

10 Ways to Think about Innovation

What successful young technologists know

By Jason Pontin

Each year, we choose the 35 innovators under the age of 35 whose new technologies seem most gloriously creative and most likely to expand human life. (Here are the [2006 winners \(/tr35/\)](#).) In editing this year's TR35--and rereading the profiles of last year's winners, whom we introduced in the October 2005 issue--I've noticed a few things about successful innovation.

(1) Successful innovators are famously untroubled by the prospect of failure. Bryan Cantrill, an engineer at Sun Microsystems who invented software that allows systems engineers to track bugs in real time (and whom we named one of 2005's TR35), says, "People who have innovated once, and who say they are not frightened that they won't be able to repeat their success, are probably lying. The challenge is not to be crippled by fear, but allow it to drive you forward." More profoundly, (2) many innovators *appreciate* failure. Yael Maguire, the chief technology officer of ThingMagic and another of last year's TR35, who has designed machines that read radio frequency identification chips, says, "If you're not working on technologies that are going to fail, you're not pushing the boundaries enough. Even if a technology failed ... you'll be able to put it in your back pocket and use it for some other purpose."

(3) Innovators commonly recognize that "problems and questions are the limiting resource in innovation," says Ed Boyden, a Stanford University neurobiologist and one of [2006's TR35 \(/tr35/Profile.aspx?Cand=T&TRID=454\)](#). He means that difficult questions are thrilling: "If we take a really hard question, like 'What is consciousness?' or 'How do we store memories?', it's not even clear how we should even approach the problem." In attempting to answer such questions, Boyden used genetic engineering to create a precise, reliable neural switching system; scientists could use it to study how brains function, and it might one day provide treatments for Parkinson's disease, blindness, and depression.

Boyden illustrates another theme: how (4) innovators find inspiration in disparate disciplines. The brain is "the ultimate computer," says Boyden, who has applied lessons to human neurobiology that he gleaned from his earlier work in computer science and electrical engineering.

Here are a few other general rules: (5) Innovation flourishes when organizations allow third-party experimentation with their products. Astonishingly, the fruitfulness of an open society is still unappreciated by some commercial technologists: "To this day, there are few technologies that are open," says Paul Rademacher of Google, a [2006 TR35 \(/tr35/Profile.aspx?Cand=T&TRID=437\)](#) winner. Before joining Google, Rademacher hacked the code behind Google Maps so that other computer programs could work with it, transforming the search firm's application into a blank canvas for software developers and a

social network for users. Also, (6) fragility is the enemy of innovation: systems should boast broad applications and be unbreakable. "Everything is about resiliency and robustness," says Ben Zhao of the University of California, Santa Barbara, one of [2006's TR35 \(/tr35/Profile.aspx?Cand=T&TRID=430\)](#). Zhao builds overlay networks, peer-to-peer networks that are less specialized than Napster and the like--and also stronger, because there are strict rules about which machines can talk to which.

(7) Real innovators delight in giving us what we want: solutions to our difficulties and expansive alternatives to our established ways. (8) They are, it is true, sometimes perplexed by our ignorance of our own needs. "You have to solve a problem that people actually have," says Joshua Schachter, the founder of del.icio.us (now a division of Yahoo) and the popularizer of Internet "tags." "But it's not always a problem that they know they have, so that's tricky." There is, however, an escape from this conundrum. (9) Successful innovators do not depend on what economists call "network externalities" (where a system, like a fax machine, has little use to its first user, but becomes increasingly valuable as more people use it): "Ideally, the system should be useful for user number one," says Schachter, our [2006 Innovator of the Year \(/TR35/Profile.aspx?TRID=432\)](#). Hence, innovators can divine needs by applying a utilitarian imperative: they ask, Would the innovation help someone *now*?

This suggests a last point: (10) many innovators become technologists because they want to better the world. Shiladitya Sengupta, an assistant professor in the Harvard-MIT Division of Health Sciences and Technology and one of 2005's TR35, who has built nanoscale drug-delivery devices for the treatment of cancer, says, "You can do top-notch research, but at the end of the day, it should actually benefit mankind." Christina Galitsky, a research associate at Lawrence Berkeley National Laboratory and this year's [Humanitarian of the Year \(/TR35/Profile.aspx?TRID=469\)](#), would agree. She has demonstrated how an efficient stove can mitigate the danger that Sudanese refugee women face collecting firewood, and she has designed a cheap filter material that could remove arsenic from the drinking water of Bangladesh. "At least now I'm doing something," she says.

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