The Computing Fields: National, Regional, UW

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REPORT TO THE PRESIDENT AND CONGRESS

DESIGNING A DIGITAL FUTURE: FEDERALLY FUNDED RESEARCH AND DEVELOPMENT IN NETWORKING AND INFORMATION TECHNOLOGY

Executive Office of the President

President's Council of Advisors on Science and Technology

DECEMBER 2010

The Impact

"From smartphones to eBook readers to game consoles to personal computers; from corporate datacenters to cloud services to scientific supercomputers; from digital photography and photo editing, to MP3 music players, to streaming media, to GPS navigation; from robot vacuum cleaners in the home, to adaptive cruise control in cars and the real-time control systems in hybrid vehicles, to robot vehicles on and above the battlefield; from the Internet and the World Wide Web to email, search engines, eCommerce, and social networks; from medical imaging, to computer-assisted surgery, to the large-scale data analysis that is enabling evidence-based healthcare and the new biology; from spreadsheets and word processing to revolutions in inventory control, supply chain, and logistics; from the automatic bar-coding of hand-addressed first class mail, to remarkably effective natural language translation, to rapidly improving speech recognition – <u>our world today relies to an astonishing degree on systems, tools, and services that belong to a vast and still growing domain known as Networking and Information Technology (NIT)</u>."

"As a field of inquiry, <u>NIT has a rich intellectual agenda – as rich as that of any other field of science or engineering</u>."

"In addition, <u>NIT is arguably unique among all fields of science and engineering in the breadth of its impact</u>."

"<u>The development and application of NIT-related systems, services, tools and methodologies have boosted U.S. labor productivity more than any other set of forces in recent decades.</u> Advances in NIT, deployed pervasively throughout the U.S. economy, have helped U.S. workers become the world's most productive and have enabled the U.S. to remain one of the world's most competitive economies."

The Future Role

"Recent technological and societal trends place the further advancement and application of NIT squarely at the center of our Nation's ability to achieve essentially all of our priorities and to address essentially all of our challenges:

• Advances in NIT are a key driver of economic competitiveness. They create new markets and increase productivity.

• Advances in NIT are crucial to achieving our major national and global priorities in energy and transportation, education and life-long learning, healthcare, and national and homeland security. NIT will be an indispensable element in buildings that manage their own energy usage; attention-gripping, personalized methods that reinforce classroom lessons; continuous unobtrusive assistance for people with physical and mental disabilities; and strong resilience to cyber warfare.

• <u>Advances in NIT accelerate the pace of discovery in nearly all other fields.</u> The latest NIT tools are helping scientists and engineers to illuminate the progression of Alzheimer's disease, elucidate the nature of combustion, and predict the size of the ozone hole, to cite just a few examples.

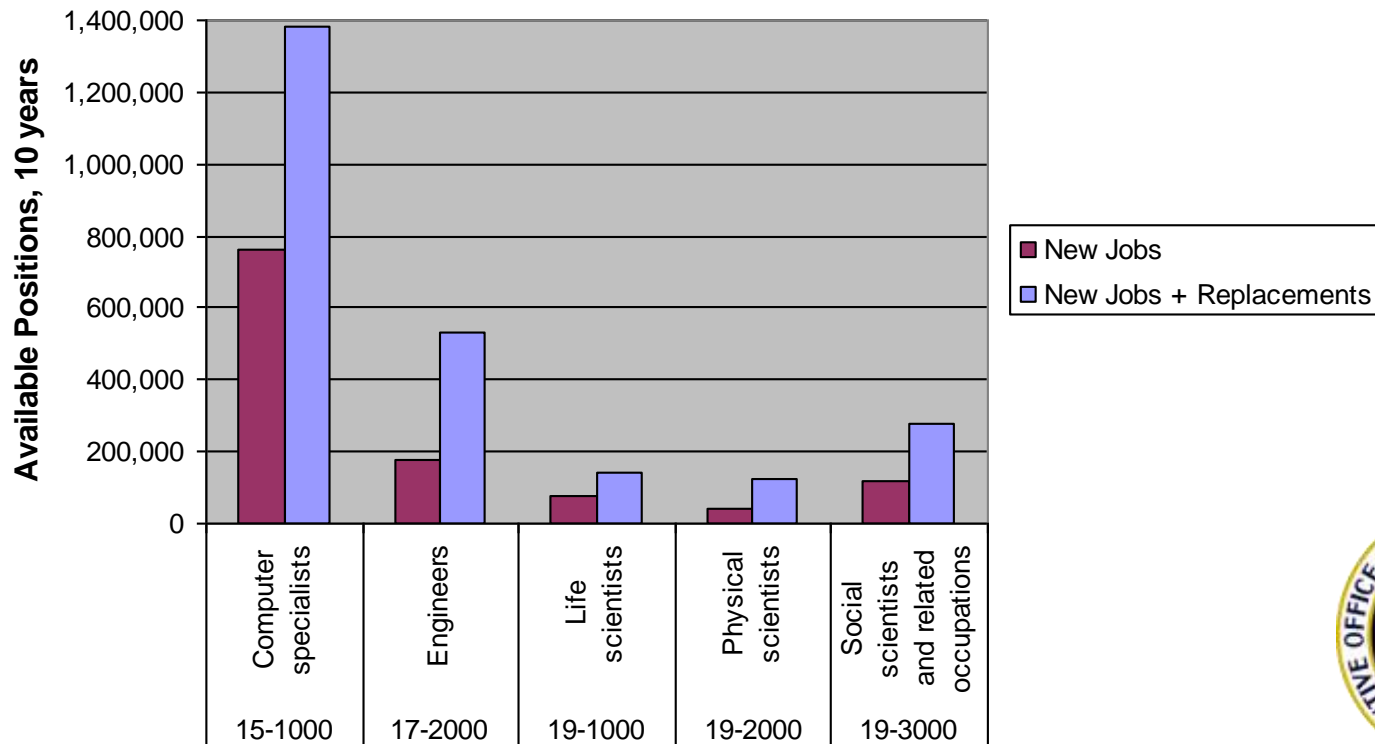• <u>Advances in NIT are essential to achieving the goals of open government.</u> Those advances will allow better access to government records, better and more accessible government services, and the ability both to learn from and communicate with the American public more effectively."

Workforce and Education

"All indicators – all historical data, and all projections – argue that NIT is the dominant factor in America's science and technology employment."

Science and Technology Job Growth, 2008-2018
(Bureau of Labor Statistics)

Bar chart — y-axis: "Available Positions, 10 years" ranging 0 to 1,400,000. Legend: New Jobs (dark red), New Jobs + Replacements (purple). Categories along x-axis: Computer specialists (15-1000), Engineers (17-2000), Life scientists (19-1000), Physical scientists (19-2000), Social scientists and related occupations (19-3000).

"The gap between the demand for NIT talent and the supply of that talent is and will remain large."

Annualized Job Openings vs. Annual Degrees Granted

Legend:
- Annualized job openings, 2008-2018 (BLS data)
- Degrees granted, 2006 (NSF data)
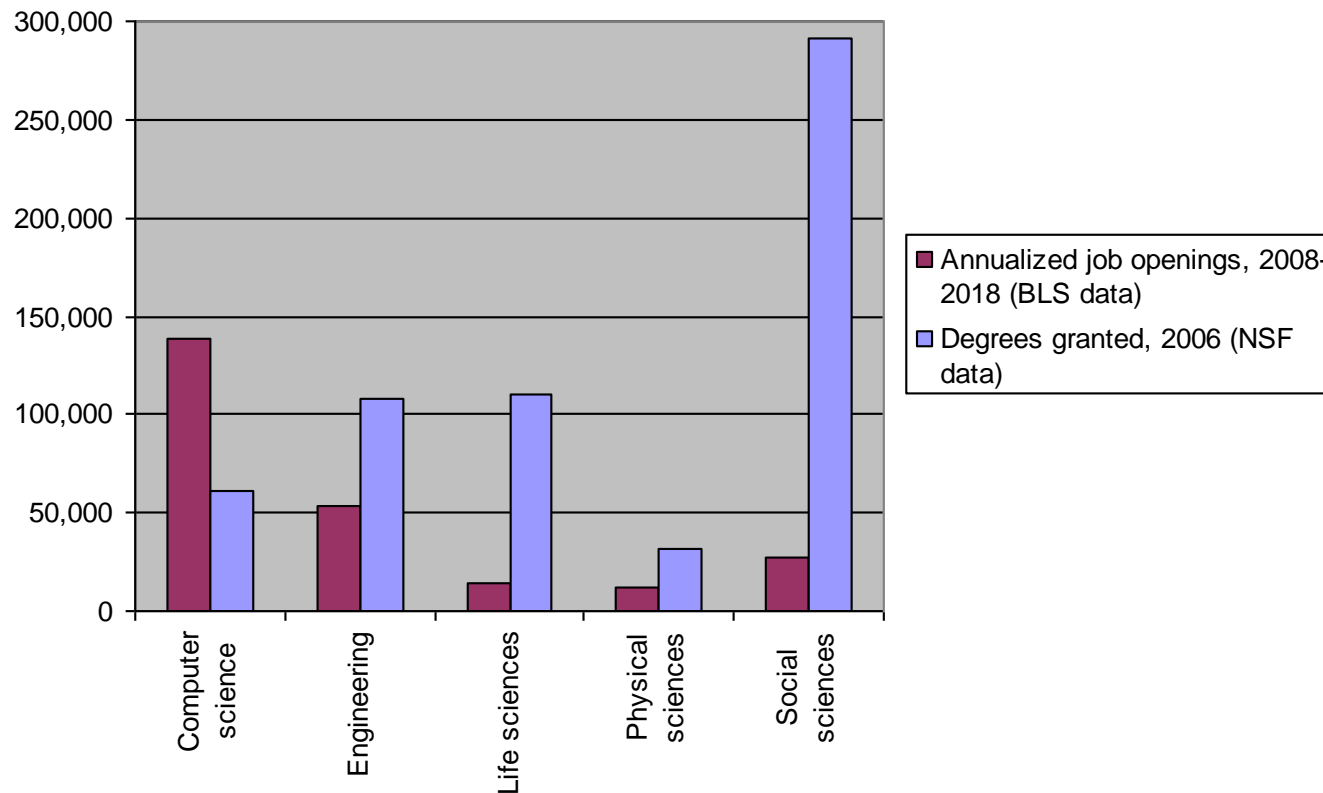
In Washington State

- Washington's **single biggest competitive advantage** – for recovery, for growth, for prosperity – is its leadership position in Information Technology.

- This leadership position in Information Technology is also **a critically important asset** in establishing and expanding competitive positions in biotech, in energy, in health care, in education, in a host of other fields.

- **We should make investment decisions as if we understood this.**

Our region has innovators in most major information technology industry sectors

Microsoft — Software

amazon.com — Broad e-tailing, Cloud

real — Online media

Expedia.com — Online travel

Google — Search, etc.

Zillow.com Your Edge in Real Estate — Online real estate

f5 THE WORLD RUNS BETTER WITH F5. — Networking infrastructure

AMAZE ENTERTAINMENT — Games

geospiza — Bioinformatics

Impinj — RFID

drugstore.com the uncommon drugstore — Focused e-tailing

ISILON SYSTEMS — Clustered storage

CRAY THE SUPERCOMPUTER COMPANY — High-performance computing

Many spawned by UW, Aldus, McCaw, Boeing, Amazon.com, and Microsoft

PUGET SOUND TECH UNIVERSE

A VISUAL HISTORY OF THE TECHNOLOGY INDUSTRY

Growth in Private Sector Technology Employment: 1988-2009
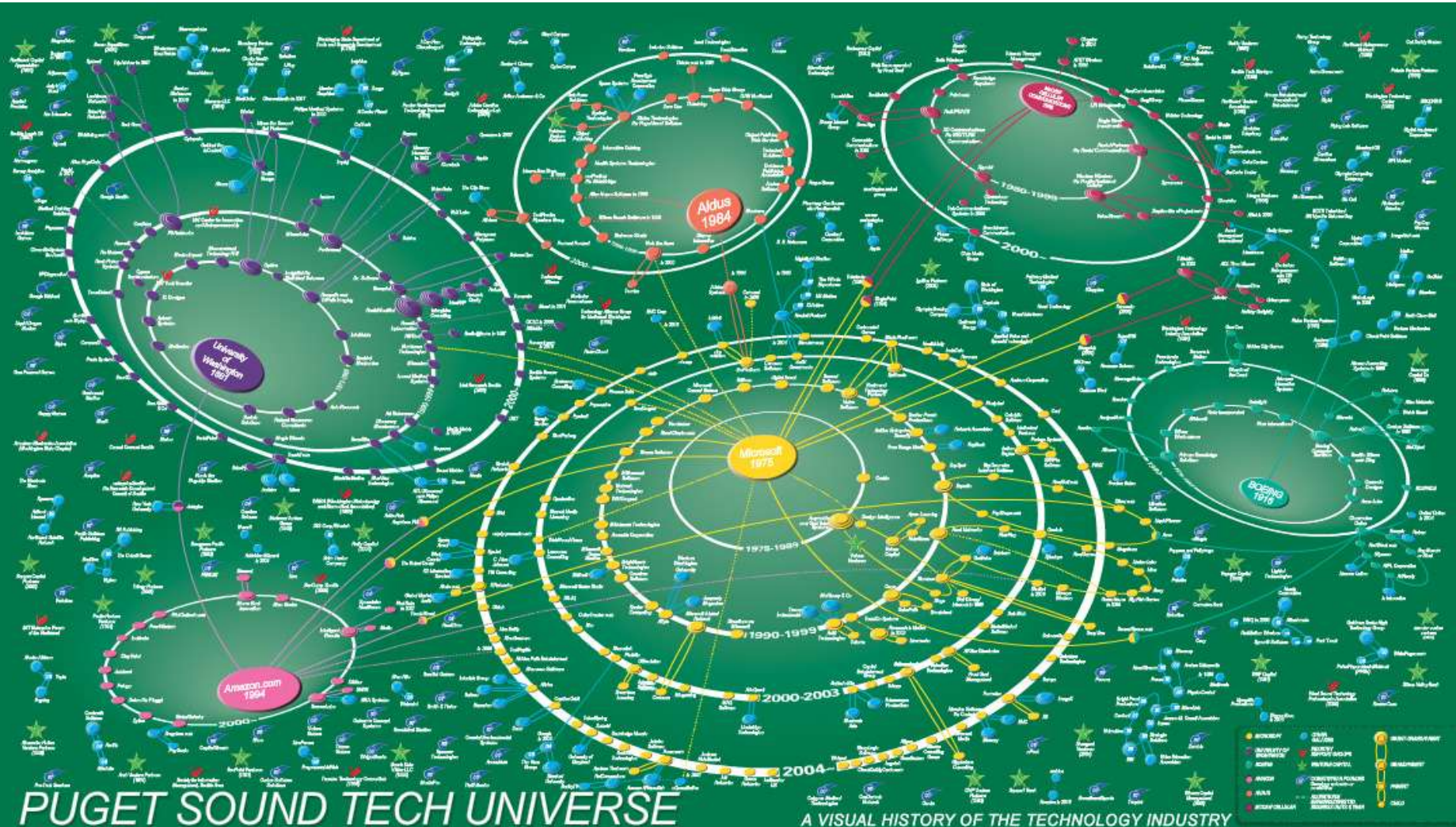
Innovative industries support 42% of all jobs in Washington State.

Other Tech

Software & Computer Services

Aerospace

400,000
350,000
300,000
250,000
200,000
150,000
100,000
50,000
0

1988 1990 1992 1994 1996 1998 2000 2002 2007 2009
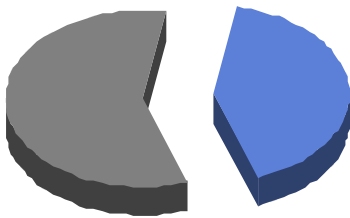
Source: Technology Alliance: *The Economic Impact of Technology-based Industries in Washington State*, 2010

Washington Innovation Summit
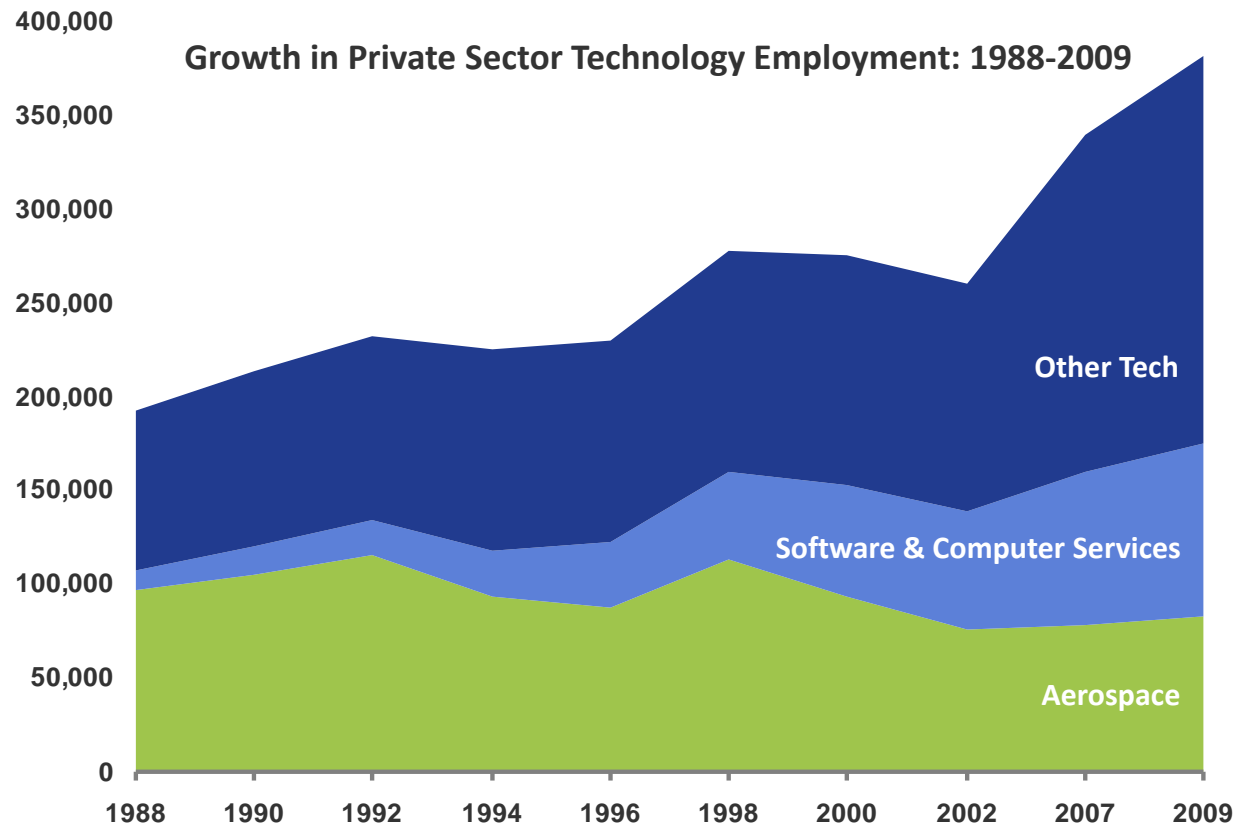
Washington is among the top states in the nation for innovative workforce (a lot of it imported).

Washington's National Rankings: Human Capital

Category	Ranking
Intensity of S&E workforce	2
Engineers	2
Computer specialists	5
S&E Bachelor's production	31
Total Bachelor's production	35
Graduate program participation	46
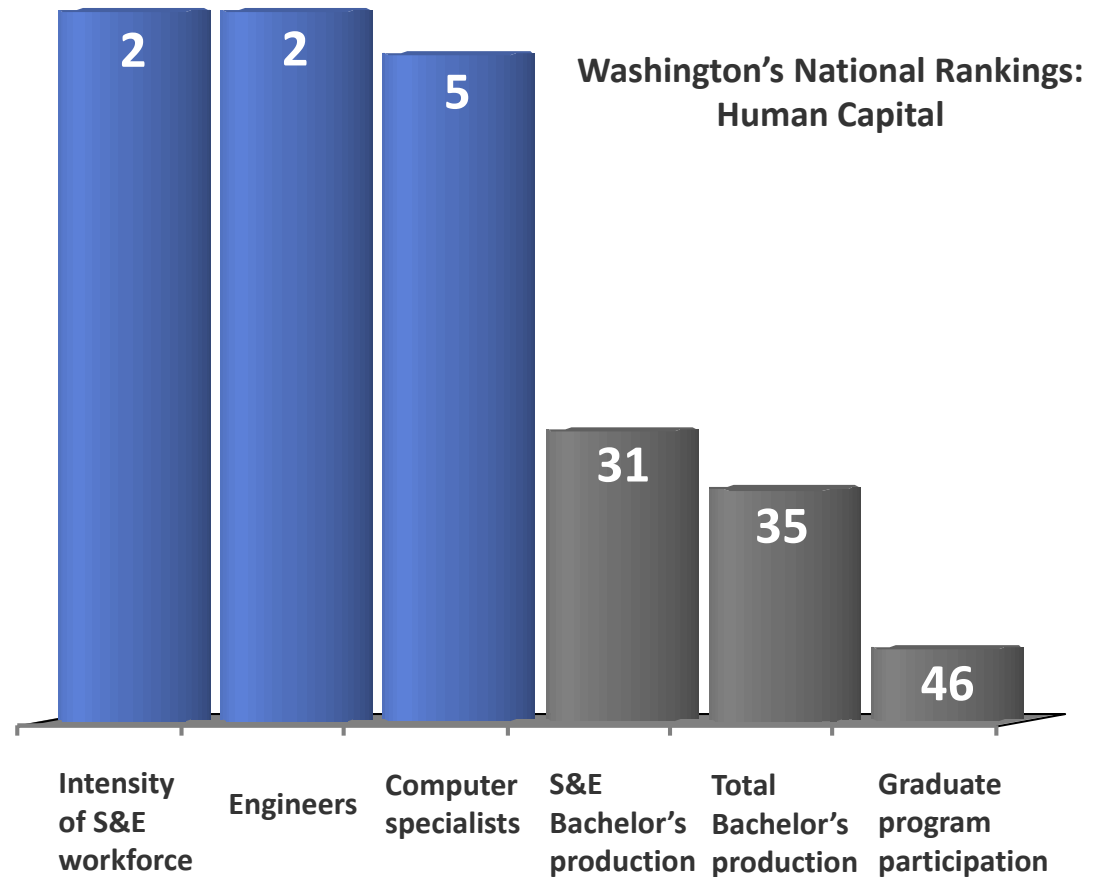
Sources: ITIF/Kaufman Foundation: *The 2010 State New Economy Index*; National Science Foundation: *Science & Engineering Indicators 2010*

Dice *America's Tech Talent Crunch* (2011)

Top 10 "Shortage States"

1. California
2. New Jersey
3. Texas
4. New York
5. Massachusetts

6. Illinois
7. Washington
8. Connecticut
9. Virginia
10. Washington D.C.

Source: Dice.com

Regional press

April 2010

The Seattle Times Company   NWjobs | NW

The Seattle Times | **Business / Technology**
Winner of Eight Pulitzer Prizes

55°F

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Brier Dudley offers a critical look at technology and business issues affecting the Northwest.

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June 8, 2010 at 12:11 PM

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Facebook chooses Seattle site, by Pike Place Market
Posted by Brier Dudley

Regional press

April 2010

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The Seattle Times | Business / Technology

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Amazon.com on a hiring spree

Amazon.com has been expanding its office complex in South Lake Union and has about 1,900 openings in Seattle.

By Amy Martinez
Seattle Times business reporter

Regional press

April 2010

February 2011

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April 2011

Brier Dudley's Blog
Brier Dudley offers a critical look at technology and business issues affecting the Northwest.

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Q&A: Zynga founder talks about Seattle hiring spree, Amazon, Facebook

Posted by Brier Dudley

National press

May 2011

National press

May 2011

June 2011

HEC Board *Regional Needs Analysis Report* (2011)

Figure 12
Comparison of Current Supply with Future Demand for
Baccalaureate and Graduate Degrees

Research, scientists, technical — 1,655 — *280*

Human/protective service professionals — 1,850 — *498*

Editors/writers/performers — 1,359 — *607*

Medical professionals — 2,493 — *1,134*

Computer science — 2,052 — *2,973*

Engineering/software enginr/architecture — 1,292 — *1,148*

Business and management — 7,805 — *304*

■ Current Average Annual Supply by Washington Institutions, 2004-2006

▪ Additional Supply Needed to Meet Average Annual Demand, 2011 - 2016

Source: Openings: Washington ESD June 2008 Long Term Employment Forecast
Supply: HECB Analysis of IPEDS data. Current supply is a 3 year annual average of degree awards, 2006-2008 adjusted for entry into the labor market.

UW Computer Science & Engineering

- Ranked among the top 10 programs in the nation
  - MIT, Stanford, Berkeley, Carnegie Mellon, Illinois, Washington, Cornell, Princeton, Georgia Tech, Princeton, Caltech, Wisconsin …
- Two undergraduate programs
  - Computer Science (College of Arts & Sciences)
  - Computer Engineering (College of Engineering)
- 160 Bachelors graduates per year (most recent expansion was in 1999)
- 80 Masters graduates per year
- 20 Ph.D. graduates per year
- Top-5 supplier of new graduates to Microsoft, Amazon.com, Google
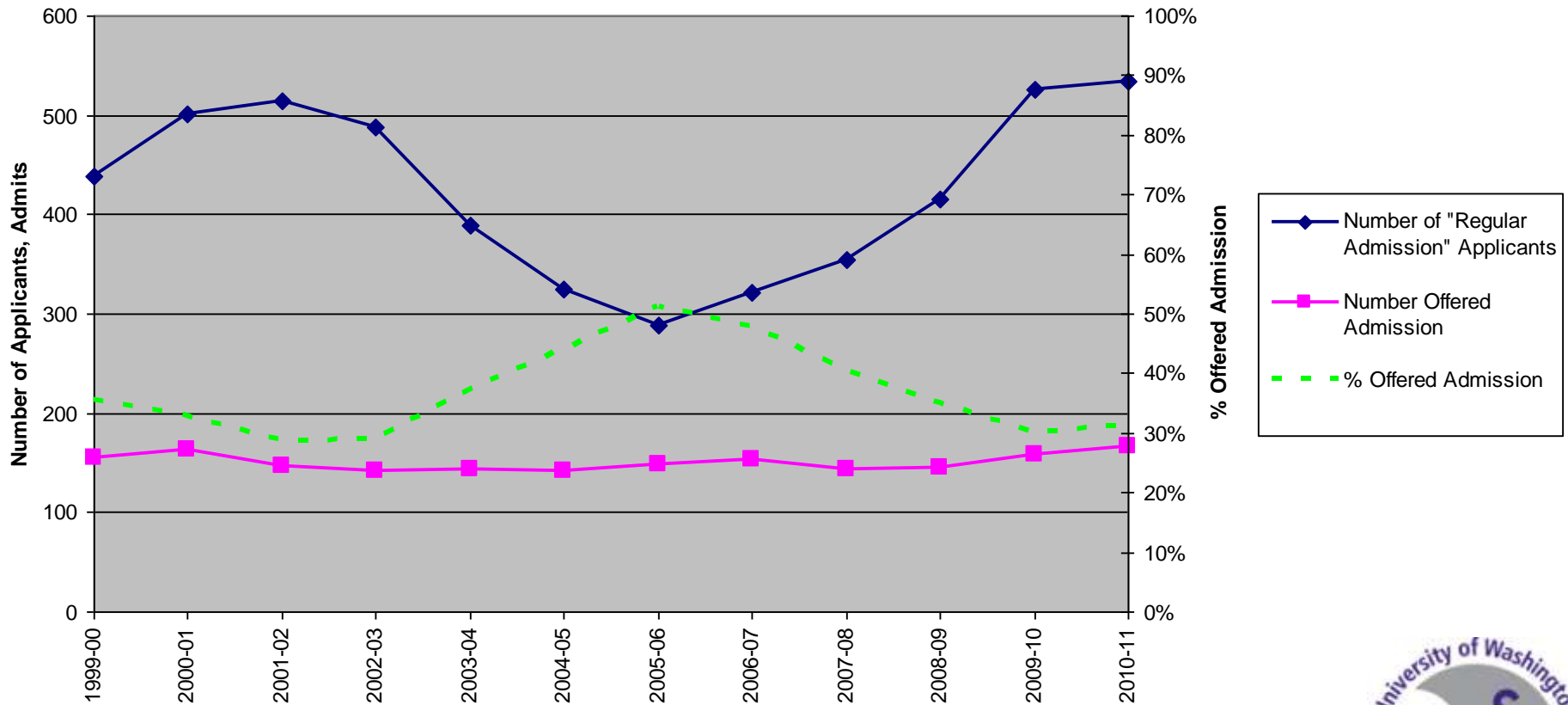 - Typically along with Stanford, Berkeley, MIT, Waterloo

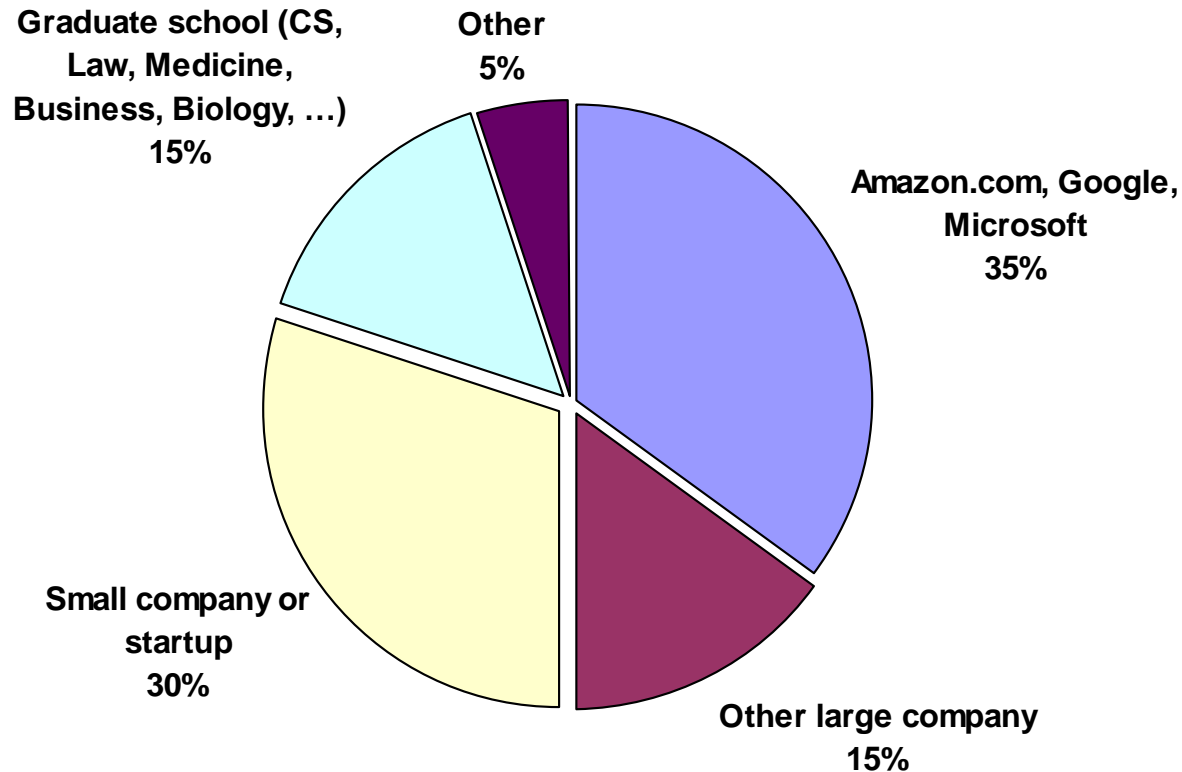# UW CSE Annualized Introductory Course Enrollment

First course (CSE 142)   Second course (CSE 143)
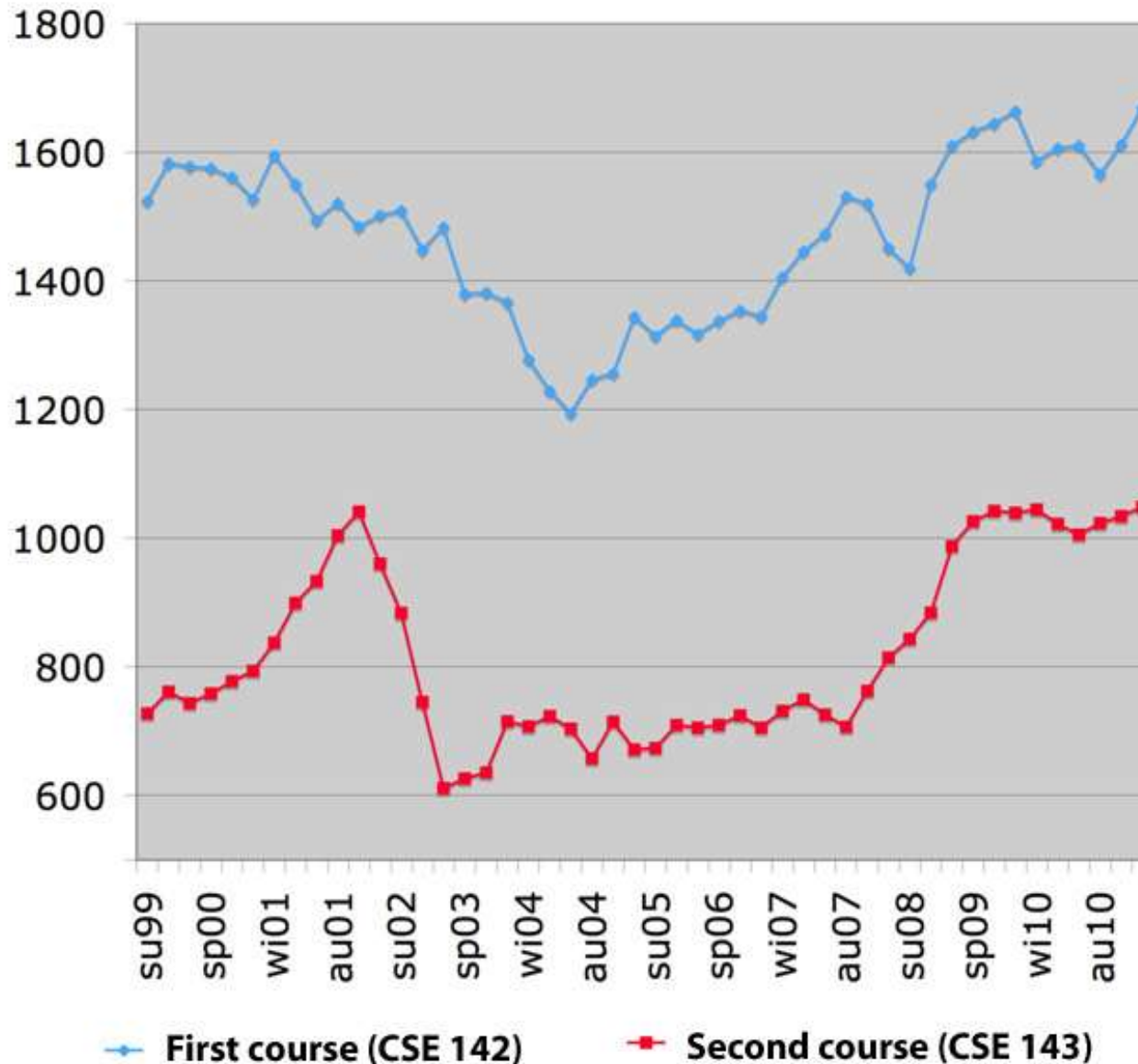
UW CSE Bachelors Program Admission

UW CSE Bachelors Student Destinations
(most recent 2 years, ~90% response rate)

Graduate school (CS, Law, Medicine, Business, Biology, …) 15%

Other 5%

Amazon.com, Google, Microsoft 35%

Small company or startup 30%

Other large company 15%

Summary

- Computing is a field of huge intellectual opportunity and unmatched impact

- Computing is *the dominant factor* in America's science and technology employment

- The same is true in Washington State

- Our economy is creating great jobs

- However, they are going to other people's kids

- In addition to disadvantaging our kids, this disadvantages smaller companies, which must recruit locally

- Ultimately it will stifle the growth of our economy