# Experimental Computer Science: Computational Test Beds for Extreme-Scale Science

*The scientific paradigm … defines computer science as a natural (empirical) science … and seeks a priori and a posteriori knowledge about* software *by combining formal deduction and scientific experimentation.[[1]](#footnote-2)*

Advancing the state of the art of collaborative science requires experiments to quantitatively study the results of computer science innovation. Optimal algorithms and novel frameworks are not sufficient -- these will only be successfully adopted by domain scientists if they can effectively deliver value in real-life situations. To perform such experimental work we need computational test beds so that we can build, test, monitor and capture new computational paradigms and abstractions – that is to conduct at scale computer science experiments that involve unbiased and engaged users. Such experiments include end-to-end demonstrations up to and including the extreme scales and in so doing establish a collaboration between computational and domain scientists operating at these scales.

By nature, computational scientists and domain scientists work under different external pressures. Computational scientists working on the bleeding edge don’t always provide the stability and reliability that domain scientists require for their science. In this context domain scientists are in effect offering up bleeding edge test facilities for the computational scientists. A computational test bed serves as a middle ground, where experiments can be conducted to understand how to bring the computational and science domains together.

As one example, the Open Science Grid is the equivalent of a supercollider for distributed High Throughput computing. It serves as a computational test bed where experiments are conducted to understand how to enable domain scientists to leverage computational science through a state of the art fabric of services. But much more can and should be done.

Test bed capabilities need to be developed that incorporate: Environments to brainstorm and capture ideas about solutions (societies); Means to inform the end-user scientists of the results and potential applications (publication and annotation); Configurable environments to construct and integrate the new methods and applications (build and test); Systems to measure and compare results (laboratories and analytics).

As computational science experiments such as these are conducted we will gradually be able to advance the state of the art in extreme scale computing.

1. Eden, A. H. (2007). "Three Paradigms of Computer Science". Minds and Machines 17 (2): 135–167. [↑](#footnote-ref-2)