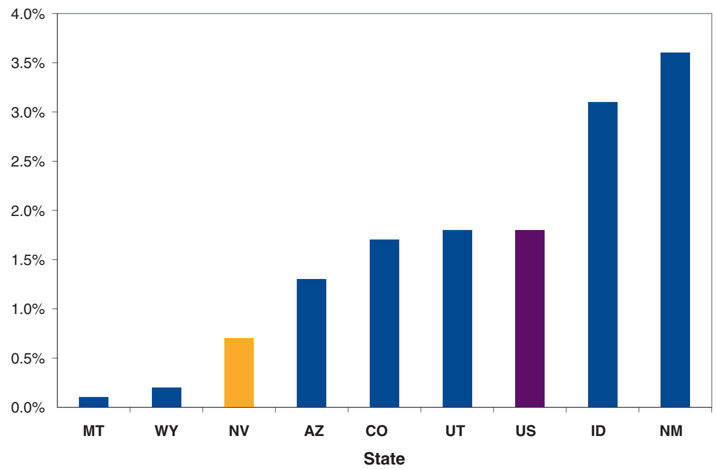
Research, Development, and Innovation

States that have a greater concentration of R&D-intensive firms, academic research, and associated inventive activity will be more competitive in the New Economy. Looking first at industrial R&D[12], it is obvious from Figure 4 that Nevada is less competitive than several of its peer states, ranking near the bottom and exceeding only Montana and Wyoming in terms of indus-

10. Policom Corporation. *The Washoe County Reno-Sparks Economy. Historical, Comparative Economic Analysis.* Jupiter, FL: The Policom Corporation, September, 1999.
11. Atkinson, R.D., Court, R.H., and Ward, J. M. *The State New Economy Index.* Washington, D.C.: Progressive Policy Institute, 1999.
12. These are data from the Progressive Policy Institute report, derived from 1995 National Science Foundation information.

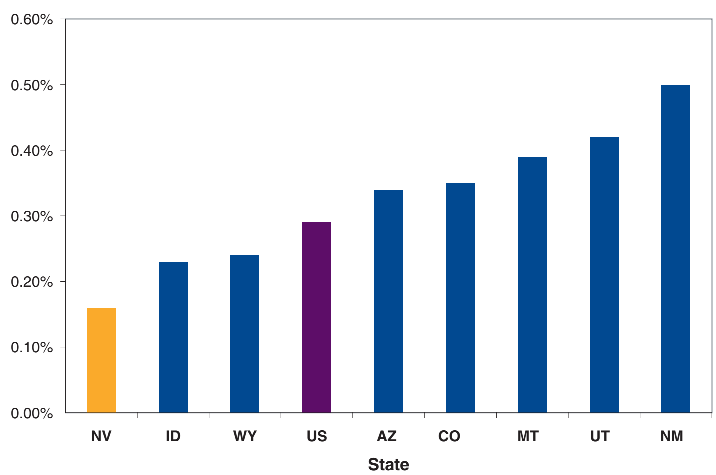
try R&D as a percentage of gross state product (GSP). It should be noted that the New Mexico and Idaho figures are somewhat larger than might be expected because of the presence of large federal R&D facilities, which are managed by private contractors.

Figure 4: Industry R&D as Percentage of GSP



Another useful metric is the scope of academic research, again as a percentage of GSP.[13] These data are presented in Figure 5. In the New Economy, academic R&D is often heavily linked to private sector business development, particularly in life science industries such as biotechnology and pharmaceuticals. Despite major gains at the state's two flagship universities over the past few years, they still lag behind the normalized performance data of all of their peer states. That is, although performance is increasing, it is still not growing faster than the overall economy. Notable in Figure 5 are the commendable performances turned in by Utah and New Mexico, other large area, low population states.

Figure 5: Academic R&D

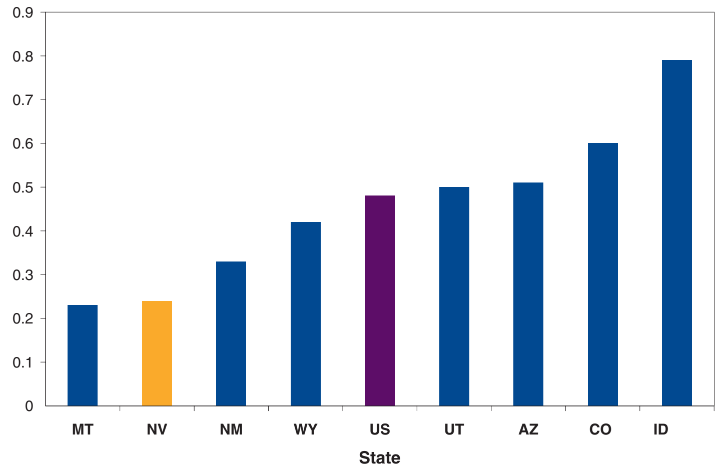


Also interesting is the base rate of innovation, using the incidence of patenting as a proxy. It should be realized, of course, that much innovation is more informal and protected by trade

13. Derived from data in *Science and Engineering State Profiles: 1998 Data Update*.

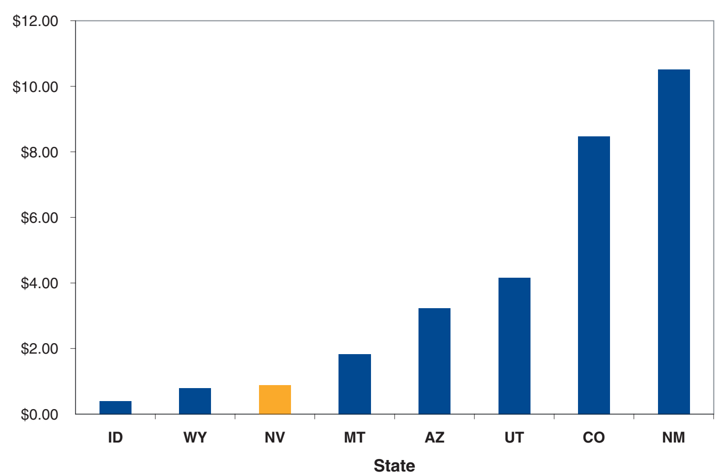
secret agreements, copyrights, or other devices. Nonetheless, looking at patents[14] per 1,000 workers in Figure 6, it is clear that Nevada trails its peer states. Since this index reflects patenting by industry researchers and university faculty, it is a statement about shortcomings in both sectors. Nevada is in a near tie with Montana for last place.

Figure 6: Patents per Thousand Workers



Another proxy for inventive activity is the relative success in competing for federal grants from the Small Business Innovation Research (SBIR) program. SBIR grant competitions operate in each of the major federal research-funding agencies, and the distribution of winners across the country has generally mapped well against the technological prowess of a state. These data[15] are presented in Figure 7. As can be seen, Nevada's success is marginal, only exceeding the performance of Idaho and Wyoming.

Figure 7: Total SBIR Funding per Resident, 1996



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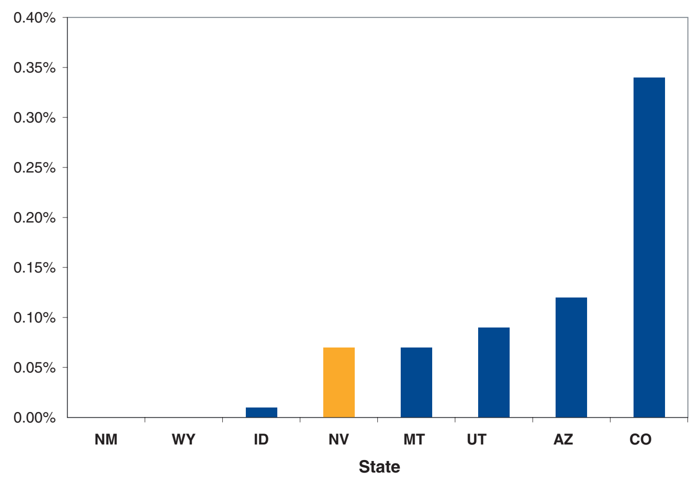
14. These are from *The State New Economy Index*, and based on 1996-1997 data from the U.S. Patent and Trademark Office.
15. These are SBIR awards per capita, 1996, and are from the *NSF EPSCoR National Almanac*.

Although inherently more difficult to track, there are national databases on the scope of venture investment by state. One of these is Price Waterhouse Coopers' list of Money Tree Investee Companies. For the fourth quarter of 1999 they list three companies in Nevada as receiving venture investment. By comparison, the list indicates 38 Colorado companies, 11 companies from Arizona, and 10 companies from Utah. These data are also available[16] in more aggregate form for 1997 as a percentage of gross state product (GSP). These data are presented in Figure 8. Within the mountain region, only Colorado is nationally competitive, ranking third in the U.S.

Figure 8: Venture Capital

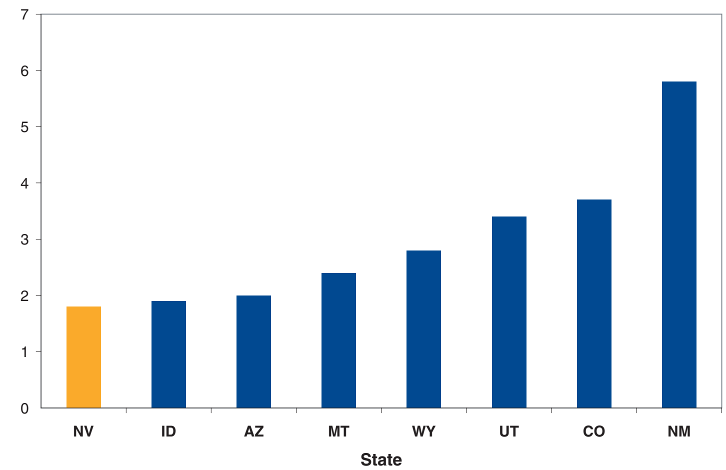


The High Technology Workforce

Key to success for New Economy companies is access to highly skilled, well-educated people. There are several ways in which a state can be assessed in this area. One is in the presence of such individuals in the existing workforce. For example, Figure 9 presents data on the number of doctoral scientists and engineers per 1,000 employed persons.[17] As can be seen, Nevada trails its peer states, particularly Colorado and Utah (as well as New Mexico, the site of a major DOE laboratory), which have perhaps the most robust technology economies in the mountainous west.

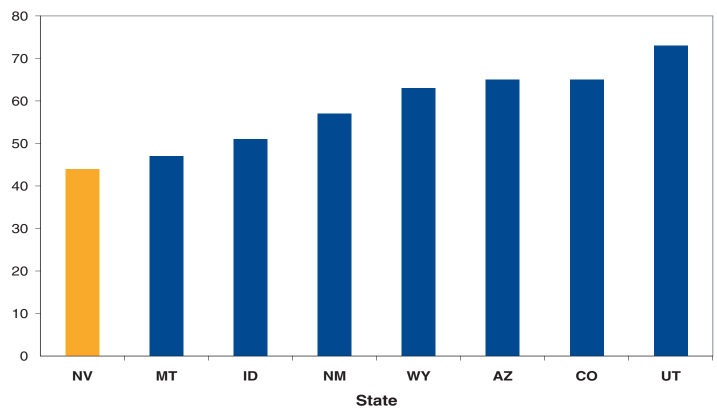
16. From *The State New Economy Index*, but originally from Price Waterhouse Coopers LLP, *Money Tree Report 1997*.
17. For 1995, and from *NSF EPSCoR National Almanac*.

Figure 9: Number of Employed Doctoral Scientists and Engineers per 1,000 Employed Persons, 1995



Another way of looking at the issue is to examine the emerging supply of knowledge workers. In Figure 10 are presented data[18] on the number of students enrolled in higher education institutions per 1,000 residents (as of 1995). Again, Nevada trails the region.

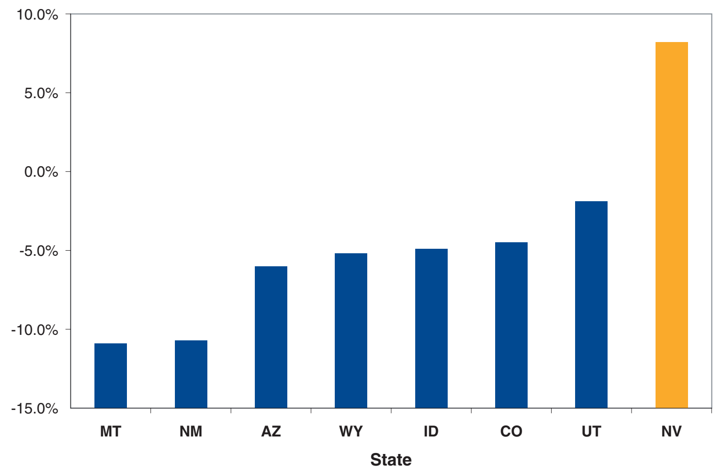
Figure 10: Number of Students in Higher Education per 1,000 Residents



Nevada has made major gains and exerted significant effort to remedy this state of affairs. A telling statistic[19] is the change in the number of graduate students enrolled in science and engineering at state-based universities between 1993 and 1997. In Figure 11 it is clear that Nevada leads the mountain region in this index. This reflects both population changes as well as recent investments to add capacity to the university and community college system of Nevada.

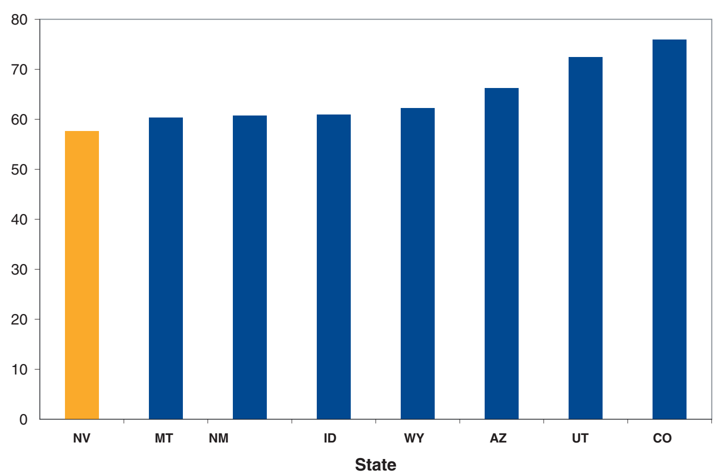
18. For 1995, and from *NSF EPSCoR National Almanac*.
19. From *NSF EPSCoR National Almanac*.

Figure 11: Percent Change of Students Enrolled in Science and Engineering, 1993 to 1997



Nonetheless, data on the educational attainment of Nevada residents suggests that the state still is far from ideal in terms of having the necessary human resources for a high-tech economy. Figure 12 presents data on a composite index[20] of educational attainment developed from data on the percentage of residents with either advanced degrees, bachelor's degrees, associate's degrees, or some college experience. As can be seen, Nevada is last among its peer states. The two mountain states that have the reputation as being high-tech also have the necessary work force credentials as well. Colorado ranks first in the country on this index, and Utah places third. Nevada ranks twenty-eighth.

Figure 12: Educational Attainment Index



Finally, there is other data that suggests that, in the absence of a robust technology-based industrial sector, increasing the supply of scientists and engineers will have diminished returns. Too many of them will leave for employment opportunities elsewhere, although this may be counterbalanced by immigration from other states. In 1998, the Southern Technology

20. The measure was developed for The State New Economy Index, and computational details are provided therein.

Council (STC) published a fifty state analysis[21] of interstate migration patterns of recent science and engineering graduates. The national rankings for the eight state mountain region on retention and net migration of recent science and engineering graduates are presented in Table 5. The former index reflects the fraction of one's own graduates that stay in-state to

Table 5: Retention and Migration Rankings

Ranking	NV	AZ	CO	ID	MT	NM	UT	WY
Retention	46	32	21	28	27	42	28	41
Net Migration	2	22	13	7	32	36	47	11

work; the latter index also factors in individuals moving into the state. As can be seen, the picture for Nevada is mixed. On the one hand, retention of recent graduates seems to be quite poor. However, there does seem to be a significant influx of graduates from elsewhere in the country, as indicated by the net migration standings. What is unclear from the STC data is whether a qualitative balance accompanies this quantitative balancing. In other words, do the best and brightest young people of Nevada leave only to be replaced by others with lesser academic records? A follow-up national analysis currently being conducted by STC indicates that students with higher grades have a greater propensity to leave. This analysis merits further study by the state's institutions of higher education.

Interestingly, in another analysis by the STC, it was found that the percentage of those who stay was an important predictor in determining retention. That is, if students stay in their home state to go to college, they are more likely to remain and work in-state after college graduation. Unfortunately, Nevada was forty-second in the fraction of individuals who stayed. It is not clear what attracts Nevada high school graduates to colleges in other states.

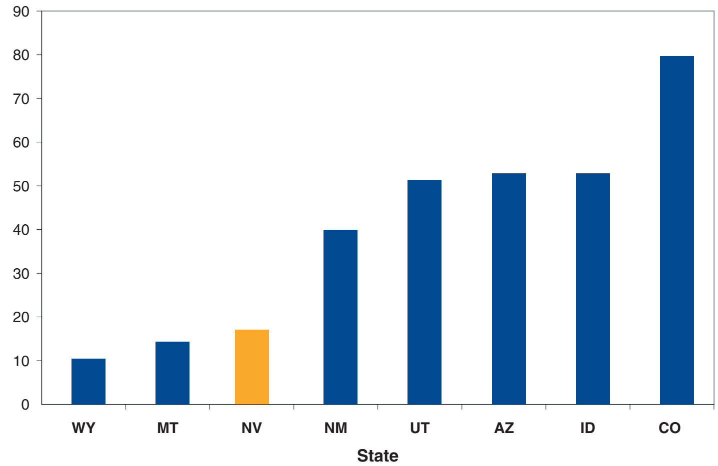
Indicators of Technology Industry

In this section, we will present several indicators of the presence of technology-intensive industry in Nevada, both broadly and in a few key industries. In the next section we will present the results of a more detailed analysis of these same questions.

One useful measure is the index that has been developed by the American Electronics Association (AEA)[22] on the number of "high tech" jobs per 1,000 private sector workers in a state. While this measure is tilted toward computer, electronics, and information technology industries (understating life science companies) and is also very broad, going well beyond sectors considered high-tech by the Bureau of Labor Statistics, it is useful nonetheless. As can be seen from Figure 13, only Montana and Wyoming score worse among peer states.

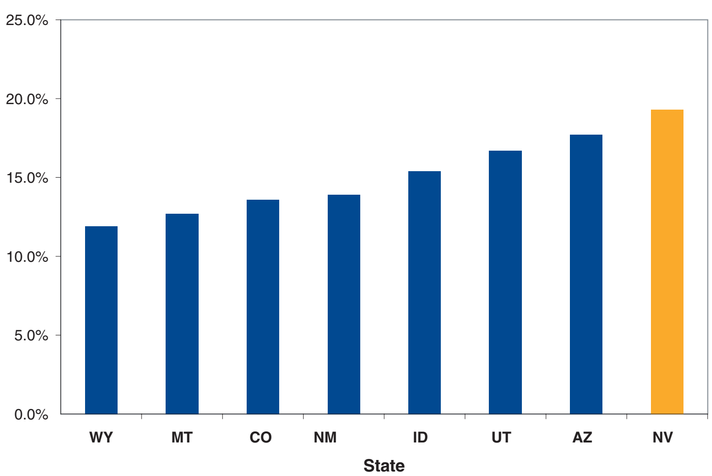
21. Tornatzky, L.G., Gray, D., Tarant, S. A., and Howe, J.E. *Where Have All the Students Gone? Interstate Migration of Recent Science and Engineering Graduates.* Research Triangle Park, NC: Southern Growth Policies Board, 1998. The detailed data in this report are provided courtesy of the Southern Technology Council.
22. American Electronics Association. *Cyberstates 3.0* Washington, D.C.: American Electronics Association, 1999.

Figure 13: High-Tech Workers per 1,000 Private Sector Workers



Some more hopeful indicators are reflected in data on the fraction of "gazelle jobs" in a state. That is, what percentage of total employment is accounted for by small, fast-growing companies? While the fraction of gazelle jobs is not a pure indicator of technology-intensive industry, it is one of the defining characteristics of New Economy regions.[23] One cautionary note: this measure is often inflated in economies in which there is large service industry employment (such as in Nevada), much of which might be in jobs based on qualifications other than knowledge. Nonetheless, the relevant data are summarized in Figure 14. As can be seen, Nevada looks very good by this measure, and in fact leads the country. At the very least, this suggests that there is a strong entrepreneurial culture in the state, which might be directed toward more technology-intensive foci.

Figure 14: Percentage of "Gazelle" Jobs in State Economies

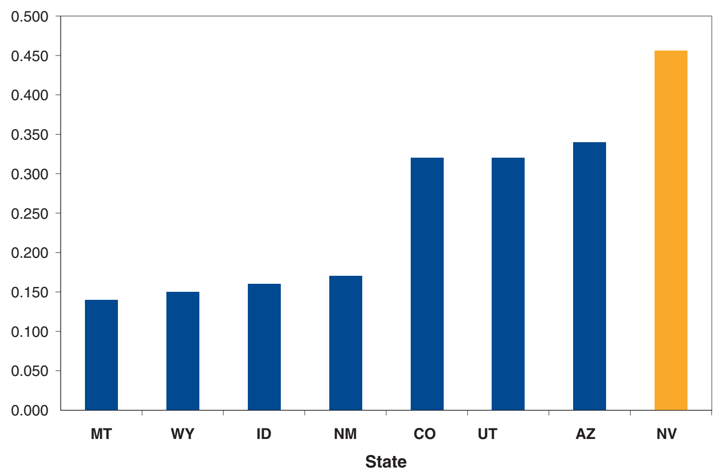


One additional indicator is presented in this section, as it is relevant to trends in the national economy. Electronic commerce and various "dot.com" enterprises have captured the attention

23. It should be noted that as usually tabulated, this measure is not a measure of public companies. The data reported here were originally developed by Cognetics Inc., under the leadership of David Birch and his colleagues, and also reported in *The State New Economy Index*, published by the Progressive Policy Institute.

of professional investors and the general public. It is clear that much future commerce, in all industries, will involve the Internet in some way. As an early measure of this activity the Progressive Policy Institute has published data and state rankings on the relative frequency of commercial Internet domains in a state. That is, of the over two million dot.com names already registered in the United States, what is the count per firm, state-by-state? Using this fairly crude measure, Figure 15 indicates that Nevada leads the country on this measure. While this performance is partly a function of the large number of entertainment and gaming enterprises in the state, it also likely reflects some significant growth in business-to-business Internet-mediated companies. For example, economic development organizations in southern Nevada are recently reporting an increasing number of such companies migrating from California.

Figure 15: Density of Commercial Internet Domain Names



Interestingly, the Internet company Yahoo has also published a ranking of "America's Most Wired Cities," focusing on metropolitan areas. This ranking also factors in Internet subscribers, which makes it a qualitatively different measure. Nonetheless, on this measure Las Vegas was ranked thirty-ninth. Among cities in peer states, it should be noted that Denver ranked eleventh, Phoenix nineteenth, and Salt Lake City twenty-fifth.

There are other metropolitan technology economy indicators that go beyond Internet usage as the primary index. For example, in 1997, the WEFA Group (formerly Wharton Econometric Forecasting Associates) published a study[24] in which lists of technology "Gorilla" and "Gazelle" communities were developed from indices on technology-based industry. The former is a list of the top metropolitan areas in the United States in terms of *existing* concentrations of technology industry. No Nevada city was in the top 100. In contrast, the parallel listing was of metropolitan areas by high-tech *growth* between 1990-1996. Las Vegas was first on that list.

24. WEFA, Inc. *Metro Growth: How Dependent on High-Tech Success?* Regional Special Study, August, 1997. Eddystone., PA.

An Emerging Technology Sector? A Quantitative Analysis

In this section the team will present analyses that go beyond the "as is" picture presented above. This is more speculative information, attempting to discern early glimmers of technology-based industry. The thrust of these analyses is to discern whether there is evidence of emerging technology industries that might form the nucleus of technology clusters. In the theory and practice of economic development, these consist of concentrations of firms that exceed the national averages, are located in a geographic area, and often involve industries with complementary business interests. The following is a useful working definition:

> *The unit of analysis within the "new economy" has now been distilled down to the essential wealth producing market area–the regional economy and its production system. The new accepted wisdom is that the more prosperous regional economies tend to be anchored by well-developed, geographically concentrated clusters of firms who trade with each other and compete against each other. These clusters develop for a host of reasons including proximity or access to customers or suppliers, to labor markets with specialized skills, to specialized information and technology, to industry leaders and innovators, or even to competitors. They are as likely to be centered on a technology like robotics or lasers as a product such as carpets or automobiles. They are characterized by a complex series of buyer-seller relationships that include producers of not only goods but also specialized support service providers such as bankers, accountants, software developers, training organizations, etc., with a specialized knowledge of their cluster and industry.*[25]

For example, in one area there might be a cluster of computer companies, manufacturers of peripherals, software developers, and microchip producers. Another area might have a cluster of pharmaceutical companies, biotech R&D organizations, and bioinformatics software companies. Each emerging technology sector has its own dynamics of interrelated business connections. The task of the analyst is to discover early indicators of emerging clusters, which will enable wise public policies to accelerate trends already underway.

Because of constraints of time and resources, the analysis reported below is not a full-blown cluster study. That would involve also looking at lower tech industries that buy from and sell to technology companies. However, as will be seen below, it is probably ill-advised to perform that more comprehensive analysis at this point in time.

Definitions, Techniques, and Data

Battelle reviewed employment data for Nevada to determine whether the state has any existing or emerging comparative advantage in industrial sectors commonly thought of as "high technology." For our definition of high technology, we used that published by the U. S. Bureau of Labor Statistics (BLS). BLS now recognizes two tiers[26] of high technology standard industrial classification (SIC) codes: one group of twelve sectors in which employment of R&D and technology workers is typically five times more intensive than the national average for all sectors, and a second group of nineteen codes in which the same ratio is at least twice the national

25. Williams, Trent. "Responding to the Private Sector: Smarter Incentives for a Smarter Economy." *Accountability: The Newsletter of the Business Incentives Clearinghouse.* Volume 2, Number 3, March, 2000.
26. Hecker, D. "High-technology employment: a broader view." *Monthly Labor Review*, June, 1999.

average. Our data came from two sources: current employment data derived from Dun & Bradstreet surveys and reported by the vendor iMarkets, and historic employment data for 1993 and 1997 published in the *County Business Patterns* of the U. S. Census Bureau. We used two basic analytical techniques: location quotients and shift-share analysis. Location quotients (LQs) measure specialization relative to the national economy: that is, when the LQ is greater than one, the sector accounts for comparatively more employment in the local economy than the same sector does in the national economy. Shift-share analysis decomposes changes in local employment over time in a given sector into three additive factors: overall growth of the national economy, relative growth of that particular sector in the national economy, and a residual representing a "competitive" shift in the local economy. Any competitive shift greater than zero is worth observing.

Location Quotients in Nevada and the Benchmark Set

Table 6 sets out the location quotients for the BLS "high-technology intensive codes" for Nevada and the benchmark states. Nevada shows no apparent specialization (LQ>1) in any of these codes, probably because its economy is so heavily specialized in resort services which benefit from high-tech growth but are not themselves classified as high-tech. The code closest to specialization is 382, which represents manufacturers of measurement and control devices. When Battelle examined employment in this sector at the next level of detail (4-digit SIC codes), we found no strong specialization in any sub-sector. There was a high number of jobs (980) in the catch-all, "not otherwise classified" code. This may represent employment in a few medium-sized plants that are not easily categorized in one of the other codes. In comparative terms, it may be important for Nevada's competitive strategy to note that each of the benchmark states except Montana shows a strong specialization in at least one of the high-tech intensive codes. For example, Colorado was strong in several sectors related to information technology, Arizona was prominent in aerospace as well as electronic components, and Utah was also strong in aerospace.

Table 6: Location Quotients in Nevada and the Benchmark Set

High-Tech Industry (BLS)	NV Jobs (2000)	NV LQ	AZ LQ	CO LQ	ID LQ	MT LQ	NM LQ	UT LQ	WY LQ
281 - Industrial inorganic chemicals	543	0.50	0.40	0.16	1.66	0.29	0.63	1.34	6.78
283 - Drugs	470	0.23	0.25	0.61	0.80	0.36	0.41	1.47	0.09
286 - Industrial inorganic chemicals, other	55	0.08	0.17	0.13	0.05	0.14	0.07	0.03	0.17
357 - Computer and office equipment	564	0.20	0.85	2.62	6.89	0.20	0.10	1.16	0.50
366 - Communications equipment	433	0.17	0.95	1.42	0.21	0.06	0.32	1.54	0.04
367 - Electronic components/accessories	866	0.20	3.66	1.11	0.79	0.08	1.51	0.83	0.00
372 - Aircraft and parts	520	0.17	1.19	1.31	0.11	0.04	1.06	0.23	0.14

Table 6: Location Quotients in Nevada and the Benchmark Set

High-Tech Industry (BLS)	NV Jobs (2000)	NV LQ	AZ LQ	CO LQ	ID LQ	MT LQ	NM LQ	UT LQ	WY LQ
376 - Missiles, space vehicles, parts	6	0.02	2.27	0.24	0.00	0.00	0.34	4.65	0.00
381 - Search and navigation equipment	119	0.11	2.05	0.22	0.04	0.10	0.23	1.86	0.00
382 - Measuring and control devices	1,421	0.63	0.99	1.15	0.15	0.26	1.67	0.59	0.17
737 - Computer/data processing services	4,742	0.37	1.00	1.73	0.50	0.36	0.37	1.18	0.28
873 - Research and testing services	2,273	0.36	0.79	1.06	2.20	0.57	3.83	0.73	1.60

In addition, the team examined location quotients in the next tier of industrial codes that are classified as high technology by the Bureau of Labor Statistics. The results of this analysis are presented in Table 7. Even using this expanded list of industries, the only one in which Nevada shows a specialization is in ordnance and accessories. This specialization may be related to contractors serving the arms-decommissioning effort at Hawthorne. There is also some specialization in engineering and architectural services, which is most likely related to construction in the gaming and resort industries, as well as residential construction accompanying population growth. Among the benchmark states, Utah and Colorado tend to show a greater degree of specialization in this second group of sectors and their location quotients tend to be larger. For example, Utah has elevated location quotients in miscellaneous chemical products, petroleum refining, industrial machinery, audio and video equipment, and medical instruments and supplies. Colorado was also strong on the medical instruments and supplies location quotient.

Table 7: Location Quotients

High-Tech Industry (BLS)	NV Jobs (2000)	NV LQ	AZ LQ	CO LQ	ID LQ	MT LQ	NM LQ	UT LQ	WY LQ
282 - Plastics materials and synthetics	151	0.14	0.19	0.11	0.00	0.03	0.06	0.16	0.00
284 - Soaps, cleaners and toilet goods	334	0.37	1.70	0.30	0.27	0.06	0.29	0.80	0.04
285 - Paint and allied products	303	0.90	0.30	0.21	0.24	0.13	0.35	0.13	0.00
287 - Agricultural chemicals	13	0.04	0.75	0.30	7.61	0.98	0.34	0.63	4.46
289 - Miscellaneous chemical products	273	0.35	0.88	0.28	0.21	0.08	0.46	1.22	0.70
291 - Petroleum refining	37	0.06	0.11	0.46	0.07	2.35	1.00	2.45	3.30
348 - Ordnance and accessories	837	2.64	0.49	0.21	3.93	0.76	0.07	0.65	0.49

Table 7: Location Quotients

High-Tech Industry (BLS)	NV Jobs (2000)	NV LQ	AZ LQ	CO LQ	ID LQ	MT LQ	NM LQ	UT LQ	WY LQ
351 - Engines and turbines	25	0.04	5.96	0.04	0.06	0.11	0.15	0.79	0.11
353 - Construction and related material	298	0.17	0.26	0.46	0.39	0.20	0.19	0.82	0.37
355 - Special industrial machinery	320	0.28	0.79	0.36	1.69	1.70	0.13	0.27	0.01
356 - General industrial machinery	750	0.45	0.19	0.37	0.11	0.13	0.22	3.04	0.32
361 - Electric distribution equipment	27	0.04	0.60	0.15	0.24	0.01	0.01	0.09	0.00
362 - Electrical industrial apparatus	97	0.08	0.36	0.26	0.27	0.07	0.15	0.32	0.06
365 - Household audio and video equipment	135	0.28	0.77	0.15	0.17	0.05	3.29	1.35	0.05
371 - Motor vehicles and equipment	734	0.12	0.37	0.16	0.10	0.03	0.35	0.36	0.02
384 - Medical equipment, instruments, supplies	406	0.20	0.40	2.02	0.64	0.20	0.87	2.98	0.11
386 - Photographic equipment and supplies	94	0.17	0.47	0.20	0.09	0.24	0.11	0.11	0.01
871 - Engineering and architectural services	7,794	1.14	1.03	1.45	2.28	0.78	1.21	0.86	0.73
874 - Management and public relations	12,039	0.80	0.87	1.28	0.38	0.51	0.78	0.99	0.38

Changes in Location Quotients in Nevada

The second phase of Battelle's quantitative analysis focused on *changes* in employment in the high-technology intensive sectors. For this work we relied on easily comparable data from the U.S. Census Bureau's *County Business Patterns*. We first calculated location quotients based on these data for both 1993 and 1997 (see Table 8). These data suggested several areas of potential interest, particularly those where there were shifts in the LQs over time. There are some limitations on this longitudinal analysis given the way the data are collected and reported in Nevada by the census,[27] particularly because of the low absolute number of companies in many of these sectors. Nonetheless, of interest are the rise in LQ for industrial inorganic chemicals (although still not strong enough to represent a specialization), and the decline in LQ for research, development, and testing services.

27. Because there are so few employers in some of these codes in Nevada, Census reports a "range" of jobs in some of these codes to avoid identifying information from individual firms, and we have therefore had to interpolate using the midpoint of this range. Similar restrictions do not apply to D&B data.

Table 8: Changes in Location Quotients for Nevada, 1993 and 1997

Location Quotients for Nevada	1993	1997
281 - Industrial inorganic chemicals	0.49	1.02
283 - Drugs	0.08	0.11
286 - Industrial Chemicals	0.01	0.07
357 - Computer and office equipment	0.21	0.22
366 - Communications equipment	0.12	0.06
367 - Electronic components/accessories	0.11	0.15
372 - Aircraft and parts	0.02	0.12
376 - Guided missiles, space vehicles	0.08	0.02
381 - Search and navigation	0.04	0.14
382 - Measuring and control devices	1.15	0.98
737 - Computer and data processing services	0.22	0.28
873 - Research, development, testing	1.26	0.77

Shift-Share Analysis for Nevada

Table 9 reports the results of our shift-share analysis. Subject again to the data limitations noted above, Nevada appears to report positive competitive shift in nine of the twelve sectors. We have highlighted those of particular interest. Industrial chemicals, aircraft and aircraft parts, and search and navigation equipment all show positive competitive shift, but none of these represent a true specialization, and in every case the sector is not growing as fast as the national economy. Measurement and control shows nearly neutral competitive shift. Possibly most interesting among these results is a positive competitive shift, combined with a positive proportional shift, in computer and data processing services. This suggests that Nevada is beginning to do better than the national norm, in a sector which is growing faster than the national economy, although prior results show there is still no true specialization in Nevada in this sector. This is consistent with some of the fragmentary information reported above about the Internet and electronic commerce in Nevada, but is in no way conclusive. This sector clearly bears further watching.

Table 9: Shift-Share Analysis for Nevada

Sector	Econ. growth	Propor-tional shift	Diff. shift	Total shift	NV employ-ment 1993	NV employ-ment 1997
281 - Industrial inorganic chemicals	0.1109	-0.2406	1.2761	1.1464	280	601
283 - Drugs	0.1109	-0.0462	0.8375	0.9022	92	175
286 - Industrial chemicals	0.1109	-0.0899	4.9790	5.0000	10	60
357 - Computer and office equipment	0.1109	-0.0335	0.3179	0.3953	296	413
366 - Communications equipment	0.1109	0.0310	-0.5110	-0.3690	168	106
367 - Electronic components and accessories	0.1109	0.0076	0.6892	0.8077	364	658
372 - Aircraft and parts	0.1109	-0.2970	5.4362	5.2500	60	375
376 - Guided missiles, space vehicles	0.1109	-0.4583	-0.4859	-0.8333	60	10
381 - Search and navigation	0.1109	-0.3606	2.1664	1.9167	60	175
382 - Measuring and control devices	0.1109	-0.0952	0.0191	0.0348	1,839	1,903
737 - Computer and DP services	0.1109	0.3974	0.8009	1.3092	1,297	2,995
873 - Research, development, testing	0.1109	0.0194	-0.3076	-0.1773	3,316	2,728

Summary And Implications

In this section the Battelle team will attempt to summarize the data and conclusions developed elsewhere in this chapter. These summary statements contextualize the final report.

Summary Findings

The findings below, developed through Battelle's analysis of existing secondary data sources, reflect Nevada's performance relative to the peer states previously listed:

- General indicators of the Nevada economy are quite robust, even more so for the Las Vegas area. This includes growth, employment, income, and income distribution.
- Population trends indicate burgeoning growth, with a heavy influx from adjacent states, particularly California.
- The Nevada economy is heavily oriented toward the service sector, with a huge role played by gaming, resorts, and associated businesses.
- Nevada is not an R&D-intensive state with respect to either industry or academia.

- Despite recent emphases on higher education, Nevada's workforce and level of educational attainment are not up to par for a high-tech state, and the state may have a "brain drain" problem in terms of its best and brightest students.
- The fraction of employment in technology-based industry is relatively low.
- The small business, entrepreneurial component of the state economy seems to have significant strength.
- Nevada is weak on measures of innovative activity involved in the creation of new technology.
- There is no persuasive evidence that any technology-based industry cluster has taken hold in the Nevada economy, although there is across-the-board growth in high tech industries. In particular, there are early indicators that a "dot.com" industry is beginning to emerge.

Is There a Nevada Technology Economy?

In a word, yes, but it is still in its infancy. The Nevada New Economy does not conform to the traditional conceptions of what a technology-based state or regional economy should look like. There are no obvious clusters of interconnected producers and suppliers in a few industry domains. There is neither a Silicon Valley, nor a biotech alley. There is no industry (other than munitions, which might be a reach) that seems to fit the bill of being a nucleus for a technology-based economy.

Nonetheless, there are a growing number of technology-based small companies (and a few larger ones) that are slowly making their presence known in the two major metropolitan areas of the state. They span the continuum in terms of product and market foci, and many of them have business or structural relationships within the California economy. However, based on the data reported here, it is impossible to define a single technology industry focus for the state.

Looking ahead, it may be a wiser course of action to look at broader issues that can impact technology-based economic development in a number of sectors. This tentative conclusion also points to a number of specific strategies and actions that will be presented by the Battelle team in Chapter 4. These will be preceded by Chapter 3, in which the Battelle team will provide a overview discussion of Nevada's strengths, weaknesses, opportunities, and threats (SWOT).

Chapter 3: Strengths, Weaknesses, Threats and Opportunities for Nevada

Introduction

This chapter provides a quick overview of the challenges, weaknesses, and external threats facing Nevada as it moves toward a more technology-based economy, as well as the assets, strengths, and opportunities that it can bring to bear at this point in its history.

The chapter is based on several analytic inputs. First, the observations and conclusions rely significantly on the secondary data reported in Chapter 2, albeit presented in a more succinct manner. Second, this SWOT analysis relies heavily on an extensive data-gathering effort conducted by the Battelle team during the spring and summer of 2000. This included interviews and meetings with over one hundred Nevada citizens, numerous phone calls to verify information and obtain further detail, and a review of over 5000 pages of text that had been provided by various individuals and organizations from within the state and elsewhere. Over half of the interviews and meeting participation involved leadership from the private sector, with the balance coming from higher education, government, and various not-for-profit organizations. Third, the preliminary conclusions of the SWOT analysis were reviewed at two focus group meetings held during August in Reno and Las Vegas and attended by over thirty members of the Project Advisory Committee, and other prominent business, academic, and government leaders in the state. Fourth, the SWOT analysis benefited from the collective wisdom of the Battelle team. Preliminary conclusions and recommendations were exposed to an intensive process of review, brainstorming, and revision, which was conducted in September at the Battelle offices in Ohio.

As suggested above, this chapter is organized into four sections: strengths, weaknesses, threats, and opportunities. In Chapter 4 we will present a set of recommended Strategies and Actions based on this SWOT analysis.

Strengths

- **Quality of Life.** Nevada has an inviting climate, extensive resort opportunities, manageable traffic, and few problems related to urban sprawl. These are all attractive to technology-oriented companies and people.

- **Cost of Doing Business.** The Nevada tax structure is attractive for companies and individuals. It has helped make Nevada the fastest growing state in the U.S. in terms of population, as well as posting impressive figures in personal income and gross state product. Nevada needs to continue to be competitive in this area.

- **Access to Government.** Nevada is in effect two city-states surrounded by vast federal holdings and a number of small rural communities. Access to state government is seen as good-to-excellent by the private sector and state leadership has a strong "local feel."

- **A Robust Economy Led by Gaming and Tourism.** Led by the dominant gaming and resort industries, Nevada has enjoyed virtually uninterrupted economic expansion for several years. This sector supplies most of the state revenues and, directly or indirectly, most of the employment. It is a superb foundation on which to build and add a technology sector.

- **An Entrepreneurial "Can Do" Culture.** Building from its western heritage, Nevada encourages small companies and individual enterprises, and benchmarks well against other states in terms of growing start-ups. Within the last few months several incubator projects have moved toward implementation.

- **Physical Infrastructure.** Airport facilities, roads, and telecommunications access are good to excellent, particularly in urban areas. The high bandwidth "pipes" that crisscross the state as a result of the federal presence represents a significant resource. Information infrastructure is essential in a global economy.

- **Partnership Trends.** There are excellent working relationships in place between economic development organizations in various parts of the state, as well as a growing number of joint initiatives within the University and Community College System. Nevada has generally been able to surmount the potential problems of North-South separation and is rapidly learning that success in the New Economy hinges on the intelligent teaming of business, academia, and government.

- **Incentives.** The state offers an attractive portfolio of incentives for companies. These include: no corporate or personal income tax; no franchise tax; no inheritance tax; no inventory tax; no special intangible tax; and no estate or gift tax. For "businesses with operations consistent with Nevada's state plan for economic development," there are also potential abatements on sales and use taxes, business taxes, and personal property taxes. There are a variety of programs that address issues of job training, construction financing, technical assistance, and outreach.[1]

- **Rapidly Growing R&D.** Although, as noted in Chapter 2, the Nevada technology base is thin and somewhat unfocused, its **growth rates** are commendable. For example, in terms of ten year (1987–1997) growth in R&D (as a percentage of gross state product), Nevada is one of only eight states in the country[2] that experienced real R&D growth in excess of three percent.

- **A Large Federal Presence with High Technology Content.** The Nevada Test Site, Nellis Air Force base, the Nellis Test Range, Fallon NAS, and the Hawthorne munitions facility represent over $1 billion in federal spending, numerous government jobs and associated civilian contractors, and a storehouse of state of the art technologies. In addition, the $380 million in federal R&D expenditures that come to the state represent a major asset.

- **Technology Corridor Propinquity.** Northern and southern Nevada (Las Vegas and Reno) are close to some of the world's most robust technology corridors, which are located in California and other states on the Pacific coast. For Las Vegas, this means the I-15 corridor to Los Angeles, Orange and San Diego counties is easy, and for the Reno-Carson City area, the

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1. Nevada Commission on Economic Development. *Select Nevada Business Assistance Programs*. Carson City, Nevada: 2000.
2. National Science Foundation, Division of Science Resources Studies. *States Vary Widely in their Rates of R&D Growth.* Data Brief, NSF 00-325, July 10, 2000.

I-80 trip to the San Francisco Bay area is only a few hours. These destinations represent huge markets, potential targets for company recruitment, sources of science and technology partnerships, and talented people who can be attracted to the state.

Weaknesses

- **Single Industry Dominance.** Both the reality and the image of the Nevada gaming industry are negatives for those in high technology. This has also dampened the enthusiasm for technology diversification among the policy community. As in many single industry dominated state economies, there also appears to be a perception of invulnerability—that the relatively recent rise in gaming and resorts will continue its rate of increase forever. There are obvious boundary conditions imposed by supplies of water and plentiful land contiguous with the established centers of gaming.

- **Absence of a Nationally Prominent Research University.** Nevada does not have a distinguished national research university, and its academic R&D performance compares unfavorably to other western states (e.g., Colorado, Utah). This situation is particularly exacerbated by shortcomings in research infrastructure and the support thereof, as well as diverse opinions, external and internal, about the roles and missions of the state's higher education institutions.

- **A Thin Technology Sector.** Nevada has not attained critical mass in any technology industry, either in terms of employment concentration or in the presence of a number of flagship facilities. It comes closest with recent growth in e-commerce and information companies. Industry R&D is low and there is no major federal laboratory within Nevada.

- **An Overstressed K–12 System.** There has been tremendous growth of the under-eighteen population segment, putting great strain on the state's K–12 system, in terms of capital investments, program development, and staffing. This situation is exacerbated by the mixed academic background of incoming students from elsewhere in the country, as well as difficulties in finding excellent teachers to fill the personnel demands of a rapidly growing system. For these and other reasons, the K–12 system ranks low on many national indices of performance, including subsequent participation in higher education. This reduces the size of the pool of appropriately skilled individuals.

- **Technology Workforce Shortages.** Technology-based companies are having a difficult time finding appropriately skilled people in Nevada at both entry and senior levels. The fallback strategy has been to go "over the hill" to California, which adds to the cost of doing business. This shortage is particularly acute for newer companies in search of key managerial talent and experienced engineers and scientists.

- **Brain Drain.** A high percentage of UNLV and UNR graduates in science, business, and engineering leave the state for employment. The perceived lack of meaningful, well-paying jobs in Nevada in their area of expertise is the primary reason for this emigration. Many graduates indicate that they would stay, or return, given a suitable opportunity structure. The question is whether millennium scholars will leave for diversified career options.

- **Weak Entrepreneurial Support and Assistance Network.** Despite encouraging recent developments in this area, there are limited technology business incubator facilities, and virtually no seed or venture capital in the state. For example, there is no SBIC in the state and limited business services catering to the needs of technology start-up companies (e.g. patent attorneys). There are relatively few incentives for start-up companies to locate in Nevada, particularly those which are still in an intense technology development phase, need capital and sound advice, and have yet to realize significant sales and profits.

- **A Weak University Technology Transfer System.** Staffing is weak in numbers and experience, policies and practices are not well developed, and the larger organizational culture is either unsupportive or indifferent. As a result, performance has not been as strong as it might. Technology transfer is not seen as a high priority item within the university sector in Nevada.

- **Statewide Coordination of Technology Programs is Weak.** The current Science Advisor office is substantively strong, but lacking in budget, program authority, flexibility, and visibility. As a result, program and activities concerning technology-based economic development are fragmented, and neither visible nor understood by the average citizen.

- **Coordination within the University and Community College System Needs Improvement.** There are weak or ineffectual relationships between different components of the system, sometimes along geographic lines and sometimes across different levels (e.g., two-year colleges vis-à-vis colleges and universities). Articulation (e.g., transfer of credits) between the universities and community colleges reportedly needs improvement, and there are relatively few joint programs that span UNR, UNLV, DRI, and the community colleges.

- **Inflexible Systems of Revenue and Spending.** While the absence of individual and corporate income taxes has been a powerful economic draw, the resultant reliance on gaming, property, and sales taxes has had implications for maintaining adequate public investments, particularly in education at all levels. A biennial budgeting process and a formulaic approach to funding higher education exacerbate this. Coupled with the reliance on gaming as a revenue source is an apparent belief that diversification will merely add to state obligations, but not increase revenues.

- **Rural Infrastructure.** Rural infrastructure, particularly telecommunications, is not sufficiently developed to support technology companies. While some communities have been able to aggregate demand in creative ways, many other areas do not have high bandwidth access to the Internet. Moreover, there needs to be a more coordinated and comprehensive strategy for rural technology-based economic development.

- **Government Use of Technology.** It is difficult for government to lead by example when it has been relatively slow to adopt technology in its own business practices. Recent analyses[3] rank Nevada 32nd in “digital government” and 47th in the effective utilization of technology in K–12 schools.

- **North-South Tensions.** The differences between the economy and culture of the north and the south tend to strain partnership relationships as well as the development and implementation of an integrated state approach to issues and problems.

3. Atkinson, RD, Court, R.H., and Ward, J.M., *The State New Economy Index,* Washington, D.C.: Progressive Policy Institute, 1999.

Opportunities

- **University Research Excellence.** There is an excellent opportunity to advance the research status of UNR and UNLV within the next few years. Targeting the hundreds of new UNLV faculty hires is an important part of this opportunity, particularly striving to provide essential research infrastructure. In addition, given the unique position of Desert Research Institute as a freestanding contract research organization, there is potential for expanding its focus in ways that will increase technology development in Nevada.

- **Leveraging Quality of Life.** As California becomes increasingly beset by problems of urban sprawl and a high cost of living, Nevada can look even more inviting. This is particularly true if there are intelligent private actions and public investments to further enhance Nevada's quality of life.

- **Changing the Image.** With modest expenditure but a coordinated effort, Nevada has the opportunity to point to the growing importance of its technology sector. External audiences—as well as Nevada residents—need to see the state as a player in the technology arena.

- **System Tightening and Tuning.** Many of the elements of an effective and coherent technology strategy are already in place. What is missing, however, are appropriate structures and policies to enable these elements to work together as an integrated system.

- **Up With People.** The most important ingredient in fostering technology-based companies is the availability of skilled people. This is also an area in which Nevada can make major improvements in the education, training, retention, and attraction of the best and brightest. A huge opportunity for Nevada lies in becoming attractive to people.

- **Building an Exemplary K–12 Education System.** Nevada cannot hope to build a robust technology-based economy unless it builds a twenty-first century educational system. The foundation of an exemplary state educational system must be in K–12 education. Nevada has both an awesome challenge and a unique opportunity to build a "best in the nation" primary and secondary educational system.

- **Encouraging the Growth of Technology Entrepreneurs.** Recruiting successful and established technology-based companies can be difficult and expensive, despite Nevada's considerable recent success in this activity. This strategy needs to be supplemented with efforts to "grow your own" technology start-ups.

- **Leveraging the Federal Presence.** As noted above, the federal presence in Nevada is significant and of long-standing. Heretofore, its impacts on the commercial economy have been derived from spillover from contract work and the presence of a federal workforce that has waxed and waned over the years. Nonetheless, Nevada could emulate the experience of other major federal facilities (e.g. Oak Ridge) and become more active and adept in commercializing technology, fostering spin-offs, and functioning as an innovation center for federal technology transfer and commercialization.

- **Broadening the Tax System.** As described elsewhere in the chapter, the state revenue base is narrow and vulnerable to downturns in the gaming and resort industry. Addressing this important and controversial public policy issue could help the long-term implementation of many of the recommendations in this report. The opportunity for the state is to ensure that the state tax structure facilitates entrepreneurial growth, through the broadening of the existing tax base.

Threats

- **Challenges to the Gaming and Resort Industry.** Gaming and associated resorts will continue to be the centerpiece of the Nevada economy for the foreseeable future. However, there are potential threats to the continued robust growth of the industry. One is the yet unknown impact of Native American gaming, particularly as enabled by Proposition 5 in California.[4] Second, is the potential growth of on-line and offshore gambling.[5] Third is the fact that Nevada's resorts are increasingly more dependent on non-gaming revenues.[6] While a huge marketing and business strategy success, ironically this may also make the gaming and resort industry more vulnerable to recessions. That is, as "optional buys" such as show tickets and upscale dinners become less attractive in tight economic times, this could impact industry revenues. All of these trends are obviously being monitored by the industry; all argue for an "insurance" investment in economic diversification into technology.

- **A Changing Technology Sector.** For much of the past decade, public policy and private markets have been focused on high technology, generally considered synonymous with information technology. However, the recent precipitous decline in Internet stocks and technology holdings should be a reminder that things do not go on forever. Nevada must move forward with a multifaceted technology strategy, mindful that there may be bumps in the road.

- **Swamping Investments by Competing States.** At least a dozen states—some of them quite large and endowed with R&D-intensive industry—have recently launched major investments in technology initiatives. The threat is that the size of these initiatives may price Nevada out of the game. For example, there are currently over 200 new university positions being recruited in the area of genomic science, many of them an outgrowth of new state initiatives. In addition, significant state technology programs are being planned and implemented in the neighboring mountain states of Arizona, Colorado, Idaho, New Mexico, and Utah. Can Nevada compete soon enough and at an appropriate level of investment?

- **The Responsive University.** A key component of a Nevada technology strategy should be to increase the scope and quality of industry-university partnerships. Yet, across the country a small group of leading-edge institutions are moving fast in this same direction. They are becoming the preferred "buying site" for industry partnerships such as sponsored research and technology transfer. They are doing this through creative combinations of mission, culture, policies, mission, and programs. Can UNLV and UNR get better fast enough?

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4. For example, see John Stearns recent weeklong series (week of December 10, 2000) in the Reno Gazette-Journal on the growth of Indian gaming in California, and its potential long term impact on the Nevada economy. It paints a very discouraging picture. The series can be viewed online at <www.rgj.com/news2/specialreport/>.
5. Pascual, A.M. "Offshore betting: The Feds are rolling snake eyes."
6. Berns, D. and T.Batt. "Casino Market: Recession could hit strip hard." Las Vegas Review-Journal, December 6, 2000.

- **The Graying of Nevada.** The demographics of population growth in the state indicate a rapid increase in the over-65 cohort. This will place significant demands on health and social services, and strain the existing tax structure.

Summary

This chapter has presented the boundary conditions within which Nevada must develop and implement a set of technology strategies and detailed activities. This has been organized in terms of strengths, weaknesses, opportunities and threats (SWOT). In the next chapter we will describe a set of strategies and an action agenda that will hopefully address the issues raised in the SWOT and enable the state of Nevada to move to a new level of innovation and performance within the New Economy.

Chapter 4: Strategies and Actions

Introduction

This chapter will provide a vision for Nevada's technology future, the strategies that need to be undertaken to achieve this vision, and the actions that can make these strategies a reality. First we will present a draft vision statement for growing Nevada's technology-based economy. This will be followed by discussions of six strategies that are essential to realizing the vision and to addressing the issues raised in the SWOT analysis.

Vision

> *Nevada will be the place where great ideas become reality. Nevada's 21st century economy will continue to be founded upon a stable and robust gaming and resort industry, but this will be supplemented by a rapidly growing entrepreneurial technology and knowledge sector. This sector will be composed of both new-to-Nevada technology firms as well as those that have thrived in the state for some time, all delivering high-value products and services that will serve national and global markets. This sector will attract the best and brightest knowledge workers, both homegrown and from afar, who will be well-paid, major contributors to the betterment of Nevada. The state will have a first-class, nationally renowned educational system—from kindergarten through graduate school—and will be in the first rank of states in R&D and innovation. The business infrastructure will be consistent with the new global economy. Nevada's New Economy will support an increasingly rich quality of life and unparalleled educational, cultural, and employment opportunities for all its citizens. For business leaders, young people, retirees, and average citizens, it will be* ***the*** *place to live and work.*

Strategies

Working with our many Nevada partners, the Battelle team has developed the six strategies listed below that, if successfully implemented, would realize the vision articulated above:

> Focus the state's economic development efforts on technology-based opportunities.
>
> Enhance the research, development, and industry partnering roles of the university system.
>
> Build a New Economy workforce.
>
> Accelerate the growth of the entrepreneurial technology economy.
>
> Create a permanent and effective organizational vehicle for implementing the Nevada Technology Plan.
>
> Leverage current and future federal investments.

We will now describe the rationale and intent for these strategies and how they might be effected in Nevada. The actions required to execute the various strategies will be explained. Finally, we will include commentary on priorities across and within the various strategies.

Strategy I: Increase the Focus of the State's Economic Development Efforts on Technology-Based Opportunities

The best paying jobs and fastest growing companies are in the New Economy. Knowledge-based companies employ highly skilled individuals who exploit the value-adding potential of science, technology, and innovation in increasingly global markets. How can Nevada succeed in this sector?

As is, Nevada is doing well with limited resources. The Nevada Development Authority can cite hundreds of new jobs associated with over three dozen information technology companies that have moved to Las Vegas in the last year. Similar successes are reported in the Reno-Sparks-Carson City area. Between 1997 and 1999, the number of technology-oriented companies increased from 499 to 670, a commendable 34 percent increase.

Nonetheless, there are a number of potential actions that might enhance the state's performance in this area, as follows:

- Increase public understanding of technology-based economic development, emphasizing the benefits in job quality and remuneration, as well as the potential costs needed to attract and retain employees, such as necessary increases in educational funding.
- Incorporate a *Technology Nevada* marketing theme into state and regional communication.
- Formalize, and make tactically more coherent, the *de facto* Pacific coast focus of most economic development in the state.
- Increase the focus on early-stage technology companies.
- Market and maintain Nevada's quality of life.
- Re-orient MAP and other similar assistance programs toward high value-adding product development and technology, as a supplement to the current emphasis on incremental process improvement and quality management.
- Launch a statewide coordinated effort to land large technology flagship companies.
- Conduct a technology core competencies analysis (see Strategy II, Action 7).
- Recruit people as well as companies.
- Launch a statewide rural telecommunications initiative.

ACTION 1: Conduct a Core Technology Competencies Analysis

As described in Chapter 2, the results of Battelle's profile of Nevada's technology were ambiguous in terms of identifying either areas of existing industry specialization or emerging growth in technology sectors. There was evidence that an information technology sector was emerging—electronic commerce, computers, information services—and at rates that compared favorably with national norms. There seems to be strength in measurement and control devices, but declining strength in research, development, and testing. Perhaps this relates to declining head counts and expenditures at state-based DOD and DOE facilities between 1993 and 1997.

Despite the limitations of these analyses, Nevada still needs to define the complementary strengths of industry and higher education by conducting a Core Technology Competencies Analysis. In effect, it needs to define its technology niches, so as to steer public policies and programs as well as to inform private actions and investments. For example, there is growing strength within the universities in biotechnology and biomedical areas, but still undefined is how this matches with complementary growth in Nevada industry.

There are several reasons for this. First, if the Nevada Research Alliance program is launched, there needs to be working (and reworkable) consensus on how to drive the recruitment of endowed chairs. Second, as economic development organizations aim their marketing at prospective technology companies (see Strategy I below), there needs to be a clear message about which technology industries in the state are achieving critical mass and how they match with research, technology, and educational assets in the UCCSN. Third, as the state's entrepreneurial support structure matures (see Strategy IV below), some analysis of comparative strengths in industry and higher education can focus efforts on those sectors most likely to grow rapidly.

Specific Sub-Actions:

- A Core Competencies Planning Group[1] should be assembled. This should consist of no more than twenty high-level technology executives drawn from universities, community colleges, fast-growing technology companies, and the federal technology sector. Individuals will be selected not only for their technology and business expertise but also for their ability to "think outside of the box" about forecasting and visioning.
- Staff support should supply the group with a limited portfolio of summary material such as national technology trends, new product opportunities (e.g. Battelle's Top Ten Products for 2006), and profiles of top-ranked university research programs. These accompany more qualitative "visioning" statements by the members of the planning group itself.
- Interviews should be undertaken in both higher education and industry to identify core competencies which could be built upon. This includes identification of current R&D strengths, expertise, equipment and facilities, and spending and investments.
- A two-day work session should map current Nevada capacities and growth sectors against projected future market and technology trends. This mapping will lead to an identification and description of those four to five areas of maximum potential. These will be the state's technology sector targets.

1. There are various methods and approaches for conducting this type of analysis at country, state, corporation or regional levels. Two worthwhile reviews are: Martin, B., "Foresight in Science and Technology," *Technology Analysis and Strategic Management*, Vol. 7, No. 2, 1995; Tornatzky, L. and Ostrowiecki, B., "Technology Needs: The Art and Craft of Identifying, Articulating, and Communicating," In Kassicieh, S.K and Radosevich, H.R. (Eds.), *From Lab to Market. Commercialization of Public Sector Technology.* New York: Plenum Press, 1994.

- Annually, the above exercise should be re-visited. Incremental or radical alterations will be based on changes in the state technology economy and the university and federal R&D sector.

Priority	Critical
Time frame	Immediate
Lead organizations	Commission on Economic Development and UCCSN
Key partners	Corporate community, federal technology community, and chief research at officers at UNR, UNLV, and DRI
Resources	One-time costs of less than $75,000, plus upwards of one person-year of donated time from stakeholders

ACTION 2: Increase Public Understanding of Technology-Based Economic Development and the New Economy

As has been pointed out in this report, and is widely acknowledged throughout the state, Nevada has thrived on and lived with its dominant industry—gaming. To a significant degree, there is no widespread knowledge about or appreciation for the New Economy. For example, there is a common belief that the technology industry would compete with, rather than provide a robust complement to, gaming and resorts. In addition to reaching out to audiences outside the state, there needs to be an extensive long-term effort to educate audiences in the state about the need and opportunity for growing the technology sector. These audiences might include civic groups, local chambers of commerce, school groups, as well as the lay public. Given the long-term positive returns from gaming, there is some suspicion about fostering technology growth which needs to be overcome.

Detailed Sub-Actions:

- A comprehensive, media-rich presentation should be developed by the Nevada Commission on Economic Development, in cooperation with technology industry leaders as well as regional economic development organizations. Consisting of several different modules and alternative media formats, it should describe the working of the knowledge economy, its links to innovation and technology, its growth trajectory, and its critical reliance on skilled human resources. It should also convey Nevada's SWOT (strengths, weaknesses, opportunities and threats) in becoming a player in this new economic environment.
- A year-long campaign should be undertaken, in parallel with other activities of this plan, to reach both key decision makers and also laypeople from various walks of life. Thus, tailored versions of the deliverable described above would reach audiences from Chambers of Commerce to middle school PTAs. To enable this activity, the presentation package described above would be available to any person in the state in a leadership position—construed liberally—who wants to reach an audience.

- A special effort should be made by economic development leadership to reach the print and electronic media of the state with a common message.

Priority	**Critical**
Time frame	**Immediate**
Lead organizations	**Commission on Economic Development**
Key partners	**Regional economic development organizations, Nevada Technology Council, TechAlliance, UCCSN, technology industry associations**
Resources	**Less than $100,000 in out-of-pocket costs, plus one to two person- years of donated time**

ACTION 3: Technology Nevada Branding and Marketing

Virtually all current marketing and communication materials of state and regional economic development organizations include some mention of technology in Nevada. However, there is great variance (and some confusion for the customer) about the extent or nature of the technology sell. Some relative advantage might be gained with a shared, more comprehensive approach to telling the technology story. In addition, some "brand name" approach should be attached to the technology story (such as Technology Nevada, or something equivalent and catchier).

Detailed Sub-Actions:

- Assemble a small statewide work group on technology marketing and image, consisting of communications specialists and leadership from state and regional economic development organizations.
- Review existing materials, messages, and communication strategies.
- Develop a "menu" of marketing materials and tools, with both strong elements of a statewide Technology Nevada theme, as well as other materials, which could highlight regional advantages and strengths.
- To tune and deliver the message, work closely with existing Nevada technology organizations such as TechAlliance and the Nevada Technology Council.

Priority	**High**
Time frame	**Immediate**
Lead organizations	**Commission on Economic Development**
Key partners	**Regional economic development organizations, Nevada Technology Council, TechAlliance, technology industry associations**
Resources	**One time costs of less than $100,000**

ACTION 4: Focus on Easy Adjacent Targets in the Pacific Coast Technology Corridor

Nevada's economic development organizations could continue to thrive if they **never** actively marketed nationally and focused virtually all of their active marketing outreach on the Pacific coast technology economy. For example, Nevada's neighboring state to the west ranks first in industry R&D, academic research and total R&D, and accounts for about one-fifth of the U.S. R&D total.[2] It is the home of much of the information technology industry and the emerging biotechnology sector, as well as a lion's share of venture capital. However, the more densely populated areas of the Pacific coast also have several growing problems that make them relatively good opportunities for an astute economic development organization. For example, there is an increasingly intractable and expensive quality of life, which encompasses crime, congestion, housing cost, environmental degradation, and K–12 education. Nevada can mine this region for technology companies and talented people.

Detailed Sub-Actions:

- Open two visible and prominent Nevada offices, in northern and southern locations in the Pacific technology corridor. These would be available for meetings and events for any economic development organization in the state of Nevada, as well as function as listening posts for Pacific coast developments that might make Nevada a more attractive location. They would be primarily, but not exclusively, focused on the technology sector. Each would be staffed by a part-time professional who has extensive Nevada ties.
- Dramatically increase the print and electronic media exposure for Nevada in these markets.
- Hold on an annual basis, perhaps rotating between northern and southern parts of the coastal technology corridor, a major Nevada technology trade show. The show should highlight the accomplishments of current Nevada companies and business partnering opportunities in Nevada, as well as market to those thinking about moving. A major theme of these shows should be executive-to-executive peer marketing of the state.

Priority	**High**
Time frame	**Long term**
Lead organizations	**Commission on Economic Development**
Key partners	**Regional economic development organizations**
Resources	**$100,000 to $200,000 annual costs**

ACTION 5: Increased Focus on Early Stage Technology Companies

Some of the shortcomings highlighted above about the Pacific coast economy and society are particularly critical for start-up and early stage companies. As they emerge from product development and early marketing into expansion planning, the problems of space, paying people enough to afford housing, and the commuting nightmare can create havoc with young

2. National Science Foundation, Division of Science Resources Studies. *States Vary Widely in Their Rates of R&D Growth.* Washington, D.C.: NSF 00-235, July 10, 2000.

companies. Admittedly, there are much more extensive opportunities for venture investment there than in Nevada, but it would seem that a marketing niche is available for the state. On an experimental basis, Nevada economic development organizations should mount a coordinated outreach to start-up and early stage companies in their first expansion mode, that are located in the coastal technology corridors.

Detailed Sub-Actions:

- Develop and inventory the technology incubator and accelerator facilities in the Pacific coast technology corridors, and conduct a "reconnaissance" marketing outreach to those firms which seem particularly appropriate to the Nevada setting (e.g. modest capital needs, non-biotech or pharmaceutical, preference of information technology industry).
- Based on the results of the marketing foray, develop a model recruiting package which addresses the most typical needs of both incubator operators (which may have equity interests in client companies) and graduating tenant companies.
- Expand the experiment into a year-long intensive marketing effort.
- Based on the success and experiences of the effort, expand to venture capital firms and other "gatekeepers" to early stage companies.

Priority	High
Time frame	Near term
Lead organizations	Commission on Economic Development
Key partners	Regional economic development organizations
Resources	Start-up costs at $100,000

ACTION 6: Market and Maintain Nevada Quality of Life

It is increasingly obvious that quality of life is a key ingredient in attracting technology companies and people to Nevada, as well as in retaining home grown technology entrepreneurs. The terms generally encompasses a number of elements: cost of living; crime rates; quality of schools, both K–12 and post secondary; resorts and leisure opportunities; traffic, congestion, and sprawl; the arts; health care; and natural beauty. New Economy workers and managers are even more likely to be concerned about these issues.

On one set of indices Nevada looks quite good,[3] although they tend to drop down in certain areas. For example, the Reno metropolitan area ranks high on transportation, climate, and resorts, and average on jobs, crime, and health care. Las Vegas scores high on transportation, jobs, climate, and resorts, and average on arts. Interestingly, Las Vegas ranked somewhat low in health care (basically an access or supply index), crime, education (probably reflecting the enrollment crunch being experienced in the area), and in a measure of cost of living; Reno

3. On the "Places Rated" report, which is developed at the metropolitan area level, Las Vegas and Reno ranked 126 and 161 respectively, out of 351 metropolitan areas. See: *Places Rated Almanac.* 5th edition. New York: Macmillan, 1997.

ranked low in the arts, as well as in terms of a favorable cost of living. It should be understood that this set of indices should be taken in context and compared to other benchmarks.

Nonetheless, in order to leverage its current relative advantage, several steps might be taken to increase the attractiveness of the state as a destination for technology workers and companies. Nevada leadership, particularly political and economic development, should take great pains to communicate the quality of life attractions of the state, as well as to support related programs that will maintain and enhance those advantages.

Detailed Sub-Actions:

- Economic development organizations across the state should increase the prominence of quality of life information in all marketing materials and communication.
- An extensive effort should be undertaken to identify, develop and use "benchmark" measures of Nevada's quality of life. Many of these are already in the open literature of regional planning and analysis, and are quite suitable for interstate or inter-region comparisons (e.g. housing cost in Las Vegas versus regions outside the state). An annual, highly readable report on these benchmarks could be part of the marketing materials for economic development organizations.
- In addition to using quality of life benchmarking as a marketing tool, it should also be used to focus public policy discussion on those areas in which Nevada's performance is less than optimal (e.g. education). Nevada's economic development organizations and its more significant New Economy companies should be advocates for enlightened public investments that will improve Nevada's quality of life, and make it more of a magnet for technology companies and people. In the New Economy, what used to be considered as the "social agenda" has come full circle and is effectively joined with the long-term interests of knowledge-based companies. Good schools, low crime, limited congestion, and a clean environment attract quality companies and people.
- In marketing the advantages of the state to New Economy companies, Nevada economic development organizations need to partner more frequently and effectively with the UCCSN (**and** vice versa). Frequently the primary concern of growing technology companies is the availability of trained personnel at all levels. If, as part of a package, a company prospect can be provided with an education and training program that is seamless, responsive, and customized—and which includes technician training, certificate programs, and baccalaureate degrees—this might make the deal. Obviously, to enable such an ideal situation, different entities within UCCSN need to continue to improve their partnering with

one another. Of the elements with the system, the community colleges have had the most inclination to and experience in functioning in these ways.

Priority	**High**
Time frame	**Long term**
Lead organizations	**Commission on Economic Development, Governor, Lieutenant Governor**
Key partners	**Regional economic development organizations, UCCSN, relevant state agencies, relevant not-for-profit advocacy and analysis organizations**
Resources	**$25,000 start-up costs, and $75,000 annual costs, plus upward of one person-year of donated time**

ACTION 7: Re-Orient MAP and Other Business Assistance Programs Toward High-Value Products

With a mix of state money, client revenues, and federal support and stewardship, a number of outreach assistance programs have been launched, not only in Nevada but also across the country. Most prominent nationally has been the Manufacturing Extension Program (MEP), organized and partially funded by the National Institute of Standards and Technology (NIST), of which Nevada's Manufacturing Assistance Partnership (MAP) is an affiliate program.

Like most MEP affiliates, the Nevada MAP has focused primarily on providing short, limited assistance engagements to manufacturing and other durable goods companies. All have less than 500 employees, and the assistance is generally in the areas of incremental process improvement, quality management issues, and human resources. These services are relatively easy to provide, and a relatively high volume of client companies can be reached.

Recent research,[4] however, suggests that this program strategy should be enlarged. While companies receiving short, limited services make productivity and business gains, the gains tend to be modest. A supplemental approach is to triage potential clients in a more up-front manner, sorting out the group of companies which really have the potential for significant growth, and providing them more intense services. In addition, the nature of those services would be qualitatively different. Rather than focusing on incremental improvements in production approaches, more impact can be realized if the assistance is directed more toward the development of high value-added products and associated market validation and business strategizing. In effect, in parallel with existing services, MAP should develop a set of more intensive product-oriented services that involve a smaller group of carefully selected client companies and do something significantly different for those companies with great potential for growth, as well as continuing the main-line services for others.

4. Luria, D. "Toward Lean or Rich? What Performance Benchmarking Tells Us About SME Performance and Some Implications for Extension Center Services and Mission." In Shapira, P. and J. Youtie (Eds.), *Manufacturing Modernization: Learning from Evaluation Practices and Results. Proceedings of Third Workshop on the Evaluation of Industrial Modernization Programs*, Atlanta, GA: Georgia Institute of Technology, 1997.

Detailed Sub-Actions:

- MAP should conduct an analysis of past service engagements, and characterize the typical customer and profile of services.
- MAP should develop the necessary staffing (or partnerships), tools, and assistance protocols for launching a new, supplemental set of services, oriented toward high value-added product development. In developing the new set of services it should benchmark the policies and practices of other programs around the country which have taken this path (e.g. KTEC in Kansas, Minnesota Technologies, and the Chicago Manufacturing Center).
- MAP should run a two-year experiment with the new service, and quantitatively assess impacts on client companies.

Priority	**Moderate**
Time frame	**Long term**
Lead organizations	**MAP, UCCSN**
Key partners	**Corporate community**
Resources	**Planning and start-up costs of $75,000; no incremental steady state costs**

ACTION 8: Go for the Tech Flagships, Private and Public

Several states or regions have kick-started their technology-based economic development by landing a major technology-intensive company and/or a major federal R&D facility. Lost to historical obscurity is the fact that the ultimate success of Research Triangle Park in NC was highly contingent on the massive infusion by IBM and a large federal laboratory. Similarly, the growth of Boise as a technology metropolis owes much to the presence of major facilities of Micron and Hewlett-Packard.

Admittedly, such prospects are hotly contested by a number of states. It is also important to realize that some deals are more beneficial long-term than others. That is, major corporate facilities that include R&D, product engineering, and precision manufacturing have more long-term viability than call centers of technology companies. The latter are much more footloose over time. Similarly, the addition of a federal facility that neither is technology-intensive nor performs major programs of R&D that might lead to commercial spin-offs adds little to building a local technology sector.

Nonetheless, many of the advantages afforded by Nevada would seem to be attractive to a large corporate re-location or expansion. In fact, as noted elsewhere, the state has been exceedingly successful in landing somewhat smaller facilities (mostly less than 500 employees). One possible target, consistent with traditional strengths, would be a large entertainment technology company with possibilities ranging from high definition/digital media to animation graphics. Nonetheless, if a coordinated effort were conducted to land a minimum of one large facility per year, over the next ten years, the Nevada economy would be transformed.

Detailed Sub-Actions:

- Form a working group or task force, consisting of the Commission on Economic Development, NDA, EDAWN, NNDA (plus other regional economic development entities), as well as representatives from major fast-growing technology companies already in the state.
- Conduct a process whereby technology sectors are targeted (building off work conducted under Strategy II, Action 7, below).
- Organize and implement, on a two-year pilot basis, an integrated state of Nevada outreach marketing effort to the targeted companies and/or federal facilities.
- Set as a goal one to several major flagship moves, each involving in excess of 1000 employees, and focused on high value-adding work (e.g. R&D, product development).
- As an adjunct to this action, the working group should be heavily involved in activities described in Strategy VI (below) to establish a major federal innovation and technology center.

Priority	**High**
Time frame	**Long term**
Lead organizations	**Commission on Economic Development**
Key partners	**Regional economic development organizations**
Resources	**No additional**

ACTION 9: Recruit People as Well as Companies

As will become more clear in the discussion below of Strategy III, the availability of skilled workers is an important ingredient of developing technology-based industry in Nevada. To a significant degree, resolution of that problem lies with the providers of education and training services in the state. However, there is an important role that economic development can play as well, and one in which they have two significant relative advantages: they are typically more attuned to the hiring needs of Nevada industry, and they routinely make marketing visits to California and other states.

In the longer term, increasing the supply of technology workers and retaining those that are trained will solve the human resource needs of Nevada technology companies. However, in the nearer term much can be accomplished by an intense effort, focused on Pacific coast technology corridors to recruit technology workers who might be attracted by the Nevada quality of life, and "repatriate" former Nevada residents who might want to return home. Recent research[5] suggests that "quality of place" can be an important draw for New Economy workers.

5. See, for example: Florida, R. "Competing in the Age of Talent: Quality of Place and the New Economy." Unpublished paper, Carnegie-Mellon University, 2000. Report prepared for the R.K. Mellon Foundation, Heinz Endowments, and Sustainable Pittsburgh.

The vehicle for this effort would be a "job fair" involving Nevada technology companies and organized by state and regional economic development organizations. These could be conducted as part of the Nevada trade fairs suggested above in Action 4 or as freestanding events. Such events are already being conducted by other states.[6] Michigan has conducted media campaigns in nearby but out-of-state metropolitan areas; the Iowa Governor has hosted a series of "recruitment parties" for Iowa alumni now leaving in large cities elsewhere; and Nebraska hosted a job fair in Annaheim, California involving 30 Nebraska businesses and agencies which attracted 170 former residents.

Detailed Sub-Actions:

- As part of the activities conducted under Strategy III below, an up-to-date picture of key personnel needs and job prospects would be made available to attendees, either in hard copy or via a Web site.
- The needs summary would be supplemented with a searchable data base on actual job openings, which would be routinely updated on a searchable Web site.
- Based on the above data, the mix of invited and involved companies would be determined, invitations extended and activities of the job fair planned;
- Attendee invitations would be organized via a cooperative agreement between the Commission on Economic Development and the UCCSN such that the alumni databases of UNR and UNLV could be searched for a mailing list of graduates in key disciplines are currently residing in California.
- Post-event activities would include facilitating contacts with employers, following up attendees for feedback on the fair itself, and developing a permanent database (a "house list") of attendees for subsequent mailings about opportunities in Nevada.
- As an adjunct to these activities, the Commission on Economic Development should explore the possibility of an arrangement with UCCSN whereby technology companies moving to Nevada could avail themselves of full-tuition scholarships for undergraduate and/or graduate training, and/or accelerated qualification for in-state tuition rates. These benefits could, in effect, be part of a comprehensive, human resources-oriented incentive package. Planning would need to focus on how such a program would operate, how UCCSN could be reimbursed for lost tuition revenues, the duration of the benefit for companies, and how broadly this approach might be applied.

Priority	**High**
Time frame	**Near term**
Lead organizations	**Commission on Economic Development**
Key partners	**Regional economic development organizations, UCCSN**
Resources	**Annual costs of $75,000–$100,000**

6. McCann, A. "Midwestern states and businesses struggle to find workers in a tight labor market." *Firstline Midwest*, Volume 7, Number 7, July/August 2000, Midwestern Office of the Council of State Governments.

ACTION 10: Launch a Statewide Rural Telecommunications Initiative

The so-called “digital divide” is an increasingly profound problem, not only for Nevada but across the country. In effect, many rural areas and communities are being passed by for access to wide-band, high-speed Internet access. This has implications for increasing the quality of life in rural communities as well as for enabling them to participate more fully in the technology-based economy.

It should be noted that the New Economy, and the business benefits of electronic commerce and the Internet, are not the exclusive property of those companies which produce high technology products such as computers, medical instruments and the like. Perhaps the most profound impacts of information technology have been to enable producers of traditional goods and services to use the Internet to reach and serve larger global markets. Unfortunately, not all communities in Nevada are thus enabled. There has been a running discussion of these issues in public policy circles around the country, as well as some recent federal legislation.[7] The situation is exacerbated as well in states in which large physical distances and multiple telecommunication providers are involved, both of which are present in Nevada.

Another problem in Nevada is that some types of telecommunication services can not be offered across the board to potential users in rural communities. For example, the System Computing Services of UCCSN has been the primary provider of high speed Internet for K-12 in rural communities. This has leveraged off the telecommunications backbone that UCCSN has created to serve its campuses around the state. Unfortunately, these publicly funded services are not available to business or industry in these same rural areas.

There are basically two approaches to addressing this problem: aggregate and stimulate demand for wide-band, high-speed telecommunication service; and aggregate and incentivize telecommunications providers to better serve rural communities. The latter typically involves direct intervention by state government, in the form of law, regulation, or “arm twisting.” There have been federal dollars available to support planning of these approaches.

Detailed Sub-Actions in support of the first approach:

- Provide resources and technical assistance so that all rural communities that so desire can develop a telecommunications Strategic Plan. Participants in the planning process would include locally based state agencies, local units of government, schools and libraries, and major employers (particularly those with experience or aspirations in electronic commerce). In exchange for state assistance, communities would need to follow a plan template and set of deliverables. A major goal of the plan is to document demand such that telecommunication companies and others might be persuaded to invest in infrastructure. This can be accomplished by aggregating demand across public and private users, as well as by documenting a single major local user that would in and of itself justify infrastructure improvement (e.g. a prospective call center being recruited);

7. See, for example: National Center for Small Communities, *Getting Online. A Guide to the Internet for Small Town Leaders.* Washington, D.C.: National Center for Small Communities, 1999; Allen, J.C. and Koffler, E. L. *The Telecommunications Act of 1996: Its Implementation in the U.S. South.* Mississippi State, MS: Southern Rural Development Center, 1999.

- Stimulate local demand by providing training opportunities through the schools, making available public access terminals (i.e. in libraries) at low cost, and conducting demonstrations. The purpose is to document unmet demand to telecommunication service providers, again to justify infrastructure improvements;
- An important role should be played by the state as well, in pulling together the strategic plans developed by local communities and generating a state vision and priorities for rural telecommunications. This may lead to other sub-activities in which the state needs to play a strong role.

Priority	**High**
Time frame	**Near term**
Lead organizations	**Governor's office**
Key partners	**State agencies dealing with telecommunications, companies in IT industry, regional economic development organizations, UCCSN, System Computing Services of UCCSN**
Resources	**One-time costs of $250,000 to support strategic planning in several rural communities**

Detailed Sub-Actions concerned with the second approach:

- An appropriate state agency and/or legislature study committee needs to examine closely the telecommunications provider industry in Nevada in terms of services, pricing, and infrastructure improvement activities vis-à-vis rural communities. In some states this analysis and planning responsibility has been assumed by a cabinet level Secretary of Technology; in others a dedicated function within a state agency or a government-affiliated non-profit organization has been the locus. Depending upon the conclusions of that study, several other sub-activities might be possible;
- Consider changes in state telecommunications regulations and law that would serve to consolidate telecommunications providers, to eliminate those small rural phone companies which do not have the capital assets to invest in infrastructure improvements, and establish deadlines and incentives for the improvement of rural telecommunications;
- Consider establishing a state-funded, privately-operated telecommunications network to serve the rural communities and areas of the state, with rates and quality of service that are comparable to that provided in urban Nevada;
- Possibly renegotiate municipal cable franchises to gain favorable terms for the provision of high speed, broad band telecommunications to rural areas.

Strategy II: Enhance the Research, Development, and Industry Partnering Roles of the University System

If one looks at states or regions with a rapidly growing technology focus, all are intellectually anchored by one or more nationally prominent research universities. This does not mean that all nationally-ranked research universities are hubs of robust technology economies, but the converse is surely true. Many examples come to mind: Boston (MIT, Harvard, University of Massachusetts), Research Triangle Park, NC (Duke, North Carolina State, University of North Carolina), Atlanta (Georgia Tech, Emory, University of Georgia), and so on. Nevada cannot hope to break into the technology sector without having university-based centers of research and technology excellence. Some have argued that Nevada can "leverage" the University of California institutions, but this is a doubtful strategy because the distance is too great. California self-interest dictates that it will **not** allow that to happen. As one prominent observer[8] of the New Economy has noted:

Research centers and institutions are indisputably the most important factor in incubating high-tech industries. A side effect of the technical capability and scientific research activities of these institutions is the training and education of the skilled labor that will be critical to the expansion and reinforcement of regional high-tech industries. (p. 13)

According to National Science Foundation data,[9] UNR, UNLV, and DRI together had $84.3 million in research expenditures in FY1998. As noted in Chapter 2, Nevada's standing on academic R&D as a fraction of gross state product trailed all other western states. In addition, the academic R&D of different universities involve industry sponsorship at different levels[10]—3.1 percent at UNR, 14.6 percent at UNLV, and 6.9 percent at DRI. Considering the three institutions together, the overall fraction of industry-sponsored research is 6.4 percent, compared to the national average of around seven percent. Notable by their absence in Nevada are the large ($1 to $3 million) centers which involve a mix of federal and industrial funding, and which have been quite successful in other institutions (e.g., Georgia Tech, Purdue). During the period covering FY1994-1998, the absolute amount of industry-sponsored R&D **declined** at UNR and DRI. More importantly, only a small fraction of the industry-supported R&D at all three institutions involves state-based companies, and this information does not seem to be systematically tracked.

Measures of R&D "productivity" for the Nevada-based institutions are also instructive. In a recent national benchmarking[11] of sponsored programs, the Nevada institutions displayed mixed performance. Three important research productivity measures included: proposals submitted per faculty member; percent of faculty who are active investigators on research projects; and sponsored project dollars per faculty member. Generally, DRI and UNR placed in the highest quartile of performance while UNLV ranked in the third or fourth quartile.

8. DeVol, R. *America's High-Tech Economy.* Santa Monica, CA: The Milken Institute, 1999,
9. National Science Foundation, Science Resource Studies. *Academic Research and Development Expenditures" Fiscal Year 1998. Early Release Tables.* To be found at <www.nsf.gov/sbe/srs>.
10. The extent of "industry" funding may be less than these figures suggest. Some private foundation money appears to be lumped with industry support, which distorts the overall picture.
11. Basic information about this program can be obtained on the Internet at <www.higheredbenchmarking.com>.

Many of the problems with academic R&D performance in Nevada involve shortcomings in "research infrastructure." These generally include state or institutional expenditures and policies regarding laboratory space, research equipment, technician support, "start-up" packages[12] for new faculty, and buildings. This hampers UNLV, which has hired several hundred new faculty in the last few years and has experienced the heavy demand for associated infrastructure investments as it has striven to meet enrollment pressures.

What, then, are the critical ingredients of a robust public research university that is also attuned to the economic development agenda of its state and region?

A prominent faculty that attracts federal research funds **and** is involved with industry and issues of applied research and technology development;

An excellent research infrastructure, particularly in those disciplines which represent the core competencies of the institution;

The support of state government, philanthropic involvement by state-based companies, and flexible, creative approaches to using those resources;

A professional, mission-driven approach to technology development and transfer and industry partnerships;

The institution's enthusiastic acceptance of its role in technology-based economic development and a reward structure that encourages faculty to become involved therein. The institution must assume a large number of program responsibilities with and for the state, particularly in the areas of industry outreach, entrepreneurial development, and industry-focused education and training;

A clear conception of the key areas of research and scholarship which will complement the best opportunities for the state to grow a technology economy.

Best Practices

Several public research universities exemplify the above characteristics.

Georgia Tech. Georgia Tech has a worldwide reputation in engineering and the sciences and is also a huge contributor to the Georgia economy. Annual research expenditures for FY 1998 were $259 million, of which a startling 22.3 percent involved industry sponsorship. Georgia Tech participates in the state-funded Georgia Research Alliance (GRA), which also involves Emory University, Georgia State University, Clark-Atlanta, and the University of Georgia. Over the past decade, 37 endowed professorial chairs have been filled among the Alliance institutions; several involve joint appointments across disciplines or universities, and many of the incumbents are active as technology entrepreneurs while pursuing their science. Georgia Tech has also partnered with GRA to establish and operate a statewide network of technology

12. When new faculty are hired in a research-intensive discipline (e.g. chemistry, microbiology), national practice is to provide them with a multi-year commitment of money and other support which should enable the new professor to start a research program, and then become competitive in winning external grants and contracts. Generally, start-up packages within the Nevada university system do not compete with those provided in the University of California system, or with other benchmark institutions.

business incubators. These generate start-up companies based on faculty inventions from the Alliance universities. Within the past few years the rate of technology transfer via start-ups has exploded at Georgia Tech, and other programs have facilitated this trend. For example, in addition to being involved in incubators, Georgia Tech operates a statewide early stage capitalization program, which provides faculty members with small grants to help develop technology with commercialization potential. For established manufacturing companies, Georgia Tech operates one of the largest and oldest industrial extension programs in the country, with regional offices throughout the state. This is supplemented by an elaborate system of short courses and certificate programs. The largest group of participants is formed by those in Georgia industry. This also exposes undergraduates to industry through an extensive program of internships and co-op placements. Finally, university strategy and mission language calls for faculty to be entrepreneurial, engaged with industry, and actively involved in Georgia's renaissance as a technology-intensive state.

North Carolina State University. NC State has also been a major contributor to regional economic development, particularly in the Research Triangle Park. Of its FY 1998 research expenditures of $254 million, 12.4 percent came from industry, and the university hosts a large number of cooperative research centers with active industry involvement. The university is developing its Centennial Campus, a research park close to the historic campus, and has developed an innovative strategy of involving industry as substantive and financial partners. Each building on the Centennial Campus is dedicated to an area of research and technology. Its layout includes laboratories and offices for faculty and graduate students **and** space for industry tenants. Most of the latter are large companies, although there is a growing number of early stage and startup companies. To accelerate entrepreneurial activities among faculty and graduate students, the university, in cooperation with the North Carolina-based Kenan Foundation, has offered a field experience and a course sequence in technology entrepreneurship, has launched an early stage venture fund, and is expanding incubation services. Not surprisingly, NC State has been a national leader in technology transfer. According to data from both the Southern Technology Council and the Association of University Technology Transfer, the institution ranks among the top ten percent in terms of patenting, licensing, royalties, and other such indices. Like Georgia Tech, NC State has operated one of the larger industrial extension programs in the U.S. for over thirty years, an activity which is consistent with its status as a Land Grant school.

Recommended Actions for Strategy II:

- Develop a renewed mission for UNR, UNLV, and DRI that emphasizes industry partnering and state economic development;
- Expand DRI's capabilities such that it can be an industry-focused, technology-development oriented organization modeled after the German Fraunhofer institutes;
- Launch a Nevada Research Alliance program, patterned after the Georgia Research Alliance, with a major emphasis on endowed chairs in key technology areas;
- Reconfigure the Applied Research Initiative into a peer-reviewed, competitive, industry-focused program that is centrally managed and closely aligned with the state's technology-based economic development strategy;

- Create higher education funding programs that are not strictly formula-based nor heavily weighted toward student head count, and which can be responsive to non-recurrent technology-based economic development opportunities and needs;
- Develop a statewide university-to-industry technology transfer function that is professional, adequately-staffed, and effective, and which contributes to Nevada's economic development;
- Conduct a technology core competencies analysis, with heavy involvement by technology-based industry, to define a small number of state R&D competencies. These should leverage complementary university capacities (e.g. across UNR, UNLV, and DRI) with the state's industries and should define the best opportunities for joint growth in technology industry as well as in university R&D. They should also be consistent with technology-intensive areas already developing in the Nevada economy (e.g. dot.com, digital entertainment, precision manufacturing, and broadband communication).

Details of Action Steps

ACTION 1: A Renewed Mission and Strategy for UNR and UNLV

While UNLV has been recently involved in institution-wide strategic planning, UNR has not been active in this area for several years. Nonetheless, the missions, goals, and strategies of the two institutions are similarly limited in terms of positive and creative comment about industry relationships. Compared to institutions elsewhere (e.g. Georgia Tech, Purdue, Penn State), Nevada's research universities are silent about the desirability of either partnering with industry or contributing to state economic development. For comparison purposes, one can begin by researching various institutions both within Nevada and elsewhere (e.g. Penn State—<*www.research.psu.edu/iro*>; Purdue—*connect.indiana@purdue.edu*). There is sparse evidence that academic units (colleges, departments) are pushing this agenda from below.

Detailed sub-actions:

- With the involvement of the Presidents, Provosts, VPs for Research, and key deans, plus private sector technology executives, both UNR and UNLV should conduct a ninety day review of institutional mission, goal, and strategy statements. The objective would be to identify and implement changes that might reflect enlarged industry partnering and economic development roles.
- In parallel, those academic units most critical in technology-based economic development should conduct a similar review, including a review of formal and informal rewards, tenure and promotion policies and practices, and hiring priorities and practices. Again, the focus should be on potential changes reflecting enlarged industry partnering and economic development roles.
- Both institutions should continue or bunch reviews of communication practices necessary for a more industry-friendly image. These should include examinations of institutional and unit Web sites, publications, and communication events and should have strong industry participation.

- All of these reviews should result in a short, action-focused report aimed at gaining campus and system leadership endorsement and implementation.

Priority	**Critical**
Time frame	**Immediate**
Lead organizations	**UNLV and UNR**
Key partners	**UCCSN, corporate community**
Resources	**Modest one-time planning expenses**

ACTION 2: An Expanded Mission for the Desert Research Institute

DRI is a unique asset. Its research program has grown from $17.9 million in FY1991 to $24.9 million for FY2000, gaining national visibility in the process. Three articles involving DRI researchers were recently accepted for publication in *Nature*, a prominent scientific journal. DRI has landed a $3 million National Science Foundation project which will involve partnerships with the Max Planck Institute in Germany and the University of Oklahoma.

DRI has developed coherent research strategies and foci that are reflected in its structures and operating procedures. It is currently structured into three divisions, reflecting R&D emphases in atmospheric science, earth and ecosystems, and hydrologic sciences.

Despite these successes, DRI has not realized its full potential in forming industry partnerships and in developing Nevada's economy. As noted above, its volume of industry-sponsored work has been modest. It has not conducted technology transfer activities, including patenting, licensing, and forming companies. This is despite the fact that technologies, particularly instrumentation technologies, have been a rich by-product of their research work. For nearly ten years, the growth rate in R&D has been respectable but not extraordinary.

One particularly problematic issue is DRI's high rate of "billability," or the fraction of available work hours which needs to be chargeable to an existing grant or contract. This billability is necessary to maintain the financial viability of the institute. In the case of DRI, this fraction is in the 80 percent range. This high level of billability permits little time to nurture industry participation or technology transfer. These areas develop payback slowly.

The 47 Fraunhofer Institutes of Germany embody an alternative organizational and financial model. There is no comparable institution in the U.S. Like DRI, the Fraunhofer Institutes focus on a narrow area of science and technology, and are also linked to and contiguous with prominent German universities. Unlike DRI, only 25 to 50 percent of their work involves research and consulting with German companies. Government-funded basic and applied research fills the balance.[13]

Organizationally and fiscally, how does this work? A significant portion of state and federal funding is **directly tied** to a Fraunhofer Institute's success in securing industry or government competitive grants and contracts. If that diminishes, so does the state match. However, the matching money is not project-specific, and institutes can use the resources for exploratory

13. Abramson, H. N., Encarnacao, J., Reid, P., and Schmooch, U. (Eds.). *Technology Transfer Systems in the United States and Germany.* Washington, D.C.: National Academy Press, 1997.

"blue sky" R&D, technology commercialization, building industry relationships, and so on. The amount of this support ranges from 25 to 40 percent of total expenditures across the existing Fraunhofer Institutes. At DRI, this scheme would create explicit incentives for researchers to focus on industry partnerships and technology transfer and would embody the "billability" relief so needed by the Institute.

Detailed Sub-Actions:

- Over a 120-day period, the DRI leadership should undertake two key steps. One is familiarize themselves with the Fraunhofer model and how it might be adapted to the DRI setting. Battelle can provide relevant publications and points of contact in Germany. Simultaneously, discussions with faculty allow DRI to explore issues and opportunities of shifting toward a Fraunhofer-like model.
- A five-year fiscal and program plan should be developed. This will tie the largest fraction of state support to success with industry partnerships and technology development as well as traditional sources of support. This would be additional to basic administrative and infrastructure expense support. By FY2005-2006, the goal for DRI support should be split between 33 percent federal grants and contracts, 33 percent industry support, and 34 percent state support. The 34 percent state "match" could be spent by DRI for any purposes consistent with their mission, including overhead cost recovery, technology commercialization, "blue sky" internal R&D, or equipment and infrastructure. The actual amount of state expenditures will be directly tied to revenue goals achieved via contracts and grants in the previous fiscal year, in aggregate and in terms of industry-government mix.
- DRI should hire or partner with new engineers, particularly those with product development expertise.
- DRI leadership should pay attention to issues of cultural change, rewards, mission revision, and faculty morale as this transition occurs.
- Appropriate committees of the Nevada state legislature should examine the need for changes in statute law to enable DRI to accomplish this transition. DRI's state appropriation will vary from year-to-year as a function of achieved performance.
- DRI should also participate actively in and potentially seek partnership in the development of the federal innovation initiative described in Strategy VI.

Priority	**High**
Time frame	**Near term**
Lead organizations	**DRI**
Key partners	**UCCSN, corporate community, and federal technology sector**
Resources	**One-time planning costs of $100,000; ongoing costs contingent upon DRI performance**

ACTION 3: Launching a Nevada Research Alliance

There are two ways to build a university's research performance. One is to build from the ground up, by hiring excellent staff at entry and junior levels, nurturing and supporting these talents for years, hoping the individuals will devote their careers to UNR, UNLV, or DRI once they reach a national level of research productivity. UNLV has been *de facto* following this approach, as it has added hundreds of new faculty, including many Assistant Professors.

Several university systems have employed a quicker and more effective approach to attaining national research prominence. The strategic hiring of several "franchise" senior professors, typically into named endowed chairs with salaries and benefits that include dedicated laboratory space and research support personnel, will attract and retain world-class scholars. For example, early in its history, the University of California at San Diego moved rapidly into national prominence by making a number of such hires, including Nobel laureate candidates and recipients. The University of Texas at Austin pursued a similar strategy in the 60s and 70s, dramatically increasing its research profile.

More recently, with significant leadership provided by Governor Patton and the legislature, Kentucky has launched a "brains for bucks" program which will significantly increase the number of productive research scholars at the University of Kentucky and the University of Louisville.[14] UNLV has recently hired a Nobel laureate in creative writing, Wole Soyinka, as the first recipient of a $2 million endowed chair supported by Mandalay Resort Group. In the past ten years, using both private and state money, the Georgia Research Alliance has created 37 endowed chairs among the Alliance Universities. Most of these are in a targeted set of science and technology areas which in turn correspond to the most promising directions for technology-based economic development in the state. Those hired were also selected as being interested in participating in technology entrepreneurship. Industry leaders aid or lead the search process. Five of the last Georgia Research Alliance chairs were filled by individuals who came directly from industry labs.

Educated by these examples, Nevada should launch a Nevada Research Alliance, which would establish, fund, and hire between twenty to thirty Alliance Chairs over a ten-year period.

Detailed Sub-Actions:

- A target number of endowed chairs should be established in consultation between the university and community college system, the to-be-created Silver State Technology Corporation (see Strategy V), the Nevada Legislature, the Office of the Governor, and campus leadership.
- After Action 7 (following) is implemented, UNR, UNLV, and DRI should decide, individually and collectively, which Nevada Research Alliance Chairs (e.g. in what science and technology areas) should reside at each institution or be configured as joint appointments. No less than fifty percent of all chairs should be dedicated to either the strategic areas defined by Action 7 or other state-level technology strategies in order that the chairs contribute directly to the technology growth opportunities in Nevada's economy. Information technology might be an area of focus, with a possible emphasis on entertainment

14. The University of Kentucky reported a 17 percent increase in research funding over the last year.

applications. There are also significant university research strengths in the biological and medical sciences, and these could be enhanced.

- Cost estimates should be established for Nevada Research Alliance Chairs. This is likely to be in the $2 to $3 million range for each chair's endowment, with laboratory and facilities expenses being the biggest variable.
- The Nevada Legislature should establish rules for financial participation in the Alliance Chairs program. At a minimum, each endowment should be fifty percent private monies from individuals, foundations, and corporations, with the balance coming from state program funds administered by the Silver State Technology Corporation. There may be opportunity for tax relief for Nevada-based corporations or individuals.
- Each institution's development function, collectively or individually, should become familiar with the role that their counterparts in other states have played in similar fund raising for endowed chairs. A strategy should be developed for integrating this fund raising focus into annual goals, as well as making it part of multi-year campaigns. Heretofore, the record of UNLV and UNR in funding endowed chairs has been weak. Conversations should be held with CEOs of Nevada-based technology companies to determine how the support of endowed chairs can be made more attractive to the corporate community.

Priority	**Critical**
Time frame	**Near term**
Lead organizations	**UCCSN**
Key partners	**UNLV, UNR, DRI, Governor, legislature, and corporate community**
Resources	**$3–$4 million to endow every Alliance chair, from government, industry, and foundation sources, with anywhere from twenty to thirty chairs established over a ten year period**

ACTION 4: Re-engineering the Applied Research Initiative

Nevada has had the wisdom to establish a state fund for the support of university research partnerships with corporations and other external entities. This is the Applied Research Initiative, founded in 1997 by action of the state legislature. According to a preliminary report,[15] 72 university-industry partnerships had been formed as of 1999, along with 53 other matching opportunities. The state support of $4 million from the estate tax funds had leveraged with $10 million in external match.

While admittedly successful in terms of fostering a broad range of partnerships with the "real world," the policies, practices, and procedures governing ARI have hampered its effectiveness as an economic development tool. Under current procedures, each institution (UNR, UNLV, and DRI) receives a formula-based allocation of money, and each of the three chief research officers have developed their own criteria and procedures for fostering proposals and making project awards. There is **no** statewide competition for the funds. In addition the "applied"

15. University and Community College System of Nevada. *Applied Research Initiative.* Preliminary Report, January, 1999.

goals of the program have encompassed social issues as well as industrial problems. While the former kinds of projects are admirable from the perspective of addressing acute social problems and involve non-technical disciplines in applied research, they have little impact on technology-based economic development. The operations of the program have created weak incentives for industrial partnership projects.

There are other examples of how state money can foster university-industry partnerships. Utah's Centers of Excellence program is organized around a small number of technical foci. The program supports partnership projects, some of which involve technology commercialization. The latter might include applied research and support for the further development of intellectual property developed by faculty. There has been a blossoming of over 100 technology-based start-ups from the University of Utah alone.

Similar results and procedures have characterized the Ben Franklin Partnership Program in Pennsylvania. Beginning in 1996, California has implemented the Industry University Cooperative Research Program (IUCRP). The program supports $60 million of R&D per year, with $21.6 million from the state, $3 million from the University of California system, and $35 million from industry match. Company participants are primarily small enterprises, with about fifty percent having fifty employees or less. The program is focused on a small number of R&D areas which have the most relevance for the California economy (e.g. biotechnology, life sciences informatics, digital media, communications, microelectronics, and semiconductor manufacturing). All of these programs have some common features: a focus on industry partnerships; support for non-academic research projects; and a drive for commercialization.

Detailed Sub-Actions:

- Operation of ARI should be transferred to a neutral third party entity, preferably not-for-profit, and separated from state government. The proposed Silver State Technology Corporation could be such an entity;
- Program funds should be expended such that no less than 75 percent of all project support go to partnering projects with industry. The balance of funds could be available for socially-relevant projects;
- Funding of commercialization activities (e.g., prototype development) should be permitted, along with more discovery-oriented projects;
- Company matching (preferably in cash) should—at a minimum—be at a one-to-one level. This might be relaxed for small Nevada-based companies, permitting "in-kind" match from firms with less than fifty employees;
- Proposal competition should be statewide with peer review by individuals from outside the state. Industry-oriented proposals would be reviewed by individuals with an appropriate commercial background;
- Technical emphases should reflect topics identified in Action 7 (to be discussed in several pages);

- Procedures and criteria should be established such that a minimum of 25 percent of total funds would be available for pre-commercial development including proof-of-concept analysis and prototype development.

Priority	High
Time frame	Near term
Lead organizations	UCCSN
Key partners	Chief research officers from UNLV, UNR, and DRI, corporate community
Resources	No increase over resources already allocated

ACTION 5: Flexible and Non-Incremental Funding within the University and Community College System

For many years, state appropriations for the UCCSN have emphasized student head count. This approach has been responsive to the needs of the institutions and the growing population of students. Recently there have been recommendations to implement head count formulas that discriminate for graduate education. Nonetheless, the existing formula-based approach has not provided forward-looking, non-incremental support for growing the research and technology functions of higher education. Excessive reliance on head count formulas, even with the allowances for disciplines and level of degree, undermines the mission differentiation and articulation of distinctive roles in the UCCSN.

For example, in order to respond to rapid enrollment growth, UNLV has hired 400 new faculty over the past five to seven years. Many of these individuals are junior or beginning faculty with Ph.D.s from excellent universities who are launching their own academic research careers. As a result, there has been an increased need for improvements in research infrastructure: labs, equipment, technical staff, and special facilities. Since student head count formulas "look backward," they are unwieldy in responding to non-incremental funding needs, particularly for research faculty. UNR's problems regarding research infrastructure are somewhat different but no less acute. While enrollment has been growing slowly, there have been healthy increases in research funding. This creates similar problems in relying entirely on a head count formula, particularly to support infrastructure needs. Some illustrative quotes (slightly edited for length) from university faculty and administrators are worth noting:

> *"The Department of Civil and Environmental Engineering has had one support technician since 1980. Since then, the department has grown from a faculty of three to a faculty of 15. A second technician has been requested since 1991 but not received authorization."*

> *"The College of Engineering has four departments occupying a 100,000 square foot two-building complex, along with about 5 trailers and one outbuilding. It is being asked to double and then triple its research funding and output. This is impossible with the current facilities."*

> *"Dr. —— received an NSF grant to develop a lab for the department. The space was bled from a turnip, so to speak, and the result is a very small room that is barely adequate… We have a new faculty member coming in the fall with no office space."*

"Three projects (representing the laboratories of five tenure track faculty members and one senior faculty member) have 'in progress' for periods of time ranging from 12 to over 24 months and have yet to be completed."

"Academic libraries in Nevada have not had any increases to the appropriated acquisitions budget for four years and there is no prospect for this next fiscal year. UN libraries cancelled almost $500,000 worth of journals this past fiscal year and will cancel slightly more than $100,000 by the end of this fiscal year."

"Our competition for new hires is offering one lab technician for every four to five faculty members. We cannot match that."

"With some creative (and expensive) renovation to the present building, it may be possible to add one or two additional research-active faculty. A new building has been in the planning stages for ten years, but awaits state approval and funding."

Head count formulas—no matter how allegedly enlightened—do the state a disservice. The fastest growing sector of the U.S. economy is in the area of information technology. As noted in Chapter 2, there is a rapidly growing IT industry in Nevada. This should prompt dramatic increases in the numbers of graduates in computer science, electrical engineering, and related disciplines. Unfortunately, since education in these disciplines tends to be more expensive in terms of faculty resources and facilities, it is difficult to quickly shift internal resources. To their credit, the Community Colleges have more successfully addressed these emergent demands at the level of AA degrees and industry-focused training.

Kentucky has a formula-based approach to funding higher education, but this has been enhanced with a competitive fund under which money is allocated on the basis of one-time or non-incremental needs and opportunities. Recently under this fund, the City of Louisville partnered with the University of Louisville and a consortium of community colleges in the establishment of a major research, education, and training initiative. This responded to the needs of a single large corporate entity that eventually located several hundred high-wage jobs in the Louisville area. As Nevada and other states aggressively compete for "flagship" facilities of large technology-based corporations, such bargaining over targeted education, training, or research programs is often part of the negotiation process. In Nevada, it is difficult to pull together such resource commitments quickly in the absence of more flexible funds.

The funding situation for higher education, particularly in the area of research infrastructure expenditures, is also complicated by the fact that the state appropriates a significant portion of the institutions' Indirect Cost Recovery on grants and contracts as a revenue source for the operating budget. This is not common practice nationally. If this money could be returned to the campuses it would potentially make an impact on the research infrastructure and other needs of the campuses. One result of the current policy is that little indirect cost money, often less than ten percent, gets channeled to the units and departments where the grant-winning researcher works. This tends to create weak or negative incentives in support of research at that level of the institution.

In June of this year, the UCCSN Board of Regents made a sweeping set of recommendations regarding the formula bases for campus budgets. Many of these recognized the special needs of the R&D enterprise noted above, and significantly shifted the formulas toward a more flexible structure. This included the establishment of a pool of funds, not to exceed two percent of the total appropriation, to be distributed to units on the basis of achieving performance goals. These included graduation rates, high school capture rate, freshman retention, and so on. The board also recommended the return of the Indirect Cost Recovery money. This change has yet to be approved.

Despite these encouraging developments, there is still need for improvement of the UCSSN funding situation.

Detailed Sub-Actions:

- Use a percentage of the UCCSN budget, initially up to five percent, to establish a Strategic Initiatives Fund. On the basis of competing program proposals, allocate that money to enhance research infrastructure and to contribute to technology-based economic development. This could be executed as a five year experiment, at which point the approach could be modified, abandoned, or continued;
- The state should abandon its de facto "tax" on the institutions' Indirect Cost Recovery funds. This has deterred the pursuit of research and is counter-productive to technology-based economic development. The bulk of the recovered money should be channeled to academic units—departments, centers, and colleges—rather than going into the institution's general budget.
- The UCSSN is currently involved in a related policy and planning analysis project focusing on issues of mission differentiation and coordination among its elements. As an extension of that work, a "best practice" benchmarking analysis of non-incremental, non formula-based strategic funding of higher education programs would be useful.

Priority	**High**
Time frame	**Long term**
Lead organizations	**UCCSN**
Key partners	**Board of regents, legislature**
Resources	**No increase over resources already allocated**

ACTION 6: Develop an Effective Statewide University-Industry Technology Transfer Function

Those universities which have a positive impact on their state's economy almost always have a robust technology transfer office (TTO). These TTOs encourage faculty inventors, inform faculty about policies and procedures for commercializing their inventions, and market those inventions to world-wide licensee corporations. The better TTOs also foster faculty spin-off and start-up companies which often become anchored in the local economy. To accomplish these goals, the TTOs have user-friendly policies and procedures; adequate, expert staffing; and an environment which rewards and values their mission.

Nevada lags other regional and national institutions in technology transfer. This year, Nevada's research institutions (UNR, UNLV, and DRI) participated in the Southern Technology Council's technology transfer benchmarking project. Data was gathered from

72 universities throughout the South and among the EPSCoR states. In 16 of 24 indices, Nevada institutions placed in the bottom quartile. Only once did they place in the top quartile. These indices included patenting, licenses, royalties, and start-up companies. All measures were developed as ratios (e.g. royalties divided by total research expenditures) to ease comparisons. In general, UNR did better than UNLV or DRI.

Ironically, there are exemplary institutions nearby. The University of Utah is in the top ten percent nationally in these same metrics. It is particularly successful at creating start-ups. The universities Nevada leaders should also visit include the University of Alabama at Birmingham, the University of California at San Diego, and North Carolina State University.

Of the Nevada institutions, UNR has been the most active. Much of its expertise is due to the Associate Vice President for Research who has had personal entrepreneurial experience. UNLV adopted and adapted the UCCSN policies that were largely developed at UNR, and has operated the technology transfer function out of research administration, with a very limited staff complement. DRI has tried to leverage off the capacities and resources of the larger institutions, particularly UNR. The scale of efforts, their integration, and the more strategic use of TTOs need to be considered if the intellectual capital of higher education in Nevada is to be captured in regional and state economic development.

According to benchmarks of TTO staffing levels, the combined research programs of UNR, UNLV, and DRI, at about $85 million in annual expenditures, ought to be served by at least four professional, experienced staff members. Counting part-time staff, the current system-wide total is much less than that, and several of these individuals have limited experience. Staff from the MAP Program with very little background in intellectual property management have been pressed into service.

Also lacking have been adequate financial resources to pursue patenting aggressively, and to support other activities necessary for successful commercialization. The latter might include the support of small, focused projects to develop a working prototype of an early stage technology or to demonstrate “proof of concept” underlying a relatively untested innovation. Other non-technical tasks—which are not adequately performed in the current system—include preliminary business planning, particularly identifying the size of potential markets and competing existing technologies.

Nevada should consider creating a centralized technology transfer function that serves all UCCSN research institutions. In time, with growth in the research portfolios of the respective institutions, this centralized system could be disbanded as each of the three partners establish their individual functions. At the current level of academic research funding, there is not enough activity to necessitate three separate functions.

There is precedent for such a joint function. During the late 1980s and early 1990s, Duke University, the University of North Carolina, and North Carolina State University operated Triangle Universities Licensing Consortium (TULCO), a collaborative entity located in Research Triangle Park. This met many of the technology transfer needs of the three partners. The consortium was particularly strong in marketing licensable technologies. After five years, the three universities had strengthened their individual technology transfer functions and offices, and the collaborative went out of existence.

Detailed Sub-Actions:

- An independent non-profit corporation should be established or identified to provide technology transfer services to UCCSN. Given the constraints in Nevada state law, an independent corporation will have more latitude in making deals. Private status will permit equity share-holding, appropriate compensation for staff, and promotion of a business orientation. By charter, all net revenues would be returned to UNR, UNLV, and DRI inventors, their units, and would be used to support research administration costs. This corporation could be free standing or a subsidiary of the Silver State Technology Corporation. For those concerned about bureaucratic expansion it should be emphasized that this organization (or program) would supplant three independent functions that currently exist at UNR, UNLV, and DRI.
- A national search should be conducted for an Executive Director and key staff.
- Develop an initial five year budget and operational plan that includes dedicated contract funding from the UCCSN and contributions from each of the participating institutions. Planning should include projections about staffing, future royalty and equity income, and necessary initial expenses. For example, there is likely to be a large sum of expenditures in the first two years, given the typical backlog of demand, patenting costs, the writing of policies and procedures, and the conducting of faculty training.

Priority	**High**
Time frame	**Immediate**
Lead organizations	**UCCSN**
Key partners	**Chief research officers at UNR, UNLV, and DRI, corporate community, and economic development organizations**
Resources	**Steady state costs of $800,000 per year plus $250,000 start-up costs. Over 5 years, royalty revenues will counterbalance a significant fraction of this**

ACTION 7: Conduct a Core Technology Competencies Analysis

This is described above, as Strategy I, Action 1. It is noted here as well in order to underline its importance.

Priority	**Critical**
Time frame	**Immediate**
Lead organizations	**Commission on Economic Development and UCCSN**
Key partners	**Corporate community, federal technology community, and chief research officers at UNR, UNLV, and DRI**
Resources	**One-time costs of less than $75,000, plus upwards of one person-year of donated time from stakeholders**

Strategy III: Build the Nevada New Economy Workforce

Nevada's workforce development organizations are many and vary considerably in scope, focus, and clientele. For example, there is a large and growing body of private sector-delivered training. Companies themselves, either through structured on-the-job experiences or in larger companies, accomplish some of this via extensive training departments. Other private sector activity includes specialized training vendors, who focus on particular industries or technology areas. Throughout the private training market (and among public providers as well) there is a growing reliance on electronic delivery either through closed circuit TV and/or the Internet. Whatever Nevada does to improve its public education and training system, it should be mindful of the fact that there is extensive competition from the private sector, as well as many opportunities for creative partnering.

The public sector workforce development system includes the K-12 system, the community colleges, and the four-year colleges and research universities. Each tends to provide some range of services, and is more or less linked to all the other components of the system, although there is some evidence that the term “system” should be used advisedly. The K-12 system has the mission of turning out high school graduates with requisite skills to either enter the workforce or to continue their education at the post-secondary level. Its attention to the needs and aspirations of the business community in general, and to the technology sector in particular, tends to be a relatively minor theme, although many programs have developed strong linkages to industry. In contrast, the community colleges of Nevada (CCSN, Great Basin, TMCC, and WNCC) have been the primary providers of workforce development services at the pre-baccalaureate level. This has included both Associate degree programs targeted toward industry needs, as well as a number of more specialized short courses—often performed on a contract basis—that are oriented to specific needs of industry. These programs tend to have significant industry input in their design and execution, and there is generally a high degree of cooperation across the colleges to avoid duplication and excessive overlap. The community colleges have been extraordinarily successful in developing robust industry partnerships. The third public sector workforce development asset is, of course, Nevada's universities, principally UNLV and UNR. Of great interest to technology-based industry, they produce baccalaureate and graduate level students in science and engineering disciplines that are acutely needed by technology industry. It should be realized that technology-intensive industry tends to have a somewhat different profile of hiring needs than does more traditional manufacturing industry. That is, all things equal there will be greater propensity to hire people with formal credentials at a more advanced level. Given this background, how does Nevada's workforce development performance compared to other states either in the region or across the country?

As described in Chapter 2, Nevada’s human resources situation is weak from the perspective of technology-based industry. In fact, the availability of entry level as well as more experienced personnel was the problem most frequently mentioned by technology company principals in our Nevada interviews. This acute problem faced by companies is typically a proxy for more long-standing shortcomings of the education and training system of a state. For example, in data published this year by the U.S. Department of Commerce,[16] Nevada ranked low in associate degrees granted as a percentage of the 18-24 year old population (48th); bachelors degrees as a percentage of the 18-24 year old population (49th); percent of bachelors degrees granted in science and engineering (50th); science and engineering graduate students as a percent of the 18-24 year old population (45th); recent science and engineering bachelor's graduates as a percent of the civilian work force (48th); recent science and engineering master's graduates as a percent of the civilian work force (47th); and recent science and engineering Ph.D. graduates as a percent of the civilian work force (50th). Coupled with the data reported in Chapter 2 on the percent of recent graduates from UNR and UNLV who leave the state, the situation confronting high tech employers becomes obvious and seriously delimiting on the growth of these industries in Nevada.

The somewhat discouraging picture presented by higher education outcomes is paralleled at the K–12 level, although national benchmark data are somewhat harder to come by. For example, we know that in high school completion rate Nevada finishes in the top quartile nationally. It is also mid-range in terms of SAT and ACT scores, although data reported in Chapter 2 indicated that Nevada does rather poorly in terms of inducing its high school graduates to stay home for college. While it is likely that the Millennium Scholarship program will have an impact on this, it is not clear how this will play out in terms of more academically gifted high school students or those interested in pursuing a science and engineering degree.

A recent national benchmarking study[17] of states' educational performance has tried to pull together various data that illustrate the functional ties between K-12 and higher education. However, on most of their measures Nevada fared poorly. For example, in the "preparation" category, in which indices generally reflect K-12 performance, Nevada received a grade of D+. In "participation," which included indices reflecting the extent to which college age residents take advantage of higher education opportunities, the state also received a D+ mark. In the area of "completion" Nevada was graded F, pointing to the fact that many higher education students do not persist in the short term, nor complete their degree aspirations in the long term. Of note, Nevada was given a B on affordability, and a C+ on benefits. The report card for the state also provides a number of individual indices of various sorts. Perhaps most telling from the perspective of *A Technology Strategy for Nevada* were the data that only thirteen percent of Nevada employers felt that the state's colleges and universities were preparing their students for the work environment, compared to the U.S. average of 46 percent. The report makes for interesting but discouraging reading.

In addition to looking at gross performance and production metrics, it is also very important to understand the "fit" between the educational system and the needs of the knowledge economy. For example, we know that the information technology sector seems to be growing at a faster rate than other parts of the Nevada technology economy. If so, are sufficient graduates being produced and/or are those graduates making connections with employers during their educational years. From student interviews that the Battelle team conducted, this seems to be an "iffy" situation at UNR and UNLV. From companies, we heard that the volume and mix of graduates being produced was not attuned to the dynamics of the business environment. All of

16. Office of Technology Policy, U.S. Department of Commerce. *The Dynamics of Technology-Based Economic Development. State Science and Technology Indicators.* Washington, D.C.; U.S. Department of Commerce, June, 2000.
17. The National Center for Public Policy and Higher Education. *Measuring Up 2000. The State-by-State Report Card for Higher Education.* Washington, DC: The National Center for Public Policy and Higher Education, 2000.

this suggests an unfortunate “passing in the night” phenomenon in which Nevada technology companies are missing out on promising UNR and UNLV graduates—and vice versa. It also suggests an insufficiently precise (or non-existent) education needs analysis function across higher education (although much less so among the community colleges).

Another sign of a responsive overall education and training **system** is the extent to which it responds to external “customers” with a single or coherent voice, which also implies that there is good cooperation among the different elements within the overall education and training system. We heard of problems of curricular articulation between universities and community colleges, as well as issues of mission differentiation. In other words, who does what vis-à-vis the needs of students and employers?

ACTION 1: Increase Technology Industry Input to Higher Education Programs

Industry input to the educational side of higher education appears to be a mixed picture in the state of Nevada. The major technology training and degree programs at the community college level have historically been very strong in this regard. Programs such as the Cisco Networking Academy at the Community College of Southern Nevada and the Institute for Business and Industry at Truckee Meadows Community College are illustrative. So too, are joint ventures involving community colleges and the universities in novel, industry-driven new degree programs and curricula. An excellent example of the latter is the collaboration between Western Nevada Community College and the University of Nevada-Reno in the development of a Bachelor of Technology in Construction Sciences, which will respect and coordinate the respective curricular strengths of the two institutions.

One factor that characterizes all of the above example programs is a strong and continuing role for industry input. Through various guidance or governance structures, the programs continue to be responsive to the changing needs of industrial partners, who in turn eventually employ the graduates. One can understand the potential for an industry-driven program by looking at the partnership between the Community College of Southern Nevada (CCSN) and Sprint. The company helped CCSN develop a state-of-the-art training lab and curriculum dealing with high speed data transmission, networking, and fiber optic technology. Enrollment in the engineering technology area has grown from 150 students in 1995 to 1,075 in fall 2000, with a long line of potential employers. Recently, Sprint has launched a system of paid internships for students enrolled in the program.

That spirit and general approach needs to be more widespread throughout the UCCSN, and operated so as to provide incentives for inter-campus cooperation. A dramatically expanded system of industry advisory councils should be established to provide input into curriculum development, degree programs, and other educational offerings. Industry involvement should be focused on those key fields critical for growing the technology economy of the state (see Strategy II, Action 7, above).

Detailed Sub-Actions

- Conduct an inventory of existing industry advisory groups within the UCCSN, albeit concentrating initially on those disciplines which are arguably more critical to a technology sector (e.g. microbiology, computer science, electrical engineering). The inventory should specify the companies and individuals involved, and roles and operations each advisory group.

- The inventory results should be scanned for overlaps in membership and foci, as well as areas in which an advisory function should exist but does not. Particular attention should be focused on those areas in which complementary (or perhaps competitive) relationships exist across units of the UCCSN.
- At the level of academic leadership (provosts, deans of instruction) across the campuses, a coordinated attempt should be made to consolidate, strengthen, and make more visible the industry advisory function. For example, if there is a decision to pursue a system-wide accelerated program in information technology education, there ought to be one super industry advisory committee to provide leadership.

Priority	**Critical**
Time frame	**Immediate**
Lead organizations	**UCCSN and Commission on Economic Development**
Key partners	**Technology industry community, UNR, and community college leadership**
Resources	**One-time costs of $75,000, plus upwards of 1 person-year of donated time**

ACTION 2: Develop an Ongoing Capacity to Assess the Emerging Personnel Needs of Nevada Technology Industry

By its nature, technology-intensive industry is a dynamic environment in terms of changes in underlying science and technology, short product life cycles, and most importantly for this context, shift in the skill needs for workers. One common approach has been to conduct period surveys of employer personnel needs, down to the level of skills, knowledge, and competencies. The logic is that these then cycle back to inform academic curriculum, required laboratory experiences, and testing and assessment practices. The problem is that such needs surveys vary widely in the quality of the resultant information, the methodologies are inconsistent across studies, they are performed by disparate organizations, utilization of the information by academic organizations is spotty, and there is little longitudinal continuity in the data. One unfortunate result may be the premature or inappropriate launching of major education or training programs in the public sector, in the absence of clear private sector demand.

Nevada could break new ground by establishing a long-term capacity to collect useful information on educational and training needs of its growing technology sector. Such a function could be conducted by an appropriate state agency or contracted to a university or non-profit research organization.

Detailed Sub-Actions:

- Assuming that a statewide core technology competencies analysis (Strategy II, Action 7, above) has been conducted, and a more coherent industry advisory system has been developed (Strategy III, Action 1, above), members of the latter informed by the results of the former should develop the specifications for what ought to be included in a educational and training needs analysis. This, in turn, should define the deliverables for the ongoing function and how the results might be disseminated to industry and UCCSN stakeholders.

- A performing organization should be selected, either by designation or competitively, and the needs analysis function should be conducted annually for at least a five year period. Methods, deliverables and approach should be tuned as per input from both industry and academic participants and users of the results. There are currently efforts underway to create a statewide directory of technology firms, which could be used to define the study sample for this action.

Priority	**High**
Time frame	**Long term**
Lead organizations	**UCCSN, corporate community**
Key partners	**Commission on Economic Development**
Resources	**Annual costs of $75,000, and start-up costs of $50,000 plus upwards of several person-months of contributed time**

ACTION 3: Expand Intern and Co-Op Opportunities Across UCCSN

An integral part of school-to-career programs is the hands-on experience that students receive in a real work setting. Similarly, several of the more prominent university systems in the U.S. have placed a major emphasis on formal co-op programs, either mandatory or voluntary. These are great opportunities for a mentoring relationship to be established between technology experts in industry and young people interested in science and engineering, and several states have reaped the benefits. For example, over forty percent of Georgia Tech College of Engineering undergraduates are involved in co-op placement, although the program is voluntary. Over two-thirds of those placements involve state-based employers, and about half of the students take a job in Georgia after graduation. At the University of Cincinnati co-op placements are **mandatory** for students in the College of Engineering, and they spend about half their time in industry placements. A large fraction of these are in Ohio or the immediate economic region, and many students go on to take a full time position with one of their placement companies.

Such programs have payoffs for students, industry, and state economic development. Students are more employable and world-wise, industry gets an early peek at potential hires, and the percent of students who end up working in the state where they do their internship or co-op is quite high. The problem for Nevada is that the scope of competitively paid co-op and/or internships is relatively low. Few units have full time co-op or internship coordinators (the College of Business at UNR is an excellent counter-example), the placement rate is not high, and a discouraging fraction of placements tend to be outside of the state or outside of technology-based industry. For example, it arguably does little for the career prospects of a budding software engineer to be doing routine system maintenance in a gaming setting. One UNLV graduate interviewed by the Battelle team pronounced his internship as “terrible...it was at an insurance company.” A UNR graduate noted that there were “lots of opportunities, but not really technical jobs.” Others reported quite positive experiences, but it seems to vary widely across departments and institutions.

This is an area where significant gain might be realized with relatively little effort and expense. If the “brain drain” of recent science and engineering graduates from UCCSN could be reduced a relatively few percentage points, that could add hundreds of new employees annually to the Nevada technology workforce. In a sense, the situation is akin to ships passing in the night. Too many graduating students are unaware of technology employment opportunities in the state, and not enough Nevada companies get first hand experience with emerging graduates. A strengthened internship and co-op program could help.

Detailed Sub-Actions:

- Using existing internship and co-op programs as a start, a system-wide planning group should be given a mandate to design the staffing, operations, employer relationship, and evaluation of a significantly enhanced internship and co-op program. Participating as well should be representatives from significant technology sector companies. At a minimum, there should be a full time campus coordinator, with support staff, at both UNR and UNLV, plus appropriate staffing at the unit level.
- As an adjunct to the expanded internship and co-op programs, an increased effort should be made throughout the UCCSN to engage Nevada technology industry with students. In particular, technology fairs for state-based employers would increase the likelihood that graduating scientist and engineers would be hired locally, as well as acquainting companies with the talent available on a “look-and-see” basis through internships and/or co-ops.

Priority	**High**
Time frame	**Near term**
Lead organizations	**UCCSN, corporate community**
Key partners	**Units (departments and colleges) at UNR, UNLV, and community colleges with particular relevancy to New Economy industry**
Resources	**Annual cost of $500,000 across UCCSN, plus start-up effort in donated time**

ACTION 4: Attain an Order of Magnitude Increase in Information Technology Graduates by Establishing a Center for Excellence in Information Technology

Academic planning proceeds incrementally, while technology sectors in the economy grow by multiplication. Based on several threads of information and data, it is obvious that information technology (IT)—including software, computer systems, telecommunication, electronic commerce, networking, and the Internet—has been driving much of U.S. economic growth during the longest boom in historical record. Alan Greenspan, Chairman of the Federal Reserve Board, has gone on record as attributing a third of U.S. economic growth over the past decade to the IT sector and the efficiencies it induces in other sectors. Not surprisingly, the number of IT jobs has grown several times faster than the economy as a whole, and there is a major crunch in finding people. Available human resources are the key to continued growth of the IT sector, and companies will happily migrate to those states and regions where that supply is assured. For example, Utah is implementing a Utah/Silicon Valley Alliance[18] which will help meet the needs of fast-growing information technology companies in California for qualified people as well as economical space in which to expand.

It should also be mentioned that there is a huge unmet demand for information-tech products, services, and people within the gaming and resort industries of the state. There are huge and increasingly complex data systems used to manage these businesses, and the current array of software systems, products, and services is inadequate. In the words of one industry executive, the "current system is held together with chewing gum and baling wire." Clearly, there is an opportunity to grow a large entertainment technology sector in Nevada, and market it to the world. However, to get there the state will have to significantly expand its education and research programs that are relevant to the information industries.

Nevada has what is perhaps a one-time chance to make a daring catch-up move. Over the past several months a group of Nevada-based technology executives have been pulling together their thoughts about a bold approach to capturing a larger share of IT for Nevada. In effect, the proposal is for high-value economic development through the rapid aggregation of talented people. This *2020 Vision Group* has been working in parallel with the Battelle team, but its recommendations are endorsed herein. They are to increase, over a ten-year period, the production of IT graduates from UNR and UNLV to **1000 per year**. The organizational vehicle would be the establishment of a Center for Excellence in Information Technology, whose headquarters would be sited at one of the University of Nevada campuses, but which would involve faculty at all of the constituent institutions of UCCSN. Assuming, as per Strategy II, a Nevada Research Alliance program had been established, some of those endowed chairs could be dedicated to the new center. The involved disciplines and fields would include computer science, electrical engineering, computer engineering, information infrastructure, network engineering, computer graphics, entertainment technologies, and technology management, to name a few. The actual intellectual structure of the resultant degree programs would be worked out via collaborative planning between industry and the university. There is a strong likelihood that IT industry would be both a substantive and a financial participant in the ultimate program.

Detailed Sub-Actions:

- Starting with the current 2020 Vision Group, a small but intellectually potent group of industry and university IT specialists would develop the intellectual structure of the proposed program, its R&D strategy and substantive emphases, the mix of current and new courses that form core and specialty curricula, the resulting degrees and/or certificates, and general strategies for student recruitment, placement, and continued industry involvement.

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18. Wallace, B. "Utah revels in high-tech alliance. The launch of union with Silicon Valley may bring jobs to state." Deseret News, Salt Lake City, UT, September 19, 2000.

- A multi-campus financial plan would be developed, including a strategy for securing foundation, private sector, federal agency, and state of Nevada funds to insure a successful five-year pilot launch.

Priority	**High**
Time frame	**Near term**
Lead organizations	**UNR, UNLV, and community college leadership, plus 2020 Vision Group**
Key partners	**UCCSN, corporate community from IT sector**
Resources	**$1 to $2 million in annual operating costs once fully operational, with majority provided by corporate, foundation, and federal agency grants, plus planning costs of $100,000, much of which will be covered by donated time**

ACTION 5: Increase General and Targeted Support for K–12 to National Benchmarks

In many states, improving the performance of K–12 education is considered an insoluble public policy puzzle, with few obvious handles to improvement. In fact, impacts can be realized, and for the country as a whole there have been modest but steady increases in student achievement outcomes for over a decade. As far as technology-based economic development is concerned, those regions which have succeeded in the New Economy also tend to have first-class K–12 educational systems. Technology performance and educational performance are inextricably linked.

One of the most comprehensive national performance and policy benchmarking studies[19] ever conducted of K–12 was recently completed by a prominent non-profit research organization. Looking at long-term data from the National Assessment of Educational Progress (NAEP), a national student achievement assessment program, the goal of the project was to determine what made a difference in students learning. The focus here was on state-level policy and funding levers, rather than detailed programming at the district or building levels. Information was available from thousands of students in 44 states.[20]

The findings were as follows:

Scores are higher in states with higher per-pupil expenditures.

Lower student-to-teacher ratios in the early elementary grades can significantly improve scores.

Adequacy of instructional resources at the classroom (teacher) level has a positive impact.

Higher pre-kindergarten participation in educational programs has a positive impact.

Lower teacher turnover helps.

19. Grissmer, D., Flanagan, A., Kawata, J. & Williamson, S. *Improving Student Achievement. What State NAEP Test Scores Tell Us.* Santa Monica, CA: RAND Education, 2000.
20. Because of longitudinal sampling issues, Nevada's data were not included in the analysis. Nonetheless, Nevada does participate in NAEP and other similar national benchmarking studies.

As a long term objective, Nevada may want to consider its goal to raise performance standards, and commensurate investments, for K–12 to the level of national benchmark states, and develop a five-year strategic plan to accomplish those goals.

Detailed Sub-Actions:

- Nevada should examine its standing relative to national norms of per-pupil expenditures, teacher-student ratio in lower elementary grades, instructional resource availability, teacher turnover, and pre-kindergarten programming.
- Spending on K–12 should be adjusted such that Nevada is at least above the median on all of these critical indices (preferably within the 1st quartile) nationally.
- Nevada should continue to participate in NAEP and other national benchmarking efforts so as to monitor its current relative performance, as well as observe long-term trends.
- Given the different growth rates, and related educational challenges, of northern and southern Nevada, this ongoing assessment and improvement process should be conducted as two or more parallel initiatives.
- In addition to this effort to come to national benchmarks of general and targeted investment in K–12, the state needs to accelerate the search for national best practice models in particular program areas such as science education, language arts, and the like.

Priority	**High**
Time frame	**Long term**
Lead organizations	**Governor, State Department of Education**
Key partners	**Legislature**
Resources	**Unknown at this time**

ACTION 6: Increase the Use of Educational Technology in K–12

Both research and accumulating practice wisdom indicates the effective and widespread use of educational technology can increase the academic performance of student population, as well as allay many classroom management issues. Currently, Nevada is behind the curve in the implementation and integration of educational technology, particularly the use of the Internet in instructional applications. According to 1997-1998 data, Nevada ranked 47th on an index[21] of classroom technology use. A 1998 report by the Nevada Commission on Educational Technology called for an order-of-magnitude increase in spending on the implementation of educational technology, in order to reach national benchmarks. Neither goal has been attained, primarily because of shortfalls in revenues and expenditures for education. This should be a high priority for the state to rectify, including the acquisition of more hardware and software,

21. Atkinson, R., Court, R. and Ward, J. *The State New Economy Index.* Washington, D.C.: Progressive Policy Institute, 1999.

but perhaps more difficult, the creative incorporation and organizational implementation[22] of these technologies.

Detailed Sub-Actions:

- Continue the statewide assessment, organized by district and primary-secondary, of the penetration of educational technologies and the Internet into Nevada K–12 education. Since this likely to be confounded with rural problems in telecommunications access, the assessment should be particularly sensitive to progress and issues in these communities. Quantitative measures of implementation should be compared to comparable national benchmarks and a composite picture developed of where Nevada stands relative to other states. This should be widely shared among corporate leaders and elected officials. It is important that Nevada stakeholders understand that mastering educational technology is a critical tool in improving the performance of K–12 generally.
- The 1998 plan developed by the Nevada Commission on Educational Technology[23] should be revisited, updated, and more widely disseminated. The basic strategy and action recommendations therein were sound and based on careful analysis by the consulting company. Nonetheless, the world has moved on and Nevada's progress (or lack thereof) in the area of educational technology needs to be recalibrated, its strategies refreshed, and the revised plan needs to be higher on the agenda of state leadership.
- Long-term goals should continue to be pursued, and should include attaining implementation parity with the top quartile of states within five years, as well as a long term funding commitment necessary to maintain that position.

Priority	High
Time frame	Long term
Lead organizations	Commission on Educational Technology, Legislature, and Governor
Key partners	State Department of Education, corporate community
Resources	Unknown at this time

ACTION 7: Expand the Scope of the Millennium Scholarship Program

Much has been said in this report of the problem of "brain drain" in Nevada. This occurs at two junctures in a student's career: when he/she graduates from high school and when he/she graduates from college.

22. See: Casson, L., Bauman, J., Fisher, E., Lindblad, M., Sumpter, J., Tornatzky, L., and Vicker, B. *Making Technology Happen. Best Practices and Policies from Exemplary K–12 Schools.* Research Triangle Park, NC: Southern Growth Policies Board, 1997.
23. Nevada Commission on Educational Technology. State Plan to Implement Technology to Support Student Learning. December 31, 1998.

Recent research[24] suggests that the likelihood of a college graduate who went to high school in Nevada will eventually work in the state after college is significantly increased if they attend college in-state after high school. In effect, once they leave they seem to be gone for good. This problem is exacerbated with students with have superior academic records. That is, the so-called "best and brightest" (e.g. class valedictorians, National Merit Scholars) tend to leave their home state to attend college.

What this suggests is that the Millennium Scholarship Program as currently structured may not be sufficiently focused on retaining this cadre of elite future leaders. However, if a sub-component of the Millennium program were particularly targeted toward retention of this small cadre, then perhaps something could be accomplished. An enhanced program would have increased financial inducements, as well as curricular implications. For example, selected students could be "fast-tracked" to existing honors programs and to unique educational experiences, such as working directly with faculty on sponsored research projects.

Detailed Sub-Actions:

- Conduct a retrospective analysis of the first wave of Millennium Scholarship awardees, and determine whether high school valedictorians and/or National Merit Scholars from Nevada high schools are being pulled into Nevada institutions of higher education at a rate that significantly exceeds that prior to the formation of the program.
- Do follow-up interviews of those valedictorians and National Merit Scholars who have left the state for college, and try to determine the scope and attractive features of the scholarship offers that they have received from other schools outside of Nevada. In that context, try to determine how much current Millennium Scholarships would need to be enhanced (e.g. adding room and board) in order to be competitive to those offers.
- On the basis of the above sub-actions, operate a three-year experiment in which an enhanced Millennium award (e.g. Super-Millennium Scholarship) is offered to high school valedictorians and National Merit Scholars, and assess its impacts on the staying vs. leaving decisions of highly talented Nevada high school graduates.

Priority	**High**
Time frame	**Near term**
Lead organizations	**Governor, legislature**
Key partners	**UCCSN, State Department of Education**
Resources	**Undefined at this time**

24. Tornatzky, L., Gray, D., Tarant, S., and Zimmer, C. *Who Will Stay and Who Will Leave? Individual, Institutional and State-level Predictors of the Retention of Science and Engineering Graduates.* Research Triangle Park, NC: Southern Growth Policies Board, 2000 (In Press).

ACTION 8: Increase and Create Incentives for Program Cooperation within UCCSN

As has been mentioned above, UCCSN has experienced some of the intra-organizational issues of program cooperation that are relatively common with large, comprehensive systems of higher education. Sometimes these express themselves as overlapping or duplicative degree or research programs, sometime as difficulties in "articulation".

In fairness, there have been great strides in responding to this problem over the past few years. For example, the UCCSN Board of Regents has recently issued a report on common course numbering between the community colleges and the universities, and transfer information is readily accessible on the Internet.

Similarly, new educational programs have been proposed that involve significant cooperation across the campuses. A new School of Pharmacy has been proposed which will involve significant articulation between UNR, UNLV, and the community colleges. A Nevada Cancer and Health Research Consortium has been proposed which will involve the University of Nevada School of Medicine, Reno, and the University of Nevada School of Medicine, Las Vegas. The new campus at Redfield is, in effect, a joint venture of UNR, Truckee Meadows Community College, and Western Nevada Community College. With support from a U.S. Department of Commerce EPSCoR grant, the city of Henderson, UNLV and the Community College of Southern Nevada are partnering in the development of curricula and laboratory facilities for a growing entertainment technologies industry in the state.

All of these efforts are commendable. Nonetheless, given the limited resources that are available within UCCSN for new program development, educational and/or research, every effort should be extended to promote inter-campus, inter-unit collaboration. There are two general approaches to fostering program development collaboration: either mandate it, or create incentives for a collaborative approach. All things equal, people tend to prefer the latter. Many of the strategies and actions recommended in this report would benefit from a collaborative approach to their execution, particularly those involving UCCSN. We would suggest the following as a start, but they do not exhaust the ways in which the Board of Regents and others could encourage program collaboration.

Detailed Sub-Actions:

- In the implementation of the proposed Nevada Research Alliance endowed chairs program, give extra credit to those proposals that clearly, and thoughtfully, leverage existing strengths at two or more campuses.
- In a re-engineered Applied Research Initiative, give extra credits to those proposals that involve research teams from two or more campuses.
- Ensure that any campus-level strategic or curricular planning, at either unit or institutional levels, involves some interaction with corresponding disciplines or departments at other campuses, prior to receiving approval for implementation.

- Dramatically increase the scope of faculty exchanges and joint teaching relationships throughout UCCSN.

Priority	**High**
Time frame	**Longer term**
Lead organizations	**UCCSN**
Key partners	**Campus leadership at the unit level**
Resources	**No additional, steer existing resources**

STRATEGY IV: ACCELERATE THE GROWTH OF THE ENTREPRENEURIAL TECHNOLOGY ECONOMY

As suggested in Chapter 2, it appears that Nevada has great potential to grow an entrepreneurial technology economy. In fact, a recent report has named Nevada as "the best state for business start-ups," on the basis of a multi-factor index that includes survival, sales growth, and start-up activity.[25] That is a very positive state of affairs, in that the competition for recruiting existing technology companies is increasingly fierce, despite the good efforts and many successes currently being realized by Nevada's economic development organizations. In addition it is increasingly obvious that the most robust technology regions in the country do not rely exclusively on large companies for growing their technology economy. When one looks closely for "where the action is," whether Silicon Valley, San Diego, Boston-Cambridge, or Atlanta, you will quickly discover that these areas have become adept at doing start-ups.

What then are the critical capacities, ingredients and best practices that characterize entrepreneurial robust regions:

There is widespread common knowledge, particularly among young people getting business or technical degrees, about the basic principles of launching a start-up company;

There is a rich network of investment entities, familiar with the challenges of technology start-ups, who can provide financing options ranging from pre-seed to mezzanine and which are operated via a bewildering array of organizational formats, ranging from loose networks of angel investors, venture capital firms, public-private organizations, and Small Business Investment Companies (SBICs).

There are a number of business assistance organizations, typically operated as technology business incubators, which can either provide or broker key expertise in exchange for either fees, equity, or economic development impact, and are operated by either government, non-profits, or private companies. These, in turn, are connected to a network of business assistance firms and consultants (e.g. patent attorneys, and accountants) who are wise to the needs of technology-based start-ups.

Since research universities are often a major source of innovative technologies around which new companies get formed, they need to be adept, policy-enabled, and appropriately staffed to deal with their faculty who want to take an entrepreneurial path.

Entrepreneurial technology development, since it frequently involves creative pubic-private partnerships, works best when there are no relevant ambiguities or outright prohibitions in statute or constitutional law.

If one maps Nevada's existing capacities and strengths against the above menu of essentials, several logical actions emerge.

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25. Eady, G. "Best States for Start-Ups". *ED Growth Strategies*, March/April 2000. Available on the Web at <www.busfac.com/news/ednews2.cfm>.

ACTION 1: Expand Entrepreneurial Education and Training

There are already a number of entrepreneurial education programs in operation in Nevada. Most prominent, from both a state and national perspective, has been the "capstone" program that Dr. John Kleppe has run for several years out of the Department of Electrical Engineering at UNR. Recently, with foundation support, Dr. Kleppe is extending the educational program to high school teachers in the Reno area, and in turn, creating a cash prize competition among students. Another initiative has been launched as a joint effort between the College of Engineering and the College of Business at UNLV, to establish an e-club to promote student invention. In addition, the business schools at both UNR and UNLV are increasing their emphases on entrepreneurial course work and experience. For example, a new certificate program in Technology Management, with a strong entrepreneurial flavor, will involve a collaboration between the business schools at UNR and UNLV, the College of Law at UNLV, and the Colleges of Engineering at both institutions. Sierra Nevada College (a private institution) offers an innovative bachelor's degree in entrepreneurship, along with recognizing the importance of the topic by having an endowed chair in the area. For example, Sierra Angels has been a strong advocate for, and participant in, many of the developments by offering seminars for entrepreneurs on issues of capital acquisition.

The experience in Nevada, and national "best practices" suggest that a meaningful entrepreneurial education program needs to have a strong experiential "hands on" component, such that students deal with real business development issues; a strong interdisciplinary and multidisciplinary flavor; instruction provided by individuals who actually have been entrepreneurs; and participation being acknowledged as satisfying requirements for a minor, major, certificate, or emphasis.

What has developed thus far in Nevada has been extraordinarily positive. The shortcoming is the relatively modest scope of the programs and their limited visibility to the general public, others in UCCSN, and elected officials. What is needed is a significantly expanded scope of entrepreneurial education, which cuts across various units of UCCSN, touches many more students, and begins to have larger impacts on business entrepreneurship in the economy.

Detailed Sub-Actions:

- Convene a statewide Entrepreneurial Education Curriculum and Program Committee (EECPC) within the UCCSN. Its first task would be to inventory all course work, minors, certificate programs, and experiential education in the area of technology entrepreneurship.
- The second task of the EECPC would be to create a core course in entrepreneurial economics which would be offered as an option in the basic education sequence for every institution in the UCCSN.
- A third task would be to organize, encourage, and obtain approval for a number of Entrepreneurial minors and majors within traditional academic units.
- A fourth task would be the design and formulation of needed new UCCSN courses in entrepreneurial topics, as well as making recommendations about curriculum, textbooks, readings, and field experiences.

- A fifth task would be to organize an annual event, which would provide a venue for the awarding of a Chancellor's Entrepreneurial Award for superior teaching or research in the area, and a Governor's Award for student excellence in a thesis, senior project, or contribution to the community. Both would be in the range of $1000. This award process could be done in collaboration with the Inventor of the Year award conducted by the Nevada Technology Council, or as separate events.
- A sixth task would be creating venues and educational outreach to the investment community in Nevada, particularly regarding the needs and opportunities represented by technology entrepreneurs. There is limited understanding among this community of the world of the technology start-up, and how a significant and remunerative business can be built around serving this community. SCR19, being championed by Senator Ann O'Connell, is one illustrative approach to this issue.

Priority	**High**
Time frame	**Near term**
Lead organizations	**Planning committee with UCCSN**
Key partners	**Entrepreneurial companies and service providers, regional economic development organizations**
Resources	**Start-up costs of $50,000 with other costs contingent upon detailed planning outcomes**

ACTION 2: Coordinate and Strengthen the Development of Incubation Services and Programs

As noted above, the offering of incubator space and, more importantly, services to start-up companies seems to be an important component in developing a state's entrepreneurial infrastructure and network. In fact, several incubator and/or accelerator[26] programs are in operation or in various stages of planning in Nevada.

Under funds from the Department of Energy, the NTS Development Corporation (NTSDC) has operated for several years a facility in Las Vegas along with a rich mix of services for start-up companies. Several of the latter are reaching business maturity, and the state can expect to see significant growth among these "graduates." NTSDC is also currently involved in the creation of the Nevada Innovation Center, a partnership involving the Nevada Development Authority (NDA) and UNLV. This new configuration will both expand the scope of resources available to start-ups as well as the number of potential deals that might be developed. This concept has been approved in principle by the leadership of UCCSN, as well as UNLV. Implementation is underway.

Earlier in its genesis is what is currently known as the Engineering Lab Center, which is a joint initiative of the UNR Colleges of Engineering and Business, as well as local entrepreneurs and investors. Suitable sites are being considered, and it is expected that both

26. An "accelerator" tends to work with companies farther along in the their cycle of development, and also is likely to be a for-profit entity with an explicit exit strategy built into their business model.

entrepreneurs as well as flagship service providers (e.g. patent law firms, investment groups) will be tenants.

Under a grant from the U.S. Department of Commerce EPSCoT program, the Henderson Chamber of Commerce is leading a consortium that intends to develop infrastructure in the area of entertainment technology, encompassing animation, multimedia software, light and sound production, and related hardware design. Much of this activity will be centered at the new Henderson Resource Center/Incubator, with extensive participation by UNLV.

A for-profit accelerator facility is being developed in the Reno area under the leadership of Fred Sibayan Associates. The project—known as *Sierra Vision Launch*—is expected to serve upwards of fifty early stage companies annually, and spin many of them out to an associated research park. Most of the companies will be in the areas of biotechnology or business-to-business Internet products and services. Companies will be “accelerated,” with infusions of capital and expertise, to the point of being appropriate for merger, acquisition, or an IPO. A 12,000 square foot temporary facility will open in December of this year, and a 100,000 square foot building is expected to come on line in October of 2001.

All of these developments are encouraging and also attest to the fact that the entrepreneurial spirit is alive and well in Nevada. What then is needed? For benefits of visibility, fund raising, and leveraging of disparate planning efforts, much can be gained by developing a statewide non-profit Incubator Association. This need not (and perhaps should not) involve any role on the part of state government. Nonetheless, other states with a number of incubators have established such entities. including North Carolina and Pennsylvania. Typically these organizations meet once or twice a year, but also host professional development activities for staff, as well as providing a highly visible platform for advocating the entrepreneurial agenda. One can also use an association to pursue federal or foundation grants that can be used to offset ongoing costs of operation. An association—or at least a for-profit affiliate—can also provide a vehicle for raising and investing seed stage capital (see below). As Nevada’s technology sector grows, particularly the entrepreneurial component thereof, there will likely be more incubator programs and facilities being established. A state association could also facilitate capital acquisition by entrepreneurs, particularly by sponsoring venture forums, or other events where principals in start-up companies can engage the investment community. A low-level statewide association could facilitate that process.

Detailed Sub-Actions

- Convene the leadership of the existing and in-development technology business incubators in the state.
- Conduct a quick practice benchmarking of those statewide associations currently in operation (e.g. the National Business Incubation Association can short-circuit this process considerable).

- Develop and incorporate the Association and secure part-time or voluntary staff direction.

Priority	**High**
Time frame	**Near term**
Lead organizations	**Leadership of existing and in-planning incubator programs**
Key partners	**Entrepreneurial companies and service providers, regional economic development organizations, UCCSN**
Resources	**No additional**

ACTION 3: Expand the Supply of Early Stage Capital for Technology Entrepreneurs

Nevada ranks low in terms of capital resources. According to recently-published data[27] the state ranked 43rd in the amount of venture capital funds invested as a fraction of gross state product (GSP), 48th in Small Business Investment Company (SBIC) funds[28] disbursed as a percent of GSP, and 37th in IPO funds raised relative to GSP. Groups such as Sierra Angels have made some impact on this state of affairs by investing in several Nevada-based technology companies. While the urban areas of the state have the opportunity to conduct business and secure capital in the technology corridors of California, capital access is nonetheless a significant problem for the entrepreneurial side of the Nevada economy. Moreover, capital funds in California are likely to demand that Nevada companies move closer to the investor principals—typically to California.

Detailed Sub-Actions:

- Recently the Small Business Administration has relaxed certain guidelines concerning the SBIC program. Heretofore, it was impossible for a business incubator to seek licensing as an SBIC, either independently or in partnership with another entity. On an experimental basis the SBIC program is encouraging applications that link together incubators (for deal flow) and SBICs. Assuming that the Incubator Association suggested above gets established, its first task should be to secure an SBIC license to serve all the technology incubators in the state as a source of seed and second stage investment. This, of course, involves a lengthy nine to twelve month process of filing a preliminary application, getting a "go forth" letter, finding and securing limited partners, and finally getting licensed to do business. Nonetheless, it would be a useful exercise to pursue.
- Over a five year period, the state needs to re-examine its pension fund investments that go into venture funds. Whether it be a fund-of-funds arrangement, or direct investment in individual funds, an effort should be considered to encourage each fund manager to locate a full or part-time office in Nevada, work with entrepreneurial development groups and organizations and angels to review potential deals in Nevada, and set a target goal of a set amount of each fund being available for the seed stage of investment in the state. Up until

27. Office of Technology Policy, U.S. Department of Commerce. *The Dynamics of Technology-Based Economic Development. State Science and Technology Indicators.* Washington, D.C.; U.S. Department of Commerce, June, 2000.
28. There is one SBIC in the state, Atlanta Investment., located in Incline Village.

recently, such a strategy might justifiably be considered as foolhardy and fiscally irresponsible, give the relatively low rate of investment opportunities that might compare with those afforded in Silicon Valley or other hot spots. In fact, the Nevada Public Employees Retirement System's equity investments have tended to be steered to the most promising national and international deals by the four to six funds with which they partner,[29] irrespective of geography. Nonetheless, that situation is changing rapidly, and if a relatively modest fraction of the actions recommended in this report come to pass the flow of attractive deals will increase significantly. Responsible pension fund officials should study the experience of the Maryland Venture Capital Trust and other state programs that implemented such a strategy.

Priority	**High**
Time frame	**Near term**
Lead organizations	**Incubator association, Commission on Economic Development**
Key partners	**Regional economic development organizations, UCCSN**
Resources	**None additional other than to support planning processes, which will involve donated time**

ACTION 4: A Start-Up Oriented University Technology Transfer System

Under Strategy II (above) a number of specific recommendations were made regarding the improvement of university-industry technology transfer in Nevada, and will not be repeated here. However, we will reiterate that a first class technology transfer system demands staff experienced in start-ups, institutional leadership that promotes the mission relevance of universities assisting in building entrepreneurial cultures, and a structure of policies and practices that are understandable and enabling for would-be faculty entrepreneurs.

Priority	**High**
Time frame	**Near term**
Lead organizations	**UCCSN**
Key partners	**Board of Regents, legislature**
Resources	**No increase over resources currently allocated**

ACTION 5: An Entrepreneurial-Friendly System of Statute and Constitutional Law

Many discussions of entrepreneurial development in Nevada, particularly when there is a likelihood of public resources or public employees such as professors being involved in the mix, are likely to lead to "can we or can't we" arguments and interpretation of state law. For example, the anti-donation clause in state law inhibits government involvement in early stage capitalization. Unfortunately, Ballot Question #1 was defeated in the November 2000 election, and the future of constitutional revision in this area is in doubt.

This body of law has implications for what state agencies can do vis-à-vis technology-based economic development, but also the role that public universities can play as well. In addition,

29. "Nevada Stays the Course in Venture Investing", *Venture Capital Journal (VCJ)*, July, 1999.

there is some ambiguity within the university system about whether (or how) the institutions and/or faculty inventors can take equity in start-up companies based on university technology. This is important from both an economic development perspective, and from the perspective of the technology transfer process. Start-ups tend to stay home, and even if they leave—and a Nevada-based entity has some equity share—some value-added can remain in the state. Carnegie Mellon University (a private institution in Pittsburgh) which spun out the Lycos search engine (for the Internet) to a local firm provides an excellent example. Carnegie Mellon took an equity piece of the deal, and when Lycos was acquired and moved to Boston, the University realized $41 million in capital gains. This paid for a new computer science building and two new endowed chairs in the computer science department.

These legal uncertainties are exacerbated by organizational design issues, such as can a university or other state agency stay clear of statute or constitutional prohibitions by conducting such business through a linked, but independent, non-profit corporation? Many states or universities have followed this strategy with considerable success. In other words, the prohibitions of statute or constitutional law are less clear cut when a university or state agency contracts with an independent not-for-profit to conduct its business in certain areas. The proposed Silver State Technology Corporation (see below) could house this function.

Regardless of the outcomes of the anti-donation issue, there needs to be a once-and-for-all understanding of any statute and/or constitutional impediments to exercising any aspects of this plan. This, in turn, could drive a comprehensive legislative agenda that could be tied to the vision embodied in the plan, in addition to addressing these legislative matters one at a time.

Detailed Sub-Actions

- Convene a working group consisting of senior legislators, the Office of the State Attorney General, university leadership involved in technology transfer and/or industry partnerships, members of the technology investment community, and Nevada technology entrepreneurs. The purpose is to identify all problematic aspects of Nevada law that have implications for this technology strategy.
- Develop a comprehensive legislative package for changes in Nevada statutes that can be advocated in whole and/or in parts, plus any needed changes in constitutional provisions. Part of the crafting of this package should involve “what-if” analysis of the use of independent corporations for many of the activities now conducted by state agencies or employees. This might obviate the need for changes in statute or constitutional law.
- Nevada should participate actively in the National Governors' Association (NGA) Center for Best Practices State Policy Academy on Entrepreneurship. The Kauffman Foundation is supporting this eighteen month process where the selected states—of which Nevada is one—will develop policy initiatives and take specific actions to improve the climate for entrepreneurship in their state. Possible actions will likely include reviewing state statutes

and regulations (as well as local ordinances and regulations) for changes that could better support entrepreneurs, and then drafting applicable legislation or rules.

Priority	**Critical**
Time frame	**Near term**
Lead organizations	**Governor, legislature**
Key partners	**Commission on Economic Development**
Resources	**No additional at this time**

Strategy V: Create a Permanent and Effective Organizational Vehicle for Implementing the Nevada Technology Plan

Implementing state technology strategies, and achieving technology-based economic development, takes years of effort, millions of expenditures, great perseverance, and unremitting focus. Programs must be funded at sufficient scale to make a difference, and a set of comprehensive, linked interventions must be undertaken that address an interrelated set of issues and problems as outlined in this report. Elected officials must be patient and allow sufficient time for programs to be started, implemented and the results assessed. States like Pennsylvania, Ohio, North Carolina, Colorado and others have seen the benefits of such efforts. But each of these states had a central coordinating agency or organization that pushed this agenda.

Best Practices

Often the major problem with maintaining momentum with technology programs is the organizational structure in which they are implemented. There are lessons that can be derived from those programs that have survived **and** had impacts on their states' technology sector.

For one, programs should not be seen as the creature of one administration or one political party. The danger—there are many examples here—is that as the ideology or party of the statehouse or governor's mansion changes, often the program disappears. KTEC, the Kansas technology organization, has representation from both majority and minority legislative leadership on its governing board as a way of defusing this situation and other programs have more informal connectivity with different political perspectives. Although seemingly trivial, it is probably useful to attach the name of some state icon to the program, particularly one that is loved or esteemed with bipartisan gusto. The Ben Franklin Partnership in Pennsylvania and Ohio's Edison program are illustrative.

Second, it is generally wise to structure state technology programs such that they are **not** attached to or located in a state agency. This seems somewhat ironic in that a major goal of these programs is to advance the economic interest of the state. Nonetheless, the most productive and useful configuration seems to be a non-profit corporation that does work on a contract basis for and with state government. For example, this structure enables the program to work with private corporations and organizations and not be encumbered by state contract and conflict-of-interest law. An important "cultural" benefit as well is that not being a line item in a state budget tends to encourage leadership and staff of the technology organization to adopt a more business-like approach to the world. It can makes the organization hungrier, more inclined to raise it own money, and ultimately to strive to be totally self-supporting.

Third, a separate corporation enables a greater degree of independence of thought and action. Responsible primarily to its governing board, the organization can occasionally take risky intellectual positions on matters of public policy. Similarly, a private corporation typically permits greater flexibility in operations, communication practices, human resources management (e.g. compensation, hiring and firing), and, as a 501(c)(3), has the ability to secure grants, loans, contracts, and contributions.

For these reasons, a state science advisor ought to be attached to the state Technology Corporation (herein referred to as Silver State Technology Corporation). While the incumbent will likely be chosen by the sitting governor along with legislative leaders, his/her organizational placement outside of state government will help to increase credibility and intellectual freedom.

Fourth, if an independent corporate entity is created to operate as the state's locus of technology strategy implementation, national experience suggests that this corporation needs a wide and inclusive mandate. In some areas, this may involve budgets to spend and programs to operate; in others areas the role may be more advisory or consultative. Nonetheless the technology corporation should not be shut out of any domain of relevance to technology-based economic development. In fact, one of the design errors of many state programs has been to declare education (K–12 and higher education) off limits to technology strategy. As the discussion in this report illustrates, one cannot have a comprehensive and high impact technology strategy if education, training, and related issues are left entirely in the hands of professional educators. The state technology corporation needs to be "at the table" when matters of importance to technology strategy are discussed. In addition, the action recommendations of this report, if implemented, will quickly overtax the people resources of agencies such as UCCSN and an SST can fill the breach.

Finally, a comprehensive technology organization can head off the proliferation of separate organizations with overlapping or complimentary responsibilities. For example, elsewhere in this report we have proposed the creation of a Nevada Research Alliance and the formation of a statewide university technology transfer organization. Another option is to house these initiatives as programs under the organizational umbrella of an SST.

Detailed Sub-Actions

- Form a ninety-day work group to define the mission, structure, governing board, and staffing of what will be known as the Silver State Technology Corporation, or shortened to Silver State Technology. Tentatively attached to the SST would be the current Science Advisor position, although the Science Advisor would not have managerial authority vis-à-vis the program initiatives discussed in this plan.
- Incorporate SST as a 501(c)(3) non-profit. At the same time, explore the possibility and desirability of creating a subsidiary, affiliate, or separate **for-profit** corporation which would enable some activities hampered under the federal tax code for a non-profit (e.g. licensing royalties and revenue from cashing out equity shares in start-up companies). It is

expected that the operational budget for an SST would be a mix of state appropriations and contracts, federal grants, private investments, fees, and royalties.

Priority	**Critical**
Time frame	**Immediate**
Lead organizations	**Governor**
Key partners	**Legislature, CED, and UCCSN**
Resources	**$25,000 to support operational planning, incorporation, executive search services, and other out-of-pocket costs, plus annual costs of $300,000 to $400,000 to support (on a contract basis) the operations of the Silver State Technology Corporation**

Strategy VI: Leverage Current and Future Federal Investments in Nevada

As noted above, the federal government's investment in Nevada is significant. Of over $1 billion spent in FY1998, approximately $380 million involved R&D, with the majority of this conducted in and for the major federal facilities in the state. Nevada ranks 27th among the states in amount of federal R&D dollars received annually. While Nevada has a number of federal facilities and federal contractor locations in the state, it is not home to a major federal laboratory, such as Oak Ridge National Laboratory in Tennessee, Sandia in New Mexico or Argonne in Illinois, although Los Alamos National Lab, Lawrence Livermore National Lab, and Sandia National Lab are extensively represented in the NTS workforce. Nonetheless, the Nevada Test Site, Nellis Air Force Range, Fallon Naval Air Station, and the Hawthorne munitions facility have a storehouse of state of the art technologies, albeit primarily focused on the missions of the supporting federal agencies (Department of Energy and Department of Defense).

There are niche areas of technology which seem to be ripe for industry partnerships and potential commercialization. Capabilities include expertise in technologies as disparate as instrumentation for measuring pressure at temperature at high extremes (NTS, Nellis), bore hole and large scale drilling and sensors (NTS), and munitions handling and disposal (Hawthorne). An illustration of the exotic nature of the technologies present within Nevada's federal sector is a facility at NTS called JASPER. This R&D program utilizes a two-stage gas gun that allows materials to be propelled at ultra high speed into one another, yielding new insights into material properties and characteristics. Thus far, the research applications have been primarily focused on DOE mission applications, but there is potential for commercial applications. As another example, the Remote Sensing Lab has a long standing program of using highly advanced sensor technology, deployed via various approaches (e.g., fixed wing aircraft, land vehicles), in order to locate hazardous pockets of radioactive material. Thus far, the primary clients for the technology and the services have been among the federal agencies, but in an era of heightened anti-terrorist security concerns around the world, the market is considerably larger. Finally, an example of a recently launched R&D partnership between the federal and academic sectors is a center for the creation of an electronic medical records system for the DOE complex. This is a multi-year project involving UNLV and the private sector, which has huge potential for the creation of database tools and methods which can applied to other settings and problems.

Does any of this have relevance to building a technology-based New Economy in Nevada? In many states major federal R&D have in fact led to the development of technology industry clusters. As noted by the Milken Institute's report on America's high tech economy:

> *The federal government had an unintended impact on the formation of high-tech clusters around the country through its location of research centers and allocation of grants.*

If one examines the dozen or so major technology regions in the U.S., in almost every instance one will find that the federal government, at least indirectly, has had some role in their success. Each of these technology regions usually has a federal lab or center in its midst serving as an anchor to spin-off firms, as well as attracting to the region firms that want to do business with that laboratory or center.

Nevada is in a good position to build on its current and developing R&D assets—such as DRI and the building of the research stature at its two research universities—to think through a strategy of building a major national or international center around expertise it has already developed. This includes environmental technologies, defense, space, advanced instrumentation, natural resources, and related areas. A major goal ought to be to secure a major federal anchor R&D facility that builds on the core competency strengths of the state.

Nonetheless, if one looks at experiences across the country in leveraging federal technology assets, there appear to be signs for either hope or discouragement for Nevada. There are essentially two scenarios for how a major federal facility can impact a state economy. The more typical scenario is where the local facility stays primarily focused on the mission objectives of the federal agency, does minimal R&D partnering with state-based corporations, universities or other institutions, and makes minimal efforts to commercialize any new technology coming out of the agency program. The economic impact tends to be a function of the size of the federal agency payroll and the scope of business contracted to local support firms. Often the latter are prohibited or given negative incentives regarding technology commercialization, frequently because of national security and secrecy issues. To the extent that technology transfer occurs, it stays within the federal contracting community or among the federal agencies. If the mission or R&D objectives of the federal agency change, there may be dramatic downturns in federal or contractor employment. There are many examples of this scenario.

An alternative example is provided by the National Institutes of Health (NIH), operating in Maryland. NIH is the largest funder in the world of biomedical science, and its total budget reached $15.9 billion in FY2000. Particularly pertinent to this discussion, the NIH budget includes a $1.6 billion intramural research operation, including the full array of substantive foci, extensive clinical research facilities, and a rich network of collaborative research relationships with dozens of universities with a few hundred miles. The majority of the intramural program is executed in Maryland. While Maryland's economy has benefited considerably from the presence of several thousand NIH federal employees, it has been even more enriched by the burgeoning hotbed of biomedical, biotech, and pharmaceutical companies that have located to or started up in the Washington, DC to Baltimore corridor. There are currently thousands of high skill, high wage biomedical/biotech workers in the region. There is also a growing number of venture capital firms, and an extremely dense entrepreneurial support infrastructure.

The question for Nevada is whether it would rather be like Maryland or mimic the experiences of the many other states which have failed to harness the commercial potential afforded by their federal guests. Assuming the former, there are several actions that might hasten that outcome. In approaching this challenge, it must be understood at the outset that Nevada is not like Maryland in many important respects, so the experience there cannot be directly translated.

There appears to be two major goals regarding the federal sector in Nevada that will serve both the interests of the state and the interests of the involved federal agencies.

For one, it is important to maintain and encourage the continuing growth and vitality of the federal R&D sector whose primary mission is to serve the national agenda as expressed through DOE, DOD, and other agencies. In other words, one cannot talk about "leveraging the federal investments in Nevada" unless those investments continue to be robust. In short, the state should come to terms anew with the likely fact that there will be a large federal presence in Nevada on into the forseeable future, that the direct contributions to the Nevada economy and society have been for the most part highly commendable, and should work hard to maintain and enhance that presence. If this occurs, there will continue to be employment possibilities, contractor business, and significant value added to the economy. However, like all federal activities in any state, that presence is always contingent upon changes in national policies and politics. Nevada needs to work hard to build and maintain the federal R&D base. This is a core business for the state.

The other side of leveraging the federal investment that needs to be addressed is how to foster the commercialization and transfer of federal technology in ways that will "stick to the ribs" of the Nevada civilian economy.

In fact, the recurrent issue concerning the federal R&D sector in Nevada has been the large extent to which industry and commercial implications have been unexplored. Of course, given the historic national security mission of much of federal investment in the state, that is understandable. However, much has changed over the past ten years within the federal R&D community. For example, a greater emphasis has been placed within DOE on technology transfer and industry partnering. The result has been a flowering of patenting, licensing, and industry Cooperative Research and Development Agreements (CRADAs). In Nevada, those changes have not been extensively realized.

ACTION 1: A Nevada Federal Technology Institute (NFTI)

Maryland had some going-in advantages to leverage the NIH intramural presence in the state. While Nevada has what amounts to a significant "intramural" R&D presence on the part of Nellis and NTS, those entities are rurally isolated from business development infrastructure, and the state in general is thin on these assets, such as venture capital and patent lawyers. In addition, the federal agency presence in Nevada has been primarily focused on a mission of winning the peace and maintaining national security. Those goals are not necessarily compatible with an aggressive, entrepreneurial approach to commercializing technology. As a result, relative to the amount of federal R&D spending in Nevada over many years, not much in the way of technology-based commercial products, services, and companies has resulted.

This situation can change if given a suitable organization and sufficient resources. It is recommended that the Nevada Congressional delegation work together to create and secure long term funding for what will be tentatively termed the **Nevada Federal Technology Institute** (NFTI). This organization would dramatically increase current resources for the commercialization of spin-off technologies, for the development of industry technology development partnerships, and for searching out these potential deals within the federal R&D community in Nevada. In effect, take an aggressive, well-funded approach to what has previously been pluck and luck.

Some of the key functions that might be performed by an NFTI are given below:

- Discovering, exploiting, and managing intellectual property, particularly focusing on the R&D assets of the federal technology organizations in the state (e.g. Nellis, NTS, Fallon, Hawthorne). Part of this would involve "boring into" the talents and capacities of the federal sector, and finding technologies with commercial potential.

- Focusing applied research on the development of pre-commercial prototypes and proof-of-concept testing.
- Business planning for technologies with commercial promise.
- Developing novel approaches to manufacturing processes and technologies.
- Fostering industry-university-federal sector partnerships for applied research and technology development, particularly in those areas where UCCSN and federal sector core competencies complement one another.
- Providing educational outreach to K-12 schools around the state on the desirability and opportunities of a career in science and technology. The program would be conceptualized as a "pre-Millennium" activity, and would be particularly focused on students with the best academic records.
- Coordinating internship opportunities within the federal R&D sector for UCCSN students in the sciences and engineering. There would be a special effort to reach and involve Millennium scholarship winners matriculating in Nevada's higher education institutions.

We do not believe that the NFTI should be a "shell" facility managed by a token staff that simply brokers other relationships. Rather, it should be a major facility, with significant lab and capital resources. It should have a permanent technical staff along with individuals (and entire technical teams) who rotate in and out from both the federal sector, Nevada-based technology companies, and the UCCSN. The NFTI should be a technological "meeting ground" where these various interests can organize around projects of mutual interest, leverage their respective areas of expertise, and build new businesses as a result. In effect, it should be a significant national experiment on how to realize the civilian commercial potential of federal mission-developed technology. This could be a near term plus for Nevada, and also a model for the country.

In order to launch this organizational innovation, a year-long planning effort should be engaged, with major financial and substantive support provided from the state of Nevada and the major federal R&D funding agencies operating in the state. This would involve government, business, and university leadership from across the state, and result in a detailed action plan for an NFTI.

Priority	**High**
Time frame	**Near term**
Lead organizations	**Nevada congressional delegation**
Key partners	**Governor, legislature, Nevada-based federal technology organizations**
Resources	**$1 million in planning and start-up costs, annual operational costs of $10 to $15 million, and a one-time investment of $25 to $50 million in capital facilities (land, building, and equipment), all of which would presumably come from federal agency funds plus industry cost-sharing**

ACTION 2: Industry, Lab, University Cooperative Research Centers.

University experience around the country indicates that a frequent precursor to robust technology development partnerships with industry, is long-term mutual commitment to basic and applied research in areas of mutual interest. The National Science Foundation's Industry-University Cooperative Research Center (IUCRC) program is an excellent example of this approach. In Nevada that opportunity has been weakly exploited. Even less common are research partnerships that involve a tripartite relationship between companies, universities, and the federal facilities (herein referred to as "labs") in the state. As an accompaniment of the NFTI described above, or as a separate program, it is recommended that at least two centers, modeled loosely after the NSF IUCRC program (albeit with greater federal financial participation) be established in Nevada. There may also be two areas of natural compatibility given the strengths within the UCCSN and the core competencies of the federal R&D presence. One is in the area of instrumentation and devices; a second might be environmental science, broadly construed, to join the interests of DRI, UNR, UNLV, and DOE. It should be noted, however, that progress is already being made in the development of large university-DOE research initiatives, including a $1.5 million project in medical records management. Again, a year-long planning and early implementation process is visualized, although this one would become more quickly focused a small number of narrowly defined science and technology areas.

Priority	**High**
Time frame	**Near term**
Lead organizations	**Nevada-based federal sector, corporate community, and UCCSN**
Key partners	**Commission on Economic Development**
Resources	**$150,000 for a year-long planning project which will determine scope and foci of centers program**

A Summary of Recommended Strategies and Actions

In Table 10 are presented, in summary form, the six strategies and 32 separate action recommendations that have been discussed in this chapter.

Table 10: Strategies and Actions

Strategy	Action	Priority	Time Frame	Lead Organization	Key Partners	Resource Requirements
Strategy One: Increase the focus of the state's economic development efforts on technology-based opportunities	Conduct a core technology competencies analysis	Critical	Immediate	Commission on Economic Development and UCCSN	Corporate community, federal technology community, and chief research officers at UNR, UNLV, and DRI	One-time costs of less than $75,000, plus upwards of one person-year of donated time from stakeholders
	Increase public understanding of technology-based economic development and the New Economy	Critical	Immediate	Commission on Economic Development	Regional economic development organizations, Nevada Technology Council, TechAlliance, UCCSN, technology industry associations	Less than $100,000 in out-of-pocket costs, plus 1 to 2 person-years of donated time
	Technology Nevada branding and marketing	High	Immediate	Commission on Economic Development	Regional economic development organizations, Nevada Technology Council, TechAlliance, technology industry associations	One time costs of less than $100,000
	Focus on easy adjacent targets in the Pacific coast technology corridor	High	Long term	Commission on Economic Development	Regional economic development organizations	$100,000 to $200,000 annual costs
	Increased focus on early stage technology companies	High	Near term	Commission on Economic Development	Regional economic development organizations	Start-up costs of $100,000
	Market and maintain Nevada quality of life	High	Long term	Commission on Economic Development, Governor, Lieutenant Governor	Regional economic development organizations, UCCSN, relevant state agencies, relevant not-for-profit advocacy and analysis organizations	$25,000 start-up costs, and $75,000 annual costs, plus upward of one person-year of donated time
	Re-orient MAP and other business assistance programs toward high-value products	Moderate	Long term	MAP, UCCSN	Corporate community	Planning and start-up costs of $75,000; no incremental steady state costs
	Go for the tech flagships, private and public	High	Long term	Commission on Economic Development	Regional economic development organizations	No additional
	Recruit people as well as companies	High	Near term	Commission on Economic Development	Regional economic development organizations, UCCSN	Annual costs of $75,000–$100,000
	Launch a statewide rural telecommunications initiative	High	Near term	Governor's office	State agencies dealing with telecommunications, companies in IT industry, regional economic development organizations, UCCSN, System Computing Services of UCCSN	One-time costs of $250,000 to support strategic planning in several rural communities

Table 10: Strategies and Actions

Strategy	Action	Priority	Time Frame	Lead Organization	Key Partners	Resource Requirements
Strategy Two: Enhance the research, development, and industry partnering roles of the university system	A renewed mission strategy for UNR and UNLV	Critical	Immediate	UNLV and UNR	UCCSN, corporate community	Modest one-time planning expenses
	An expanded mission for the Desert Research Institute	High	Near term	DRI	UCCSN, corporate community, and federal technology sector	One-time planning costs of $100,000; ongoing costs contingent upon DRI performance
	Launching a Nevada Research Alliance	Critical	Near term	UCCSN	UNLV, UNR, DRI, Governor, legislature, and corporate community	$3-$4 million to endow every Alliance chair, from government, industry, and foundation sources, with anywhere from twenty to thirty chairs established over a ten year period
	Re-engineering the Applied Research Initiative	High	Near term	UCCSN	Chief research officers from UNLV, UNR, and DRI, corporate community	No increase over resources already allocated
	Flexible and non-incremental funding within the University and Community College System	High	Long term	UCCSN	Board of Regents, legislature	No increase over resources already allocated
	Develop an effective statewide university-industry technology transfer function	High	Immediate	UCCSN	Chief research officers at UNR, UNLV, and DRI, corporate community, and economic development organizations	Steady state costs of $800,000 per year plus $250,000 start-up costs. Over 5 years, royalty revenues will counterbalance a significant fraction of this
	Conduct a core technology competencies analysis	Critical	Immediate	Commission on Economic Development and UCCSN	Corporate community, federal technology community, and chief research officers at UNR, UNLV, and DRI	One-time costs of less than $75,000, plus upwards of one person-year of donated time from stakeholders
Strategy Three: Build the Nevada New Economy workforce	Increase technology industry input to higher education programs	Critical	Immediate	UCCSN and Commission on Economic Development	Technology industry community, UNR, and community college leadership	One-time costs of $75,000, plus upwards of one person-year of donated time
	Develop an ongoing capacity to assess the emerging personnel needs of Nevada technology industry	High	Long term	UCCSN, corporate community	Commission on Economic Development	Annual costs of $75,000, and start-up costs of $50,000 plus upwards of several person-months of contributed time
	Expand intern and co-op opportunities across UCCSN	High	Near term	UCCSN, corporate community	Units (departments and colleges) at UNR, UNLV, and community colleges with particular relevancy to New Economy industry	Annual cost of $500,000 across UCCSN, plus start-up effort in donated time
	Attain an order of magnitude increase in information technology graduates by establishing a center for excellence in information technology	High	Near term	UNR, UNLV, and community college leadership, plus 2020 Vision Group	UCCSN, corporate community from IT sector, and from those sectors with major IT applications	$1–$2 million in annual operating costs once fully operational, with majority provided by corporate, foundation, and federal agency grants, plus planning costs of $100,000, much of which will be covered by donated time
	Increase general and targeted support for K-12 to national benchmarks	High	Long term	Governor, State Department of Education	Legislature	Unknown at this time
	Increase the use of educational technology in K-12	High	Long term	Commission on Educational Technology, legislature, and Governor	State Department of Education, corporate community	Unknown at this time
	Expand the scope of the Millennium Scholarship Program	High	Near term	Governor, legislature	UCCSN, State Department of Education	Undefined at this time
	Increase and create incentives for program cooperation within UCCSN	High	Longer term	UCCSN	Campus leadership at the unit level	No additional, steer existing resources

Table 10: Strategies and Actions

Strategy	Action	Priority	Time Frame	Lead Organization	Key Partners	Resource Requirements
Strategy Four: Accelerate the growth of the entrepreneurial technology economy	Expand entrepreneurial education and training	High	Near term	Planning committee with UCCSN	Entrepreneurial companies and service providers, regional economic development organizations	Start-up costs of $50,000, with other costs contingent upon detailed planning outcomes
	Coordinate and strengthen the development of incubation services and programs	High	Near term	Leadership of existing and in-planning incubator programs	Entrepreneurial companies and service providers, regional economic development organizations, UCCSN	No additional
	Expand the supply of early stage capital for technology enterprises	High	Near term	Incubator association, Commission on Economic Development	Regional economic development organizations, UCCSN	None additional other than to support planning processes, which will involve donated time
	A start-up oriented university technology transfer system	High	Near term	UCCSN	Board of regents, legislature	No increase over resources currently allocated
	An entrepreneurial-friendly system of statute and consistutional law	Critical	Near term	Governor, legislature	Commission on Economic Development	No additional at this time
Strategy Five: Create a permanent and effective organizational vehicle for implementing the Nevada technology plan	Create a permanent and effective organizational vehicle for implementing the Nevada technology plan	Critical	Immediate	Governor	Legislature, CED, and UCCSN	$25,000 to support operational planning, incorporation, executive search services, and other out-of-pocket costs, plus annual costs of $300,000 to $400,000 to support (on a contract basis) the operations of the Silver State Technology Corporation
Strategy Six: Leverage current and future federal investments in Nevada	A Nevada Federal Technology Institute (NFTI)	High	Near term	Nevada congressional delegation	Governor, legislature, Nevada-based federal technology organizations	$1 million in planning and start-up costs, annual operational costs of $10 to $15 million, and a one-time investment of $25 to $50 million in capital facilities (land, building, and equipment), all of which would presumably come from federal agency funds plus industry cost-sharing
	Industry, lab, university cooperative research centers	High	Near term	Nevada-based federal sector, corporate community, and UCCSN	Commission on Economic Development	$150,000 for a year-long planning project which will determine scope and foci of centers program

Chapter 5: Implementation

INTRODUCTION

This section of the report describes the recommendations and their priorities, short term necessary actions, budgetary issues, and outcome evaluation. Since the six strategies and thirty-three action recommendations cover a wide range of activities—not all of which can be, nor should be, addressed at the same time—each action was given a priority ranking of **critical**, **high**, or **moderate**. This assessment of criticality was confirmed at a late-October meeting of the Project Advisory Committee. In addition, an implementation time frame has been estimated for each action. Some recommended actions require more time to conduct detailed planning and get started.

SIGNIFICANT AND CRITICAL ACTIONS FOR LONG-TERM SUCCESS

Among the thirty-two actions suggested, seven are seen as **critical** for the long-term success of the strategies and the overall plan. These highest priority items are:

- Conducting a Core Technology Competencies Analysis.
- Launching a Nevada Research Alliance.
- A renewed mission strategy for UNR and UNLV.
- Increasing public understanding of technology-based economic development and the New Economy.
- Increasing technology industry input to higher education programs.
- An entrepreneurial friendly system of statute and constitutional law.
- Creating a Silver State Technology Corporation.

Discussion has already begun on the implementation of several of these items. However, in most cases serious implementation actions have not commenced. A small number of these critical priority items, as well as some high priority actions, can achieve significant results over the next twelve months in terms of implementation. They are:

- Conducting a Core Technology Competencies Analysis.
- A renewed mission strategy for UNR and UNLV.
- Increasing public understanding of technology-based economic development and the New Economy.
- Increasing technology industry input to higher education programs.
- Technology Nevada branding and marketing.
- Creating a Silver State Technology Corporation.

Budget and Resources

Financing the strategies and actions recommended in this report could be broken down into two components: one-time investments for start-up planning or capital expenditures, and ongoing investments to support the operational costs of a program or activity. It should be realized that most of these costs are spread across several funding sources: the federal government; state of Nevada government agencies; the private sector; and foundations.

One-time and start-up costs. The following actions involve one-time early stage investments of the following magnitude:

DRI mission expansion	$100,000
Statewide technology transfer	$250,000
Core technologies competencies analysis	$75,000
Increased focus on early stage technology companies	$100,000
Technology Nevada branding and marketing	$100,000
Nevada quality of life	$25,000
Re-orient MAP	$75,000
Statewide rural telecommunications	$250,000
Increase technology inputs to higher education	$75,000
Assess personnel needs of industry	$50,000
IT Center of Excellence	$100,000
Expand entrepreneurial education	$50,000
Create Silver State Technology Corporation	$25,000
Nevada Federal Technology Institute	$26,000,000
Cooperative research centers	$150,000

Ongoing costs. Several actions involve ongoing cash support which can come from a variety of sources. In addition, some of these costs will be defrayed or obviated in time by revenues deriving from the program. The on-going annual costs include:

Focusing on targets in the Pacific coast technology corridor	$100,000 to $200,000
Launching a Nevada Research Alliance	$3 to $6 million
Statewide technology transfer	$800,000
Nevada quality of life	$75,000

People-oriented recruiting	$75,000
Assess personnel needs of industry	$75,000
IT Center of Excellence	$1 to $2 million
Create Silver State Technology Corporation	$300,000 to $400,000
Nevada Federal Technology Institute	$10 to $15 million

Accountability and Measures of Success

In various parts of this final report it has been suggested that various activities and outcomes be "benchmarked" against regional or national trends. It is also recommended that a more comprehensive approach to assessing the outcomes of various strategies and actions be adopted.

A Nevada New Economy Report should be developed and produced on an annual basis. It should include results being achieved as a result of implementing various recommended actions of this plan, and it should also include broader indices of the development of a technology sector in Nevada.

The latter can generally be adapted from various federal agency data sources, or better yet by building on one or another of the various compilations of New Economy measures[1] that are increasingly popular. These include efforts of the U.S. Department of Commerce Technology Administration, the Southern Technology Council, the National Science Foundation EPSCoR Program, and the Progressive Policy Institute. These have been referenced in several sections of this final report. Some of the more obvious indicators that are already being gathered and published include the following:

State R&D per capita (corporate and academic).

SBIR awards (normalized by population).

University licenses and royalties, per $10 million of R&D expenditures.

Venture capital per capita.

Percentage of college graduates leaving the state.

Indices of K–12 classroom technology intensity and degree of utilization.

Other, more program-specific outcome and process measures, will need to be devised by whatever organization has overall managerial responsibility for the strategies and actions that will be implemented (e.g., Silver State Technology Corporation). It is recommended that a firm that has a track record in evaluating science and technology programs be given a long-term contract, after a competitive bidding process, to gather, analyze, and report on these data.

1. An overview of benchmarking approaches to understanding impacts and critical factors of science and technology programs can be found in: Tornatzky, L. "Benchmarking University-Industry Relationships: A User-Center Evaluation Approach". Paper delivered at Bad Herrenalb, Germany, September 15, 2000. A copy is available from the author through Battelle.

Some of the types of outcome information that will need tailored approaches to data collection and analysis include the following:

Extent of implementation of mission changes at UNR, UNLV, and DRI.

Commercialization and research productivity outcomes of Nevada Research Alliance chairs.

Fraction of university licenses and royalties from in-state deals.

Increases in commercialization outcomes from federal sector R&D.

Increases in IT graduates and the fraction of Nevada-employed.

Increases in dot.com enterprises based in rural Nevada.

Changes in public attitudes toward the New Economy.

Changes in the mix of companies moving to Nevada.

Intern and co-op participation and resultant changes in state-base hiring.

SUMMARY

Nevada can diversify its economy, seeking greater strengths in the technology sector. It has a robust economic base in its gaming and resort industries, the growing prominence of its higher education sector, and an increasingly visible and productive group of technology-based companies. With several major investments, the state could be a different kind of place. There can be a greater array of opportunities for its young people, a national-class higher education system, a vibrant cadre of technology entrepreneurs, and a strong economic base which can support the quality of life that Nevada citizens cherish and enjoy.