

## Free Executive Summary



### **Changing the Conversation: Messages for Improving Public Understanding of Engineering**

Committee on Public Understanding of Engineering Messages, National Academy of Engineering

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**E**very year, hundreds of millions of dollars are spent in the United States to improve the public understanding of engineering (NAE, 2002). Despite these efforts, educational research shows that K–12 teachers and students generally have a poor understanding of what engineers do (Cunningham et al., 2005; Cunningham and Knight, 2004). Polling data show that the public believes engineers are not as engaged with societal and community concerns as scientists or as likely to play a role in saving lives (Harris Interactive, 2004). And when asked to judge the relative prestige of professions, people tend to place engineering in the middle of the pack, well below medicine, nursing, science, and teaching (Harris Interactive, 2006). Parents, however, are generally amenable to the idea of their sons and daughters opting for careers in engineering.

Understandably, engineers, engineering educators, and the organizations that represent them want people to have an accurate, more positive impression of engineering. However, there also other important reasons for improving the public understanding of engineering:

## CHANGING THE CONVERSATION

- **Sustaining the U.S. capacity for technological innovation.** A better understanding of engineering would educate policy makers and the public as to how engineering contributes to economic development, quality of life, national security, and health.
- **Attracting young people to careers in engineering.** A better understanding of engineering should encourage students to take higher level math and science courses in middle school, thus enabling them to pursue engineering education in the future. This is especially important for girls and underrepresented minorities, who have not historically been attracted to technical careers in large numbers.
- **Improving technological literacy.** To be capable, confident participants in our technology-dependent society, citizens must know something about how engineering and science, among other factors, lead to new technologies (NAE and NRC, 2002).

### GOAL OF THE MESSAGING PROJECT

The goal of this project, primarily funded by the National Science Foundation with additional support from the Georgia Institute of Technology and the S.D. Bechtel, Jr. Foundation, is to encourage coordinated, consistent, effective communication by the engineering community to a variety of audiences, including school children, their parents, teachers, and counselors, about the role, importance, and career potential of engineering. The project had three objectives:

- to identify a small number of messages likely to improve the public understanding of engineering
- to test the effectiveness of these messages in a variety of target audiences
- to disseminate the results of the message testing to the engineering community

This project did not have the goal of developing metrics for measuring the effectiveness of messaging efforts. Nevertheless, it is reason-

able to ask what one might look for as evidence of “improvement” in public understanding of engineering. One indicator of improvement would be the number and diversity of organizations using this report to shape their engineering outreach. Over time, we would hope to see growth in this set of organizations, and that might be measured through surveys of the engineering community. A longitudinal study, combined with “dipstick” surveys before, during, and after the deployment of new messages, could indicate the extent to which the public recognizes the new messages or associates certain key words, such as creativity and innovation, with engineering.

The remainder of the Executive Summary is focused on survey results for the messages, and it briefly discusses testing data related to several shorter, more punchy “taglines.” Additional findings are described in the full report, and complete data tables of the survey results are provided in an accompanying CD. The CD also contains a copy of the full report as a PDF.

## **METHODOLOGY**

Through a request-for-proposals process, the committee selected the communications firm Bemporad Baranowski Marketing Group to oversee message development, in partnership with Global Strategy Group (GSG), a market research company. GSG and Harris Interactive, another market-research firm, were selected to test the messages.

The study used qualitative and quantitative research. The qualitative research included in-depth interviews, youth “triads” (same-sex groups of three 9–11-year-olds), and adult and teen focus groups to determine perceptions of engineers and engineering by different groups as a basis for developing a positioning statement, messages, and taglines. The quantitative research consisted of an online survey that oversampled for African Americans and Hispanics. The goal of the quantitative research was to shed light on the findings of the focus groups and provide a statistically sound foundation for the committee’s recommendations. The committee also solicited feedback through presentations at relevant meetings and by posting an interim status report on the National Academy of Engineering (NAE) website to encourage input from a cross section of the engineering community and others.

In the interviews, focus groups, and youth triads, small samples were selected without statistical procedures. The results of this qualitative research had to be tested through quantitative methods. In the quantitative research, the online survey, respondents were part of volunteer survey panels. Thus we could not control exactly who would take part in the survey, and the responses may not accurately reflect the demographics of the sample populations. This common limitation was addressed by weighting (i.e., adjusting survey responses upward or downward to match the demographic variable of interest). Non-responses also affect the representativeness of a sample, and thus the “generalizability” of the results. Another limitation was that respondents were required to have access to the Internet. In the committee’s view, these methodological issues do not detract from the usefulness of the study’s findings.

### **THE ENGINEERING MESSAGING LANDSCAPE**

Current and past engineering outreach to the public and message development have been ad hoc efforts, and metrics for tracking results have rarely been used. Although a variety of useful tactics have been tried, no consistent message has been communicated, even among projects by the same organization. Most outreach initiatives target high school students with an eye toward “priming the engineering education pipeline.” Less attention has been paid to elementary and middle school students, where efforts would serve a “mainline” function of promoting technological literacy and stimulating interest in mathematics and science. With the notable exception of National Engineers Week, most outreach programs have been local.

In general, messages targeting younger children attempt to convince them that mathematics and science are easy or fun and that engineering is challenging, exciting, hands-on, and rewarding. Messages for older, prospective college students tend to emphasize career potential. For the most part, these have been direct statements emphasizing the personal benefits of being an engineer.

A recurring theme in many messaging efforts is that engineering requires skills in mathematics and science. Frequently, these messages

suggest that students must have an aptitude for and strong interest in these subjects to succeed in engineering.

## **CHANGING THE CONVERSATION**

In collaboration with the committee, the consultants developed a positioning statement to guide future outreach activities by the engineering community (Box ES-1). This optimistic, inspirational statement emphasizes connections between engineering and ideas and possibilities, rather than engineering as a math and science based method of solving problems. The statement describes engineering as inherently creative and concerned with human welfare, as well as an emotionally satisfying calling. In short, the statement changes the tone and content of the conversation about engineering. A positioning statement is the conceptual foundation for a communications campaign, but it is not usually shared with the public.

### **BOX ES-1 New Positioning Statement**

No profession unleashes the spirit of innovation like engineering. From research to real-world applications, engineers constantly discover how to improve our lives by creating bold new solutions that connect science to life in unexpected, forward-thinking ways. Few professions turn so many ideas into so many realities. Few have such a direct and positive effect on people's everyday lives. We are counting on engineers and their imaginations to help us meet the needs of the 21st century.

## **Findings from the Qualitative Research**

Students in the focus groups and triads were asked to describe their images of engineers, their understanding of engineering, their reactions to examples of engineering, their views on current school subjects, and their hopes for future careers. Participants in the parent

group were asked to describe their thoughts and ideas about career choices for their children. Both students and parents were also asked their reactions to several preliminary messaging “themes” (Box ES-2) based on the positioning statement.

**BOX ES-2**  
**Preliminary Messaging Themes**

**Ideas in Action.**

This theme underscores how engineering uniquely bridges the world of science with the real world.

**Life Takes Engineering.**

This theme focuses on the field’s essential role and life-changing work.

**A Limitless Imagination.**

This theme speaks to the innovative, design-driven nature of engineering.

**Free to Explore.**

This theme evokes the constant journey that is the engineer’s quest for new solutions.

**Shape the Future.**

This theme speaks to how engineering offers an empowering and rewarding career.

**An Enterprising Spirit.**

This theme recognizes the inventive spirit and pioneering contributions of the field.

***Summary Findings: Students***

- Most students understand that engineers “design and build things” but have a limited sense of what engineers actually do.
- Students have a generally positive impression of engineers, but many feel that they are not smart enough to become engineers.

- Many students believe engineering work is sedentary, performed mostly on computers, and involves little contact with other people.
- Most girls believe women can be engineers as well as men.
- When asked to name engineers, most students could only name men.
- Examples of engineering related to familiar objects and activities stimulated the most interest in learning more about engineering.
- “Making good money” was named most often as a career goal.<sup>1</sup> However, the idea of “making a difference” also had very strong appeal.

### ***Summary Findings: Parents***

- Most parents thought engineering would provide job security (e.g., good salary and benefits) and a career path for advancement and success.
- Parents tended to favor the practical messaging themes, reflecting their emphasis on job security for their children.

### **Findings from the Quantitative Research**

To test the results of qualitative research, the committee collected quantitative data from an online survey administered to nearly 3,600 individuals. The survey instrument comprised six questions about views of engineering and engineers and four questions about the proposed messages and taglines that had been refined to reflect the results of the focus groups and triads (Box ES-3). The survey was administered in two phases: to an initial sample of teens and adults in December 2006 and an oversample of African American and Hispanic teens and adults in spring 2007.

All five messages were scored at least “somewhat appealing” by the overwhelming majority of adults and teens. The message with the

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<sup>1</sup>By contrast, teens in the online survey rated the importance of salary second or third behind “interesting work” and “work that makes a difference, is meaningful.”



**BOX ES-3**

**Messages Tested in the Online Survey**

**Engineers make a world of difference.\***

From new farming equipment and safer drinking water to electric cars and faster microchips, engineers use their knowledge to improve people's lives in meaningful ways.

**Engineers are creative problem-solvers.**

They have a vision for how something should work and are dedicated to making it better, faster, or more efficient.

**Engineers help shape the future.**

They use the latest science, tools, and technology to bring ideas to life.

**Engineering is essential to our health, happiness, and safety.**

From the grandest skyscrapers to microscopic medical devices, it is impossible to imagine life without engineering.

**Engineers connect science to the real world.**

They collaborate with scientists and other specialists (such as animators, architects, or chemists) to turn bold new ideas into reality.

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\*This message was inspired by a similar theme used to promote National Engineers Week.

highest “very appealing” rating among all groups was “Engineers make a world of difference.” This message was also considered the “most believable” and “most relevant.” In general, however, girls were less enthusiastic than boys about all of the messages.

“Engineers connect science to the real world” was given the fewest votes for “very appealing” among all groups and was the least “personally relevant” for all groups but African American adults. This finding was confirmed when survey participants were asked to choose a single “most appealing” message.

The survey also revealed some significant gender differences. For example, boys in the initial sample found “Engineering makes a world of difference” and “Engineers are creative problem solvers” equally appealing. Girls also found “Engineering makes a world of difference” the most appealing. However, the second most appealing message for girls was “Engineering is essential to our health, happiness, and safety.” Girls ages 16 to 17 in the African American sample and all girls in the Hispanic sample found this second message significantly more appealing than did the boys in those groups.

### ***Testing of Preliminary Taglines***

In addition to messages, the online survey tested several preliminary taglines (Box ES-4). Because of time and funding constraints, the taglines had been developed intuitively from the results of the qualitative research, without the benefit of creative prototypes (such as posters, TV ads, or web pages). In addition, the taglines were only tested in the online surveys. Thus the results may not represent the best measure of their true potential. Nevertheless, several taglines tested well.

The tagline “Turning ideas into reality” tested well among all survey respondents. This straightforward tagline, which is consistent with the messages used to promote National Engineers Week, is more descriptive than evocative and conveys a direct message that does not require additional creative context. As a stand-alone *tagline*, it makes

#### **BOX ES-4 Preliminary Taglines**

- Turning ideas into reality
- Because dreams need doing
- Designed to work wonders
- Life takes engineering
- The power to do
- Bolder by design
- Behind the next big thing

the most sense of the seven. It is interesting to note, however, that the phrase “ideas into reality” also appears in the full description of “Engineers connect science to the real world,” which was the least appealing of the five tested messages, especially among women. This discrepancy reinforces the need for additional testing of taglines. A tagline that tested especially well among teens in the initial survey was “Because dreams need doing.”

## **CONCLUSIONS AND RECOMMENDATIONS**

Happily, our research showed that engineers do not have major image problems. In fact, contrary to the image engineers have of themselves, the public views engineering and engineers in a relatively positive light. Our research showed that fewer than 15 percent associated the words “boring” or “nerdy” with engineering. In fact, most adults and teens respect engineers and consider their work rewarding and important, but perhaps not enough to inspire them to become engineers.

We did find that the public has a poor idea of what engineers actually do on a day-to-day basis; and there is a strong sense that engineering is not “for everyone,” and perhaps especially not for girls. Most current messages are framed to emphasize the strong links between engineering and just one of its attributes—the need for mathematics and science skills. In other words, current messages often ignore other vital characteristics of engineering, such as creativity, teamwork, and communication.

Based on our research, we can make a strong case that effective messaging will require audience segmentation. The “branding” of engineering must be modified to appeal to (1) teens in general, (2) teenage boys, and (3) teenage girls, as well as to (4) adults.

## **RECOMMENDATIONS**

The committee’s first two recommendations address how the positioning statement and messages should be used. These recommendations are immediately actionable by organizations interested in improving public understanding of engineering. The third and fourth

recommendations, which suggest the need to refine the preliminary taglines and to develop a public relations “tool kit” for the engineering community, can be addressed in the near term and will require dedicated personnel and funding. Efforts to carry out the last recommendation, which proposes an ambitious, large-scale communications “campaign,” can begin immediately, but successful implementation will require long-term, sustained effort by many organizations.

### **Using the Positioning Statement**

**Recommendation 1.** To present an effective case for the importance of engineering and the value of an engineering education, the engineering community should engage in coordinated, consistent, effective communication to “reposition” engineering. Specifically, the engineering community should adopt and actively promote the positioning statement (Box 4-1) in this report, which emphasizes that engineering and engineers can make a difference in the world, rather than describing engineering in terms of required skills and personal benefits. The statement should not appear verbatim in external communications but should be used as a point of reference, or anchor, for all public outreach.

One of the most significant findings of this project is the strong association in the mind of the public between competency in mathematics and science and the ability to become an engineer. “Must be good at math and science” was by far the most frequently selected attribute of engineering in the online survey, suggesting that messages emphasizing this attribute have been understood by all adults and teenagers. Unfortunately, many of them appear to consider this a negative, a barrier to engineering studies. In keeping with this finding, our testing also showed that the weakest of the five tested messages portrayed engineers as “connecting science to the real world.”

We conclude, therefore, that continuing to emphasize math and science in marketing or rebranding engineering is unnecessary and may damage rather than increase the appeal of engineering. The same can be said of messages that focus on the practical benefits of

being an engineer, rather than the inspirational, optimistic aspects of engineering.

An example of how the medical profession is promoted may help illustrate the potential value of Recommendation 1. The medical profession does not market itself to young people by pointing out that they will have to study organic chemistry or by emphasizing the long, hard road to becoming a physician. The image of the physician is of a person who cures diseases and relieves human suffering.

When promoting engineering, our appeal should tap into the hopes and dreams of prospective students and the public. This approach would also have the virtue of placing math and science, correctly, as just two of a number of skills and dispositions, such as collaboration, communication, and teamwork, necessary to a successful engineer.

### **Adopting Tested Messages**

**Recommendation 2.** The four messages that tested well in this project—“Engineers make a world of difference,” “Engineers are creative problem solvers,” “Engineers help shape the future,” and “Engineering is essential to our health, happiness, and safety”—should be adopted by the engineering community in ongoing and new public outreach initiatives. The choice of a specific message should be based on the demographics of the target audience(s) and informed by the qualitative and quantitative data collected during this project.

Our research should not preclude others from pursuing message development, but we strongly feel that the rigorous process we used to generate our messages justifies their widespread use. In February 2008, the NAE launched a new website, Engineer Your Life ([www.engineeryourlife.org](http://www.engineeryourlife.org)), which aims to interest academically prepared high school girls in careers in engineering. The site used our message “Engineers make a world of difference” on its homepage and adopted other key words vetted in our research, such as creativity and problem-solving.

### **Using the Preliminary Taglines**

**Recommendation 3.** More rigorous research should go forward to identify and test a small number of taglines for a nationwide engineering-awareness campaign. The taglines should be consistent with the positioning statement and messages developed through this project and should take into account differences among target populations. In the interest of encouraging coordination among outreach activities, the results of this research should be made widely available to the engineering community.

Given additional resources, it would have been useful in this project to develop and test more taglines in context and to test the contextualized taglines in focus groups. The results reported here should be viewed as preliminary, but the positive responses to several of our preliminary taglines in online testing suggest that they may be able to be used effectively for engineering-outreach projects.

### **Developing a Shared Public-Relations Resource**

**Recommendation 4.** To facilitate the deployment of effective messages, an online public relations “tool kit” should be developed for the engineering community that includes information about research-based message-development initiatives and examples of how messages have and can be used effectively (e.g., in advertising, press releases, informational brochures, and materials for establishing institutional identity). The online site should also provide a forum for the sharing of information among organizations.

One reason ad hoc efforts to promote public awareness of engineering have had limited success, at best, is that they do not convey consistent messages. In addition, because of the discontinuity and lack of coordination among these activities, effective metrics cannot be used to refine messages or improve outreach. The committee believes that, in the short term, consistent use of messages, even by a modest number of organizations, would be a huge step forward in promoting a more positive public perception of engineering.

### **Launching a Campaign**

**Recommendation 5.** A representative cross section of the engineering community should convene to consider funding, logistics, and other aspects of a coordinated, multiyear communications campaign to improve the public understanding of engineering.

Over the long term, the committee believes a more explicit, coordinated approach to public outreach is likely to yield better results than we have obtained so far. Thoughtful targeting of the messages and further refinement of taglines will be necessary, but not sufficient, for success. Messages and taglines must be embedded in a larger strategic framework—a communications campaign. The most effective campaigns are driven by a strong brand position communicated in a variety of ways, delivered by a variety of messengers, and supported by dedicated resources. Effective campaigns also measure the impact of their activities and, most important, are given enough time to succeed.

A campaign of the necessary size and duration to measurably improve the public understanding of engineering will require significant resources. Our consultants proposed a “conservative” price tag of \$12 million to \$25 million per year for two or three years. The committee believes that, although this may be enough to initiate a campaign, the long-term costs would be much higher.

Three concerns must be addressed for such an undertaking. First, resources on this scale are not likely to be provided by government or foundations. The engineering community, particularly large, influential, technology-focused corporations, must be enlisted to support the campaign.

Second, the committee believes that centralized planning will be necessary to ensure effective coordination and communication, which would require agreement by the major participants. National Engineers Week, a cooperative outreach venture in engineering, might be leveraged for this purpose. However, the creation of a new structure may be necessary to coordinate a campaign.

Third, metrics will be essential to determining the effectiveness of messages, strategies, and taglines. Although measuring the outcomes of public outreach efforts is notoriously difficult, a campaign of this

scope must include a substantial evaluation component to determine what works and to improve upon elements that are not as effective as expected.

### **A FINAL WORD**

The project described in this summary and expanded upon in the full report has followed a carefully designed process for developing messages for public understanding of engineering. The approach utilized the services of professionals in the fields of communications and market research, and it employed quantitative as well as qualitative research methods. To ensure balance and accuracy, the committee's report and its findings and recommendations were carefully reviewed by an outside group of experts. The rigor of the study process should reassure the engineering community—and others interested in this important topic—that there is now a tested set of tools available to promote a more positive image of the field.

The most significant outcome of this project is the recasting of engineering in the positioning statement. If it is adopted by the engineering community, it will not only reshape engineers' self-image, but will also empower engineers to communicate more confidently with the public.

As work continues on enriching, expanding, and disseminating messaging resources, the engineering community can take immediate action. Even if a national campaign is not immediately forthcoming, the creative implementation of the messages and taglines in this report can have an impact. Combined, consistent efforts by multiple organizations following the same “playbook” can create positive momentum toward making engineering more appealing and better understood by students, educators, parents, policy makers, and society at large. In this way, we may truly begin to change the conversation.

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# CHANGING THE CONVERSATION

MESSAGES FOR IMPROVING PUBLIC  
UNDERSTANDING OF ENGINEERING

Committee on Public Understanding of Engineering Messages

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## PREFACE

**T**his report is the final product of an 18-month study by the Committee on Public Understanding of Engineering Messages, a group of experts on diverse subjects brought together under the auspices of the National Academy of Engineering (NAE). The committee's charge was to identify and test a small number of messages that appear likely to improve the public understanding of engineering. To fulfill that charge, the committee used the services of professional marketing and communications firms, hired through a competitive request-for-proposals process. Working with the committee, these firms conducted qualitative and quantitative research to collect data and develop messages, themes, and taglines based on that data.

This report follows *Raising Public Awareness of Engineering*, an NAE report published in 2002, which revealed that the engineering community has been spending hundreds of millions of dollars annually to promote the public understanding of engineering with little measurable impact on young people or adults. That study's committee concluded that the messages being communicated had not been developed in a systematic way and recommended that more effective, consistent messages be developed and used in a coordinated way by



organizations interested in enhancing public understanding of the critical role engineers play in today's world.

Given the concerns in the United States about the importance of STEM (science, technology, engineering, mathematics) education to global competitiveness, national security, and quality of life, the current report is especially timely. But messaging is about much more than “priming” the engineering-education pipeline. The vast majority of Americans will never become engineers, but all Americans—young and old—can benefit by having a better understanding of the role engineers play in the creation of technologies. Effective messaging can help raise the level of technological literacy in the general population, a key competency for the 21st century.

This report will be of special interest to engineering professional societies, technology-intensive industries, colleges of engineering, science and technology centers, and other organizations that communicate with policy makers, K–12 teachers and students, and the public at large about engineering. Federal and state agencies concerned with reforming STEM education and supporting research, innovation, and technology development similarly will find that this report can be useful in outreach efforts.

On behalf of the committee, I urge the engineering community to embrace the very useful information in this document.

Don P. Giddens, *chair*  
Committee on Public Understanding  
of Engineering Messages

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**T**his report has been reviewed, in draft form, by individuals chosen for their diverse perspectives and technical expertise, in accordance with procedures approved by the National Academies. The purpose of this independent review process is to provide candid and critical comments to assist the committee and the National Academy of Engineering (NAE) in making its published reports as sound as possible and to ensure that the report meets institutional standards for objectivity, evidence, and responsiveness to the study charge. The reviewers' comments and the draft manuscript remain confidential to protect the integrity of the deliberative process. We wish to thank the following individuals for their reviews of this report:

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\*Appendix G is reproduced on the CD (inside back cover) that contains the full report but is not included in the printed report.

# CHANGING THE CONVERSATION

