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New Media in Action: Two Hypothetical Case Studies

To round out the more abstract ideas presented so far, I give here two concrete examples of how the engineering profession might use new media to achieve timeless goals. The first focuses on creating interest among teenagers about engineering, the second on educating the broader public about crucial issues with the power grid using "Citizen Science" methods. Where appropriate, I contrast the old and new media approaches.

Communicating engineering to young audiences

The u.s. faces a tremendous decrease in global competitiveness. As a measure, consider that the u.s. is now a net importer of high technology products (plus $54 billion in 1990 to a negative $50 billion in 2001). The seminal report *Rising Above the Gathering Storm*[41] highlighted the main element in reversing this trend: creating "a new generation of bright, well-trained scientists and engineers" who can "transform our future," noting that this must "begin in the 6th grade ...." The report mentions the need to "significantly enlarge the pipeline" of engineers, but as others have noted, this need is nuanced. It isn't the sheer number of new

[41] *Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future* (Washington: The National Academies Press, 2007).

engineers that solves the problem but the type of engineer.[42]

The NAE's report *The Engineer of 2020*[43] pinpointed the key issue:

> *Whatever other creative approaches are taken ....the essence of engineering - the iterative process of designing, building, and testing - should be taught from the earliest stages ....*

This means that we need to develop a cohort of pre-engineering students who have actually *done* engineering. In a field like engineering, nothing can replace "doing" because therein lies engineering's essence.[44] Thus, an important project for the engineering profession is to reach thirteen- to sixteen-year-olds who desire to create engineering projects in their time outside of class but lack both the information to make these projects successful and, although they don't know this, information on what really constitutes an engineering project.

Contrasting old and new media approaches

Oddly, the communication problem doesn't lie in the students' lack of interest in engineering as might be supposed. Research reported in the excellent NAE report *Changing the Conversation: Messages for Improving Public Understanding of Engineering*[45] found that tweens and teens very much resonated with the goals of engineering -- of creating a better, healthy, greener world.

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[42]See, for example, V. Wadha, et al., "Where the Engineers Are," *Issues in Science and Technology*, Spring 2007.

[43]*The Engineer of 2020: Visions of Engineering in the New Century* (Washington: National Academies Press, 2004).

[44]For learning by doing, see Zhu, X., & Simon, H.A., "Learning Mathematics from Examples and by Doing," *Cognition and Instruction*, 4, 137-166, 1987.

[45]*Changing the Conversation: Messages for Improving Public Understanding of Engineering* (Washington: National Academies Press, 2008.)

Yet few could make the connection between their ideals and the work of an engineer. The report uncovered a critical step in engaging this age group: involve them in actual engineering. To do this, though, they need a community, information, interactivity, and role models that appeal to them. We could do this via old media or new media methods. Let's look at each.

The report *Changing the Conversation* bores in on creating a mass message. Using sophisticated polling methods they developed this 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.*

A positioning statement lays the conceptual foundation for a communications campaign, but it is not usually shared directly with the public.

The old media approach - which has its merits - involves filtering of possible taglines. The very capable marketing firm hired to do this work developed taglines and then tested (filtered) how well they played with specific demographics focusing on the teen audience with the hope of enticing them to become engineers. Not surprisingly, no single message appealed to all groups, so they chose the "best" based on the teen sample and the marketers' considerable intuition. They chose a tagline for marketing: "Engineering because dreams need doing." By definition, the impact of

this line is a compromise. The report goes on to suggest building a "public relations 'tool kit' to be used in advertising, press releases, [and] informational brochures." Could the same positioning statement be implemented with new media? Yes - and likely more effectively.

New media approach

Web 2.0 methods allow 13- to 16-year-olds to create content meaningful to them, instead of having to use an "educated guess" at a message. The content created will reflect their interests and style. Also, having a long Web 2.0 tail means that with the right new media message vehicle we can reach everyone - perhaps a particular experiment will be popular with only a few, but the cheapness of digital storage allows a description of this project to be kept up forever. Recall the pairwise matching mentioned in chapter three – that is, not a person speaking to a mass audience, but instead interacting via social media with two or three people at a time .

To engage 13- to 16-year-olds in actually doing engineering, one could create an organization that runs hundreds of after-school and summer camps for teenagers where they actual *do* engineering. The central new media piece would be a rich repository (a "long tail" in new media language) of step-by-step engineering project videos. This would be of a wiki format that allowed students themselves to add and emend projects; that is, to participate and thus bring the full power of Web 2.0 to the wiki. A key, though, would be seeding a wiki.

To seed the "long tail" of user-generated content, one needs photos, videos, audio, and text. Video would be generated by undergraduate students at engineering schools. Each of these schools would have what's called an

"Engineering Open House" in which - outside of class - the students build real, detailed engineering projects. The video blogging and wiki entries would document how their projects were done. Each could be rated and shared by the public. The key to making a successful long tail lies in uploading a huge amount of content fitted with social bookmarks that allow users to rate, comment, and forward video. A user of the site should be able to easily search for content, browse by subject or department, sort by rating, length, and so on, and rate and comment on videos. And the public should be able to upload their own "how-to" videos. Additionally, the videos should be easily downloadable to an iPod or other handheld device. The site should contain several RSS feeds:[46] one for all content, and feeds for specific subjects.

Why would such a site work?

- First, it focuses on the "How do you do it?" question so essential to making a successful wiki. In this case, tweens and teens doing science projects can see the details and contribute their own videos, rather than passively watching saccharine videos telling them how interesting engineering is.
- Second, it appeals to kids younger than the majority of participants in the videos. In his insightful book *Convergence Culture,*[47] Henry Jenkins notes that kids typically like to watch what people five to six years

[46]"RSS is a family of Web feed formats used to publish frequently updated works - such as blog entries, news headlines, audio, and video - in a standardized format. An RSS document (which is called a 'feed', 'web feed', or 'channel') includes full or summarized text, plus metadata such as publishing dates and authorship. Web feeds benefit publishers by letting them syndicate content quickly and automatically. They benefit readers who want to subscribe to timely updates from favored websites or to aggregate feeds from many sites into one place. RSS feeds can be read using software called an 'RSS reader', 'feed reader', or 'aggregator' which can be web-based or desktop-based." *Wikipedia.*

older than them are doing and model their behavior on that. This is part of the appeal of *American Idol*: half of its audience is composed of 13-year-olds who want to see an 18-year-old performing.

- Third, it offers long-term funding beyond the usual federal and foundation support through ad revenues because the audience of these videos is a prime demographic for advertisers. In the "old" media days, the restrictions on television and radio removed this opportunity.

Citizen engineering: Web 2.0 and the masses

In addition to reaching an audience of "future engineers," the engineering profession needs to tackle public literacy about engineering – to battle technological determinism rather than instill hard science literacy. The power grid offers a prime example for how knowledge creates a better citizen.

The public has great interest in solving the energy problems we face in the future but little knowledge of how to do so.[48] Currently 40% of our energy usage comes from electricity - power that is typically generated by coal, oil, and some nuclear. Clearly the United States will need to move toward alternative sources, and as that transformation occurs, the public will be faced with difficult choices. While they remain fascinated by these sources, the public rarely appreciates that these new energy technologies have an Achilles' heel: transmission.

As a recent issue of the *Economist* pointed out, "perhaps the greatest obstacle to the wider adoption of wind power is the

[47]Jenkins, Henry, *Convergence Culture: Where Old and New Media Collide* (New York: New York University Press, 2006).

[48]Mckeown, Rosalyn, "Energy Myth Two - The Public Is Well-informed about Energy," *Energy and American Society – Thirteen Myths,* edited by Benjamin K. Sovacool and Marilyn A. Brown (Springer Netherlands, 2007).

need to overhaul the grid to accommodate it."[49] So, as the United States moves toward alternative energy sources, for its citizens to be effective -- as voters or in applying knowledge in their own communities -- they need to understand the electrical grid.

Many electrical and power engineers feel the public underestimates the difficulty with which renewables can be added to the electrical grid. In the grid's nuances and peculiarities lies a major hurdle to using and incorporating non-fossil-based alternatives into our nation's energy mix. The public rarely thinks of the grid, yet it is the nervous system of our nation's energy infrastructure. We often concentrate on that system's "heart" (the generation of power by coal, oil, hydro, or nuclear) but rarely think of its transmission. To facilitate that understanding and to create literate citizens, the project described below makes citizens an active part of monitoring and developing the new grid. The long-term goal is to develop smart meters for an intelligent grid - a grid designed to be more responsive to changes in load and designed to give feedback to consumers. One way to achieve literacy about the grid is to use a "Citizen Science" approach enhanced by Web 2.0 techniques.

Citizen science

The development of social networking tools has given new impetus to Citizen Science, which Wikipedia aptly defines as:

> *.... a term used for projects or ongoing programs of scientific work in which individual volunteers or networks of volunteers, many of whom may have no specific scientific training, perform or manage research-related tasks such as observation,*

[49]"Wind of Change," *The Economist Technology Quarterly,* December 6, 2008, p. 22-25.

measurement or computation.

Citizen Science projects have engaged the public to classify over a million star clusters, to collect data on ecosystems, and to help researchers better understand birds and their habits.[50]

Web 2.0 social tools, then, offer the promise of vastly expanding citizen science projects and of increasing their efficacy. Bruce V. Lewenstein, Professor of Science Communication at Cornell University, notes two additional benefits of Citizen Science to the engineering profession: 1) the engagement of non-scientists in true decision-making about policy issues that have technical or scientific components; and 2) the engagement of researchers in the democratic and policy processes.[51]

In many ways engineering lends itself better to this approach than does science because it is a process-oriented activity with a teleological goal of producing something, whereas science is focused on discoveries about nature. Consider a project that would inform citizens about current issues, problems, and research on the power grid.

Power engineers need to know, to meet the U.S. energy needs of the 21st century, how new technologies affect the grid. They would like to know, for example, what happens to the grid if everyone installs compact fluorescent bulbs. Or, what if the sales of hybrid cars skyrocket? How would cars plug into the grid at night? In their studies of "load

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[50]See *www.galaxyzoo.com* for details on stars, for ecosystems see C.B. Cooper, et al. "Citizen Science as a Tool for Conservation in Residential Ecosystem" *Ecology and Society* 12(2) issue 11 (2007); for studies with birds refer to the work of the Cornell Lab of Ornithology.

[51]Lewenstein, Bruce V. "What does citizen science accomplish?" Paper read at CNRS colloquium, 8 June 2004, in Paris, France.

modeling" - a very important topic in the field now - they are concerned with "power electronics" in the home. A home solar system, for example, contains these power electronics. These devices can really mess with the grid.[52] To understand the grid's behavior more deeply and to monitor it more closely, engineers need many independent observations; exactly where a citizen engineering project excels.

Citizen engineering methods make use of the thousands of eyes and brains of their participants to gather and, in some cases, to analyze data that stretch across a large distances. For example, Cornell's Lab of Ornithology uses Citizen Scientists to track birds across the U.S. In the power grid example, a frequency meter, power meters, and other devices would be located in the home of every participant.

The project would use a new technology, called FNET (frequency monitoring network technology), developed at Virginia Tech by YiLu Liu, a professor of electrical and computer engineering and an expert on the electrical grid.[53] She and her team have developed a small box - called a Frequency Disturbance Recorder - to measure changes in frequency on the grid.

The simplicity of the technology from a user's point of view is rather astounding. There are no installation costs; the

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[52]A simple definition for power electronics would be "the control of 'raw' input electrical power through electronic means to meet load requirements." Power electronics is interdisciplinary and is at the confluence of three fundamental technical areas: power, electronics, and control.

[53]S.-J. S. Tsai, J. Zuo, Y Zhang and Y. Lui, "Frequency Visualization in Large Electric Power Systems," Power Engineering Society General Meeting, 2005 (IEEE), Issue 12-16, June 2005, p. 1467-1473; L. Nystrom, "Energy Grid," Virginia Tech Research, Summer 2006, p. 1-5.

user just plugs a unit into a standard electrical outlet. What is the value in knowing the frequency at many points on the grid? The grid generates power at a specific frequency of 60 cycles-per-second. If any part of the grid deviates by as much as 1/20 cycles per second, trouble develops. If it drops to 59 cycles per second then havoc, such as the blackout of 2003, results. The frequency, then, is akin to a human pulse: its measurement and value tells us something about the health of the grid. With the fifty or so devices that Professor Liu has employed across the Eastern Interconnect - the grid that powers the mid-west, eastern seaboard, and parts of Canada – she has detected, earlier than anyone else, disturbances in the grid. The goal of a power grid project would be to deploy thousands more of these devices and to get fine-scale information about the current health of the grid and about the grid's behavior as we add renewables and power electronics. Currently there are 50 or so meters out there. With 2,000 or more researchers, we could truly understand the grid at a very local level, thus preventing disturbances nationwide and providing the essential data for adding renewables. Recall that the grid is both highly local and interdependent. The blackout of August 2003, for example, occurred because a small northern Ohio power company failed to trim a tree along a power line.

To incorporate these local frequency and power meters into a true citizen engineering project, we would need to develop the proper cognitive tools (e.g., a wiki) so that each participant would be able to see, share, discuss, and enhance their own observations. One can picture a visualization software package for “citizen engineers” that shows a large amount of information in a single computer-generated

image - images that are useful, even indispensable, to monitor the electrical grid. These would allow a citizen to track flows of electricity in their own community and to see how they are linked, and thus interdependent with much of the rest of the nation. In short, visualization allows a member of the public to comprehend the grid by lifting the truly significant events out of the background noise. The power meters could also be used to locate "energy vampires"[54]- in a home. The wiki will allow users to share thoughts and offer suggestions on how to improve energy efficiency in their houses. An outcome of this enhanced interest would be a new cache of public knowledge about the power grid: its prowess, its promise, and its limitations.

[54]Those electronic devices that silently suck away energy even when they appear to be turned off.

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