

Can We Engineer The Perfect Engineer?

**Susan Hassler
Editor-in-Chief
IEEE Spectrum Magazine
s.hassler@ieee.org**

19 June 2004

What Are the Characteristics of a “21st Century Engineer”?

US National Science Foundation

- **They need to know about terascale, nanoscale, complexity, cognition, and holism.**
- **They need to be astute makers, trusted innovators, agents of change, master integrators, enterprise enablers, technology stewards, and knowledge handlers. They will need more than first-rate technical and scientific skills. They need to embrace complex systems and the issues they present, and reach the right decisions about how huge amounts of time, money, people, knowledge, and technology are tasked to a common end.**

What Are the Characteristics of a “21st Century Engineer”?

The Accreditation Board for Engineering and Technology (ABET)

- **an ability to apply knowledge of mathematics, science, and engineering;**
- **an ability to design and conduct experiments, as well as to analyze and interpret data;**
- **an ability to design a system or process to meet desired needs;**
- **an ability to function on multidisciplinary teams;**
- **an ability to identify, formulate, and solve engineering problems;**
- **an understanding of professional and ethical responsibility;**
- **an ability to communicate effectively;**
- **the broad education necessary to understand the impact of engineering solutions in a global/societal context;**
- **a recognition of the need for and an ability to engage in lifelong learning;**
- **an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.**

What Are the Characteristics of a “21st Century Engineer”?

ASEE Engineering Deans Council and the National Research Council Study, Engineering Education, Designing an Adaptive System (1995)

- **Leadership (an ability to develop and demonstrate it);**
- **An understanding and appreciation of diversity and pluralism;**
- **A commitment to quality, timeliness, and continuous improvement;**
- **Experience in undergraduate research and engineering practice.**

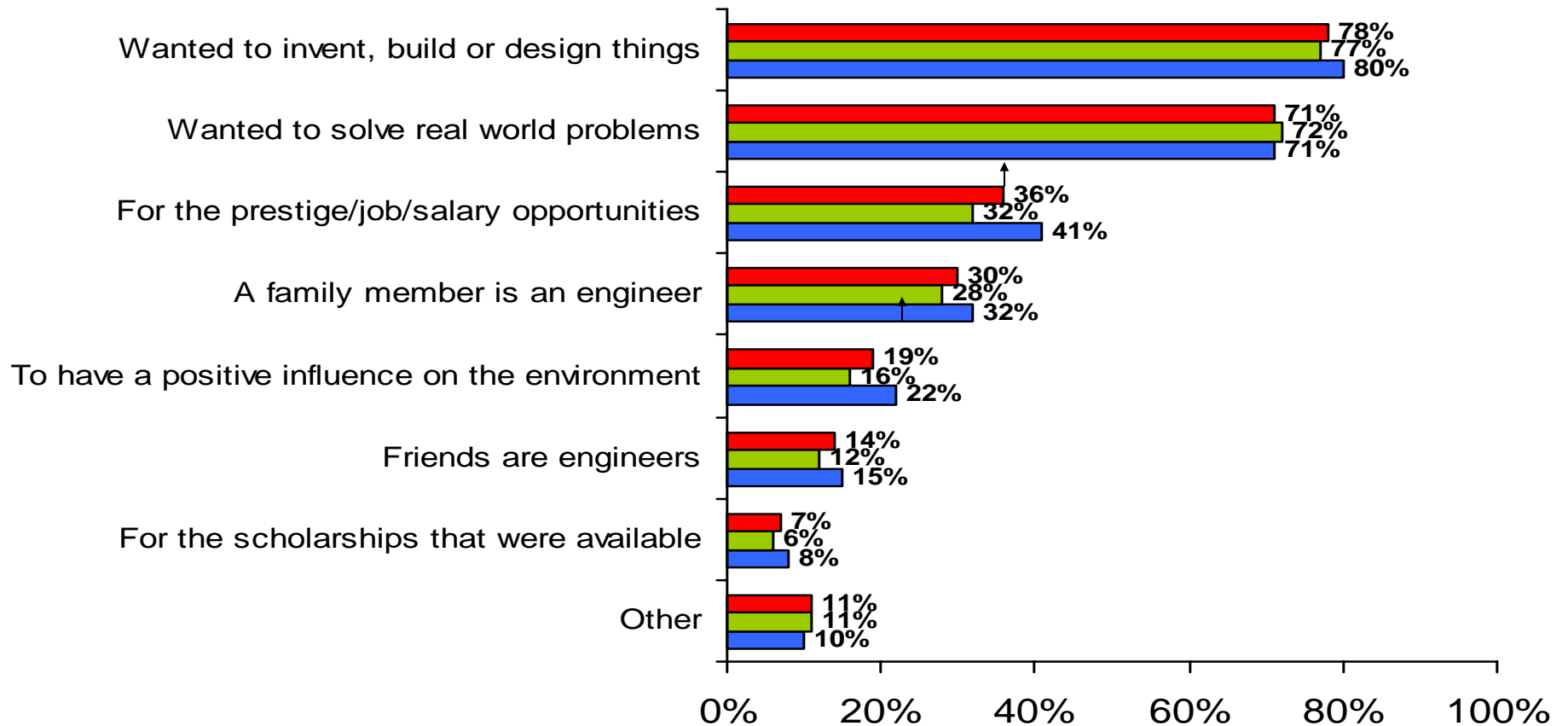
These “Engineers” Would Do Well At Whatever They Turned To



But What About the Rest of Us? A Tale of Two Surveys

- Survey of IEEE member engineers and IEEE student members---what “Josephine Engineer” thinks (*IEEE Engineer/Technology Professional Web-Based Study—December 2003*)
- IEEE Spectrum Reader Panel Surveys (2004)

What helped motivate you to become an engineer/technology professional?



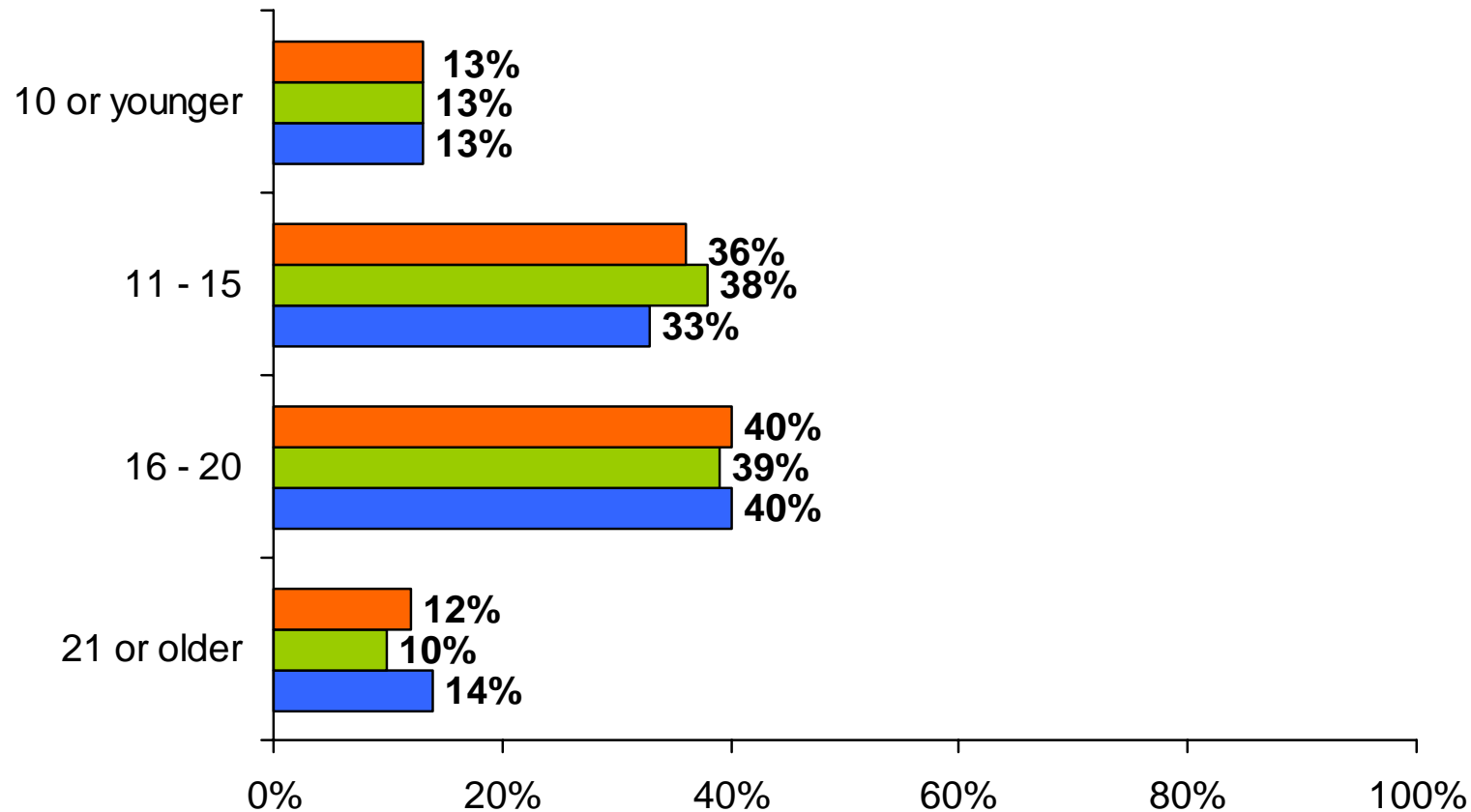
↑

■ Students (n=403)

■ Engineers (n=426)

■ Total (n=827)

At what age did you first think about becoming a engineer/technology professional?

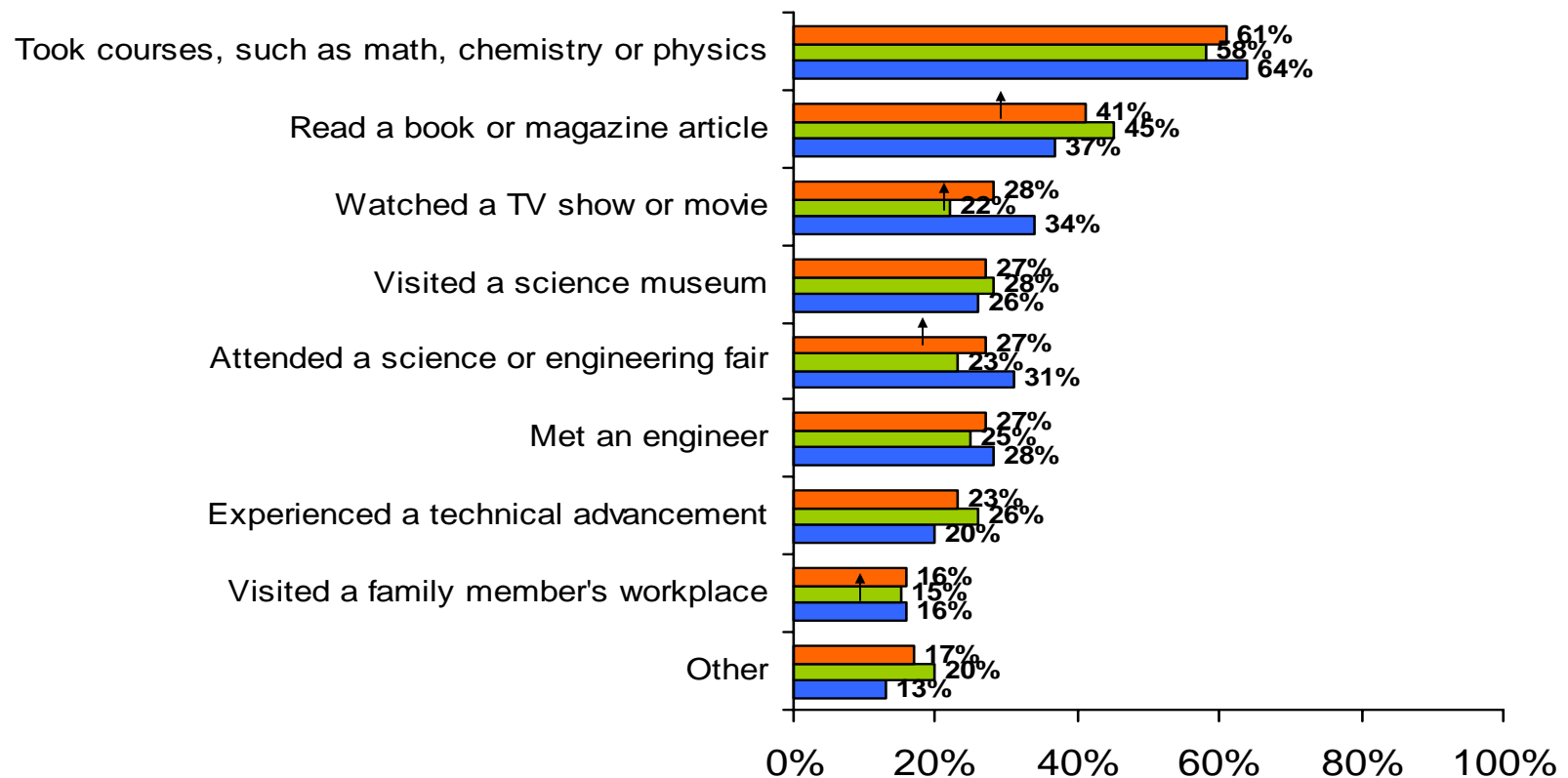


■ Students (n=350)

■ Technology Professional (n=402)

■ Total (n=752)

Which of the following activities prompted you to first think about becoming an engineer/technology professional?

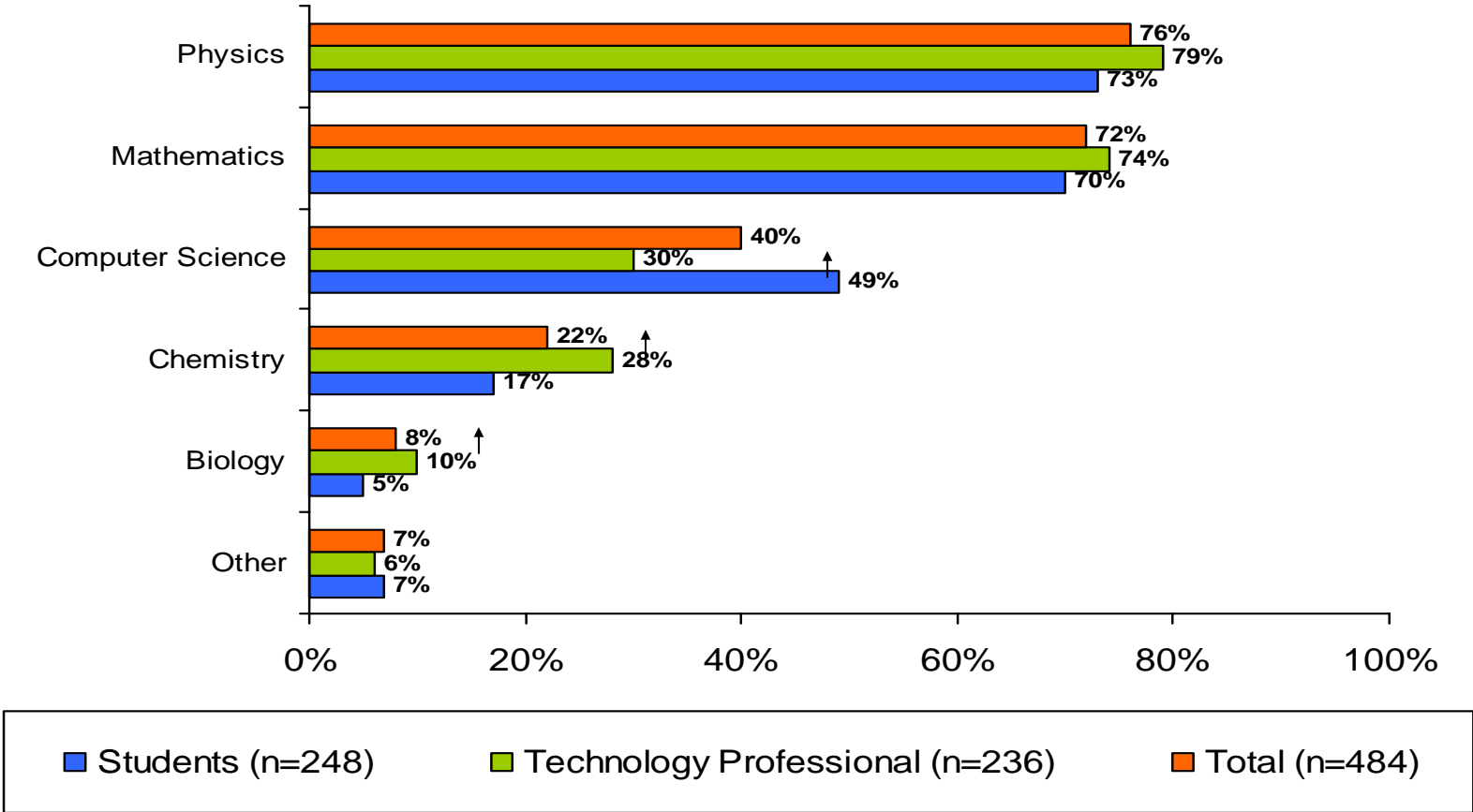


■ Students (n=393)

■ Technology Professional (n=415)

■ Total (n=808)

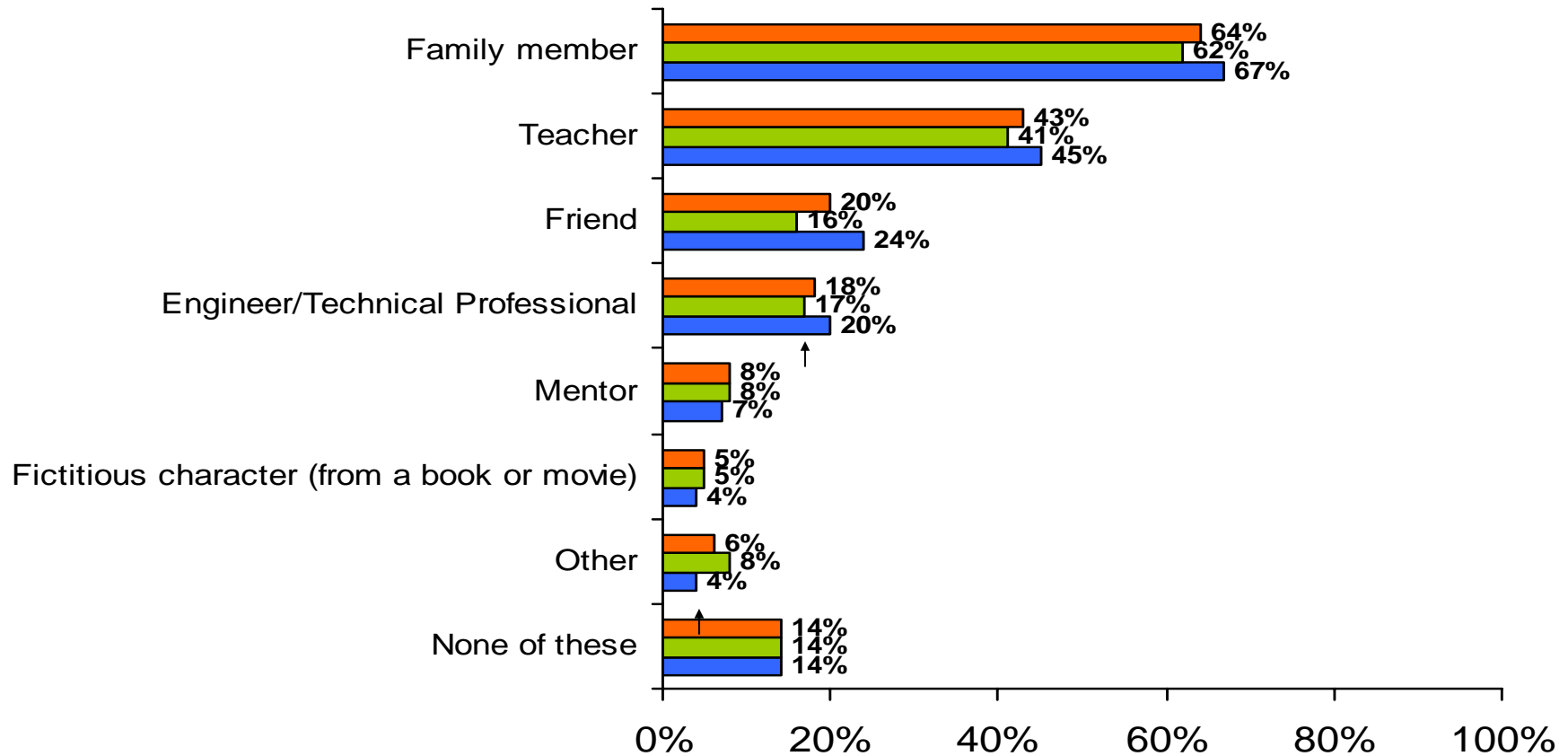
What courses first made you think about pursuing a technology career?



↑ Indicates a statistically higher percentage

* Base = Those who took courses that prompted engineering interest

Who, if anyone, encouraged you to pursue a technology career?



■ Students (n=391)

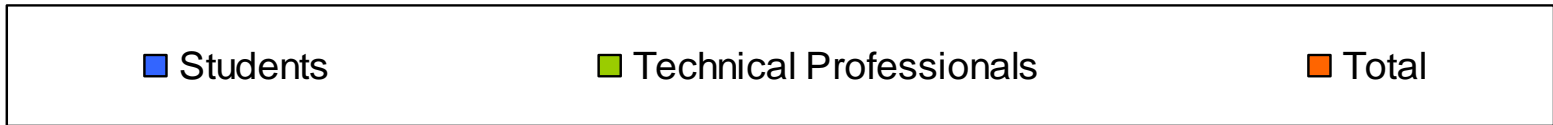
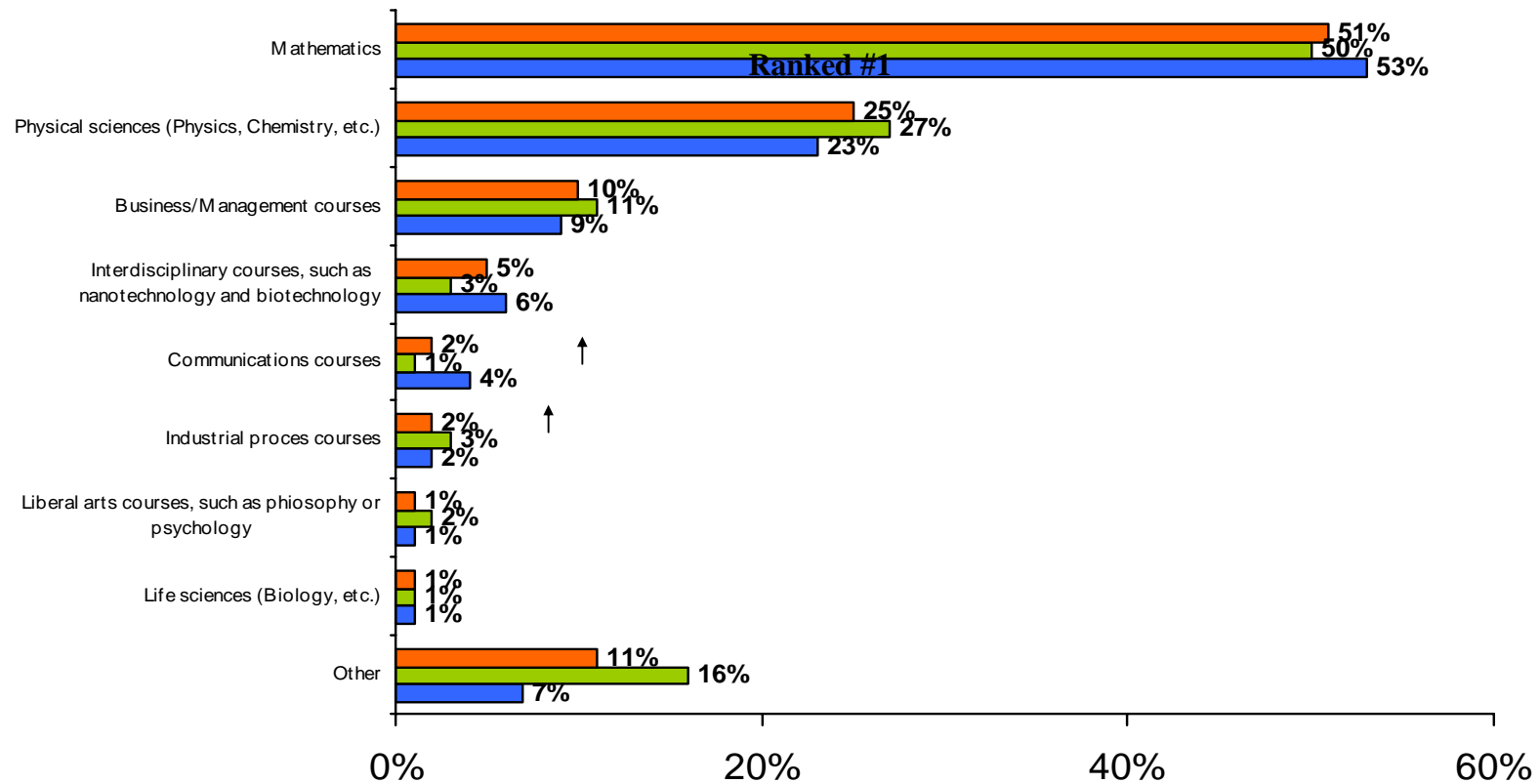
■ Technology Professional (n=419)

■ Total (n=810)

↑ Indicates a statistically higher percentage

* Base = Those who took courses that prompted engineering interest

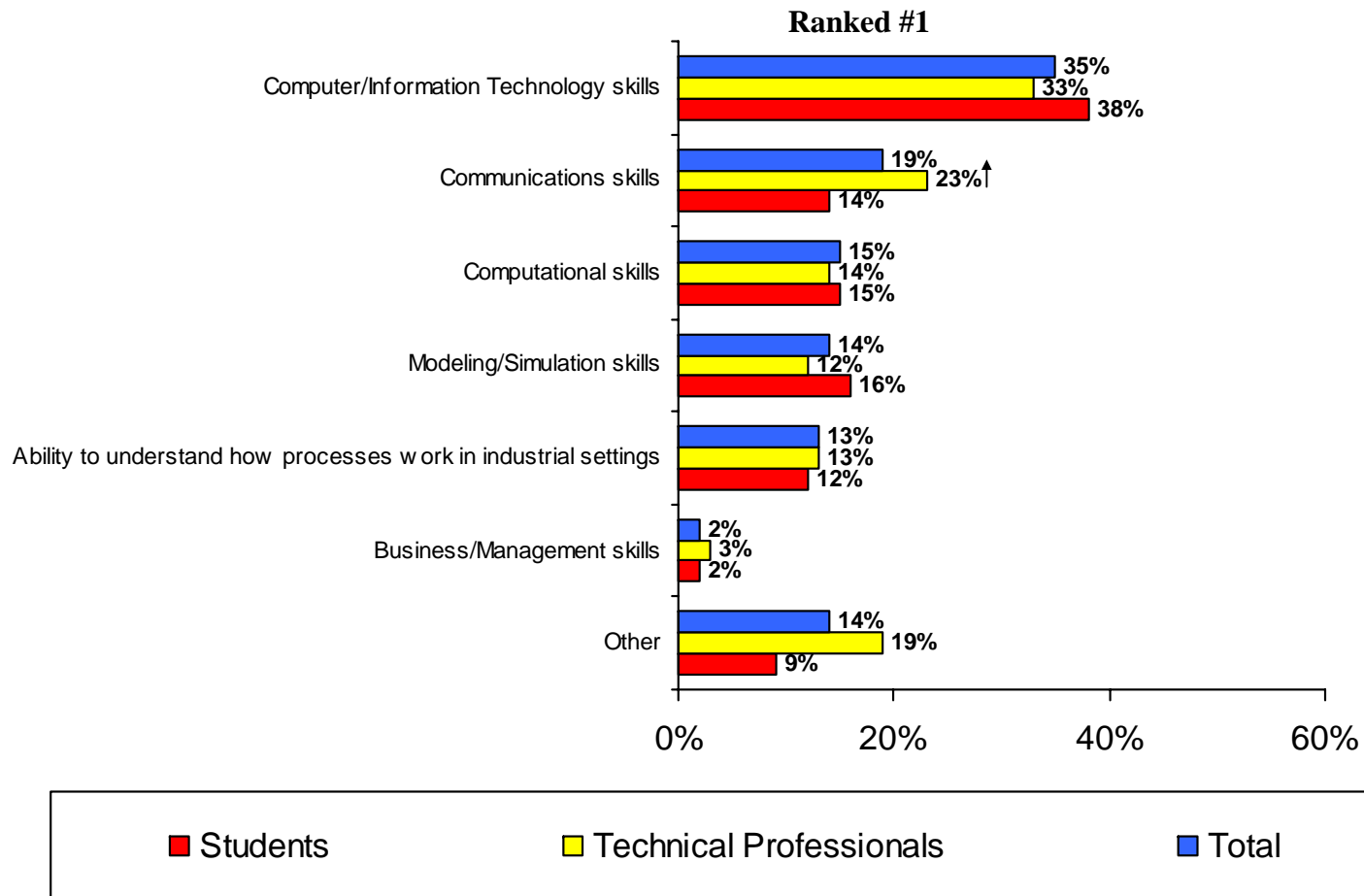
Besides standard engineering courses, what courses should be emphasized the MOST in order for to prepare undergraduate and graduate students to work as engineers/technology professionals today?



↑ Indicates a statistically higher percentage

*Base sizes vary

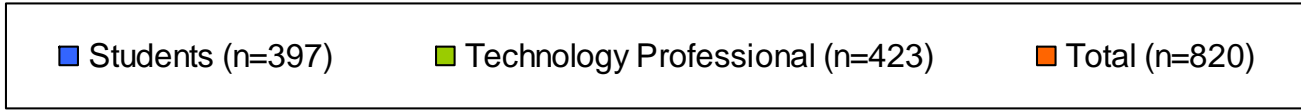
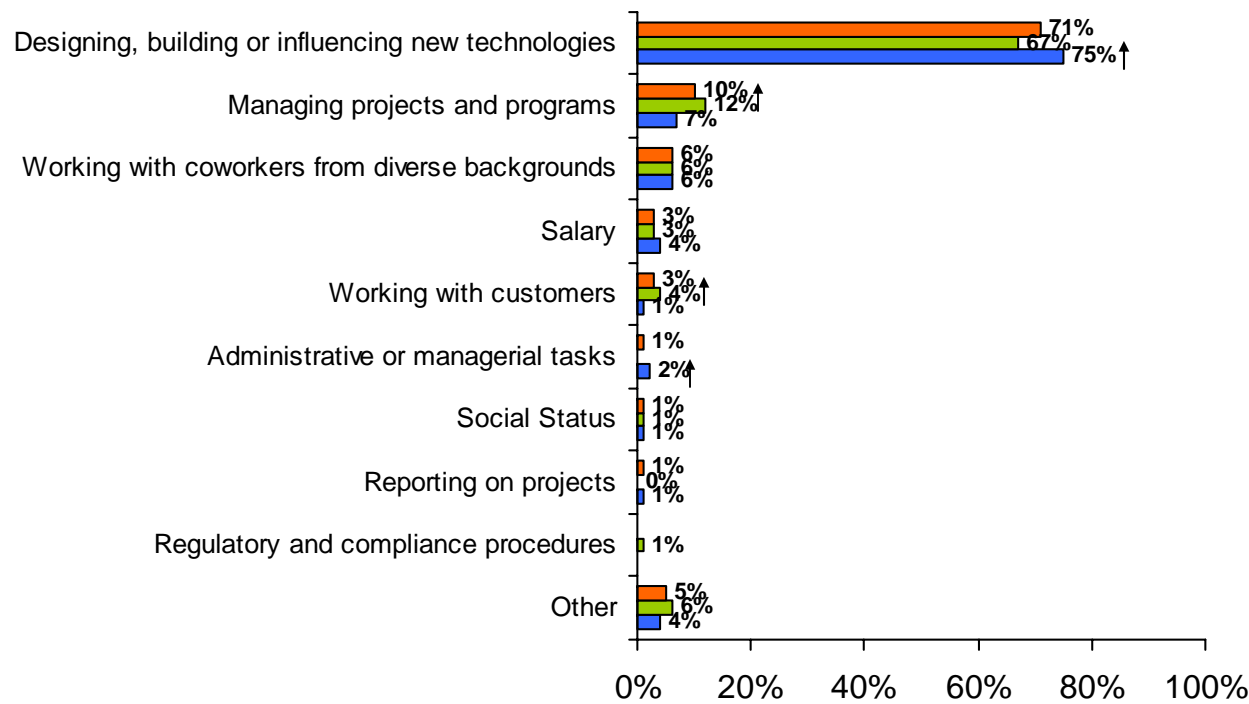
In general, what skills do undergraduate and graduate students need the MOST to be prepared to work as engineers/technology professionals today



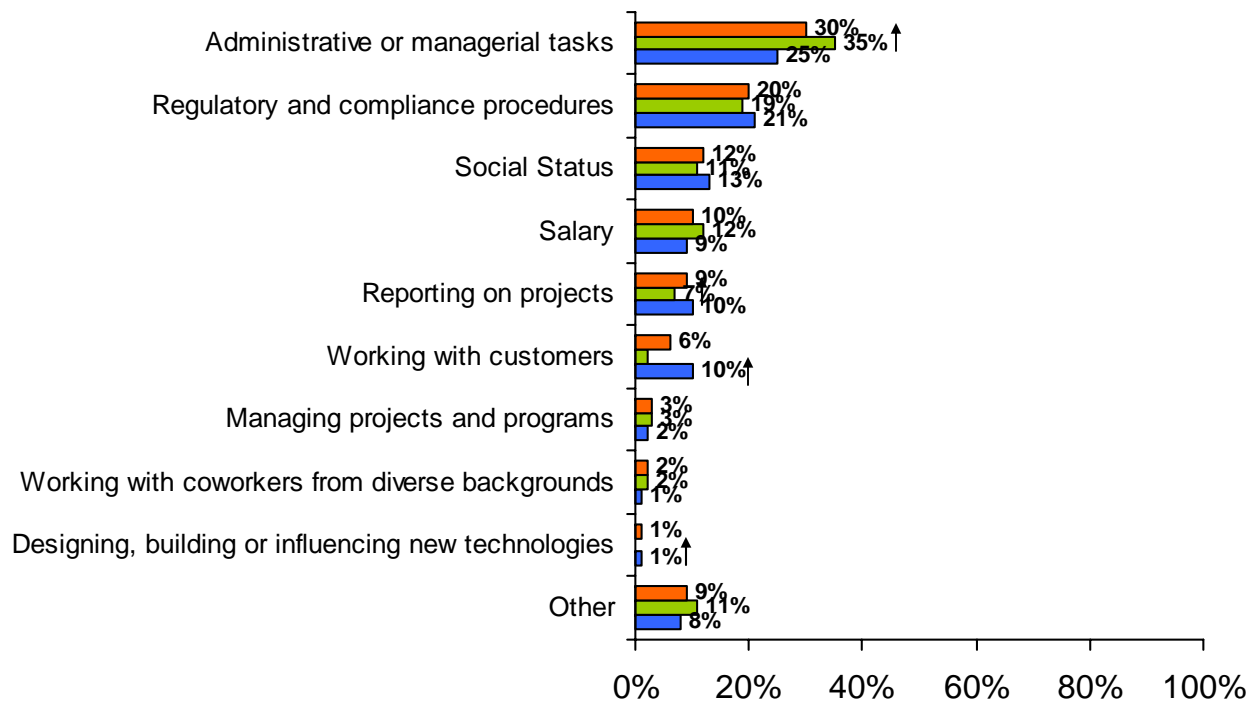
↑ Indicates a statistically higher percentage
Base sizes vary



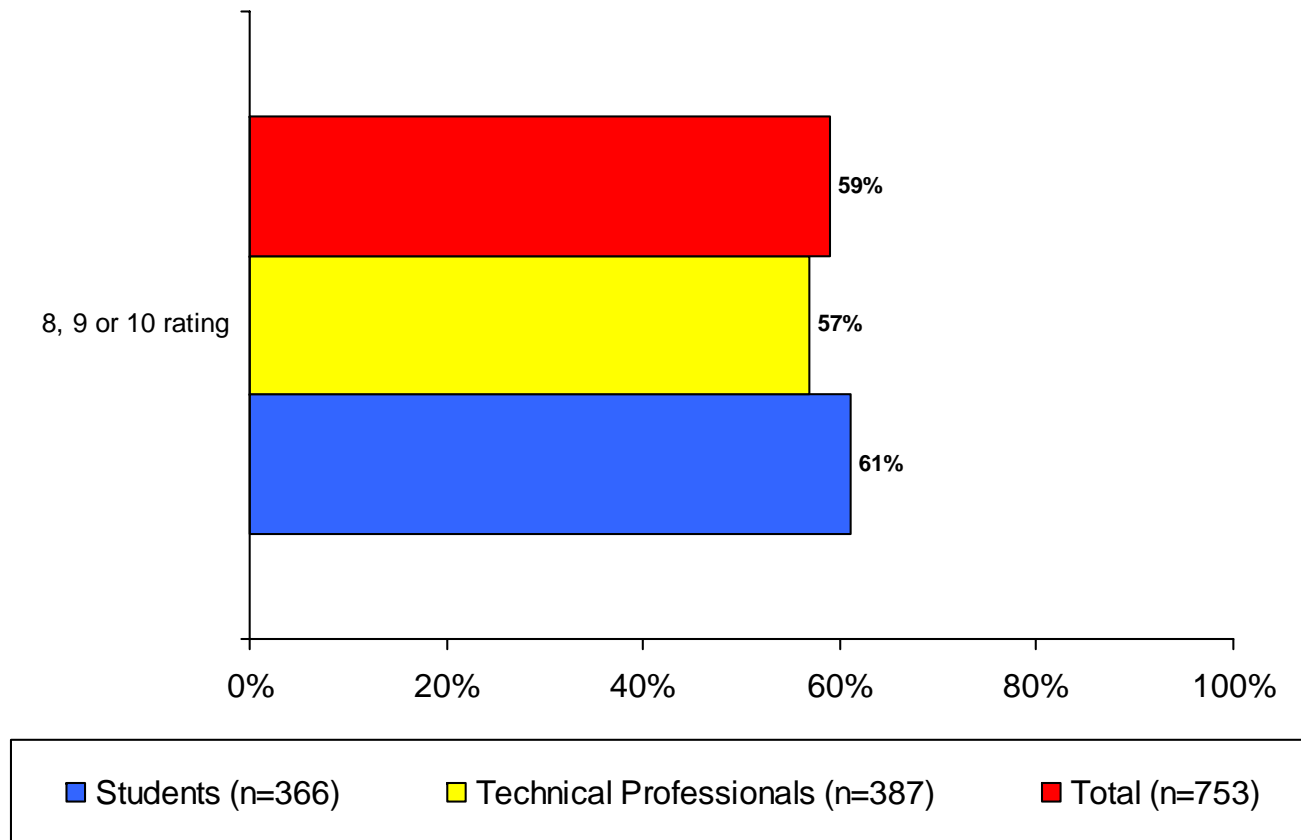
What do you feel is the MOST rewarding aspect of being an engineer/technology professional?



What do you feel is the LEAST rewarding aspect of being an engineer/technology professional?



Are technology professions more open to women and minorities today than 10 years ago?



Where do you believe industry engineers spend most of their work time?

- **Managing systems and processes**
- **Managing people**
- **Improving existing technology**
- **Inventing new technology**
- **Learning new things**

Please indicate another area in which industry engineers/technology professionals spend their time

- **Educating others on technology**
- **Communication with others: Documenting or describing ideas/proposals, pitching or presenting ideas, and then documenting the product for use once it is created/delivered. Manuals, documentation, etc.**
- **Paperwork and reports**
- **Coordinating between functional groups. Customer discussions to solve problems.**
- **Helping colleagues to understand engineering. Exchanging ideas. Training newer engineers. Planning and budgeting.**
- **Project management/Fire fighting**
- **Maintenance/Quality control**
- **Dealing with company politics.**
- **Re-learning old skills applied in a different way.**
- **Attending meetings and more meetings which have no practical utility except for preparing Minutes of meeting.**

Does your current job title or job description contain the words “electrical engineer”?

- Yes 23.4%
- NO 76.6%

Most Job Titles Are About Managing, Directing, Leading

- **Product Manager/Program Manager**
- **Senior Advisory Engineer**
- **Analysis Director of Energy Markets**
- **President**
- **Sr. Principal Systems Engineer**
- **University Lecturer**
- **Customer Engineering Engineer**
- **Technology Programs Director**
- **Director Environmental Affairs**
- **Director, Intelligent Technologies**
- **Chief Scientist**
- **Director New Business Development**
- **Senior Research Engineer**
- **Software Engineer/Developer**
- **Deputy Director**
- **Principal Consultant**
- **Distinguished Technologist**
- **Director of IT Services**
- **Business Development Manager**
- **Distribution Design Engineer**
- **Executive Vice President**
- **Professor and Dean**
- **VP, Strategic Development**

More Than One Type of Perfect Engineer?

- Most engineers/technology professional will not end up being “intellectuals” or inventors
- There is a disconnect between what is emphasized and what most engineers end up doing—rank and file and students don’t see this (IEEE Fellows saw things differently)
- College is too late, teaching engineers to be good multicultural citizens and ethical people begins in grammar school (FIRST)
- Diversifying the student body is not just a good thing to do it is the smart thing to do.
- Should undergraduate engineering be broadened (followed by graduate specialty training (as in law/medicine)?

A Measure of Excellence

Too often universities define academic excellence in terms of the things they provide for students. They refer to award-winning faculty, to the number of volumes in their libraries, to faculty/student ratios or to the dollars they devote to the academic mission.

These and other factors are certainly indications of how serious universities are in creating an excellent academic environment. However, the real measure of academic excellence can be found in a university's alumni and how they live their lives. A university that is academically excellent produces graduates who are intellectually capable and curious, who are humane and respectful of other people, who are people of integrity and character, and who succeed not only in elevating their own lives but also the lives of those around them

William Gordon, Wake Forest College Provost