IS WASHINGTON'S HIGHER EDUCATION PROVIDING A FOUNDATION FOR A STRONG ECONOMIC FUTURE?

ASSESSING WASHINGTON'S PERFORMANCE

A Technology Alliance Report

Reports written by:

Paul Sommers, Ph.D.
Professor
Institute of Public Service and
Albers School of Business
Seattle University

and

Hitachi Consulting
Seattle

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Technology Alliance

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June 2004

Acknowledgements

A study committee consisting of business executives, higher education administrators, professors, and lawyers specializing in technology company issues guided the study's researchers, authors and Technology Alliance staff to create this report. The committee defined the key questions this report addresses, determined the indicators to measure and analyze, and selected the industries and companies for which to seek interviews with business executives for perspectives on higher education in Washington. In addition, the Technology Alliance executive committee and board reviewed and provided input to the study at several stages. The many hours these individuals have contributed to the final product is gratefully acknowledged.

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We would like to thank the sponsors of this study for their generous support: Microsoft and Davis Wright Tremaine LLP. Their interest in this issue highlights the growing concern of businesses for the future excellence of higher education in Washington. **Special thanks to DeLee Shoemaker from Microsoft for her vision and time on this study**.

We would also like to thank Hitachi Consulting for their pro bono services and support of this study. More than 20 members of the Seattle Hitachi Consulting practice, including all eight local senior executives listed below, who developed and conducted the interviews, compiled and analyzed the results, and presented the findings:

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Introduction

The Technology Alliance is a statewide consortium of leaders from technology-based businesses, research institutions, and organizations dedicated to Washington's economic success. The vision of the Technology Alliance is that all of Washington's citizens should benefit from a vibrant technology-based economy. Such economies are based on sound educational systems, strong research capacity, and robust entrepreneurial activity. In a thriving economy, Washington's research institutions spawn new discoveries and promising technologies; our companies develop innovative products and provide job opportunities locally; and, our schools, colleges and universities produce the best and brightest graduates to contribute back into this cycle.

In late 2002, the Technology Alliance set out to understand how well Washington state is competing against other leading states in building and supporting a technology-based economy. We benchmarked ourselves against eight peer states on the drivers of a technology-based economy. Over 40 indicators were measured and analyzed in the areas of education (both K-12 and higher education), research capacity, and entrepreneurial climate. The results of this initial benchmarking study were frankly distressing (See: *Drivers for a Successful Technology-Based Economy: Benchmarking Washington's Performance*. May 2003. Seattle: Technology Alliance – http://www.technology-alliance.com). Of particular concern was our state's performance in the higher education benchmarks. The number of Washington high school students continuing on to higher education is low. The number of bachelor's degrees granted by our higher education system, especially in science and engineering majors, is in the lowest third of the nation on a per capita basis. Washington's higher education system is simply not generating enough graduates to meet the needs of our technology-based economy.

Our benchmarking study generated concern and discussions within a variety of sectors around the state. Clearly, many recognized that a strong higher education system is essential to Washington's ability to compete with other states and countries in future technology-based advancements, business opportunities, and jobs. Many brought their concerns to us, with interest to understand the problem better and to see what they could do to help address the issues. Thus, we decided that it was important to look more deeply at the challenges associated with Washington higher education. This publication presents two reports: (1) benchmarking of education in math and science fields of study against our peer states, and (2) a distillation of technology-based business leader perspectives regarding their company's needs from higher education. We asked Paul Sommers, Ph.D., economist and author of our first benchmarking report, to collect and analyze new indicators in K-12 and higher education. Hitachi Consulting provided support and services by conducting interviews with 39 business executives from around Washington, and collected and analyzed their views on the role of higher education in the future of our technology-based economy.

The following reports look more deeply at indicators measuring the strength of our state's education system and reveal what Washington's business leaders are thinking regarding our technology-based economic future. What does our higher education system need to produce in order for Washington to be globally competitive in 2015? How can we produce the quality and quantity of graduates we need to sustain and enhance whatever comparative advantage we currently enjoy as a region? What will businesses need in order to continue innovating, competing, and leading? The findings of these reports tell us that we have work to do if we want to ensure that Washington continues to be a major innovator and leader of technology-based goods and services into the future. Business leaders are concerned that our education pipeline lacks the depth and quality needed to feed talent and resources into our knowledge-based future. We need to transform our K-20 education system to better serve the needs of a high tech economy.

These reports tell us where we are starting from, and the findings are designed to help us understand where we collectively need to go. If our goal as a state is to compete in today's global economy and to ensure jobs for our

children, then we need a clear vision, a commitment to achieve, and strong partnerships with every sector in our state. The findings of these reports will be used to inform the further development of policies and priorities for the Technology Alliance, as well as for other organizations and agencies around Washington. We will engage in discussions with a broader range of business leaders, and will continue the dialogues and collaborations with leaders from education, government, and the broader community. Our commitment to ensuring that Washington stays a world leader in producing the smart people who will be tomorrow's innovators must not waver. We look forward to working with concerned leaders from around our state to create a place where all citizens have the opportunity to participate in and benefit from a vibrant technology-based economy.

Study Co-Chairs

Brad Smith
Senior Vice President, General Counsel and
Corporate Secretary, Law and Corporate Affairs
Microsoft Corporation

Karen Lane
Consultant
Cedar River Group

PART ONE

04

Education and the Advanced Technology Industries in Washington

By Paul Sommers, Ph.D.
Professor
Institute of Public Service and
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Executive Summary

This report examines Washington's performance relative to peer states on a key driver of advanced technology development—education in math and science. For Washington's research institutions and private companies to succeed in these fields, they must have a ready supply of workers with the necessary technical education. Of course, companies can recruit staff from other states, but this practice limits the availability of good jobs and exciting careers to Washington's youth. This report examines Washington's education system based on comparisons with peer states competing in similar advanced technology industries.

Preparing for College

In order to enter technical majors at the university level, students must do well in preparatory courses throughout the K-12 school years, particularly in mathematics and science. The Washington Assessment of Student Learning (WASL) is a set of examinations administered in 4th, 7th, and 10th grades in a number of subjects including math, reading, and writing. The math scores are discouraging, with only about 40 percent of 10th graders passing the examination. About 60 percent are passing the reading and writing examination, less than desirable, but better than the math scores.

The College Board administers the SAT to students applying for college admission. Over half of Washington high school seniors take the SAT. Surveys on high school course taking completed by SAT takers provide additional indicators of preparation for college. However, the percentage of Washington students who take the math and sciences courses needed to prepare for a career in advanced technology is relatively low compared to peer states:

- Fewer of Washington's students take 4 or more years of math than in six other states, and the differences among student cohorts in the various peer and neighbor states are large, up to 16 percentage points.
- Washington's students lag all of the peer state students in the percentage who take biology (but the differences are small – 2 to 7 percentage points since the vast majority of SAT takers in all states take biology).
- Fewer Washington students took chemistry than in 8 peer states (the differences again are small).
- Washington students lag peers in 6 peer and neighbor states in the percentage who took physics.

University Graduates

Once students enter college, the key factor for advanced technology industries is the number who major in science and engineering fields. Compared to peer states, Washington ranks:

- 6th in the number of biological and life science graduates per 100,000 population.
- 8th in the number of engineering graduates per 100,000 population (tied with Texas in last place).
- 9th (last place) in the ratio of doctorate degrees to bachelor's degrees granted.

University quality rankings by US News and World Report are widely used by students to select universities, and by employers to judge the quality of applicants for positions in their companies. Washington ranks 4th among peer states in the number of graduates from Top 100 universities. Considering that this state has only two universities that make it onto the Top 100 list, this is an admirable performance, but the fact that only the University of Washington and Washington State University have achieved this level of quality limits the options for college-bound youth within the state. Many of them apply to universities in other states as a consequence and may seek job opportunities outside Washington when they graduate.

These data suggest that Washington's system of public and private colleges and universities lags most of the peer states in supporting the workforce needs of our advanced technology industries.

Conclusions

Compared to peer states competing in the same advanced technology industries, Washington is significantly lagging in its output of college graduates who are trained in science and engineering fields. Washington also falls behind its peers in preparing students to enter scientific majors in college as demonstrated by WASL scores, math and science course taking in high school, and other indicators. Washington also lags in degree granting in scientific and engineering disciplines at the bachelor's degree level, and in the proportion of its degrees granted at the graduate level. Washington has only two top ranked research universities, and therefore a limited number of seats in top ranked departments, which in effect encourages talented high school graduates to choose universities in other states. A careful examination of our education system from bottom to top is needed to correct these problems and to provide better support for science and technology industries in the future. Lacking such reforms, the leading industries in the state will face substantial problems in keeping up with their competitors in our peer states.

Introduction

This report examines Washington's performance relative to peer and neighboring states on a key driver of advanced technology development—education in math and science fields of study that are essential to the development of advanced technology industries. In order to enter technical fields in college, students must do well in high school, making the entire range of education from kindergarten on up relevant to the issue of preparing students to enter advanced technology fields. Computer science, bioscience, mathematics, and engineering, are just a few of the key disciplines used in today's advanced technology fields.

For Washington's research institutions and private companies to compete successfully in these fields, they must have a ready supply of workers with the necessary technical education. Of course, companies can recruit employees from other states, but this practice limits the availability of good jobs and exciting careers to Washington's youth, and it raises costs to companies, making them less competitive. A more prosperous future will be achieved by both companies and residents of this state if our colleges and universities are able to graduate sufficient scientists and engineers at the bachelor's and graduate degree levels. Unfortunately, this report demonstrates that Washington is not doing well compared to peer states in preparing students to enter technical majors in college, has relatively few students who take the appropriate courses in high school, and has only a few top-ranked colleges and universities to attract the most talented students in the state.

This report relies on comparisons to peer states, a methodology used in a previous report examining a range of drivers of advanced technology industry development. The methodology for picking peers is based on similarity of advanced technology industry employment. The report also presents data on our neighboring states, Idaho and Oregon. These states have very different industry structures, and by and large their technological strengths are in industries in which this state is not strong. However, they are neighbors and there are many business relationships, as well as a notable flow of college students in and out of these states, making them of interest to many readers. Readers interested in the details of this methodology are referred to the previous benchmarking report.[1]

Preparing for College

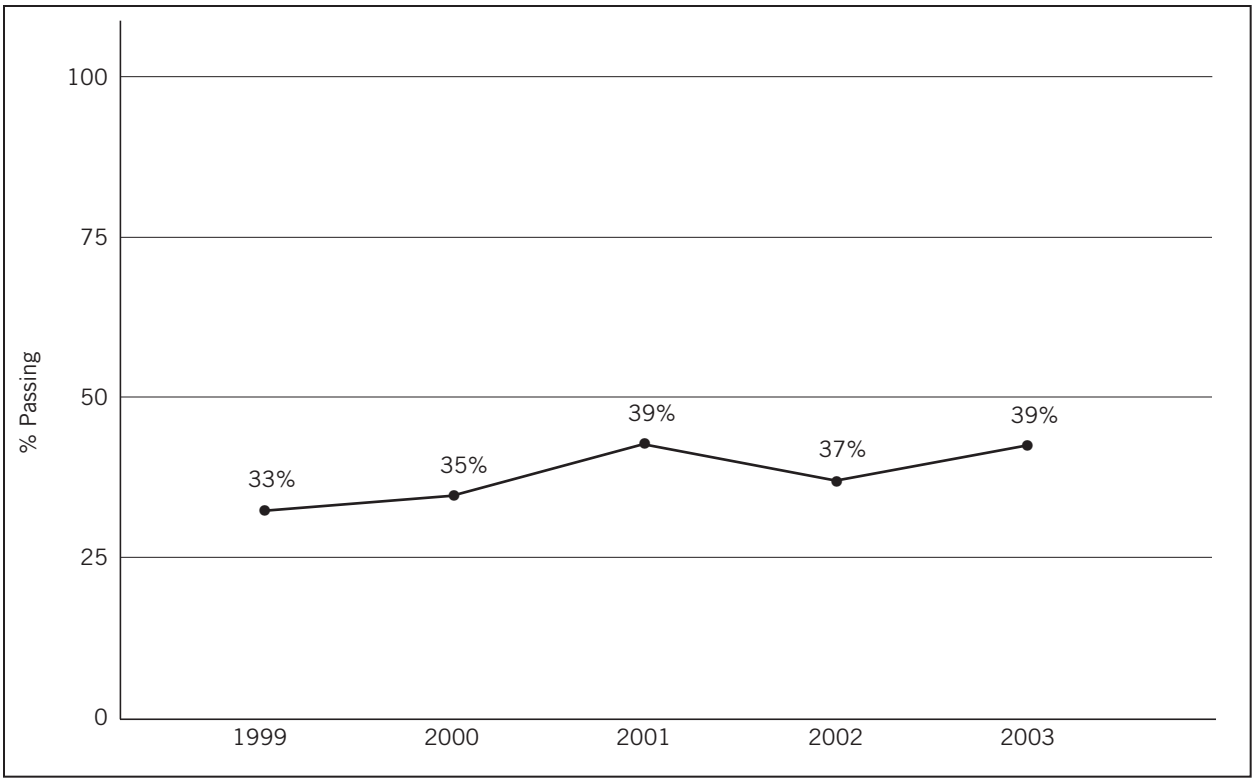
In order to enter technical majors at the university level, students must do well in preparatory courses throughout their K-12 school years, particularly in mathematics and science. Several indicators are available of performance in these key subjects.

The Washington Assessment of Student Learning (WASL) is a set of examinations administered in 4th, 7th, and 10th grades in a number of subjects including math, reading, and writing. A listening test has been in use for several years but is being dropped, and a science test was added in 2002-03. The tests have been administered since the 1996-97 school year, and starting in 2008, students must pass these tests in order to graduate from high school.

The following chart (Chart 1) shows that 60 percent students statewide are not passing the WASL math exam at the 10th grade level, and the subsequent chart (Chart 2) shows that the classes at the 4th and 7th grade levels are far from a satisfactory level of performance as well. In fact, the majority of students are not passing the reading test either at the 10th grade level (48 percent passed in 2002-03), and on writing alone slightly more than a majority passed (55 percent). With only 4 years to go before passing these tests becomes a graduation requirement, it is not obvious how this can be achieved. Many students may have to spend the last two years of high school in remedial classes to achieve the minimum requirements for graduation rather than continuing to expand and deepen their skills in these years.

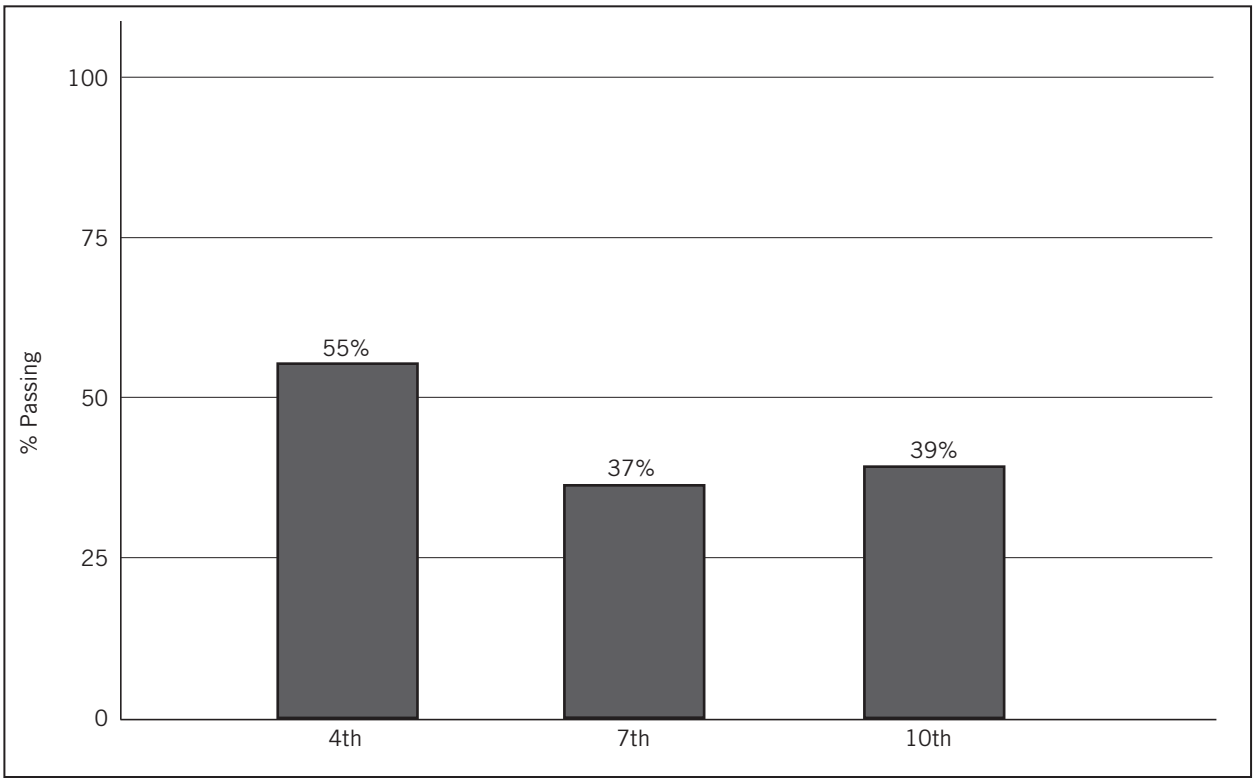
[1] P. Sommers, *The Drivers for a Successful Technology-Based Economy: Benchmarking Washington's Performance*. May 2003. Seattle: Technology Alliance (available at http://www.technology-alliance.com).

Chart 1. Percentage of 10th Graders Passing the WASL Mathematics Examination, 1999-2003



Source: Office of Superintendent of Public Instruction, 2003

Chart 2. Percentage of 4th, 7th, and 10th Grade Classes Passing the WASL Mathematics Examination, 2002-03



Source: Office of Superintendent of Public Instruction, 2003

Additional benchmarks of high school student preparation in math and sciences come from the SAT examination administered by The College Board. To gauge readiness of college applicants to undertake college level course work, admissions officers rely on one of two examinations, the SAT or the ACT, with the ACT being somewhat more popular among eastern U.S. schools. The College Board collects data from examination takers regarding their course taking during high school. While this is not a representative sample of high school graduates, it is a broadly representative sample of potential college students, particularly for western institutions of higher learning. As can be seen on the table below (Table 1), SAT taking varies widely among the peer states, with a low of 11 percent in Michigan (where universities may rely on some other exam or indicator of readiness) to 84 percent in Massachusetts. These variations should be kept in mind in reviewing the data on course taking by SAT takers. In Georgia, Massachusetts, and Virginia, a substantially higher percentage of students take the SAT than in Washington. Washington's percentage is similar to California, Oregon, and Texas.

Table 1. SAT Takers as Percentage of High School Graduates, 2003

	SAT Takers as % of H.S. Graduates
Massachusetts	85.8%
Georgia	72.6%
Virginia	71.0%
Maryland	67.8%
Washington	52.4%
Texas	51.2%
California	49.0%
Colorado	28.4%
Michigan	11.1%
Idaho	18.0%
Oregon	56.4%

Source: The College Board. 2003

However, the percentage of Washington students who take the math and sciences courses needed to prepare for a career in advanced technology is relatively low. As shown in Table 2 and the graphs on the following pages:

- Fewer of Washington's students take 4 or more years of math than in six other states, and the differences among student cohorts in the various peer and neighbor states are large, up to 16 percentage points.
- Washington's students lag all of the peer state students in the percentage who take biology (but the differences are small – 2 to 7 percentage points since the vast majority of SAT takers in all states take biology).
- Fewer Washington students took chemistry than in 8 peer states (the differences again are small).
- Washington students lag all peer states in the percentage who took physics.

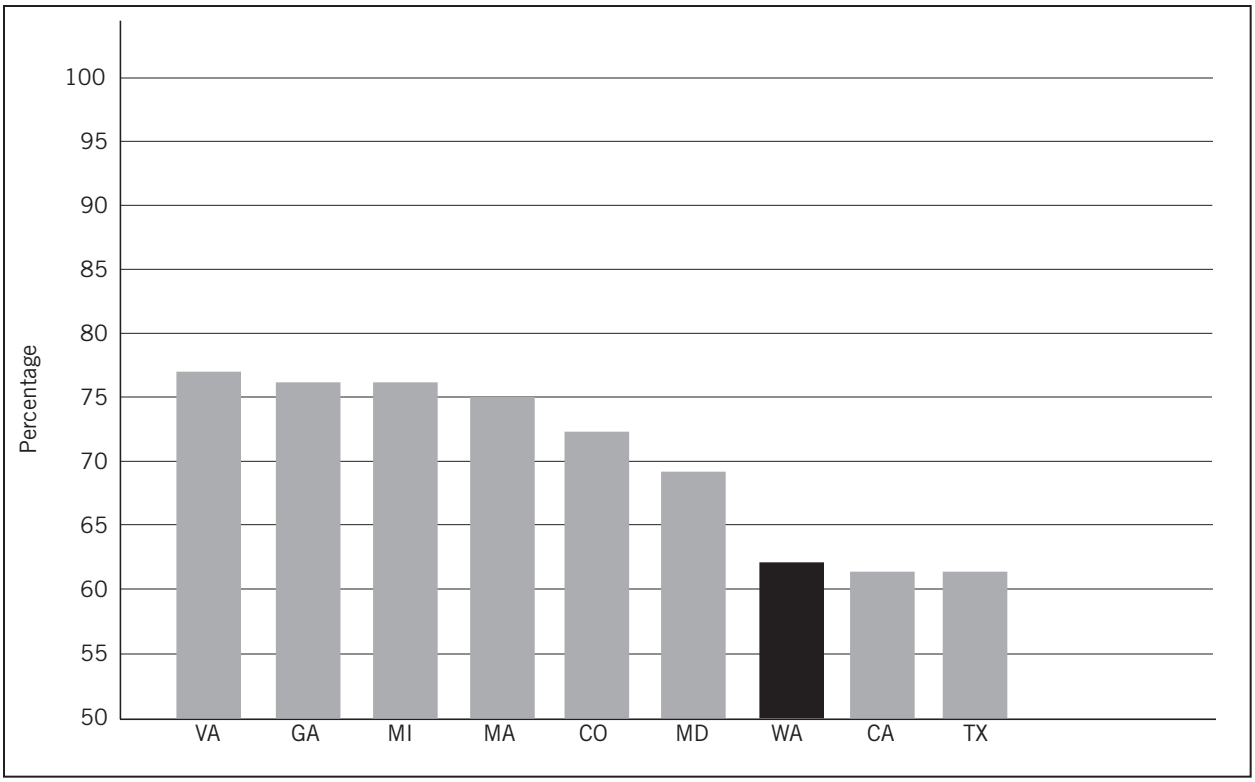
The course taking data from SAT takers suggests a consistent pattern that fewer college bound youth are taking the rigorous math and science courses needed to enter technology and science fields in college. The large differences on 4 or more years of math are particularly disturbing since mathematics is at the core of all scientific disciplines.

Table 2. Percentage of Course Taking Among Students Who Took the SAT, 2003

	4 or More Years of Math	Biology	Chemistry	Physics
California	61%	94%	82%	43%
Colorado	72%	95%	89%	57%
Georgia	76%	98%	85%	43%
Maryland	69%	98%	89%	50%
Massachusetts	75%	96%	87%	51%
Michigan	76%	97%	90%	64%
Texas	61%	99%	92%	59%
Virginia	77%	98%	87%	48%
Washington	62%	93%	77%	42%
Idaho	65%	94%	77%	41%
Oregon	61%	94%	73%	44%

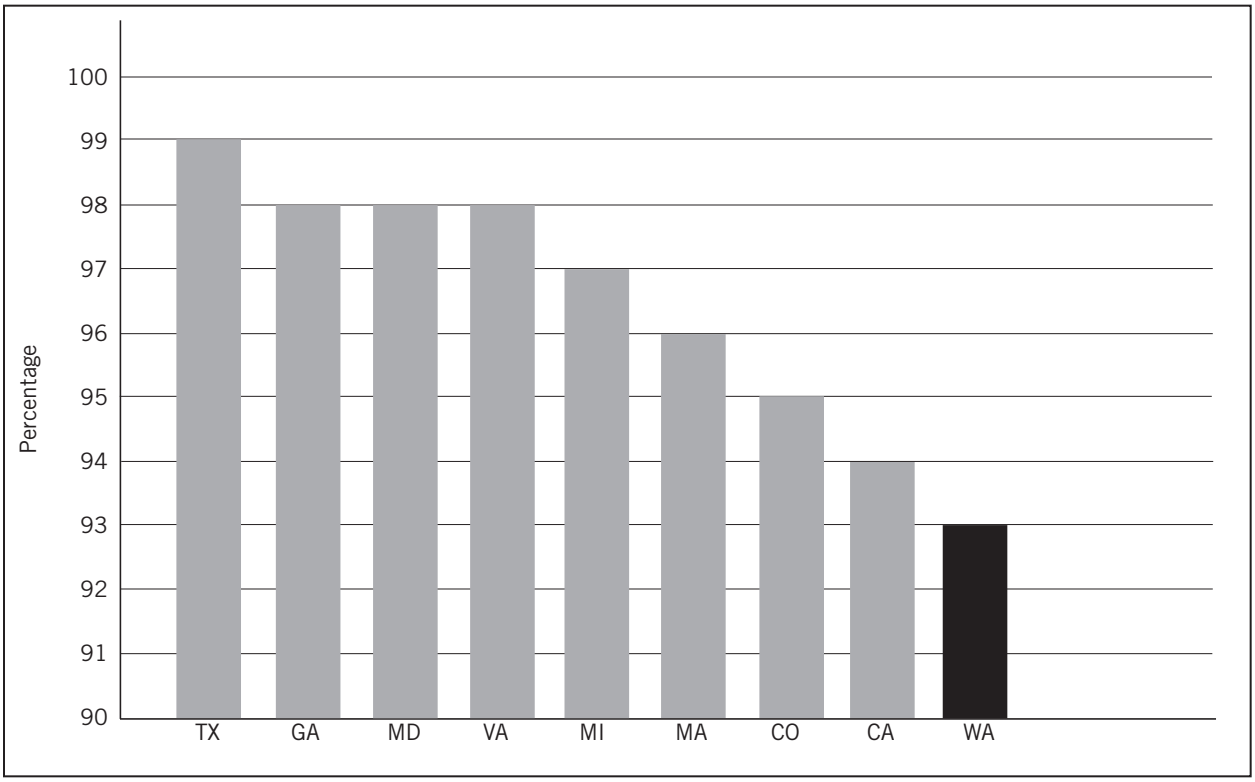
Source: The College Board, 2003

Chart 3. Percentage of SAT Takers Who Took 4 or More Years of Math, 2003



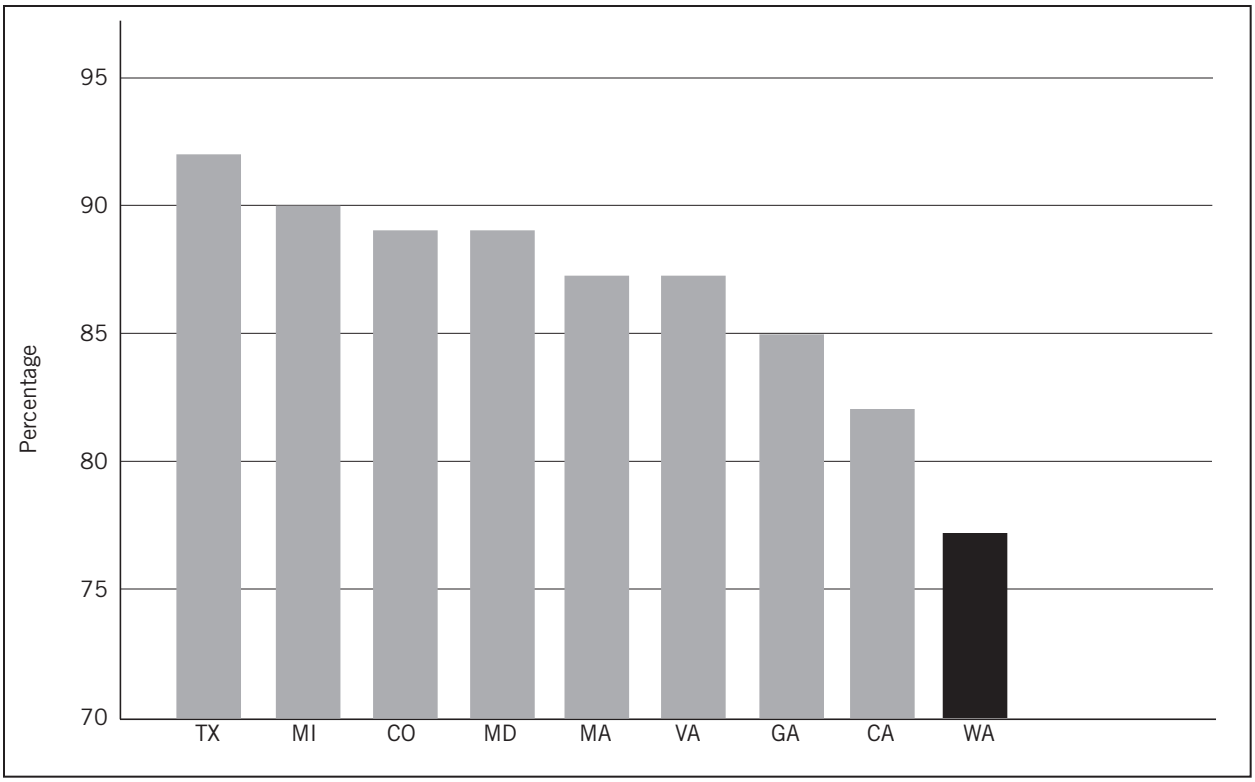
Source: The College Board, 2003

Chart 4. Percentage of SAT Takers Who Took Biology in High School, 2003



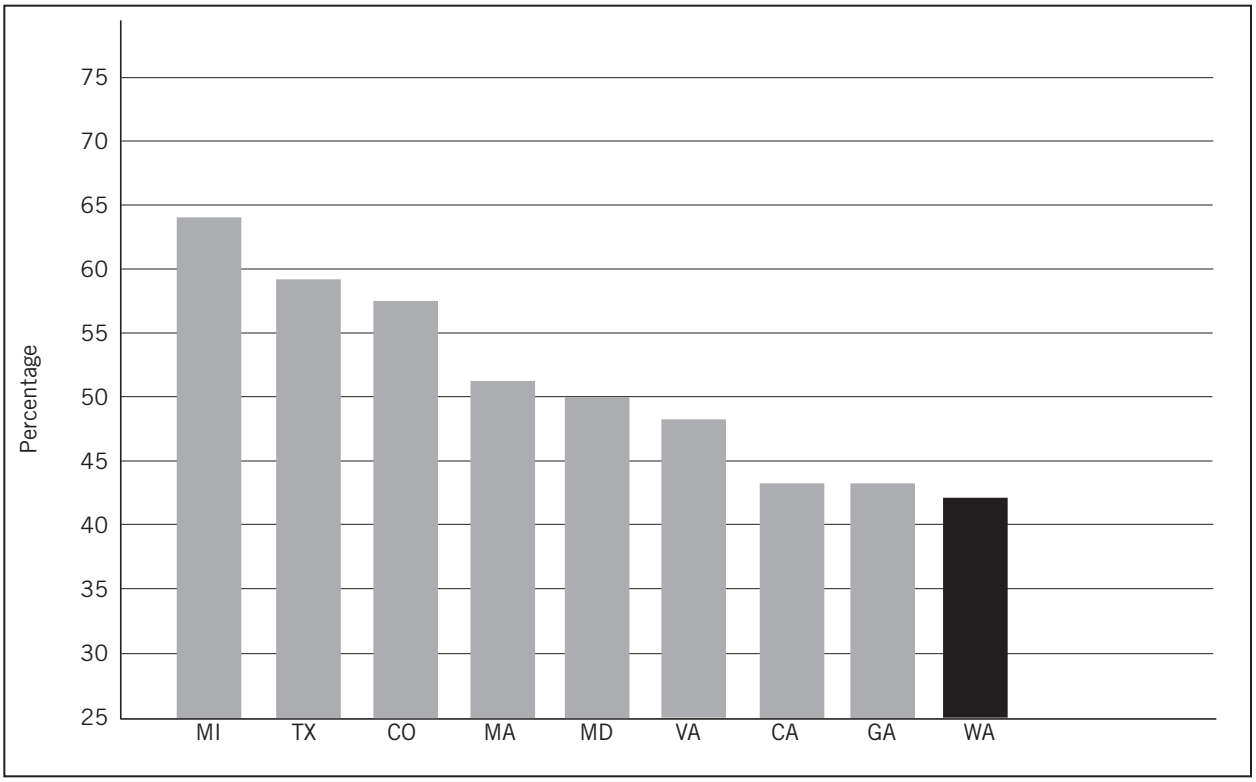
Source: The College Board, 2003

Chart 5. Percentage of SAT Takers Who Took Chemistry in High School, 2003



Source: The College Board, 2003

Chart 6. Percentage of SAT Takers Who Took Physics in High School, 2003

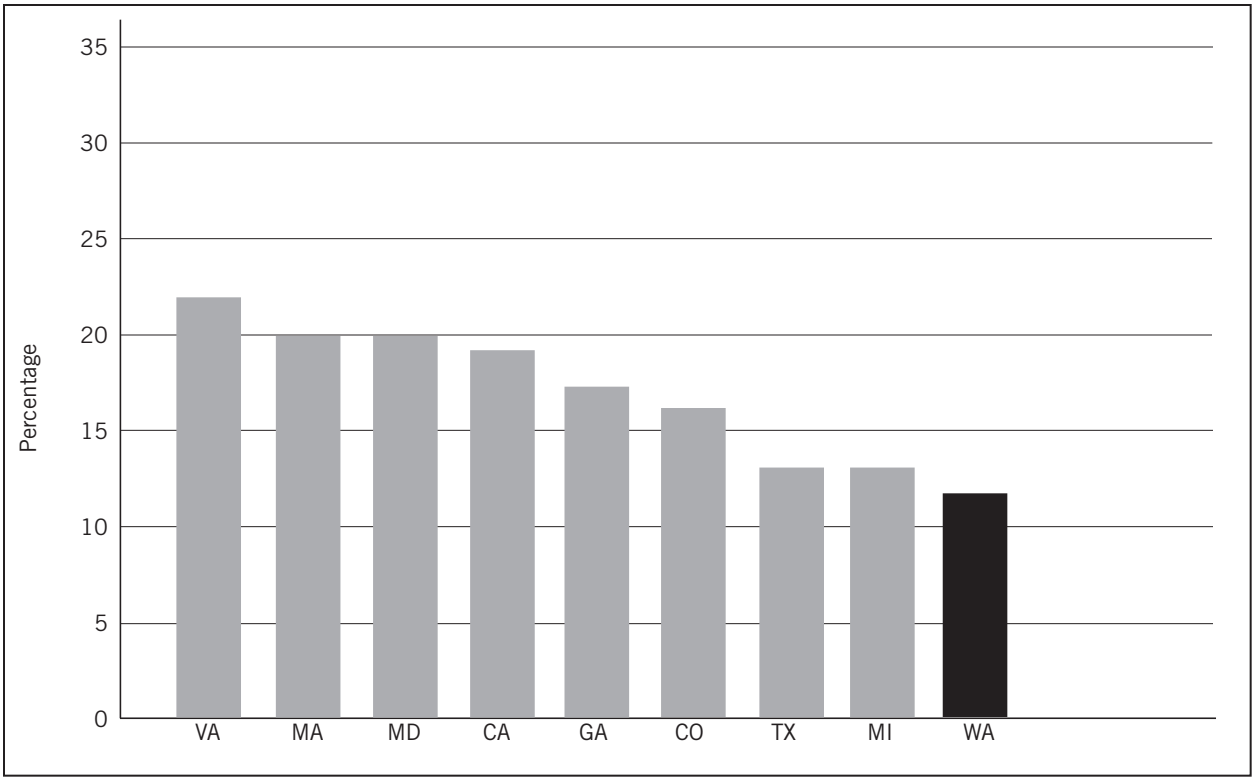


Source: The College Board, 2003

Students headed toward college can also take advanced placement (AP) tests offered by The College Board to obtain college credit for advanced work done in high school. The percentage of students who take these tests is another measure of accelerated academic achievement that will help a student get into a better university program. If the advanced placement test is in math or a science discipline, it may also help a student in getting into a scientific major that is competitive at many universities. Relatively few Washington students take these tests; Washington students rank last among the peer states on this measure.

The overall conclusion is that only relatively few Washington high school students are preparing for a career in science or technology. Less than half are passing the WASL examinations, and a smaller proportion are taking the necessary courses, or taking other measures such as preparing for advanced placement tests, than in peer states.

Chart 7. Percentage of High School Seniors Who Took Advanced Placement Tests, 2003



Source: The College Board and Western Interstate Commission for Higher Education, 2003

Turning Out the Graduates: College and University Output and Quality Measures

Turning to the output of the universities, the key measures are the number of degree completions in science and engineering fields. Advanced technology companies devote substantial resources to research and development, and therefore need many scientists and engineers in their workforce. In addition, Washington has a number of significant research institutions, including two research universities and several non-profit research institutes. These organizations also require many graduate degree level employees. The data show that Washington is not adequately meeting industry needs.

In the biological and life sciences, Washington is tied with Michigan for sixth place among peer states in the number of graduates (Chart 8).

In engineering, Washington is tied with Texas for last place among peer states in the number of college graduates (Chart 9).

Finally, the ratio of doctoral degrees to bachelor's degrees granted falls below all of the peer states, indicating a low priority on graduate education compared to peer states (Chart 10). The research and development necessary to compete in advanced technology fields depends on talented staff with advanced degrees, including many Ph.D.s, especially in life science fields, but also in chip design, computer technologies, and many other areas in which Washington is trying to compete. The public and private research institutes in Washington have a large number of Ph.D.s and masters degree holders on their staff. The data suggest that the universities are not training enough Ph.D.s to meet the needs of these key research institutions.

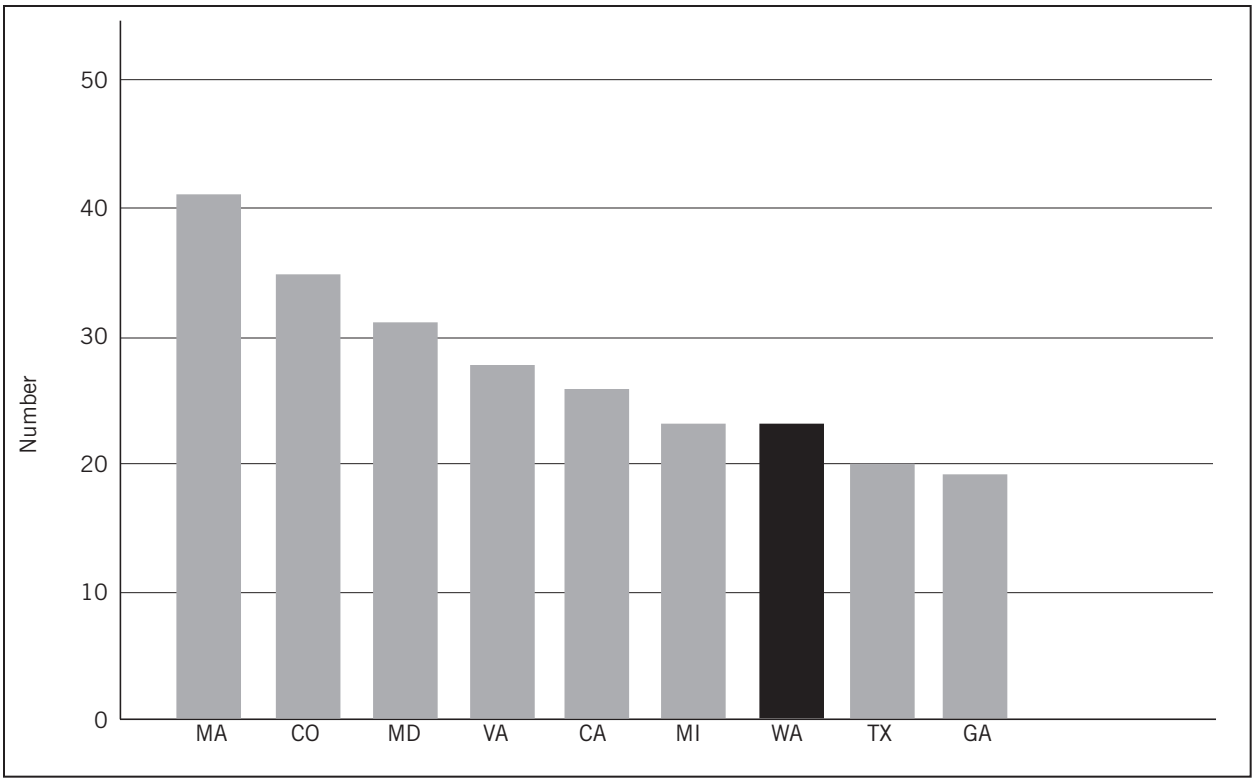
The only conclusion one can draw from this examination of the educational output of the state's colleges and universities is that Washington lags behind most of its peer states in training college graduates and advanced degree holders in the scientific and engineering disciplines needed to support advanced technology industries.

Table 3. Graduate Degree Completions in Science and Engineering Fields, 2000-01

	Biological Sciences/ Life Sciences	Graduates/ 100,000 Population	Engineering	Graduates/ 100,000 Population	Ph.D.s Awarded per 1000 Bachelors Degrees
California	9111	26	10476	30	40.7
Colorado	1578	35	2217	49	30.8
Georgia	1643	19	2250	26	37.7
Maryland	1733	31	4164	65	48.8
Massachusetts	2666	41	1922	35	40.7
Michigan	2323	23	5944	59	29.9
Texas	4469	20	5564	25	34.7
Virginia	2061	28	2736	37	33.7
Washington	1415	23	1520	25	25.7
Idaho	317	23	310	23	18.4
Oregon	788	22	849	24	27.4

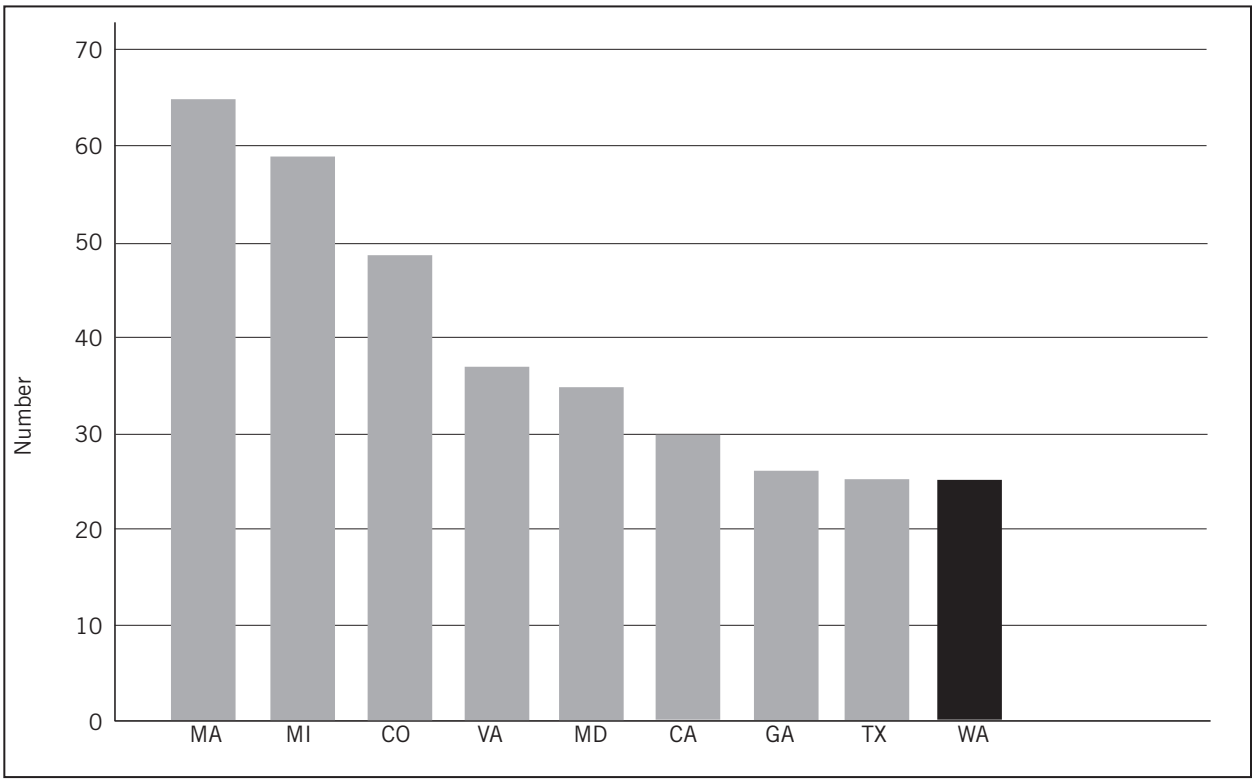
Source: National Center for Education Statistics

Chart 8. Number of College Graduates in Biological and Life Sciences per 100,000 Population, 2000-01



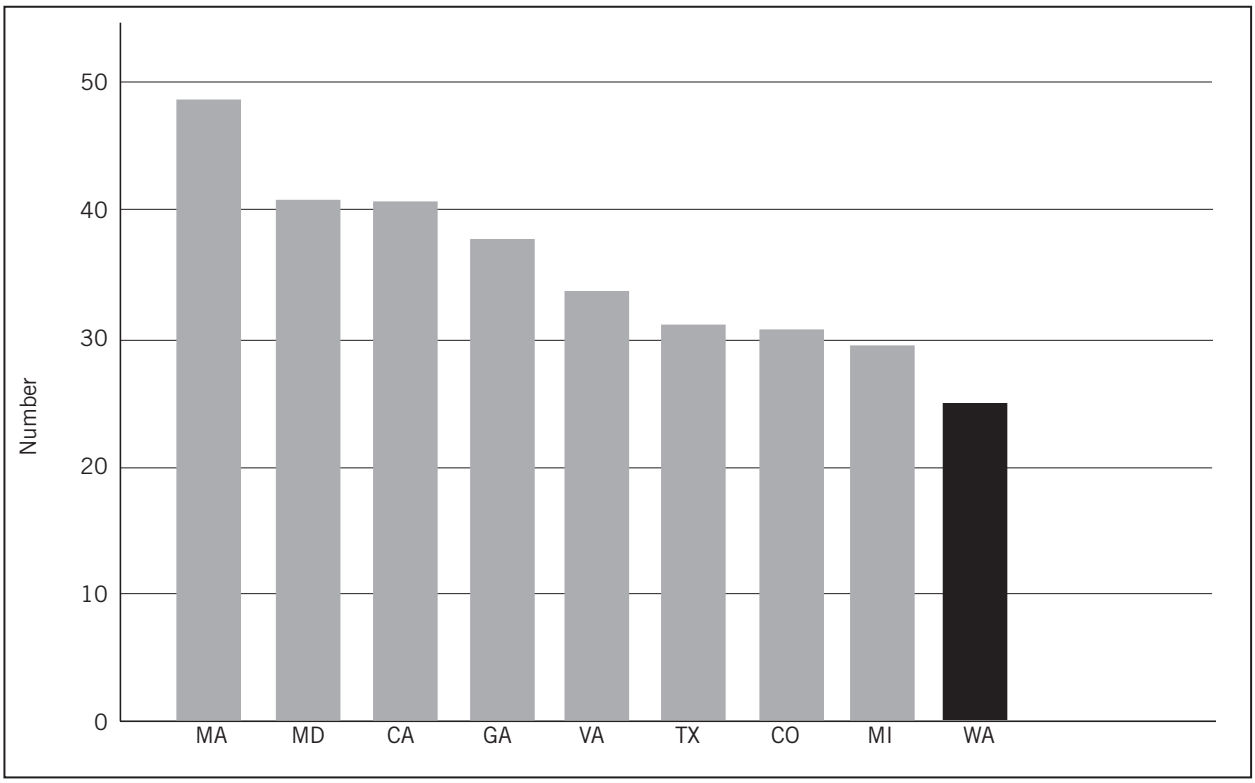
Source: National Center for Education Statistics, Census Bureau

Chart 9. Number of College Graduates in Engineering per 100,000 Population, 2000-01



Source: National Center for Education Statistics, Census Bureau

Chart 10. Doctorates Awarded per 1000 Bachelor's Degrees, 2000-01



Source: National Center for Education Statistics

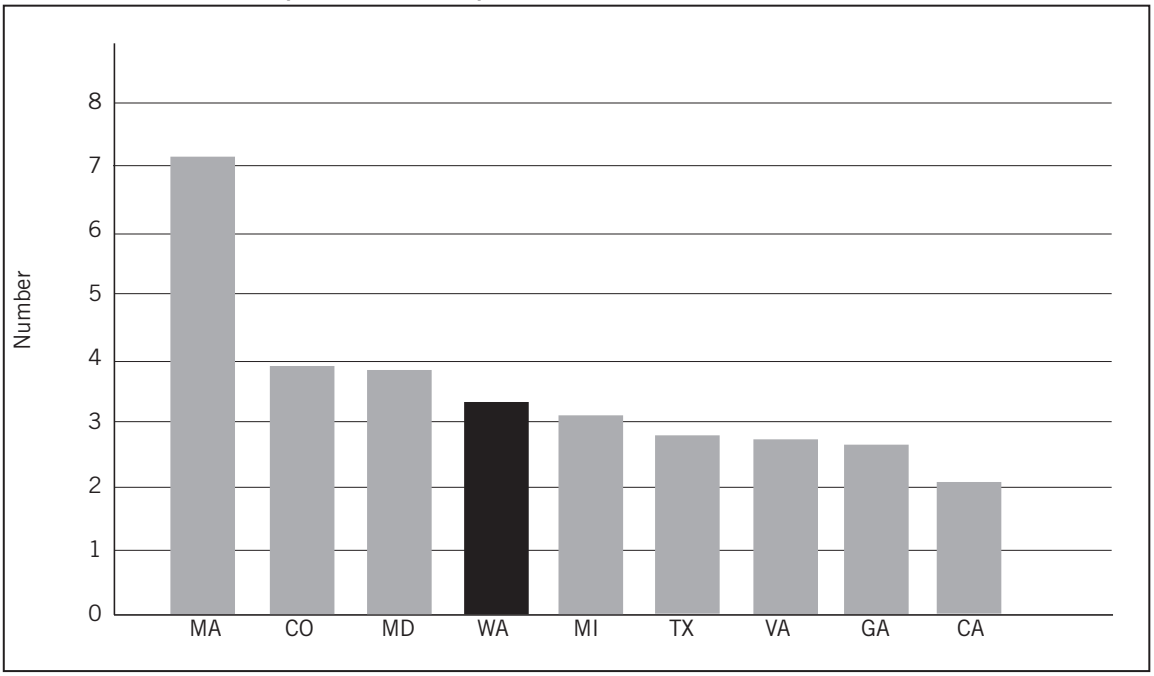
One reason Washington lags behind its peers in science and engineering graduates is that the state does not have many highly ranked higher education institutions. The U.S. News and World Report ranks colleges and universities nationwide on a variety of measures to produce overall indices of educational quality. This rating program groups institutions into comparable categories such as research universities and nationally known liberal arts colleges, regional colleges, and so forth, in order to make the rankings more meaningful to students deciding which institutions to seek to enter. Table 4 shows that Washington has only 2 universities among the top 100 in the country (University of Washington and Washington State University). With relatively few top-ranked institutions from which to choose, many talented high school seniors apply to out-of-state colleges and universities, thereby decreasing the pool of students who might work toward a science or technology degree at a Washington institution. Washington ranks 4th among peer states (Chart 11) on the number of graduates from top ranked colleges and universities per 1000 residents in all fields of study. This relatively high ranking is a tribute to the large overall capacity of the two top ranked universities in this state.

Table 4. Graduates from Top 100 Universities, 2004

	Number of Top 100 Universities	Top 100 Graduates per 1000 Population	National Rank
Massachusetts	9	7.17	6
Colorado	2	3.88	9
Maryland	2	3.83	10
Washington	2	3.33	17
Michigan	3	3.15	18
Texas	6	2.77	21
Virginia	3	2.75	22
Georgia	3	2.57	27
California	13	2.08	29
Idaho	0	0	NA
Oregon	0	0	NA

Source: U.S. News and World Report College Rankings, 2004

Chart 11. Graduates from Top 100 Universities per 1000 Residents, 2004



Source: U.S. News and World Report College Rankings, 2004

Conclusions

Compared to peer states that are competing in the same advanced technology industries, Washington is significantly lagging in its output of higher education graduates who are trained in science, technology, and engineering fields. Washington falls behind its peers in preparing students to enter scientific majors in college as demonstrated by compulsory examinations at several grade levels in math in elementary and secondary school, in encouraging college bound high school students to take math and science courses, and in the number of college bound youth who prepare for advanced placement examinations. Washington also lags in degree granting in scientific and engineering disciplines at the bachelor's degree level, and in the proportion of its degrees granted at the graduate level. Washington has only two top ranked research universities, and therefore a limited number of seats in top ranked departments, which in effect encourages talented high school graduates to choose universities in other states. A careful examination of our education system from bottom to top is needed to correct these problems and to provide better support for science and technology industries in the future. Lacking such reforms, the leading industries in the state will face substantial problems in keeping up with their competitors in our peer states.

PART TWO

04

Business Leader Perspectives

By Hitachi Consulting
Seattle, Washington

Executive Summary

In March and April 2004, Hitachi Consulting conducted structured interviews on behalf of the Technology Alliance. The goal of this study was to collect the views of business leaders regarding the role of higher education in the future of Washington's technology-based economy.

Three general observations emerged from the interviews. Business leaders:

- Shared a fairly consistent view of the issues.
- Depicted an environment in which K-20 education, research institutions, government, and business are all inexorably intertwined.
- Expressed a sense of vulnerability for the state because future success is not assured.

The profile of the interviewees includes the following:

- They are a diverse group with representation from western and eastern Washington, biotech, software and other high-tech industries, venture capital firms, major educational and research institutions, and other companies ranging from start-ups to large, established businesses.
- They view higher education as a critical issue about which they are quite passionate – 94% designated it an issue they personally view as important.
- They are educated primarily out of state – 89% received their college degrees and 81% received their advanced degrees from outside of Washington.
- They are very interested in the whole education system (K-20) – 64% of their own children have attended public K-12 schools.
- Most view research universities and private research institutions, 88% and 68% respectively, as playing extensive roles in driving the tech-based economy.

The following six key themes were drawn from the interviews:

1. A technology-based economy won't continue to thrive unless it reaches a critical mass.
2. It's a global marketplace for recruiting employees.
3. Washington's K-12 pipeline for higher education needs to be improved.
4. There is a need to improve the quality of the higher education experience and, over the long term, to increase the quantity of science and technology graduates in Washington state.
5. More effective partnerships among higher education, research institutions, and business are needed.
6. To affect change, long-range vision and a steady hand are required to stay the course.

Introduction

The Technology Alliance partnered with Hitachi Consulting and interviewed 39 Washington state business leaders to collect their perspectives on what is needed to sustain a technology-based economy in this state.

The Technology Alliance's Higher Education Committee based the study on the following problem statements, study purpose, and goals:

Problem Statements

- Washington state higher education is not oriented to meet the needs of a research and development economy.
- Many technology-based jobs are filled by people who have moved here from other states.
- It appears Washington business leaders are concerned that there is less interaction/collaboration between higher education and business than in other peer states.
- Higher education has not been a priority of Washington state businesses.

Study Purpose

In order to address both the educational requirements for our children and the quantity and quality of employment needs necessary to sustain Washington's technology-based economy into the 21st century, we assessed the current and future needs of the business community. The Technology Alliance will use the study results to engage in high level collaboration with higher education and research universities, as well as public policy officials, to create useful strategies for expanding "home-grown" opportunities.

Goals

- Interview approximately 40 CEOs in Washington state to obtain perspectives on what higher education should do to meet the needs of 21st century enterprises.
- Prepare a report that assesses the situation and can be presented to multiple audiences, including Washington state policy makers (mainly shapers of higher education), business and community leaders, and the public at large.
- The Technology Alliance will review the findings from the benchmarking data, CEO interviews, and other analysis to arrive at:

a) A vision statement for higher education in 2015.
b) Recommendations for principles that should be applied and followed to address our higher education needs.
c) Specific actions to be taken to move Washington state towards a shared vision.

Methodology

To address the goals set out by the Higher Education Study Committee, Hitachi Consulting executives interviewed 39 business leaders on behalf of, and selected by, the Technology Alliance, using a consistent, structured interview. The leaders interviewed are listed in Appendix A.

Interviews were conducted between March 22 and April 28, 2004. At the beginning of each interview, the interviewee was asked to complete a brief survey regarding their personal education background and overall perspectives regarding Washington state higher education. The results are summarized in Appendix B.

The interview employed a consistent set of core questions which were asked of each of the business executives, in the same order. Questions were designed to be open-ended, generating a free flowing conversation. The interview also included open-ended follow-up questions that provided the executives with an opportunity to share their general views. Interviewees were assured that their comments would not be quoted and attributed to them without their review and agreement. The intent of the interviews was to provide primarily qualitative rather than quantitative results.

For each interview, two interviewers took notes on the executive's responses to the questions. Most of the interviews were also audio recorded so transcripts could be available to augment interviewer notes. The Hitachi Consulting executive team identified common themes after reviewing detailed interview summaries. Several tools were used to analyze the interview comments. The tool which seemed to be the most useful was a structure which categorized the comments into strengths, weaknesses, opportunities and threats (SWOT Analysis).

Among the structured interview questions were two card-sorts in which the interviewee was asked to rank issues related to a particular question. This was done by sorting a stack of eleven small cards, each of which contained a single issue which might be a concern related to the question. One of the cards provided the interviewee an opportunity to add any concern they viewed as relevant which was not included among the other ten issued cards. The interviewees were asked to sort the cards into two stacks—one for cards containing responses which they viewed as the highest priority concerns related to the question and one stack for cards containing issues they viewed as of less concern. We solicited comments on each of the cards sorted into the high priority concern category. Although we performed frequency and weighted analysis on the card-sort results from all interviewees, we primarily used these card-sorts as a tool to frame the interviewee's qualitative comments about priorities and concerns. The results are summarized in Appendix C.

Additionally, we sent a survey regarding the education background of employees to the human resource organizations of each leader interviewed. Only a few surveys were returned, and several organizations indicated they didn't have or collect the data requested. Because of the low response to the education background survey, the data collected does not represent a sufficient sample to warrant inclusion in this study report.

Core Interview Questions

1. (a) What significant business challenges will your company/industry face in the next year? 3 years? 5 years? 15 years? (b) What role do you see higher education playing in overcoming those challenges?

2. (a) Do you have any technology-related business issues that you have been unable to address due to the lack of qualified candidates? If so, what are those issues? (b) What role could higher education play in addressing those issues?

3. In order to create a sufficient pool of future candidates to fill anticipated jobs in Washington's technology-based

economy, how would you rank the following issues in order of concern? [card-sort exercise]:
a. K-12 science/technology preparedness
b. Quantity of U.S. science/tech degrees offered in higher education
c. University research capacity
d. Quality of higher education preparedness
e. Quantity of degreed graduates
f. Minorities/women pursuing science/technology degrees
g. Types of science/tech degrees offered
h. Retention of foreign-born science and engineering Ph.D. H1b Visa holders
i. Competing demand for candidates
j. Off-shore resources shifts dis-incenting student educational pursuits
k. Other

4. In order to expand new opportunities for a technology-based economy in Washington, how would you rank the following drivers in order of importance? [card-sort exercise]:
a. High quality of life to attract and retain highly educated people from around the world
b. Development and retention of leading scientists and researchers
c. Proximity of high quality research universities
d. Availability of local management for high-tech companies
e. Level of dynamic research programs yielding commercializable technology ideas
f. Level of R&D funding
g. Availability of local funding for new high-tech companies
h. K-12 science/technology preparedness
i. Other

5. What is the single most important initiative the state can pursue to ensure our future competitiveness?

6. What recommendations do you have for policy makers regarding Washington state higher education?

7. What would an excellent higher education system in 2015 look like to you? How would those graduates be any different from today?

General Observations

In addition to the specific themes which are described in the following sections, three general observations emerged from the analysis of the interviews. Business leaders interviewed:

1. Expressed a fairly consistent view of the primary issues facing higher education and Washington's technology-driven economy.

2. Described a highly interdependent environment in which higher education, K-12 education, research institutions, government, and business are all inexorably intertwined. Even when asked specifically about Washington higher education, their answers often included K-12 education, research, and other aspects of an ecosystem that can provide an environment in which the technology-based economy can thrive.

3. Expressed a sense of vulnerability for Washington's technology-based economy. While the state has experienced some success, there is a strategic concern that weaknesses in Washington's technology-based economy and the momentum of competing regions, both in the U.S. and internationally, threaten to erode its current position and limit future success.

Interview Themes

Multiple analytic techniques were used to merge the perspectives shared by the business executives from their interviews. The objective of this analysis was to glean the key themes which were largely shared across the business executive interviews. As noted in the general observations above, there was a fairly consistent view common among the leaders interviewed. There were only two topics on which there seemed to be opposing views among the leaders. Those two areas will be discussed later.

Six key themes emerged. Each includes a headline, summary statement, and representative comments taken directly from interview notes and transcripts.

1. Our technology-based economy won't continue to thrive unless it reaches a "critical mass."

Biotech was identified as being on the cusp of reaching "critical mass." Critical mass was expressed as both the number of research universities and institutions, and the close proximity of research universities and institutions. Numbers and proximity help to create a vibrant intellectual community, and would have two major benefits: it would stimulate scientific and technological advancements, and just as important, help to recruit up-and-coming scientists and technologists because of the opportunities for long-term career growth.

Representative comments:

- "It's a vibrant feeling, excitement around the community, a resource where people can go to bounce their ideas off of their peers."
- "I love Seattle, but if I were in Boston, I know that if I

left one company, there would be many other companies that would hire me."

- "When you recruit people, they recognize that you may recruit to a pre-profitable company. A smart person is going to look around and say, 'What happens if this company doesn't do well?'"
- "It is no longer a competition simply around the abundance of natural resources, which is how Washington got in the game in the first place. It is now about the abundance of ideas that make life better for other people."
- "The public has the greatest interest in contributing to the creation of a critical mass of great minds."
- "Even if the University of Washington was perfect, it can't carry the region. It is not healthy. We need diversity of educational institutions."

2. It's a global marketplace for recruiting (but not if you're a start-up).

Interview respondents overwhelmingly stated they did not have technology-related business issues that they could not solve because they lacked qualified candidates. They are finding their candidates by recruiting nationally and internationally and their concerns instead focused on challenges in recruiting and retention. Key retention issues link to other themes—improving K-12 education and building critical mass. Some noted that start-ups were unable to recruit nationally or internationally, and therefore are impacted more directly by the lack of local qualified graduates.

Representative comments:

- "When we recruit for specific positions, we recruit on a national basis."
- "We end up going and recruiting out-of-state for mid-level management."
- "Seattle is not good for CFOs; we are not really growing quickly enough here so we recruit a lot of them in."
- "Even on the technical scale, a lot of the highly technical positions you wind up recruiting from elsewhere."
- "We hire out of studios in L.A. We hire out of the networks in New York. We hire out of the large ad agencies in London, New York and Hong Kong. That's where the bulk of our new employees come from."

But not if you're a start-up…

- "You particularly can't import when companies are just starting. To import you need more money."
- "We have not had the same kind of troubles that you have if you were forming a start-up or if you were a middle tier company."

3. Washington's K-12 pipeline for higher education needs to be improved.

Interview respondents consistently expressed concern about the quantity and quality of graduates from Washington's K-12 schools. The need to foster an early fascination and curiosity in math and science was expressed—it's too late to wait until a student is in college to begin a science or technology track. Developing a solid foundation in the fundamentals of writing, communications, math and science were identified as keys to success in science and technology in higher education and in the high-tech workplace. Weak K-12 schools were also identified as a key barrier to recruiting and retaining top talent.

Representative comments:

- "If you don't have great K-12 science and technology, it's very difficult to be able to have great programs at the university level."
- "I think one of the reasons people are not pursuing science and technology is they are not getting a good basis in K-12."
- "Having teachers that ignite the enthusiasm of kids at a fairly early stage is critical."
- "The pool of future candidates has an entry-level problem and that is K-12."
- "Seattle's public schools are terrible, and is that a big part of it? I send my kids to private school, it costs me a lot of money, and I am recruiting people who don't have the salary I do, and it's hard."
- "People in intellectual type jobs expect that there is going to be a great educational system for their kids and a lot of that is K-12. I don't think they want to go someplace to work and live if there is not an adequate educational system for their own kids."

4. There is a need to improve the quality of the higher education experience and, over the long term, to increase the quantity of science and technology graduates in Washington.

While several interview respondents expressed a need for graduates trained in specific fields, a consistent theme developed around the need for "well-rounded" graduates. This included graduates with writing, communication, and critical thinking skills. Graduates also need the ability to adapt to ever-changing industry needs, with the capacity for lifelong learning. Respondents identified the need for students to obtain real-world experience before entering the market. The value of interdisciplinary education was consistently highlighted. In the context of 15 years from now, there was a common concern about the number of science and technology graduates at all levels.

Representative comments:

- "Are we purposeful about giving students experiences where they are making real contributions? Are we systematic and thoughtful about learning outside of the four walls of

the university, about how technology and science can be totally stranded and lost in the realities of markets and organizations?"

- "There needs to be greater thought given to how we prepare people to have evolving skills rather than stationary skills in a world that moves so fast."
- "The thing that has amazed me is how little you can predict the future, and the more I do and the more I learn, the more I appreciate how important it is to be flexible and to have basic skills that translate over time."
- "You want scientists who can manage other scientists, and scientific training does not necessarily do that. So I'm interested in people who have as well rounded training as they can get."
- "I need scientists who can write and communicate. I need managers in finance, marketing and other disciplines who have a basic understanding of science."
- "It's not a matter of cranking out a quantity of degrees; it is a matter of making sure that they are effective."
- "The higher education curriculum needs to keep abreast of industry changes in technology."
- "The best students aren't choosing science and technology degrees right now, which we should be worried about. They're choosing business and law."
- "Higher education needs to be more conceptually oriented, more problem-solving oriented and strikingly more cross-disciplinary."

5. More effective partnerships among higher education, research institutions, and business are needed.

While most interview respondents cited successes based on partnerships between higher education, research institutions, and business, there were sentiments expressed that the partnership could be higher profile, more impactful, and less painful. Partnership was mentioned as a tool for helping higher education to graduate students in specialties that were in demand by industry, as well as a way to provide students with the opportunity to obtain practical, real-world experience prior to entering the job market. Partnership between research institutions and business needs to be streamlined.

Representative comments:

- "Technology agreements between biotech and the university could help train a lot of students so that by the time they graduate, they've had important industry training."
- "There's a lot that needs to be fixed in relation to technology transfer between universities and industry—but there's also been a lot of gain lately."
- "I think the more we can collaborate on what the business problem is at hand, and work together despite some of our differences in how we get there—we would agree on a problem, we would agree on some of the chief solutions—and then we would collaborate towards those. That is a very first step."
- "The higher education world and the business world need to continue building stronger partnerships so there is more back and forth."
- "I think it is so unbelievably important for us to have the University of Washington here. If the University of Washington and its whole medical school and training center and systems and clinical trials and post-doctoral fellows were not here, we would not be here."
- "If the university built a real functioning pilot plant and had advanced degrees in biotechnology development, that pilot plant would make money because I would sign up."
- "Create positive incentives for faculty to connect with the community they serve. Connect with alumni about the relevance of the degree. Connect with business about whether or not you are actually training people that help them to do what they need to do."

6. To affect change, long-range vision and a steady hand are required to stay the course.

The relationship among the players in the Washington high-tech economy is complex and interdependent. Long-term success was viewed by the interview respondents to require a steady, sustained focus on a Washington technology economy strategic vision for as long as 20 years. There was a clear interest among the business executives to work with educators, researchers, and state government to develop long-term strategies focused on driving the tech-based economy.

Representative comments:

- "We need more leaders who have a clear vision, and the vision has to do three things: 1) integrate the uniqueness of this region, 2) appeal broadly to all people, and 3) include the eastern part of the state as well as the western part of the state."
- "Does Seattle really aspire to be in the first rank of technology-driven cities, and if the answer is yes, I think the only way we're going to get there is through leadership and vision."
- "What I would like the state to know, and I think they do understand it, is that every nickel they put into training more scientists benefits and expands the biotech community."
- "At this point, the lack of investment in higher education is becoming a drag on Washington state's economy."
- "You need a statewide strategy and coordination of federal, state, private and philanthropic research dollars."
- "We need to increase capacity, create more accountability, give more flexibility to institutions, and the institutions will likely create methods that will ensure more and more access happening."

Other Topics

Two topics on which there was not a common view were community colleges and the availability of seed funding for start-ups.

1) Community colleges

It should be noted first that most of the business executives interviewed had very little to say about community colleges. They stated that they didn't know much about community colleges or they did not see them as highly relevant to the technology-based economy.

Of those interview respondents who did express a perspective on community colleges, the comments fell into two groups:

- Community colleges fill a necessary gap between K-12 education, which does not adequately prepare students, and Washington state four-year colleges.
- Community colleges should get out of the business of bridging the gap between K-12 education and four-year university education and focus on the trades which support a tech-based economy. Technicians and nurses were mentioned as supporting trades.

2) Availability of seed funding for start-ups

Two opposing points of view were expressed on the availability of seed funding for Washington state start-ups. Business executives from the biotech community consistently expressed the opinion that there is not enough funding available for the very early start-up companies. This was often referred to as the first $500K.

Outside of the biotech community a much different perspective was expressed, one which did not view the availability of seed funding as a significant problem holding back the Washington state technology-based economy.

SWOT Analysis - Strengths, Weaknesses, Opportunities and Threats to Washington's Technology-Based Economy

The business executives interviewed frequently used a competitive model to discuss Washington state's technology-based economy. We identified the primary competition as other regions in the United States that are pursuing similar technology economy development goals for their regions. The Bay Area and San Diego in California, Massachusetts, and North Carolina were the most frequently cited "competitors." Several business executives also identified emerging competition from other countries as an important factor.

SWOT is an analysis tool used frequently to evaluate an organization's relative competitiveness. Using a SWOT analysis, the recurrent perspectives of the interviewees were grouped into four categories:

- **Strengths** – Drivers of the current Washington technology-based economy
- **Weaknesses** – Barriers holding back the Washington technology-based economy
- **Opportunities** – Potential drivers for the Washington technology-based economy if Washington takes action
- **Threats** – Strengths of competing regions which could limit the success of the Washington technology-based economy

SWOT Analysis: Strengths

- Natural assets of the Puget Sound's physical environment and accompanying recreational opportunities help attract top talent.
- Significant funding for research is flowing primarily to the University of Washington and to the Fred Hutchinson Cancer Research Center. It also flows, to a lesser extent, to Washington State University and others.
- High profile companies that dominate their fields help drive our tech-based economy.
- Biotech has momentum and is on the cusp of gaining critical mass.
- There is an entrepreneurial spirit and availability of funding (primarily angel funding) for technology start-ups. (This view was expressed outside Biotech; see conflicting Biotech view under Threats.)

SWOT Analysis: Weaknesses

- The Washington technology-based economy faces a shortage of management and leadership talent in the local community.
- It is challenging to recruit and retain the top talent that drives Washington's technology-based economy.
- K-12 education quality is perceived weak and inadequate for their children.
- There is too narrow of an employment opportunity base, which in the event of changing jobs often means having to uproot families and moving to other regions of the country.
- The budget and governance process for public higher education is not insulated from state level politics, creating an environment of inaction and instability.
- Legislative controls hinder the pursuit of excellence in public higher education.
- Public higher education institutions are unable to make basic operating decisions, including conflict of interest rules, tuition setting, class size, hiring, faculty salaries and programmatic decisions.
- The state budget falls victim to the vagaries and instability of the election cycles.

- Washington does not have enough premier universities and research institutions acting as magnets to drive the technology-based economy.
- There is an insufficient number of seats available in Washington universities to fill needs, especially in science and engineering fields.
- Community colleges are not leveraged to drive the technology-based economy.
- Community colleges are not well understood and not viewed as a significant contributor to the technology-based economy.
- The integration of four-year universities and community colleges is weak.
- There is a lack of consensus on the role of community colleges—farm system for four-year institutions versus trade school to produce supporting professional (i.e., lab technicians and nurses).

SWOT Analysis: Opportunities

- Attain critical mass for the Washington technology-based economy.
- Improve technology transfer from Washington universities and research institutions to the local technology-based economy.
- Attract more of Washington's own best and brightest to Washington higher education, avoiding the drain of many who currently leave the state to pursue their education at other institutions.
- Improve Washington K-12 education to develop students with strong foundational skills in science, math, writing and communication.
- Increase the number of students who pursue science and engineering degrees.
- Spark interest within K-12 schools to generate future scientists and engineers.
- Expand the pool of potential candidates by engaging women and minorities in technology-related fields.
- Include practical, up-to-date experience in the higher education curriculum, through cooperation with businesses to provide internships and other practical learning opportunities.
- Teach "thinking skills"—creativity, innovation and analytical skills—which allow graduates to continue to learn and apply knowledge to solve practical problems.
- Create stronger interdisciplinary programs that develop graduates beyond their core science education (i.e., engineering and business scientists with management background, and technically skilled graduates who also have strong writing and communication skills).

SWOT Analysis: Threats

- Other regions in the U.S. are outpacing Washington—Boston and the Bay Area were mentioned most often. San Diego was also cited repeatedly by biotech business executives. These areas have achieved critical mass and have the strong intellectual culture which draws the best and the brightest to them.
- International competition from India, China, and other countries is emerging and poses a potentially greater strategic threat because of the emphasis on science and technology in their cultures as a way to improve their social and economic status. The pipeline in those countries for educating future scientists and technologists is generally viewed to be significantly stronger than in the U.S.
- The absence of a sustained focus on the technology-based economy by government, higher education, research institutions, and the business community leaves Washington increasingly vulnerable to other regions which have developed a stronger vision and partnerships.
- The Washington environment to support technology start-ups is not competitive with other regions.
- Other regions have a more attractive tax structure for start-ups and entrepreneurs.
- Other regions have better local sources of seed money, defined as the first $500K. (This view was expressed by Biotech; see conflicting view under Strengths.)
- Other regions have better developed technology transfer (state regulations which do not inhibit technology transfer) from research institutions to business.

Additional Comments and "Out-of-the-Box" Ideas

In addition to the comments which aligned with the major themes observed in the interview responses, many other unique ideas were expressed. These comments include the following, and are grouped by subject area:

Biotech

- "We need to attract a big biotech player to Seattle. The sale of Immunex and loss of it as an anchor company has hurt the region significantly. The state should aggressively recruit a new anchor company."
- "The BIO 21 initiative is an important foundation for continued biotech success in Washington."
- "The University of Washington should build a biotech manufacturing plant which could employ graduate students working on advanced biochemistry degrees. The plant could do contract manufacturing for biotech companies and make a lot of money for the university while improving the quality of advanced degree graduates."

Higher Education

- "Washington needs to move to a mixed public/private funding model for key higher education institutions."

- "Graduate programs should retain a portion of any revenue generated from technology transfer, versus directing revenue to subsidize undergraduate programs."
- "Build more remote campuses to provide diversification and additional bandwidth, as in the approach taken by the University of Massachusetts, for example."
- "Better cooperation among Washington's higher education institutions is needed to avoid wasted duplication."
- "Is the goal to educate all, or to be a top-ranked higher education institution? (University of Michigan picked the latter.)"
- "Moving to a 365-day school year would increase Washington higher education capacity without building new campuses."
- "Business-higher education collaboration needs to be more sophisticated than just simple internships. This requires resources to manage a program that delivers value to the business, the student, and the university."
- "Increase the number of out-of-state students (with accompanying higher tuition)."

Technology Transfer

- "The two organizations supporting technology transfer from state-funded higher education and research to business should be consolidated into one."

K-12 Education

- "Provide UW materials to deputized high school teachers as a way to improve K-12 science education."
- "We need to pursue second-generation immigrants to recruit for science. A significant number of scientists immigrate to this country and take jobs outside of their fields. Their children represent an untapped pool of potential scientists."
- "Rescind the super majority rule for K-12 education funding. The election process is costly and many 55 percent plus majority-approved levies require multiple attempts or don't get passed at all."

Other

- "The west coast of the U.S. should be a national leader in hydrogen as a fuel for transport."
- "Acquire a huge tract of land in Bothell or east of Lake Sammamish, establish a campus the size of the one at University of California at San Diego, and call it the Washington Institute of Technology. Take a couple of the key tech departments out of the University of Washington's Montlake campus and move them to the new campus."

Appendix A: Business Leaders Interviewed

Business Leader Name and Title	Company Name
Han Nachtrieb, VP for Human Resources	Fred Hutchinson Cancer Research Center
Tom Alberg, Managing Director	Madrona Venture Group
Mike McGavick, Chairman, President and CEO	Safeco
Paul Clark, Chairman and CEO	ICOS
Russell Crawford, Managing Partner	KPMG
Dan Rosen, Managing Partner	Frazier Technology Ventures
Sally Jewell, COO	Recreational Equipment Incorporated
Robert Hershberg, Senior VP and CMO	Dendreon
Len Peters, Director	Pacific Northwest National Laboratory
Lane Rawlins, President	Washington State University
Jim Voelker, Chairman and CEO	InfoSpace
Steve Davis, President and CEO	Corbis
Bruce Carter, President and CEO	Zymogenetics
Darrel Bowman, Vice President	AppTech
Doug Walker, Chairman and CEO	WRQ
Richard McAniff, Corporate Vice President	Microsoft
Dan Hesse, CEO	Terabeam
Lee Huntsman, President	University of Washington
Clay B. Siegall, President and CEO	Seattle Genetics
Cheryl Scott, President and CEO	Group Health Cooperative
Chad Waite, General Partner	OVP Venture Partners
Melissa Waggener Zorkin, CEO, President, Founder	Waggener Edstrom
Michael Brochu, President and CEO	Primus Knowledge Solutions
Bernie Paul, Vice President of HR	Corixa
Dan Matte, Vice President of Product Marketing	F5 Networks
Bob White, President	Medtronic Physio-Control
Peter H. van Oppen, President and CEO	Advanced Digital Information Corporation
Mike Galgon, Chief Strategy Officer	aQuantive
Greg Meyer, Vice President	Atlas DMT
Leroy Hood, President	Institute for Systems Biology
Robert Giles, Managing Partner	Perkins Coie LLP
Robert Nelsen, Managing Director	ARCH Venture Partners
Stewart Parker, President and CEO	Targeted Genetics
Don Pickering, President and CEO	Memetic Systems
Joe Sasenick, CEO	Alcide Corporation
Kyatsandra Gopinath, Director, BCA Engineering	Boeing Corporation
Brian Schlosser, CEO	Attenex
Lewis Rumpler, CEO	INTEC
Kim Pearson-Gillman, Senior Vice President	Avista

Appendix B: Interview Survey Results

Business Leader Interview Survey Results

The survey results provided insight into the personal education experience of the business executives as well as their children. Only 14 percent of the leaders received higher education in Washington. Eleven percent of all undergraduate degrees and 19 percent of all graduate degrees were obtained in Washington.

A higher than expected 64 percent of the children of the business executives interviewed have attended public school at the K-12 level.

The survey also included the following questions. The percentages of business executive responses for each option are detailed in the table below.

How does higher education rank as a key concern for you personally?	No Interest 0%	Little Interest 0%	Some Interest 6%	Much Interest 9%	Highly Interested 85%
How does higher education rank as a key concern for your company?	No Interest 0%	Little Interest 0%	Some Interest 15%	Much Interest 32%	Highly Interested 53%
What is your opinion of the overall quality of Washington's higher education institutions?	Don't Know 9%	Poor 0%	Good 32%	Above Average 41%	Excellent 18%
How passionate are you on the topic of higher education policy and support?	No Interest 0%	Inquisitive 9%	Informed 18%	Involved 24%	Committed 49%
What role do you see private, independent colleges playing in addressing our higher education needs?	Don't Know 6%	None 0%	Some 18%	A Lot 29%	Significant 47%
What role do you see research universities playing in technology economies?	Don't Know 0%	None 0%	Limited 0%	Supportive 12%	Extensive 88%
What role do you see private research facilities playing in technology economies?	Don't Know 3%	None 0%	Limited 0%	Supportive 29%	Extensive 68%

Appendix C: Interview Card Sort Results

Interview Card Sort Results

While the primary purpose of the card sort questions was to stimulate a discussion, the results of which are included in the findings above, some analysis was done on the sorts themselves to identify the highest priority responses for each question. Three analysis techniques were used:

Frequency Analysis

The first analysis considered the frequency with which each individual issue was deemed to be of high importance. We tallied each issue, summing the number of times a respondent considered the issue to be of high importance. Once all issues were totaled, the raw number was converted to a percentage. A higher point or percentage corresponds with issues that were more often considered of high importance.

Weighted Analysis

The second analysis considered the numbered rankings given by the respondents. A first place ranking was given ten points for card sort one, and nine points for card sort two (the number of points given was based on the total number of cards). The number of points subsequently descended. For example, in card sort one, first place was given ten points, second place was given nine points, third place was given eight points, and so on. Once points were assigned, a sum was totaled for each issue. The raw number was then converted to a percentage. Higher points and percentages correspond with issues more often ranked on the higher end of the scale.

Distribution Analysis

The third analysis considered the distribution of first-place rankings, second-place rankings, and third-place rankings.

Results

Based on these three analysis techniques, the top answers and full distribution, using weighted analysis, to each of the card sort questions follows.

Card Sort #1

Question: In order to create a sufficient pool of future candidates to fill anticipated jobs in Washington state's technology-based economy, how would you rank the following issues in order of concern?

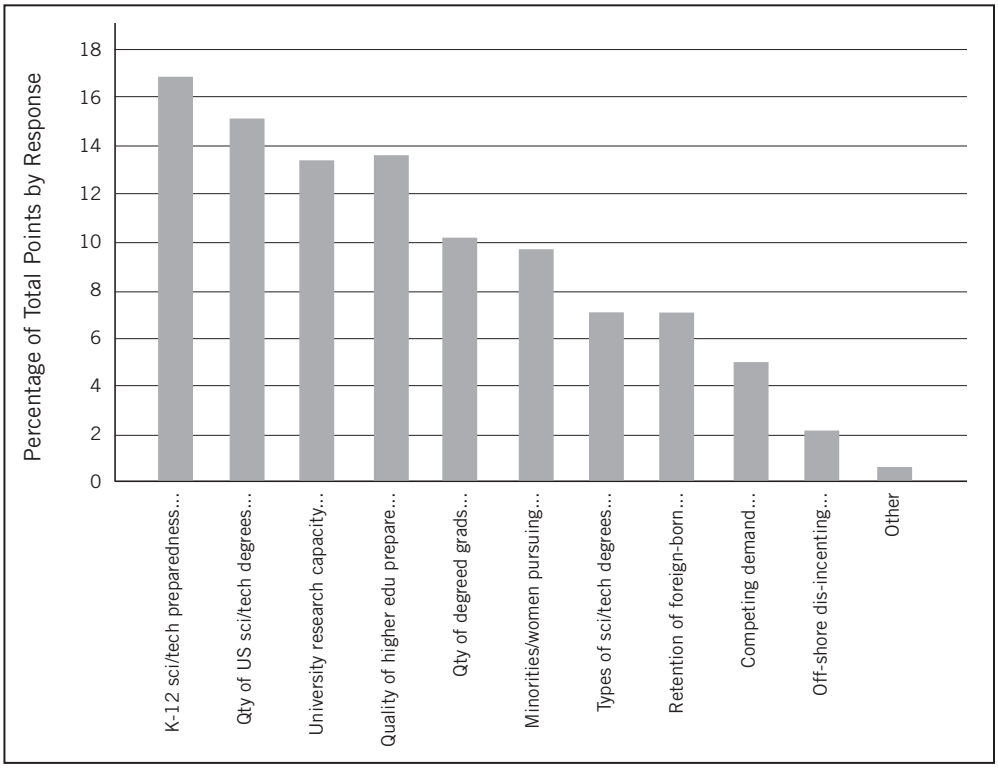
Choices:

a. K-12 science/technology preparedness
b. Quantity of U.S. science/tech degrees offered in higher education
c. University research capacity
d. Quality of higher education preparedness
e. Quantity of degreed graduates
f. Minorities/women pursuing science/technology degrees
g. Types of science/tech degrees offered
h. Retention of foreign-born science and engineering Ph.D. H1b Visa holders
i. Competing demand for candidates
j. Off-shore resources shifts dis-incenting student educational pursuits
k. Other

Most frequently identified as top concerns:

- K-12 science/technology preparedness
- Quantity of U.S. science/technology degrees pursued
- University research capacity
- Quality of higher education preparedness

Weighted Based on Importance Rankings



Card Sort #2

Question: In order to expand new opportunities, for a technology-based economy in Washington, how would you rank the following drivers in order of importance?

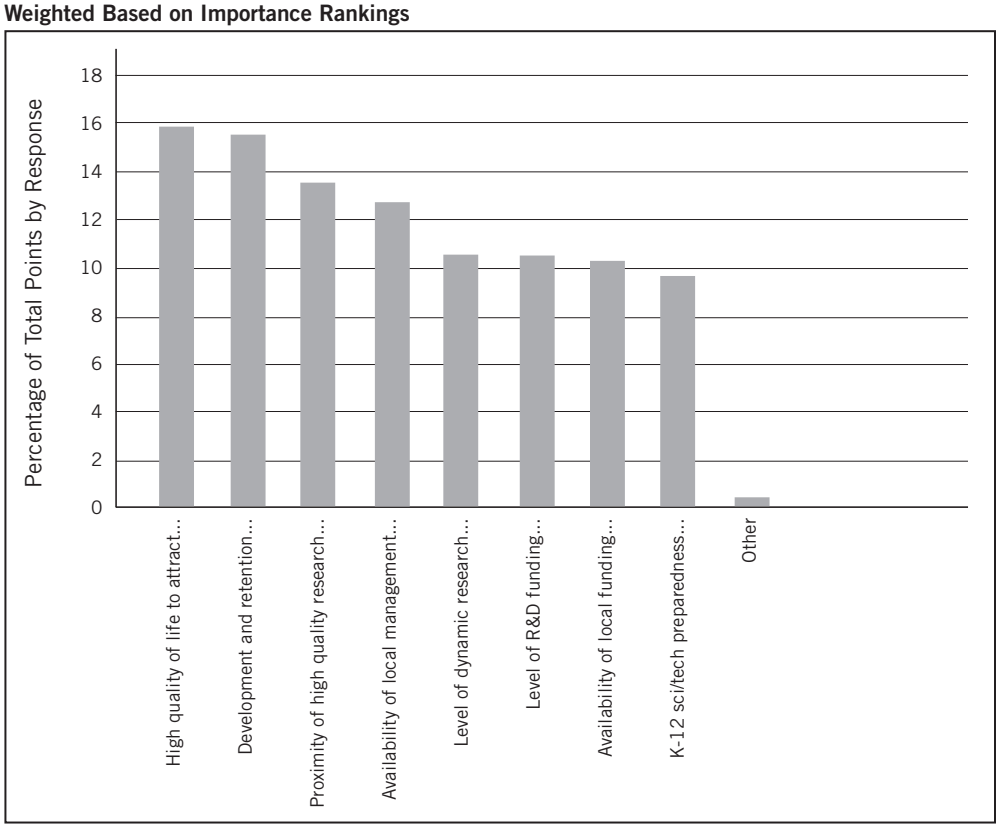
Choices:

a. High quality of life to attract and retain highly educated people from around the world
b. Development and retention of leading scientists and researchers
c. Proximity of high quality research universities
d. Availability of local management for high-tech companies
e. Level of dynamic research programs yielding commercializable technology ideas
f. Level of R&D funding
g. Availability of local funding for new high-tech companies
h. K-12 science/technology preparedness
i. Other

Most frequently identified as top drivers:

- High quality of life to attract and retain highly educated people from around the world
- Development and retention of leading scientists and researchers
- Proximity of high quality research universities
- Availability of local management for technology-based enterprises

Weighted Based on Importance Rankings



Bill Gates, Sr. founded the Technology Alliance (TA) in 1996 by bringing together leaders from Washington's diverse high-tech, education, and community sectors to focus on improving the underpinnings of our technology-based economy. That vision continues to guide the TA today. A CEO-level board from high-tech companies and research institutions around the state directs the TA's work.

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