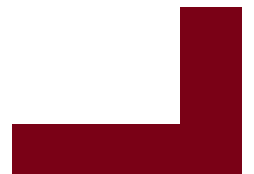




The Software Talent Shortage Impact on the Software Industry

**Enterprise Software Roundtable
September 4, 1997**

Avron Barr and Shirley Tessler
Co-Directors of the Software Industry Study
Stanford Computer Industry Project
<http://www-scip.stanford.edu/scip/>





The Stanford University Computer Industry Project

- ◆ Alfred P. Sloan Foundation, Industry Studies
- ◆ SCIP's Corporate Sponsors
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SCIP

Software Industry Team

- ◆ Professor William F. Miller
 - ❖ Professor of Computer Science and Public & Private Management
 - ❖ Senior Fellow, Institute for International Studies
 - ❖ President Emeritus of SRI International
- ◆ Shirley G. Tessler
 - ❖ Co-Director, with Avron Barr, of the SCIP Software Industry Study
 - ❖ Fifteen year's experience in banking and corporate finance
 - ❖ Expert on software startup financing and management
 - ❖ Research on the worldwide software labor supply
- ◆ Avron Barr
 - ❖ Edited the *Handbook of Artificial Intelligence* with E. A. Feigenbaum
 - ❖ Consultant for 15 years on corporate use of advanced technologies
 - ❖ Expert on software technology & knowledge management systems





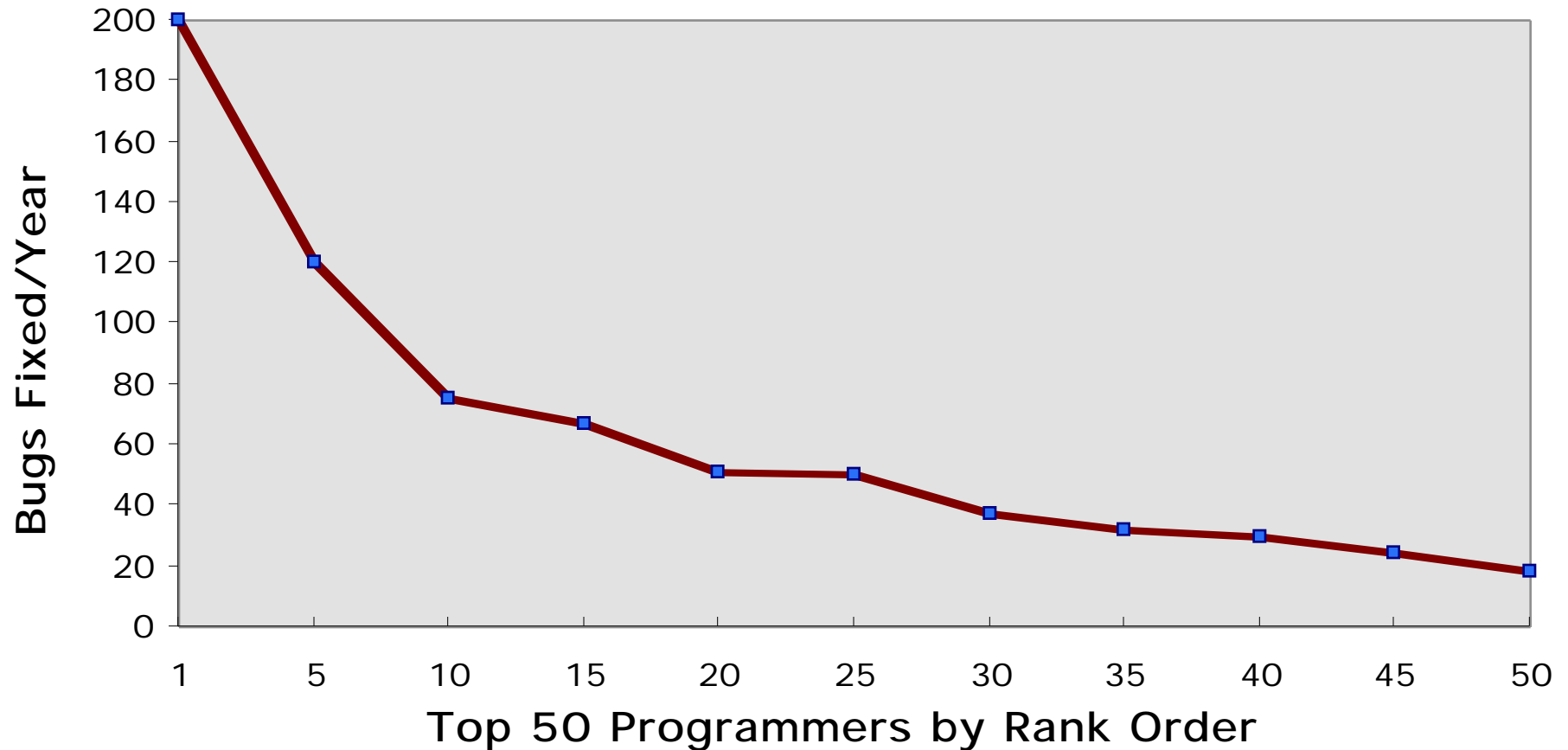
A Serious Shortage of Talent Will Reshape the SW Industry

- ◆ The ITAA (1997) reports 190,000 open positions, excluding government and non-profit orgs.
- ◆ Gartner estimates a shortage of 500,000 people.
- ◆ The fundamental cause of the shortage is the inexorable rise in demand for SW of all types.
- ◆ The rise in demand was masked for years by massive downsizing in MIS, aerospace/defense and large computer firms, and the simultaneous growth of Indian software services exports.
- ◆ Software publishers are the last to feel the pinch.





The Software Labor Pool — The Best are Significantly Better

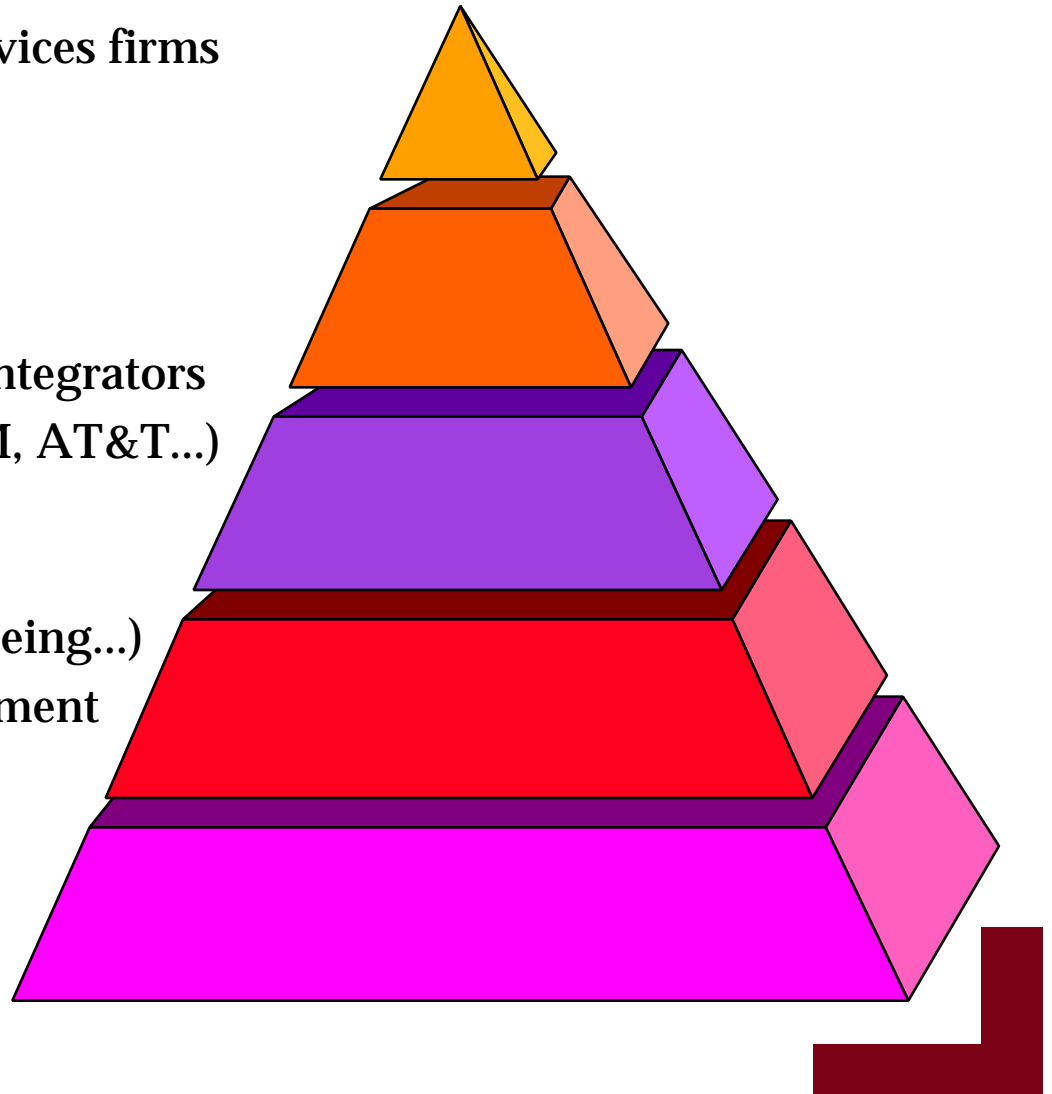


“Not All Programmers Are Created Equal,” G. Edward Bryan, IEEE, 1994



Software Labor Shortages: Who's Getting the Top Talent?

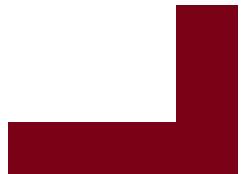
- ◆ Software start-ups & boutique services firms
- ◆ Software publishers
- ◆ R & D (corporate & university)
- ◆ VARs, consulting firms, systems integrators
- ◆ Software intensive industries (IBM, AT&T...)
- ◆ Aerospace systems firms
- ◆ Incidental embedded SW (GM, Boeing...)
- ◆ Corporate IS, application development
- ◆ DoD
- ◆ Federal, state & local government





Some Common Misconceptions About the SW Talent Shortage

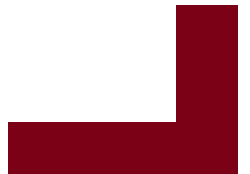
- ◆ This shortage is global, not local to Silicon Valley or to the US.
- ◆ It is not limited to Year 2000, Java, SAP or any other technical specialty.
- ◆ The shortage is not likely to be very sensitive to future economic cycles because it is driven by demand for software across all industries.





Reasons for the Talent Shortage: Supply vs. Demand

- ◆ Demand for SW of all sorts is growing.
- ◆ Productivity of developers is constant.
 - ❖ SW development is still a tedious process.
 - ❖ Tools have not kept up with complexity.
- ◆ Global supply of programmers is limited.
 - ❖ Interest in computing careers has declined.
 - ❖ This is not the job for everyone.





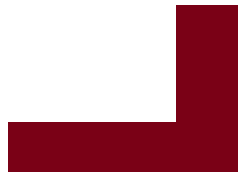
The Shortage is Driven by the Growing Demand for Software

- ◆ Publishing: applications, tools, games, ...
 - ❖ \$106B, growing at 15%
- ◆ Enterprise information systems
 - ❖ \$1Tr, growing worldwide at 10%
 - ❖ Competitive weapon, not just “productivity”
 - ❖ Infrastructure in developing countries
- ◆ Embedded code in products of all types
 - ❖ Cellular phones, airbags, Tamagotchi
 - ❖ Creators are not counted as “programmers”



The Supply of Software Talent Has Natural Limitations

- ◆ Talented people have many alternatives
 - ❖ Still not recovered from layoffs in early '90s
- ◆ Not an attractive career, especially in IS
 - ❖ The Dilbert Syndrome, low prestige
 - ❖ Time pressure, working conditions
 - ❖ Good work not recognized, errors brutalized
- ◆ Schools have a limited capacity
 - ❖ Competent teachers have better alternatives





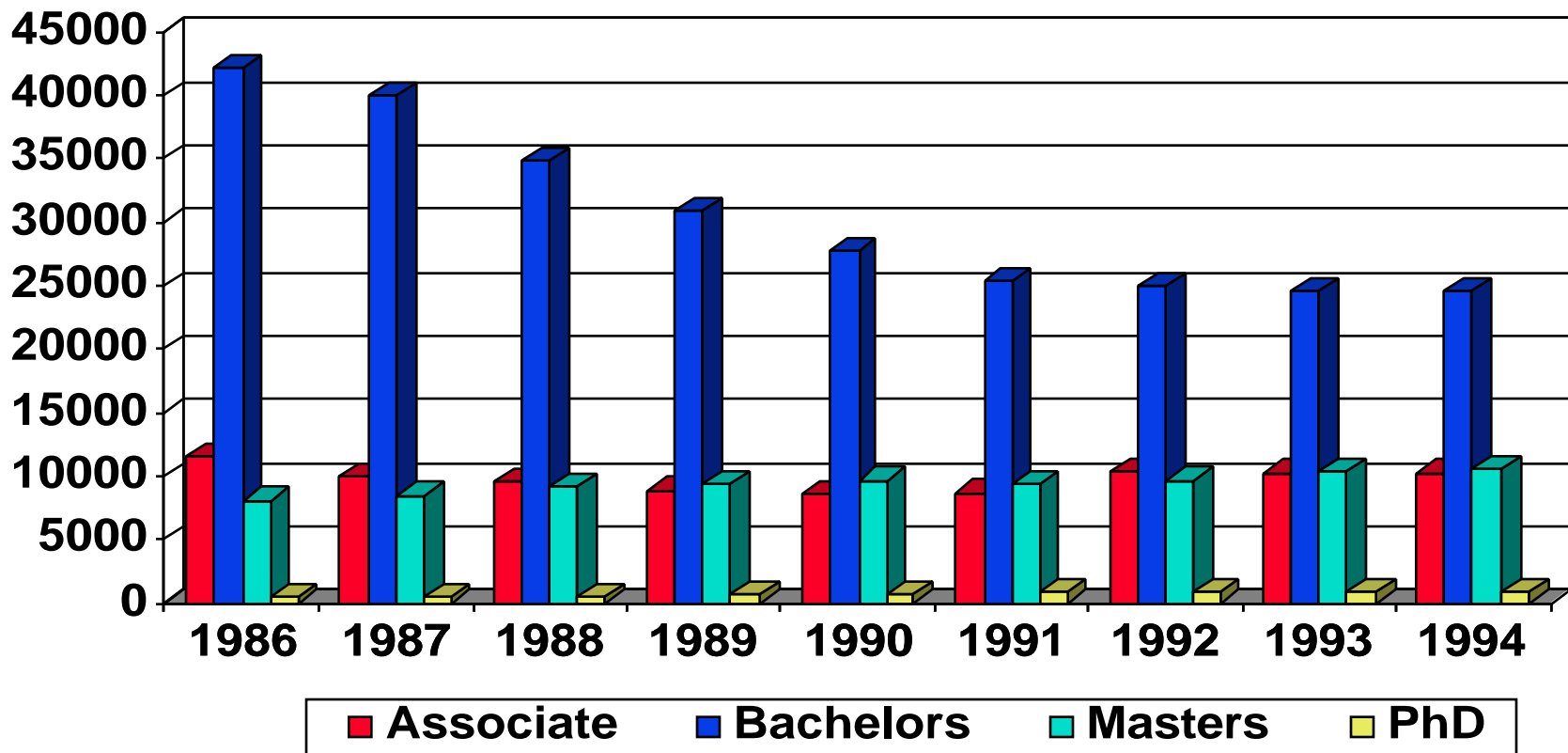
The Supply of Software Talent (continued)

- ◆ Productivity of developers is constant
 - ❖ SW development is still a tedious process
 - ❖ Tools have not kept up with complexity
- ◆ Offshore outsourcing is small potatoes
 - ❖ Indian SW services exports totaled \$1B in '96
- ◆ Demographics are working against us
 - ❖ The first generation is retiring
 - ❖ Women & minorities are not entering the field





CS Graduates in the US 1986-1994

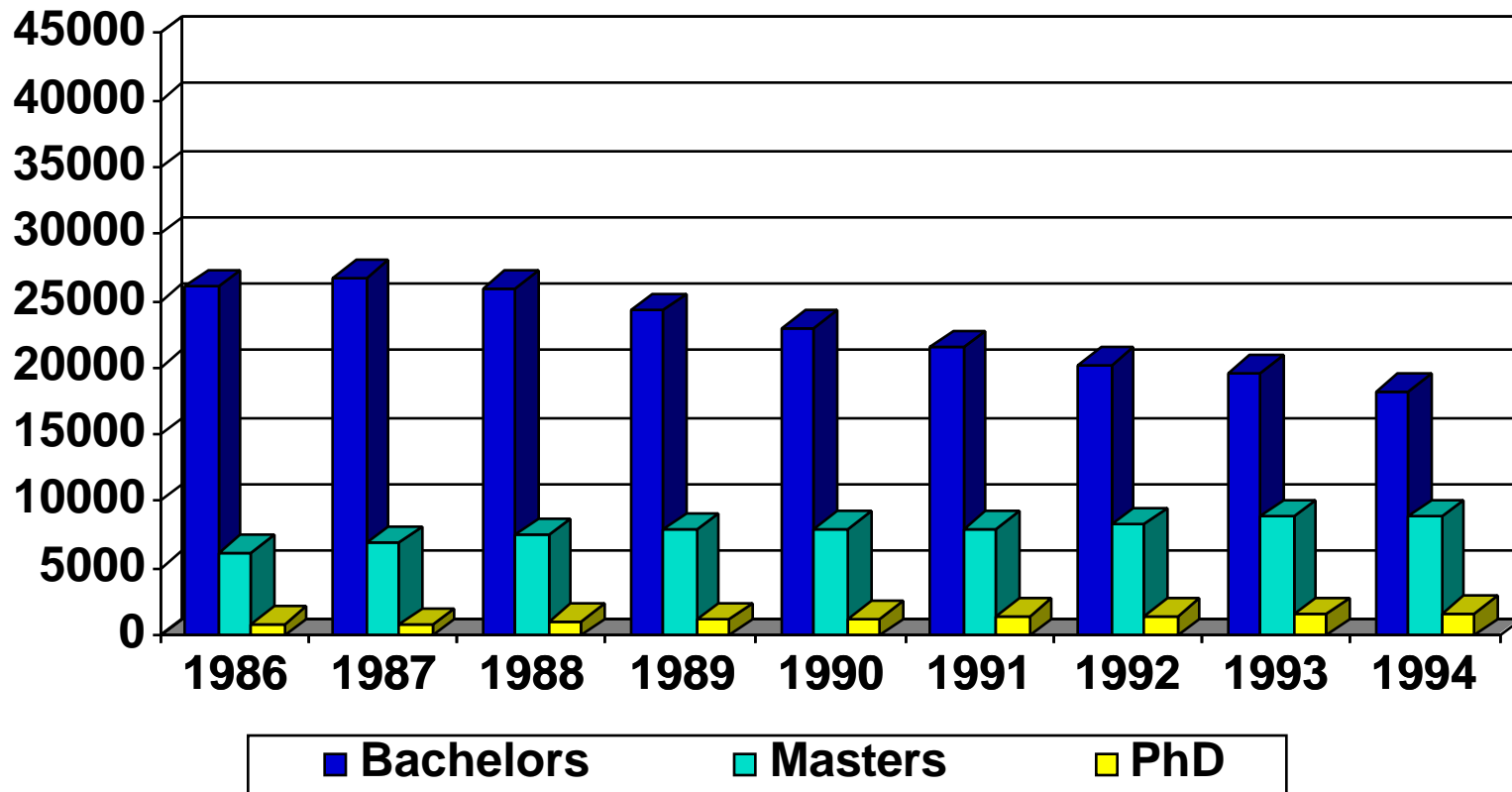


Source: Science and Engineering Indicators, 1996, 1997
Note: Associate Degrees includes Math and CS





EE Graduates in the US 1986-1994

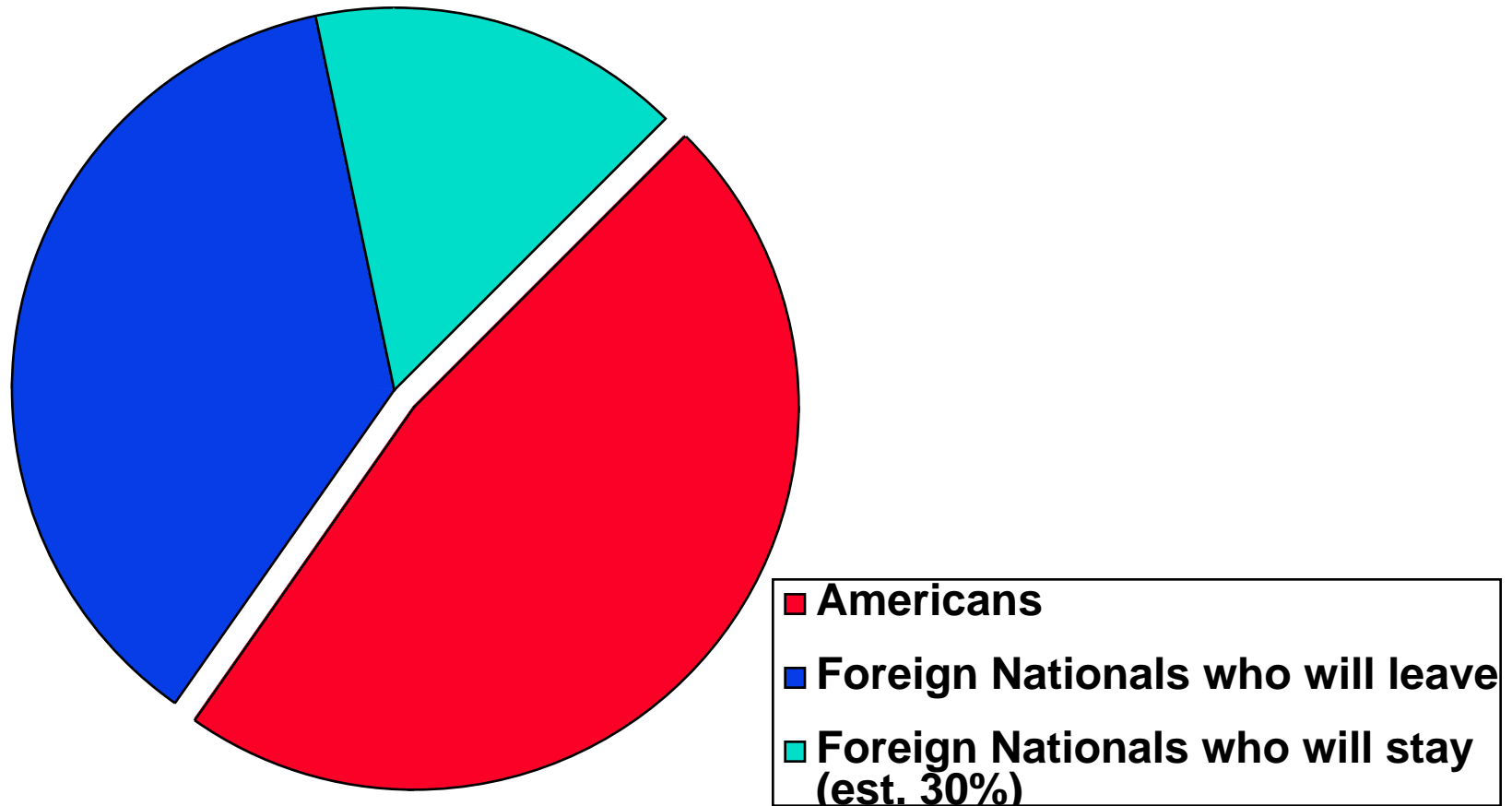


Source: Science and Engineering Indicators, 1996, 1997

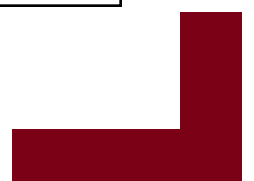




Full-Time CS Students MS & Ph.D., Fall, 1996



Source: Engineering Workforce Commission, 1996





Supply and Demand in the US: A Back-of-the-Envelope Tally

Demand

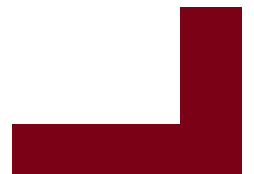
2 million SW people in the US,
15% growth in demand
10,000 retiree replacements
(increasing rapidly after 2000)

- ◆ 310,000 new jobs this year
- ◆ 415,000 new jobs in 2000

Supply

46,000 CS graduates (all levels)
31,000 EE grads
- 8,000 foreign students who go home
20,000 MIS graduates
30,000 permanent immigrants
(0% growth)

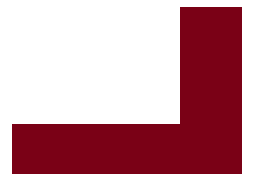
- ◆ 119,000 new people this year, max
- ◆ 184,000 new people in 2000
(with 20% growth in graduates)





The Talent Shortage Will Have Serious Consequences

- ◆ Slower technology adoption & evolution
 - ❖ Your customers must integrate new offerings
 - ❖ Their best talent is now working for you
- ◆ Project delays
 - ❖ Key people leaving, hiring delays
 - ❖ Bringing less qualified people up to speed
- ◆ Predatory recruiting practices
- ◆ Escalating wages

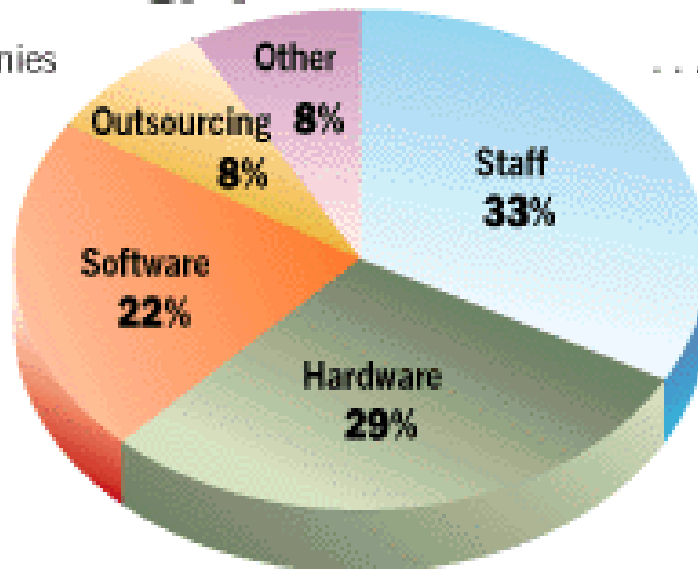




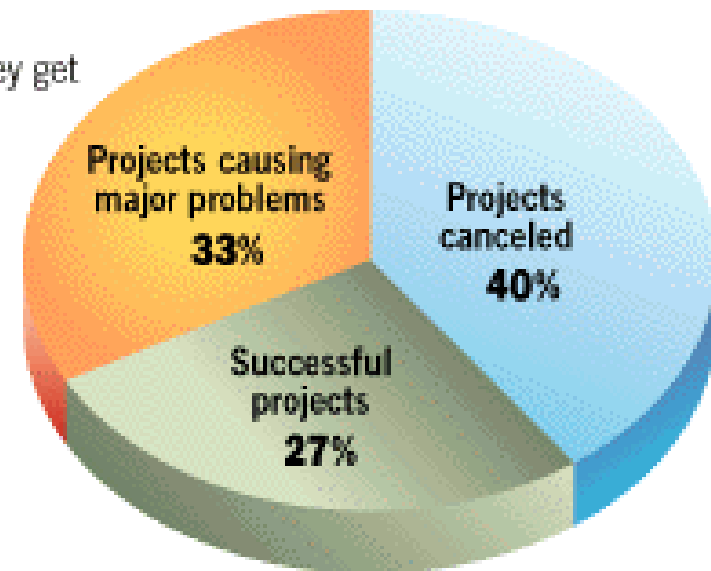
Customers are Already Having a Hard Time with Their Projects

The technology pit

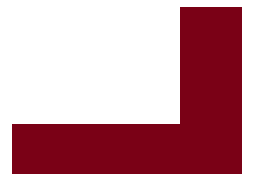
How companies spend . . .



. . . What they get



From **Forbes**, December 30, 1996. Sources: Computer Economics, Inc.; based on a survey of 300 managers; The Standish Group International, Inc.; based on a survey of 365 companies





There Is No Quick Solution

- ◆ Education and re-training of SW people
 - ❖ Attracting more bright, young engineers
 - ❖ Increasing the capacity of training programs
- ◆ Tapping talent pool in other countries
 - ❖ There will not soon be another India
- ◆ New technologies for SW development
 - ❖ E.g., component-based software assembly
- ◆ Conclusion: a ten year drought, at least
 - ❖ Things will get worse before they get better



How to Approach the Problem

1. Rethink the way we satisfy the demand for software products and applications
 - ❖ SAP and the off-the-shelf movement
 - ❖ Assembly of software components:
investment in architecture & infrastructure
 - ❖ Synchronize with customer adoption, needs
 - ❖ Help them avoid “build and scrap” cycles
2. Rethink skills and job classifications
3. Rethink the way we train the labor force



Some Possible Actions

- ◆ Industry-funded training programs
 - ❖ In addition to partnerships with schools
 - ❖ Certification of some types of professionals
 - ❖ Project management as important as coding
 - ❖ Making this international would be smart
- ◆ Maximize productivity of current workforce
 - ❖ Retraining and retooling
- ◆ Lobby for research on
 - ❖ Skills needs for the future
 - ❖ SW development technologies

