

## [M.K. THOMPSON] Innovation versus the status quo

Governments, universities, professional societies and the media all stress the need for innovation in these uncertain economic times. This has led to suggestions of innovation-based economic stimulus packages and increased scientific research funding to foster innovative technologies. Individuals from every field are being asked to propose new ideas, explore emerging research areas, and focus their efforts on projects with the highest potential reward. But this is easier said than done.

Innovation is nearly always at odds with the status quo. Change is natural, but often uncomfortable. The resistance to new ideas - especially within the established scientific community - can be enormous. And the consequences for being overly enthusiastic can be severe.

In 1600, Giordano Bruno, an Italian mathematician and astronomer, was found guilty of heresy and burned at the stake for hypothesizing that the sun was one of an infinite number of independently moving heavenly bodies. Later that century, Galileo Galilei was placed under house arrest for life for his support of Copernican astronomy and the heliocentric universe.

Four hundred years later, inventor and design theoretician Genrich Althshuller was sentenced to 25 years in prison for suggesting to Stalin that his theory of innovation could be used to improve the USSR. (He only served five years and went on to write many books about invention and innovation.)

Today researchers in many countries enjoy great academic freedom and are permitted to pursue radical new ideas. But it is still not an easy undertaking.

Securing funding to perform cutting-edge research requires an established publication record with numerous papers in high impact journals. Unfortunately, producing the results necessary to create that record requires funding. The circular nature of the system means that it is easy to do high-impact research once you are well established, but it is very difficult to get started. The situation is complicated by the fact that the individuals who make the decisions about research funding and publications are often competing with those who are being judged.

In addition, reviewers often have difficulty seeing the contribution of a paper that advances the state of the art because they are rooted in the status quo. It is not uncommon for journal papers that propose stunning new ideas to be rejected and returned with comments that can be briefly summarized as "come back in 20 years." As a result, doing something that has been declared to be "impossible" by senior members of the scientific community can be far less difficult than publishing the results obtained in the process.

Many of the greatest minds in the world have faced this problem at one time or another. George Akerlof, Joseph Stiglitz and Michael Spence won the Nobel Prize in 2001 for their work on incorporating information asymmetry into economic theory. But 30 years earlier, Akerlof's famous paper "The Market for Lemons" was rejected by one journal because they "did not publish papers on subjects of such triviality" and by another on the basis that if the paper were indeed correct, "[e]conomics would be

different."

This is a well documented problem in academia. Max Planck observed that "**[a] new scientific truth does not triumph by convincing its opponents and making them see the light, but rather because its opponents eventually die, and a new generation grows up that is familiar with it.**"

The problem has not improved with time. In 2003, Peter Lawrence published a commentary in Nature in which he noted that young faculty members are learning "that building capital in the hard currency of the audit society can be safer and easier than founding a reputation on discoveries." But where does that leave the people who are making the discoveries, let alone the societies and nation who need them?

Things are sometimes no better in the laboratory. Johannes Kepler's laws of planetary motion were not only criticized or ignored by other leading scientists including Galileo and Descartes. They were also attacked by his own teacher, Michael Maestlin who objected to the application of physics to astronomy. Young researchers today surely feel the same sting of disappointment when their research advisers direct them to lower-risk and more established lines of scientific inquiry.

But innovation is not hopeless. Max Planck observed: "Anybody who has been seriously engaged in scientific work of any kind realizes that over the entrance to the gates of the temple of science are written the words: **'Ye must have faith.' It is a quality which the scientist cannot dispense with.**"

And so with faith, patience, perseverance, and the help of peers, publishers, and public servants who are able to treat innovation as an opportunity instead of a threat to the status quo, we will change the world for the better.

To learn more about the history of science and innovation, see "The Structure of Scientific Revolutions" by Thomas Kuhn.

*Mary Kathryn Thompson, Ph.D., is an assistant professor in the Department of Civil and Environmental Engineering, the Korea Advanced Institute of Science and Technology. She can be reached at [mkthompson@an.kaist.ac.kr](mailto:mkthompson@an.kaist.ac.kr). - Ed.*

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