THE NATIONAL ACADEMIES

MEETING SUMMARY

The Impact of Social Networking and Crowdsourcing on Research, the Enterprise, and the Workforce

Government-University-Industry Research Roundtable Meeting
October 4-5, 2011

By Robert L. Post

Even though it is only in its early infancy, social networking appears likely to have a profound transformative effect on how people gain and share knowledge, collaborate with others, and identify innovative solutions to problems that have previously resisted traditional approaches. This impact will be felt across the broad spectrum of government, academic and industry sectors. In the sciences, social networking may result in a "paradigm shift" in science education and the conduct of many kinds of research. The presentations in the October 4-5, 2011 GUIRR meeting examined the underlying nature of social networking, and how it is affecting areas ranging from basic research to education, intelligence gathering, community-based programs, personal networking, business and the workplace.

An opening presentation was provided at the dinner on October 4 by **Jay Walker**, TEDMED Curator and Chairman of Walker Digital, LLC. His talk, "Imagining the Future: The Surprising Impact of Accelerating Technology," considered the broad implications of social networking on the Internet for the future. His focus was not on the technology of such networking, but rather the societal implications for how people will make use of the developing technology to relate to each other and get things done in the future.

Walker compared the emerging information architecture with the dominance of cities in the physical architecture of the modern era, and argued that the former will have implications for the future of civilization as profound as the latter. He emphasized that unlike the profound physical effect of cities on human society, the information revolution is changing human architecture in an equally profound, but *non-physical* way.

He also emphasized that we are at day one in this process. Human society is in a complex adaptive system, where inputs do not determine outputs in any predictable way: we just don't know what is going to happen and it is not possible to make predictions for what the future will look like in any detail.

THE NATIONAL ACADEMIES
Advisers to the Nation on Science, Engineering, and Medicine

National Academy of Sciences • National Academy of Engineering • Institute of Medicine • National Research Council

However, he noted some broad characteristics for what is taking place at present:

- *Independence of geography*. Networked communities are not constrained by locality or nationality, but by common interests.
- *Economics does not matter*. In digital systems, there is no appreciable variable cost involved in the growth of a virtual community. This near-independence of economics is probably as big a deal as the use of electricity in daily life, beginning in the late 1800s and early 20th century.
- *Virtual communities exist without regard to time*. There is no 9 to 5 time window. He noted that text messaging is asynchronous, a major break with the historic synchronicity of human conversations.
- *Virtual communities exist without regard to language*. English is now the lingua franca (e.g., there are now more Chinese that can speak at least some English than in the U.S.).
- *Virtual communities exist without regard to family structure*. Walker noted the anecdotal example of a teenage girl being upset over the father of a network friend (who she had not physically met) being "mean" to that friend.
- *All information is moving to the network*. He also noted that society is at the beginning of a far-reaching mind-machine interface, which will be a big deal in the future.

In view of the above broad trends, Walker stated that decision-makers will need to emphasize the following:

- Emphasize strategy over tactics. Walker noted that there has been a recent inversion in military affairs, where the "grunts" now commonly know more about tactics and other lower-level knowhow than the generals. In digital networking, tactical thinking should be resisted, and the question should be on what general strategy should be adopted.
- Put the values into the system at the outset. If one waits, it may be too late to do it in the future. The U.S. Constitution is an excellent example of where basic values (e.g., embodied in checks and balances) were engineered in the system of government.

In the question and answer period, one questioner asked what governments should be doing with this fundamental shift. Walker answered that there is no way of knowing what specifically should be done, but that there is a need for humility in what we, as a people, do not know, and that human society should be recognized as a complex adaptive system. In the case of governments, the emphasis should be on adaptability, rather than on re-engineering government operations and systems (where the latter assumes there is a better level of general knowledge than is the case).

In response to another question which noted that the above uncertainty is kind of scary, Walker said people do seem to be living in a "post-factual" age, e.g., where decision-making is becoming more "twitterized." On a more positive note, he said that one must distinguish between long-term climate and (time-varying) weather, where the long term trends are, in his judgment, positive.

In response to a question on values in digital networking at a world level, Walker said that people should not look to governments, either domestically or internationally, to inculcate such values. Rather it is the duty of individuals to give back to society in embedding such values. He thought that such global values are emerging.

In response to a question on how such venues as Twitter are changing how people get information, Walker said that 95% of the time, one decides on which information is credible by "smell," e.g., what others are saying. There is a biological competition for individual tweeters to get above the "noise" level on the network. Walker also noted the danger of runaway feedback in complex human systems leading to catastrophic results (e.g., the emergence of Hitler in the 1930s). In the case of digital networking, there is a need for "circuit breakers" to prevent episodes of runaway feedback.

The meeting continued the next day with a presentation by **Ben Shneiderman**, Professor, Computer Science and Founding Director, Human-Computer Interaction Laboratory, University of Maryland at College Park.

In his talk, “Social Networking: Deep Science, Extreme Technologies and National Priorities,” Shneiderman began by noting the radical changes in social networking over the last six years, e.g., where Twitter did not even exist six years ago, and the ongoing shift in society from a natural science based focus towards design science in driving societal change.

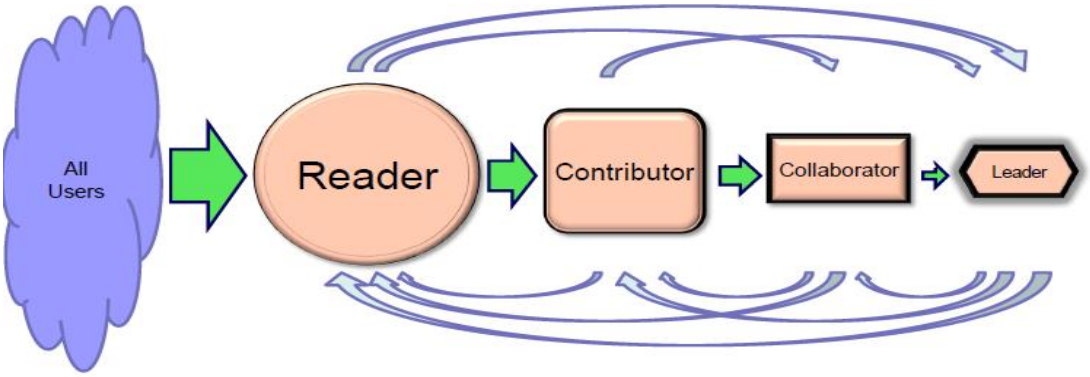

Figure 1: **From Reader to Leader -** Motivating Technology-Mediated Social Participation.
Source: Preece & Shneiderman, AIS Trans. Human Computer Interaction 1 (1), 2009: aisle.aisnet.org/thci/vol. 1/iss1/5/

The emphasis is now on *what people do, rather than what computers can do*. However, he noted that there are a number of challenges with the use of social networks, e.g., privacy issues, malicious web-based acts, and use by terrorists.

On the positive side, he noted the examples of the Amber Alert (child abduction alert bulletin that has solved some 500 abductions), improvements in disaster preparedness and response, and patient support systems. Rather than being primarily technological constructs, social networking systems, as networks of humans, embody human values such as trust, empathy, responsibility, and privacy.

The next talk, “Intelligent Social Computing” by **Elizabeth Mynatt**, focused on conceptual approaches for better design of collaboration software. Mynatt is Executive Director, Institute for People and Technology, College of Computing, Georgia Institute of Technology. Intelligent social computing issues include: quality (do you value the content produced?); trust (do you trust the information you receive?); and engagement (how do you incentivize participation?).

As an initial example of algorithms for social computing, Mynatt gave the example of the DARPA Red Balloon Challenge, where teams competed to identify the locations of a number of red balloons at unknown locations in the U.S. The winning team, MIT, used an approach involving recursive techniques, with the sharing of prize money with all informants either locating a balloon or providing a contact in a chain of contacts leading to the location of a balloon.

The second and third place teams, GTRI and iSchools, used different algorithms (e.g., altruism, where the prize money was given to a charity, with the use of mass media and analytical techniques). The games were a real eye opener for intelligence agencies in catalyzing the formation of a large functioning social network in a very short period of time. (The winning team from MIT found all of the balloons in only eight hours, which was a shorter time than DARPA originally considered feasible.)

Wikipedia is another example of social collaboration, Mynatt mentioned, with the production of an online encyclopedia that would take some 125 years for all of the material to be read. Wikipedia is based on the efforts of a very large number of networked volunteers, with only a very small central management team.

Other communities include apprenticing, e.g., movie making using networked individuals. Other communities provide online support for autistic individuals providing help in responses to a wide variety of social situations (e.g., a given movie being sold out at a theater).

Other communities provide real time information on voting irregularities (e.g., in Nigeria). In other cases, social networking enables real-time health coaching support for diabetics (the latter having mobile units).

Next to speak was **Irene Greif**, IBM Fellow and Director, Collaborative Users Experience, IBM. Her talk, titled "The Impact of Social Media on the Workplace and on User Experiences," focused on the use of social software to draw people into sharing. When incorporated into collaborative tools, social software can change the character of collaboration (though international collaboration is still a challenge).

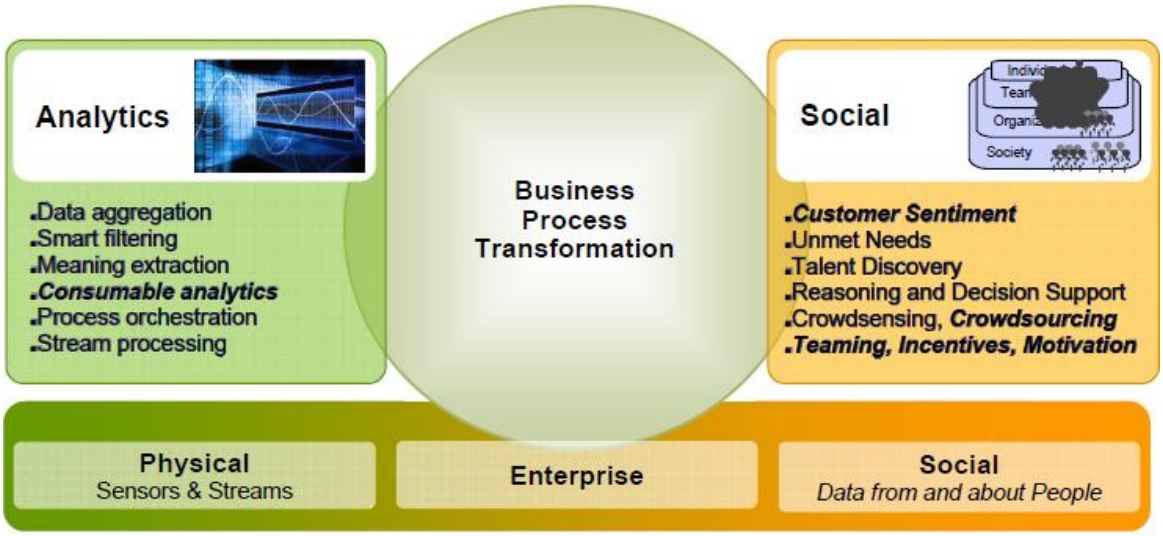

Figure 2: Socially Synergistic Enterprise Solutions (S3): Integrating social with information and analytics can transform collaboration.
Source: 2011 IBM Corporation

For example, "lurkers" (who only read online content) make up over 90 percent of online communities, Greif said. Lurkers, however, spend considerable time learning about their respective online communities, and have potentially valuable knowledge to contribute. A challenge for knowledge management is getting this information out of their heads and online. IBM-developed social software has elicited the contributions of 30 percent of lurkers by facilitating online recognition for such contributions. An interesting characteristic of lurker contributions is that they have changed what online communities see on the community homepage.

Greif's thesis is that IBM is transitioning from an analytical business to a business with a significant social content, where network-facilitated creativity is increased by augmenting traditional tools with social software, thereby changing the character of collaboration. Social software facilitates the addressing of customer sentiment, unmet needs and talent discovery, through crowdsourcing, crowdsensing, and teaming.

Raymond Kerins spoke next on "Social Media in an Unsocial World." Kerins is Vice President, Corporate Communications, Pfizer, Inc. Kerins noted that one percent of people generate web content, nine percent share that content with others, and the remaining 90 percent just learn from the content. He noted that, like other pharmaceutical companies, Pfizer has a problem with negative publicity and negative public perceptions. Pfizer is addressing this problem by enhancing its presence on Facebook, and by increasing Twitter updates.

The result is that public perceptions of Pfizer have noticeably improved. There are now 22 Pfizer Facebook sites in 10 languages (where Pfizer regards the future of social networking as being largely in the markets of emerging nations).

One question asked of Kerins was how the methods of Pfizer might be applied to a company like, say, Archer Daniels Midland. Kerins answered that an initial phase of research on ADM and its markets should drive the use of social media by ADM (as with other companies).

Richard Moser then spoke on "Radical Collaboration: The Science of Crowdsourcing and Crowdsourcing Science." Moser is a Research Psychologist, Behavioral Research Program, Division of Cancer Control and Population Sciences, National Cancer Institute. He noted that for a subset of tasks, the collective intelligence of groups can greatly exceed the intelligence of the smartest single individuals in the group. This harnessing of collective intelligence can take the form of user-generated content which is made available to everyone (e.g., Amazon, Wikipedia, blogs). In addition, crowdsourcing software can apply collective intelligence to the accomplishment of specific tasks, e.g., networked collaborations of research scientists and networking of "citizen scientists." The 2011 Grid Enabled Measures (GEM) effort, for example, has resulted in the harmonization of scientific data generated by disparate groups of scientists. There have been only a small number of (minor) transgressions in providing such data to GEM.

The 2011 Electronic Health Records (EHR) Campaign has achieved consensus on common data elements for patient-reported health behaviors. The latter is an example of "Citizen Science," where patients offer personal health data on the web. Such collaborations have great promise in scientific research. For example, an NIH program took six years to establish a correlation between Gaucher's and Parkinson's diseases using traditional scientific methods, whereas crowdsourcing methods required only eight months to reach similar conclusions.

In response to questions, Moser said that diversity is very important to avoid the pitfall of factionalism in crowds. The Internet has the potential to promote factionalism, where people listen primarily to those who share the same views, and that there is the challenge of distinguishing between "noise" and the "wisdom of crowds" on the Internet.

Next to speak was **Dwayne Spradlin**, President and CEO of InnoCentive. Spradlin spoke on "Crowdsourcing: What it means for Innovation." Spradlin made the point that the wisdom of a crowd in getting an accurate estimate of the number of jellybeans in a jar is not the same thing as using a networked group to further innovation.

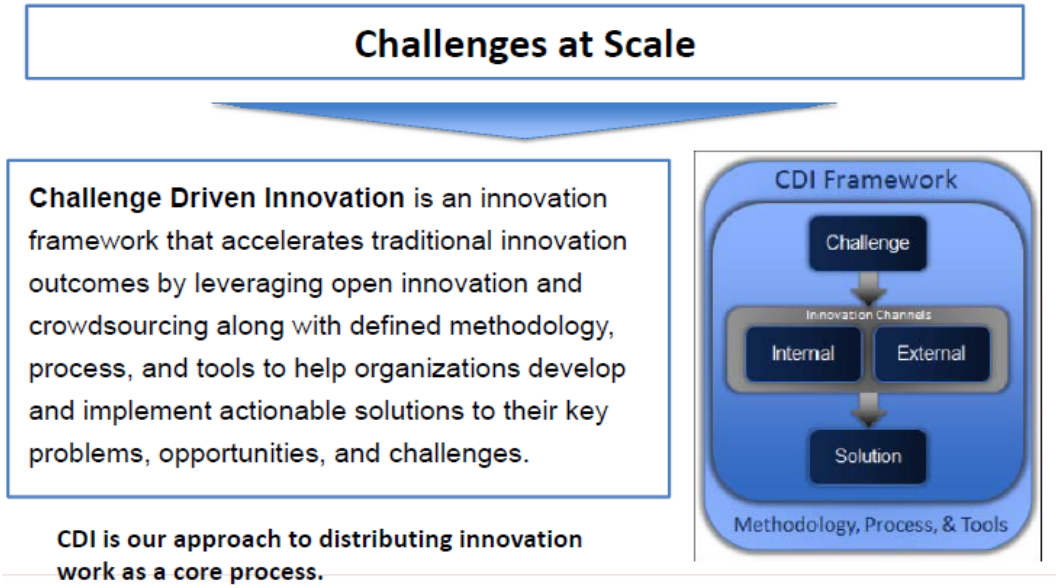

Figure 3: Challenges Driven Innovation.
Source: Dwayne Spradlin, InnoCentive

In the latter case, a well-defined challenge and a well-defined outcome is key to the successful use of networked groups, i.e., where innovation is challenge-driven and facilitated by crowdsourcing software, combined with a careful framing of the problem to be solved. As an example, InnoCentive posed the challenge (with a $20,000 prize) of identifying a means of liquefying frozen oil from the Exxon Valdez spill. This problem had been worked on for 15 years without success.

A successful solution was found by a construction engineer from the Midwest who was able to modify off-the-shelf equipment (previously used for cement) to vibrate frozen oil, thereby liquefying it. Another challenge, posed by NASA, was to find a way of accurately forecasting solar flares for use in the space program. A retired PhD in rural New Hampshire found a solution that exceeded NASA requirements.

These (and other such) challenges found solutions in a small amount of time, for very small amounts of prize money, that would have required a lot of time and money by traditional methods, if a solution was found at all. Such crowdsourcing points to a future of innovation that emphasizes strategy (e.g., problem formulation) over tactics, and "what" is to be done over "how" to do it.

The lunch talk was given by **Carmen Medina**, Specialist Leader at Deloitte and Former Director for the Study of Intelligence at the Central Intelligence Agency. In her talk "Why Social Media Makes Sense: New Methods for Understanding the Future," Medina addressed how the use of crowdsourcing can be used in historical analyses, analyzing current trends and predicting the future.

As an example of the use of open source data in historical research, Medina gave the example of evaluating the sway of the Nazi government over the war years by looking at open source obituary notices. In the earlier years, virtually all of the deceased German soldiers were described as "dying for the Fuehrer." In the later years, such references were in the single digits. She noted that in evaluating instability trends in the Middle East, the bloggers were the ones who got the trends most right, and not journalists.

Medina believes that social networking marks a fundamental shift in how knowledge is obtained and communicated. She believes that Twitter-like approaches have greatly increased importance as a strategy in obtaining knowledge and will emerge (e.g., with peer indexes measuring the contributions of individuals) as a virtual requirement in the not distant future for individuals making their living as intellectuals in a variety of (e.g., academic) fields.

Vikram Savkar then gave a talk on "Scitable: A Social Network for Science Research and Education." Savkar is Senior Vice President and Publishing Director, Nature Publishing Group (NPG). Although the NPG has historically been a publishing entity, in recent years there have been expansions into scientific communication, digital science tools and education. Scitable is a continually growing library of scientist-authored, peer-reviewed learning content, with a suite of classroom and personal learning tools. It includes a network of committed mentors, teachers, students and lifelong learners. Launched in 2009, it currently has more than 300,000 active users. Savkar identified several lessons stemming from this effort:

- Social networks can create a classroom, but moderators are needed to be effective.
- Scale is a challenge, and high quality of information is valued.
- Expended time is the equivalent of capital investment (the more the better) and people should provide tools, rather than impose controls.

The final talk was given by **Rafael Sidi** on "Collaboration and Crowdsourcing to Accelerate Science." Sidi is Vice President, Elsevier, Application Marketplace and Developer Network. Sidi noted that the social network surpassed email in volume in 2010 and is growing rapidly. The social network is providing a rapidly growing means of furthering a variety of scientific research. For example, researchers are using social networking to find public sources of funding for their research. A wide variety of scientific research is now being furthered by the networked contributions of a large number of individuals.

Examples are:

- Helping astronomers to classify a large number of distant galaxies – too many to be handled by the astronomers.
- The Dragonfly Swarming Project where different kinds of dragonfly swarming require observations of very ephemeral swarming phenomena, thereby requiring the participation of a large number of individuals to sufficiently raise the probability of actionable observations.
- Obtaining of local data on numbers of species versus habitat productivity for small plots in 48 sites in five continents, to further ecological science.

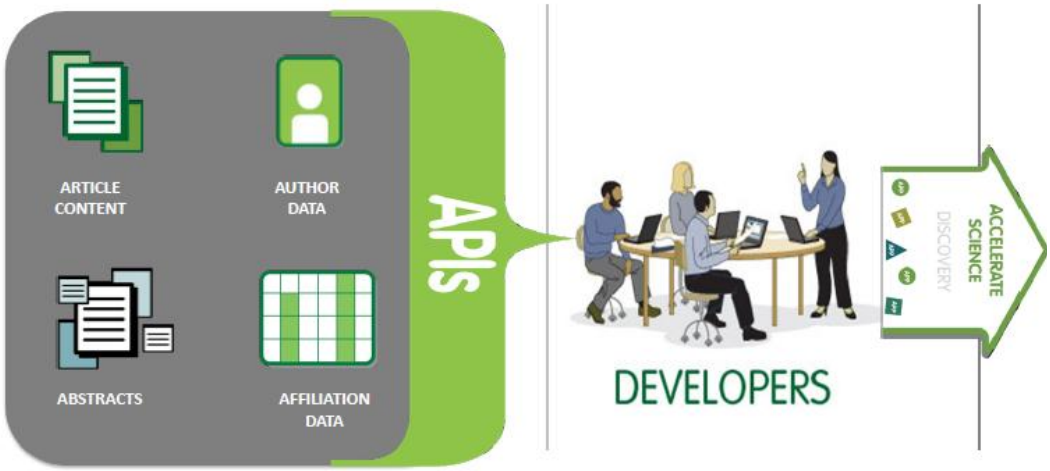

Figure 4: Collaboration and Crowdsourcing to Accelerate Science.
Source: Rafael Sidi, Elsevier

Planning Committee for the Impact of Social Networking and Crowdsourcing on Research, the Enterprise, and the Workforce: Kelly O. Sullivan (Chair), Pacific Northwest National Laboratory; Tilak Agerwala, IBM Thomas J. Watson Research Center; and Stephen Cross, Georgia Institute of Technology Research Institute. Staff: Susan Sauer Sloan, Director, GUIRR.

The summary was reviewed in draft form by James Duderstadt, University of Michigan, to ensure that it meets institutional standards for quality and objectivity. The review comments and draft manuscript remain confidential to protect the integrity of the process.

ABOUT GUIRR

GUIRR's formal mission, revised in 1995, is "to convene senior-most representatives from government, universities, and industry to define and explore critical issues related to the national and global science and technology agenda that are of shared interest; to frame the next critical question stemming from current debate and analysis; and to incubate activities of on-going value to the stakeholders. This forum will be designed to facilitate candid dialogue among participants, to foster self-implementing activities, and, where appropriate, to carry awareness of consequences to the wider public."

For more information about GUIRR visit our web site at http://www.nas.edu/guirr
500 Fifth Street, N.W., Washington, D.C. 20001
guirr@nas.edu 202.334.3486