Social Computing and the Smart Grid

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Introduction

Phones, cars, buildings, roads, and cities are all getting smarter. Used in this sense, "smart" means that things are becoming digitally enabled. Sensors transmit data to 'the cloud,' where it is analyzed and used to track, manage and optimize the functioning of systems. This view of "smartness" is focused on technology; people, when considered at all, are relegated to the periphery.

A complementary approach to smartness is that of social computing. From this perspective, people are seen as active parts of systems – in fact, their participation is fundamental to the operation of systems. In such systems digital smartness is augmented by social intelligence: people provide content, and respond to the input of others. As a consequence, social computing systems are designed with people in mind, and with an eye to how they are recruited, enlisted and motivated. This perspective complements the technology-focused view of "smarter," and it is going to have a decided impact on future systems of all kinds.

Social Computing

Today, social computing is mostly associated with systems that are, well, social – they let people interact with one another. People post messages on Facebook; rate products on Amazon; and edit articles on Wikipedia. Whatever the activity, it has three characteristics: people enjoy contributing; others find the contributions valuable, interesting or fun; and the cumulative effect is to encourage more activity, leading to a positive feedback loop.

While social computing began with online communities and social networking sites, its functionality is showing up in all sorts of digital systems. More and more systems will take people into account, and they will do so by providing support for social features like identity, reputation, and relationships and by providing social functionality like communication, sharing and recommending. And as this happens, systems will begin to exhibit social phenomena such as norming, imitation, and peer pressure – to name a few of the factors that shape human behavior.

The Smart Grid

The Smart Grid [3.] is a vision of a future electricity infrastructure that involves the bidirectional transmission of electricity (so that anything that can consume energy can also produce it and return it to the grid), advanced metering infrastructure (so that electricity can be measured in an accurate and real time manner), and two-way communication and control (so that electricity providers, consumers, and other stakeholders can interact with one another).

Among its many aims, the Smart Grid offers the prospect of supporting active participation by consumers, thus enabling social intelligence to augment the digital smartness of the grid. Consumers can participate in the smart grid in a number of ways:

- **Demand Response**. Periods of high electricity use (peak demand) require bringing expensive or dirty sources of energy online, or in extreme cases may result in brownouts or grid failure. One way to address these problems is to encourage consumers to shift their energy use to non-peak periods by offering incentives, financial or otherwise, thus contributing to the economy, flexibility and resilience of the grid.

- **Energy Conservation**. Energy generation facilities are expensive, and often have negative environmental impacts. Enabling consumers to reduce their consumption is a promising alternative to constructing new facilities. One approach is providing consumers with real-time, fine-grained feedback on the amount of electricity consumed – often such feedback results in reductions in consumption on the order of 10%. [1.]

- **Energy Production**. The smart grid can benefit consumers who wish to become producers, enabling them to sell locally generated or stored energy back to the grid. For example, electric vehicles may charge their batteries at night when electricity is cheap and sell it back to the grid during the day at a profit, providing the grid with storage that enables it to cope with demand.

Consumer participation in the smart grid poses several challenges: consumers will need a better understanding of how the grid works; consumers will need ways of figuring out how smart grid technologies apply to their lives; and they will need to change their everyday behaviors to benefit from the smart grid. Let's look at how social computing addresses these issues.

Social Computing Meets Smart Grid

Seeing Energy: Understanding the Smart Grid

The smart grid is far more complex than today's grid. Whereas today's consumers need only understand that electricity comes from a power plant over wires to a meter at their home, they will need deeper understandings to benefit from the smart grid. For some users a shallow understanding may suffice: for example, to save money via demand response they may select among "home energy policies" that use electricity when it is cheaper (i.e. they understand that electricity prices fluctuate). Other users – perhaps sustainable energy enthusiasts or building managers who may be able to substantially cut costs – may be interested in deeper understandings that allow them to program the smart-enabled functionality of their new systems or sell cheap electricity stored in their car batteries back to the grid for a profit.

In addition to influencing how consumers interact with the grid, these understandings will shape how they feel about it. Consumers will feel one way about fluctuating prices if they see the smart grid as a regional network that is continually balancing energy generation capacity with demand. They will react differently if they see the smart grid as a means by which the government controls their thermostats and imposes 'stealth taxes.' The understandings people form of a system shape their feelings toward it and thus how readily they adopt it, and how and why they use it.

A social computing approach that is relevant here is the creation of shared, interactive visualizations. One of the interesting prospects of the smart grid is that the very technology that makes it smart – the ability to measure the production of energy, trace its distribution, and track when and how and why it is consumed – offers the ability to make the operation of the smart grid transparent. Imagine a visualization that showed the ebb and flow in the production and consumption of energy, and showed how much was generated locally and from what sources, and to where it was going. Perhaps viewers could see statistics on the number of consumers who were putting energy back into the grid, or participating in demand response programs. There is a large body of information that could help consumers understand the complexity of the smart grid, and – at least at a general level – the reasons that prices are fluctuating, and what those fluctuations achieve in terms of balancing energy use.

There is evidence that such visualizations might be of general interest. During the California energy crisis of 2000 – 2001, an energy visualization that contrasted available supply with predicted demand put up by the Lawrence Livermore National Lab received over 2 millions hits a day; comments from users suggested that some were modulating their energy use in response to the visualization (Darby, 2006, p24).

Peer-to-Peer Interaction: Tapping Local Knowledge

Beyond general understandings there will be many details – often particular to localities – that consumers will need to understand to adopt smart grid technologies. Those interested in solar panels will need to know everything from the impact of local conditions such as snow, hail, and leaf-fall in the autumn, to socio-political issues such as local building codes and the likely receptivity of neighbors. Those interested in demand response programs will want to know whether they are at risk of being miserable during a heat wave, or whether their clothes will come out wrinkled if the utility temporarily turns off their dryer's heating element.

The best source of such knowledge is the local community. Someone down the block can best advise whether local snow conditions will interfere with solar panels. Someone in the neighborhood can report on whether local zoning codes permit wind power generators. Someone in the same utility district can provide an account of their experience with demand response. Knowledge that comes from one's community takes local conditions into account in a way that a generic brochure or web page simply cannot. And, furthermore, people are often more willing to trust their neighbors to offer frank and practical accounts of their experience than they are the public relations arm of their utility or local government.

Social computing systems can support such peer-to-peer knowledge exchange through social networks, blogs, mailing lists and other channels. One person might use a social networking system to indicate that they are a "fan" of a demand response program, thus quietly and indirectly informing their "friends" of the system's efficacy. Another might post a rant about a negative experience in trying to dispose of fluorescent light bulbs – perhaps with responses from others describing local recycling options, or perhaps kicking off a community discussion about developing such options. And so on. In any community, there is a small set of early adopters or "lead users" who explore new technologies, push them to (or beyond) their limits, and are eager to share their experience with others [5.]. Social computing systems can tap this resource and make it available to the broader community via peer-to-peer discussion, thus speeding adoption (and adaptation) of new technologies.

Changing Large-Scale Behavior: Approaches to Crowdshifting

Armed with a general understanding of how the smart grid works, and primed with local knowledge about particular uses of smart grid technologies, consumers may well be prepared to adopt smart grid technologies. However, it is one thing to know, and another thing to act. This brings us to another aspect of social computing: crowdshifting. Crowdshifting has to do with designing systems that support large-scale, voluntary behavioral change. Examples of behavioral change include purchase decisions (buying an energy-efficient appliance), everyday habits (changing one's practices about leaving lights on), and program participation (agreeing to participate in demand-response).

Social computing draws from social psychology (e.g., [1.]) and behavioral economics (e.g., [4.]) to develop crowdshifting techniques that support consumers in changing their behavior in socially beneficial ways. One phenomenon that underlies many social computing techniques is called social proof: people decide how to behave based on what they see others around them doing, especially if those others seem similar to themselves. Thus, showing consumers how their energy consumption compares to that of their neighbors, or that many in their community are participating in energy conservation programs, can help encourage behavior change. Other approaches include tapping into people's competitive impulses (e.g., sponsoring energy reduction contests), getting people to make shared public commitments (e.g, my church is giving up plastic bags for lent), or providing non-monetary incentives like points or badges for doing particular things (e.g., I can display a solar-energy-guru badge on my Facebook page).

Conclusion

Although much of the smart grid's 'smartness' comes from digital technology, it is important to realize that social intelligence will play an increasing role as well. People will participate in the smart grid by conserving energy, shifting their use to avoid periods of peak demand, and taking on roles as energy producers and arbitragers. This increased participation will be mediated by social computing systems that will help consumers understand the grid as a whole, tap local knowledge through peer-to-peer communication, and support voluntary behavioral change through crowdshifting. This increased participation will not only speed the adoption of smart grid technologies, but will increase the public acceptance and perceived legitimacy of the smart grid, and counter concerns about 'Big Brother.'

References

1. Cialdini, R. B. *Influence: Science and Practice.* Pearson, 2009
2. Darby, Sarah. (2006) *The Effectiveness of Feedback on Energy Consumption: A Review for DEFRA of the Literature on Metering, Billing and Direct Displays.* April 2006. Available at http://www.eci.ox.ac.uk/research/energy/electric-metering.php
3. NIST. *NIST Framework and Roadmap for Smart Grid Interoperability Standards, Release1.0.* Available at http://www.nist.gov/smartgrid/upload/FinalSGDoc2010019-corr010411-2.pdf on April 14. 2011.
4. Thaler, R. H. and Sunstein, C. R. *Nudge: Improving Decisions about Health, Wealth and Happiness.* Yale University Press, 2008.

5. von Hippel, E. *Democratizing Innovation*. MIT Press, 2005. Available at http://web.mit.edu/evhippel/www/books.htm

Author's Biography

Thomas Erickson is an interaction designer and social scientist at IBM Research. He studies and designs systems that enable large distributed groups to interact coherently over a distance; his interests include computer-mediated communication, online communities and urban informatics. Erickson has published over eighty articles, edited two books, holds eight patents, and is a Fellow of the ACM. Erickson's three-decade career has taken him from a tiny startup to Apple's Advanced Technology Group to IBM Research.