

New Review Slams Fusion Project's Management

ITER, the international fusion reactor project in France, is reeling from an assessment that found serious problems with the project's leadership, management, and governance. The report is so damning, *Science* has learned, that after a 13 February special session that reviewed and accepted the report's conclusions and recommendations, the ITER Council—the project's governing body—restricted its readership to a small number of senior managers and council members. “We feared that if [the assessment] leaked to people who don't know about the ITER agreement, the project could be interpreted as a major failure, which is not what the management assessor intended,” says nuclear engineer Bob Iotti of the consulting firm CH2M HILL, who chairs that council.

Backed by China, the European Union, India, Japan, Russia, South Korea, and the United States, ITER aims to build a testbed for fusion energy. Under construction at Cadarache in southern France, it is often described as the most complex machine ever built. In its cavernous doughnut-shaped vacuum vessel, the reactor will heat heavy hydrogen to 150 million °C so that the nuclei will fuse to form helium, releasing energy.

Since the project began in earnest in 2006, the expected completion date has slipped from 2016 to 2018 to 2020, the estimated cost has tripled to at least €16 billion, and there's been a major change of leadership. “ITER had to create a project, a design, a laboratory, and an institutional culture. That's very many things to create at once,” says Steve Cowley, head of the Culham Centre for Fusion Energy in the United Kingdom.

The ITER agreement requires management assessments every 2 years. The previous two were critical, but nothing like the latest, conducted by Bill Madia, former director of the Pacific Northwest and Oak Ridge national laboratories. “It didn't mince words,” Iotti says. “It could be read as an indictment of the current director general [Osamu Motojima], but one should also look at the obstacles in his path. Some are not under his control.”

Because all the partners want to gain experience from building ITER for what could be a lucrative future industry, the ITER agreement carves up the construction of reactor components among partners, each of which has created a “domestic agency”

to handle the contracts. The result is far from efficient: Superconducting cable for the reactor's magnets is manufactured in six different nations and the 5000-tonne vacuum vessel is being built partly in Korea and partly in Europe.

ITER management acts as ringmaster, overseeing the reactor design, enforcing technical standards, and resolving conflicts. “The ITER Organization and the seven domestic agencies should work as a single project team,” says Jean Jacquinet, scientific adviser to the head of France's Atomic Energy Commission. “But that's not really the case. Communication is not ideal.”

The relationship is often acrimonious and when conflicts arise, domestic agencies sometimes go behind the central management's back and put pressure on

day-to-day management team is inflexible and top-heavy, in part because the nationalities of senior management and the staff as a whole must reflect the division of funding. “Inefficiencies were built in with the full consent of the parties,” Iotti says. The number of managers should be reduced, the report says, identifying one whole level that, if removed entirely, would improve efficiency and decision-making.

Iotti says that in response to the assessment, Motojima and ITER's senior management have proposed organizational changes that the council has “temporarily endorsed” because it “is not convinced that it is the ultimate answer.” The council has asked for more information and justification for the changes. “ITER is still a young organization and it takes a very long time for



Rock bottom. Work on the circular foundations for the ITER fusion reactor was halted last June following disputes over the design. Construction did not begin again for 8 months.

it via their delegates to the ITER Council. Iotti believes this antagonism is “one of the biggest problems.” The assessment found that voting on the council is often swayed by political considerations and that it acts only on unanimous decisions, which has had a devastating effect on the project's cost and schedule. Iotti, who took over the council chair at the start of the year, accepts the criticism. “We need to simplify our activities. ... Then we can focus on the controversial issues,” he says.

The assessment also found that ITER's

different cultures to work as a single team,” Jacquinet says.

Perhaps most controversially, a source tells *Science*, the assessment calls for the council to “accelerate the transition to a new director general.” Brought in as part of a 2010 management reboot, Motojima ends his 5-year term in June 2015. Motojima, who declined comment, insists on consensus in decision-making and has surrounded himself with a coterie of staff, all Japanese, who meet with him daily outside the normal management structure, according to people

who have worked closely with ITER officials.

ITER's schedule continues to slip, which will push up costs. ITER has said its reactor will power up for the first time before the end of 2020, but that date is widely discounted. "We don't have a realistic, believable, very high quality schedule," Iotti says. The council is now planning to announce

an updated schedule at its meeting in June 2015. "We need to be sure," Iotti says. "Once we have a schedule, then we can talk about cost." ITER leaders fear that further delays, combined with the damning assessment, could cause backers to pull their funding; the United States has threatened doing so more than once.

Despite the problems, Iotti is optimistic. "The project is making progress; things are being built," he says. This summer, the first items of hardware will start arriving on site. "When stuff comes together, you will see a completely different attitude ... [but] there are still going to be difficult times ahead."

—DANIEL CLERY

SOCIAL SCIENCE

Twitter Offers Entire Data Pool, but Some Wary of Diving In

Earlier this month, the social media company Twitter offered academic researchers a chance to play with a vast treasure trove of data—all 500 million of the 140-character "tweets" its 200 million users generate daily, as well as all tweets on record going back to Twitter's creation in 2006. Many scientists, eager to study social dynamics on a massive scale, are scrambling to apply by the company's 15 March deadline. But some, scrutinizing the

Massachusetts, used the API to harvest 604,000 tweets from people in New York City. Users of Twitter's mobile app have the option to reveal their location when they tweet, and about 3% do so. By analyzing the sentiment in those geolocated tweets, the team mapped out the city's emotional landscape in time and space in exquisite detail. Conclusion: New Yorkers love parks and hate transportation.

When he learned last week that Twitter was granting researchers access to the full "firehose" of its data, Bar-Yam was thrilled. "Twitter data is an incredible resource," he says. "We want to use it to understand society, and also to help solve problems ranging from violence to pandemics."

But the 1% of tweet data now available through Twitter's free API is too limited for some research projects, says Nick Obradovich, a political science Ph.D. student at the University of California, San Diego. Obradovich wants to compare sentiments about climate change in U.S. geolocated tweets with local temperatures; according to one theory, unusually hot days make people more open to the idea that the scientific consensus about climate change is correct. Given that only a small proportion

of tweets are geolocated, and an even smaller portion pertain to climate change, he needs a deep dive into Twitter's data.

The contract that researchers must sign to apply for the program, however, includes language that some find troubling. Simply by applying, it states, "you are granting Twitter an unconditional, irrevocable, non-exclusive, royalty-free, fully paid-up, fully transferable, perpetual and worldwide license to evaluate, use, copy, perform, display, publish, transmit, or create derivative works ... [and] hereby waive all copyright, trademark, trade secret,

patent and other intellectual property right claims you may have against Twitter" related to that content.

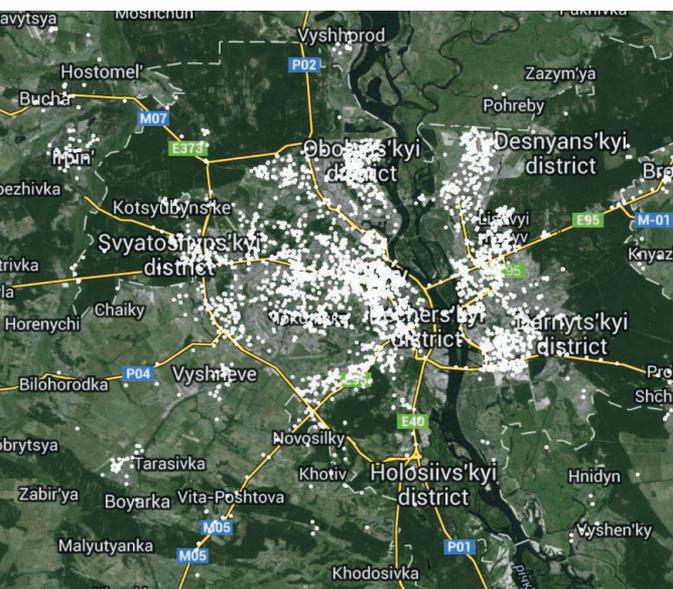
Some researchers interpret that as handing ownership of their ideas to Twitter, even if their applications are turned down. In principle, Twitter could then publish those ideas, sell them to third parties, or develop technologies based on them without compensating or even crediting the researchers. "These types of data are useful for my research, but I am not applying because of concerns about the Ownership & License section of the agreement," says Sarita Yardi Schoenebeck, an information scientist at the University of Michigan, Ann Arbor. "It does indeed read like they want to own the ideas," Obradovich agrees, "and any potential derivative ideas they choose to pursue, which is somewhat troubling." But he plans to apply nevertheless.

A Twitter representative did little to clarify the situation for researchers, writing briefly in an e-mail to *Science*: "Just as users own their Tweets, researchers own their ideas. This program is no different: the license pertains to our ability to further explore the contributions of the research community and advance our offerings to the community as a whole."

The confusion over Twitter's legalese is part of a wider debate about intellectual property (IP) and academic research, Bar-Yam says. "The question here is not whether there is IP but who gains the rights." If another company owns your ideas, it's nearly impossible to get commercial funding, he says. "The whole purpose of IP is to allow people with ideas to build on them. ... Without IP protections, investors don't give resources to develop those ideas."

Still unclear are Twitter's terms for actual access to its full data trove—the debate so far has been over just the application process. "Since applying is the first step, the submission agreement is the only available agreement at the moment," the company representative notes.

—JOHN BOHANNON



Social unrest. Social scientists can analyze tweets during protests, such as these 7458 from Kiev region over 2 days in mid-February.

fine print of the application, worry about legal strings that seem to grant Twitter ownership of their research ideas. "This would be a non-starter for us," says systems scientist Yaneer Bar-Yam, who is among those reluctant to apply for Twitter's full data set.

Twitter has for several years provided free access to 1% of tweets through an online application programming interface (API). For many research projects, that's enough. Last year, for example, a team led by Bar-Yam, president of the New England Complex Systems Institute in Cambridge,