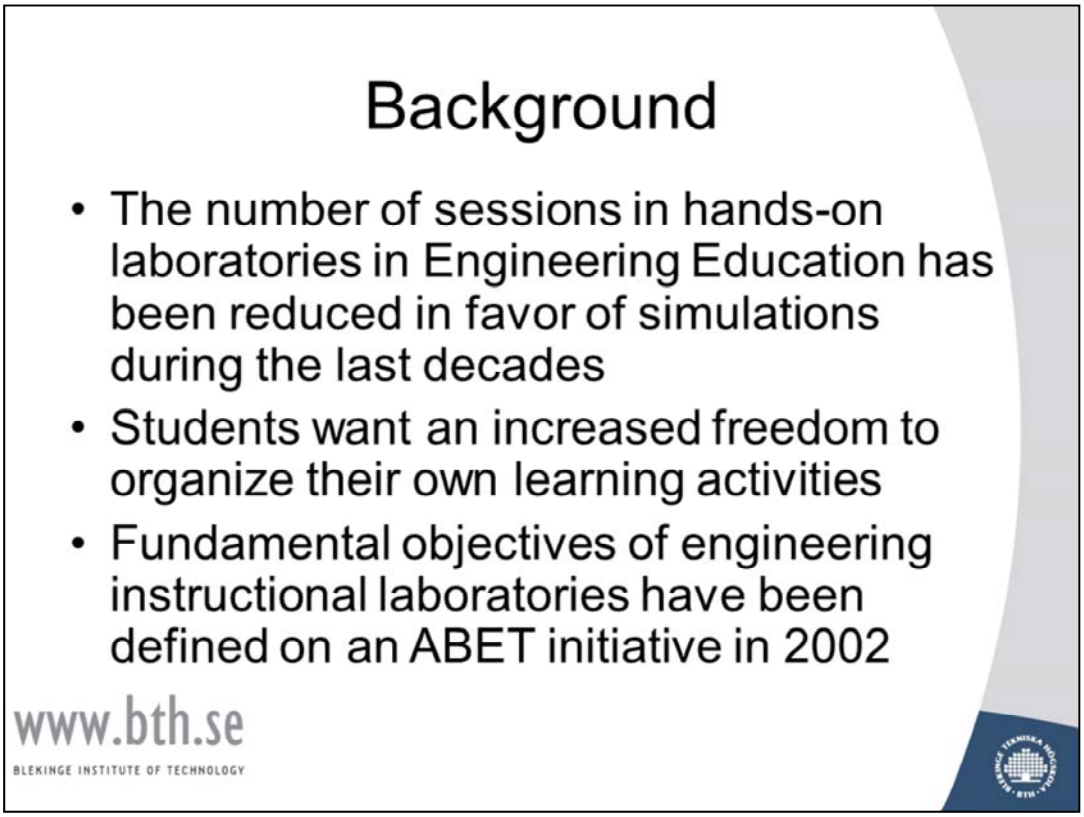
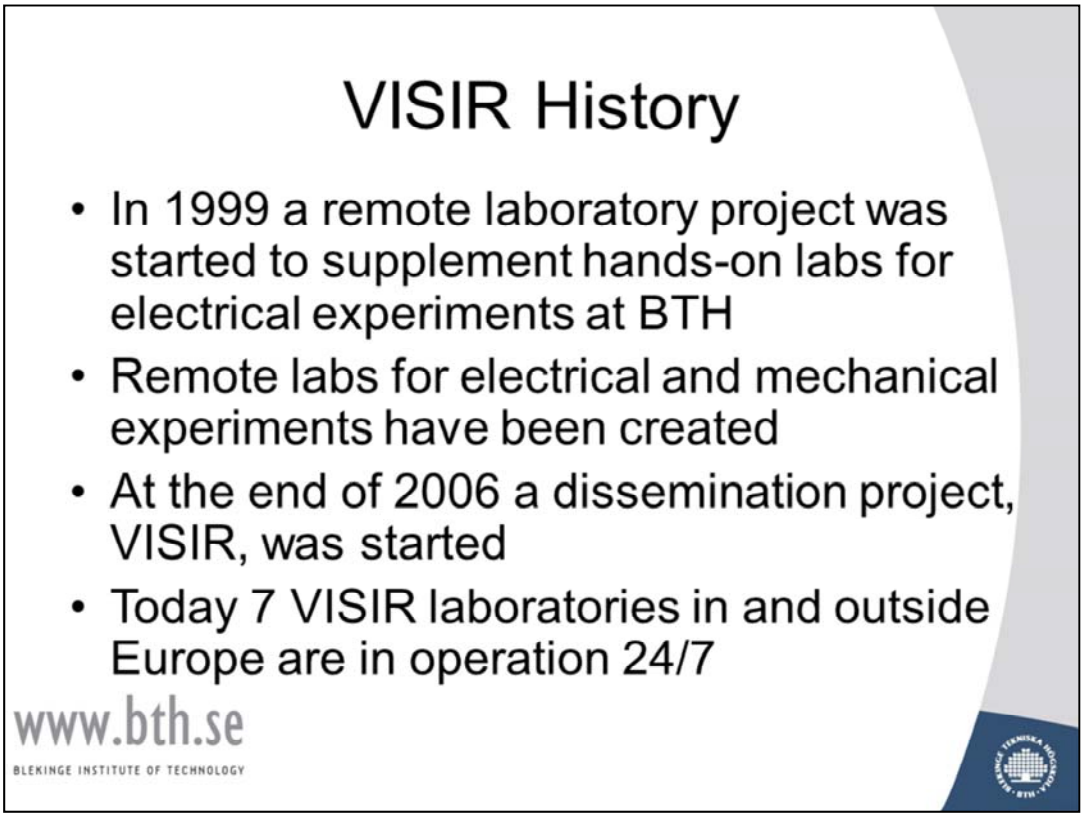
VISIR is an acronym for “Virtual Instrument Systems In Reality”. Apart from BTH, the Knowledge Foundation and VINNOVA are funding organizations of VISIR. Instrument grants have been received from National Instruments.

When students, especially undergraduates, perform physical experiments, it is typically not to extract some data necessary for a design, to evaluate a new device, or to discover a new addition to our knowledge of nature. Students attend laboratory sessions and perform experiments to acquire laboratory workmanship and to ascertain that models taught are useful predictors of real-world behaviors. Unfortunately, the number of sessions in hands-on laboratories offered at most universities around the world has been reduced during the last decades. The prime cause for the decline in laboratory work is clearly the task of coping with greatly increased student numbers, while staff and funding resources have scarcely changed. Nowadays, most engineering courses focus on theories and mathematical models. Students use simulators to become familiar with them but simulation cannot replace physical experiments if the intention is probing how accurate a model describes a particular phenomenon in nature. In fact, students need heavy laboratory practice to become engineers that are able to design goods and services, which are in tune with nature. Furthermore, today students want extended access to learning resources and increased freedom to organize their own learning activities, which is also one of the main objectives of the Bologna Process. I will discuss a solution enabling universities to deliver engineers compatible with a sustainable society.



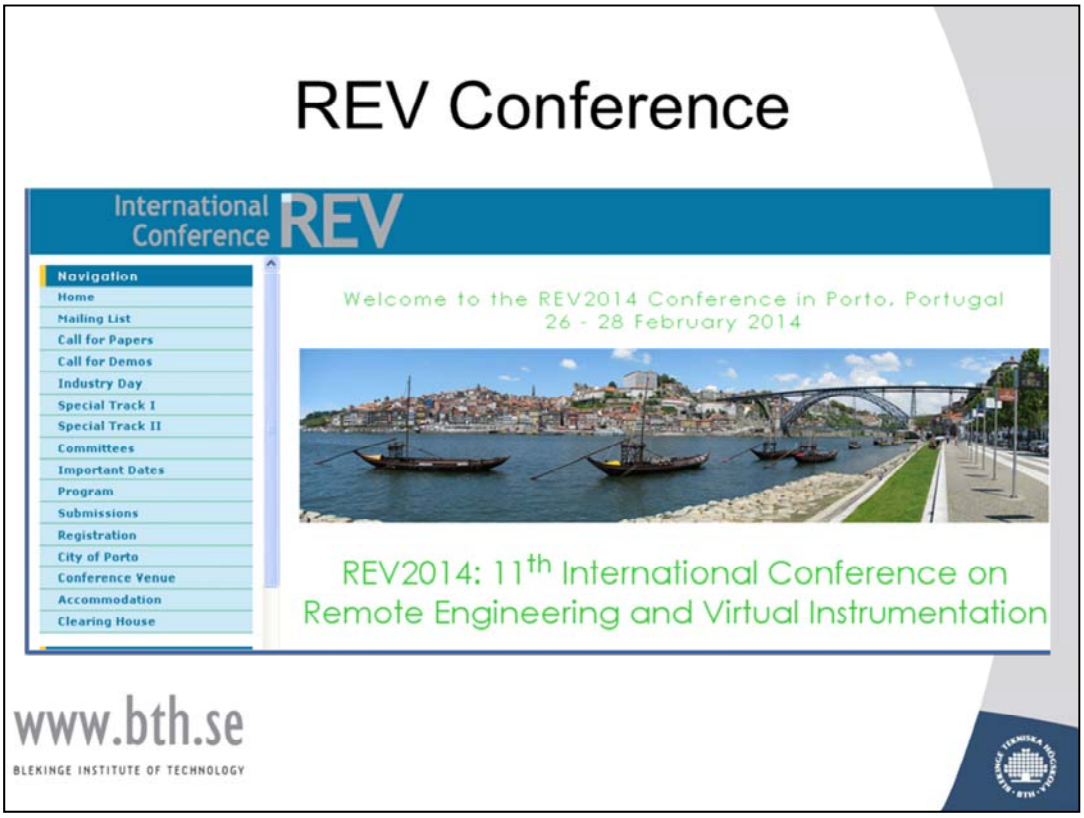
1. Nowadays, engineering courses focus on theories and mathematical models. D. Magin and S. Kanapathipillai, “Engineering Students’ Understanding of the Role of Experimentation”, *European Journal of Engineering Education*, 2000, Vol. 25, no. 4, pp. 351-358.
2. Students nowadays want extended access to learning resources and an increased freedom to organize their own learning activities, which is also one of the main objectives of the Bologna Process.
3. While there seems to be general agreement that laboratories are necessary, little has been said about what they are expected to accomplish before ABET (Accreditation Board for Engineering and Technology) The objectives is listed in L.D. Feisel and A. J. Rosa, “The Role of the Laboratory in Undergraduate Engineering Education”, *Journal of Engineering Education*, Jan. 2005, pp 121-130.



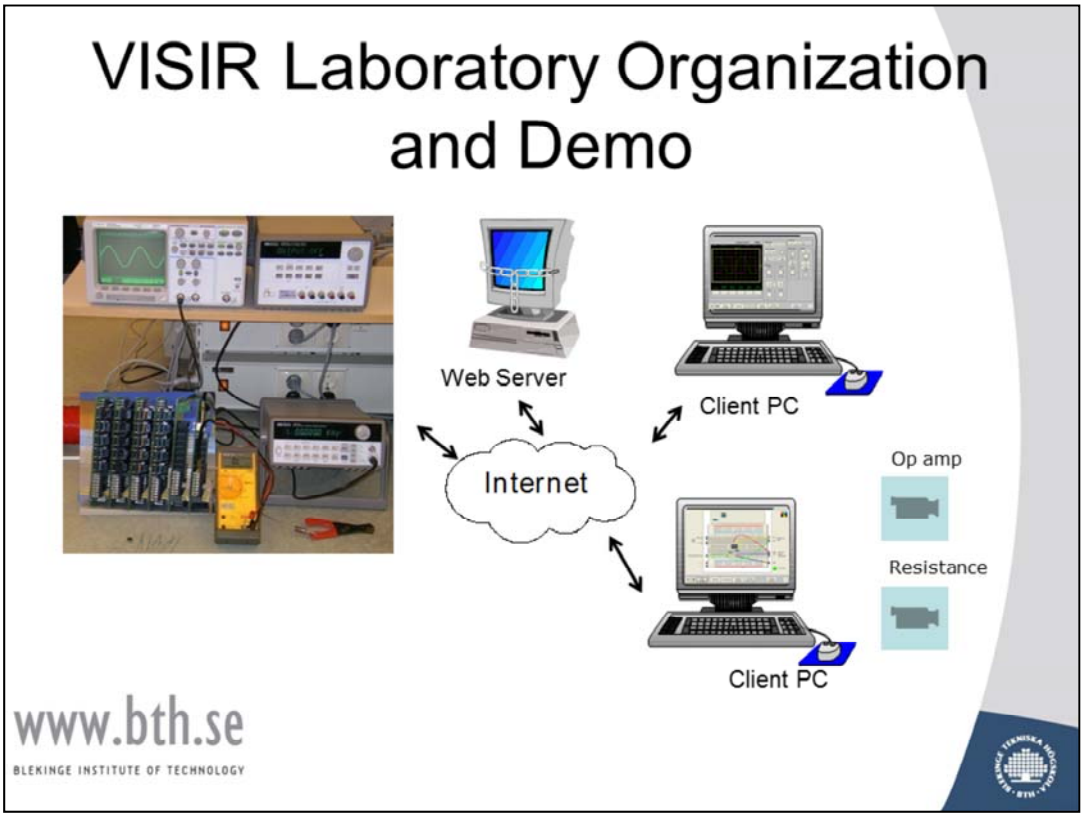
1. In 1999 a remote laboratory project was started to supplement local instructional laboratories in terms of accessibility in collaboration with National Instruments and Axiom Edutech. The was vision is a low-cost online laboratory for electrical experiments that could be used by many students or student teams simultaneously.
2. Today laboratories in electronics, security, radio and signal processing are online. They are used in regular courses for students who can be on campus or off campus.
3. At the end of 2006 a disseminating project known as VISIR was started. **We wanted to invite others to participate in the further development.**
4. Most remote laboratories enable students to perform physical experiments 24/7 by controlling distant equipment over the Internet using a web browser only and the students will get results identical with those they would have obtained in a hands-on laboratory. In VISIR laboratories students are able not only to execute prepared experiments remotely but also to do the actual preparation remotely within limits set by a teacher and to acquire laboratory workmanship as well.

UNED has used their VISIR laboratory in a MOOC, F. Garcia, G. Diaz, M. Tawfik, S. Martin , E. Sancristobal, M. Castro, “A practice-based MOOC for Learning Electronics”, Proceedings of the EDUCON 2014 Conference, pp 969-974, Istanbul, Turkey.

The red marks are the locations of the VISIR laboratories.



People of the inner circle of the VISIR Community meet twice a year or so.

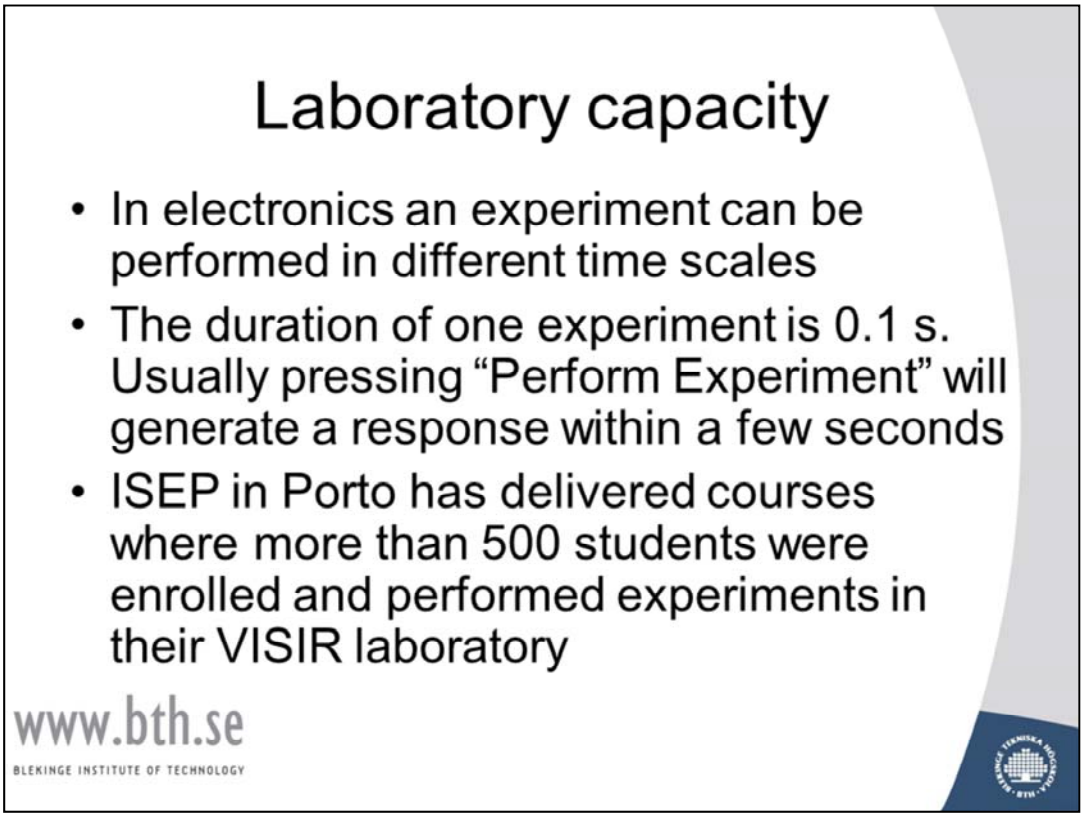


Here is a traditional workbench for electrical experiments. Most electronic instrument can be controlled remotely but the breadboard can not. It must be replaced by a device for circuit wiring possible to control remotely e.g. a switching matrix equipped with electro-mechanical relays, sockets for components, and instrument connectors.

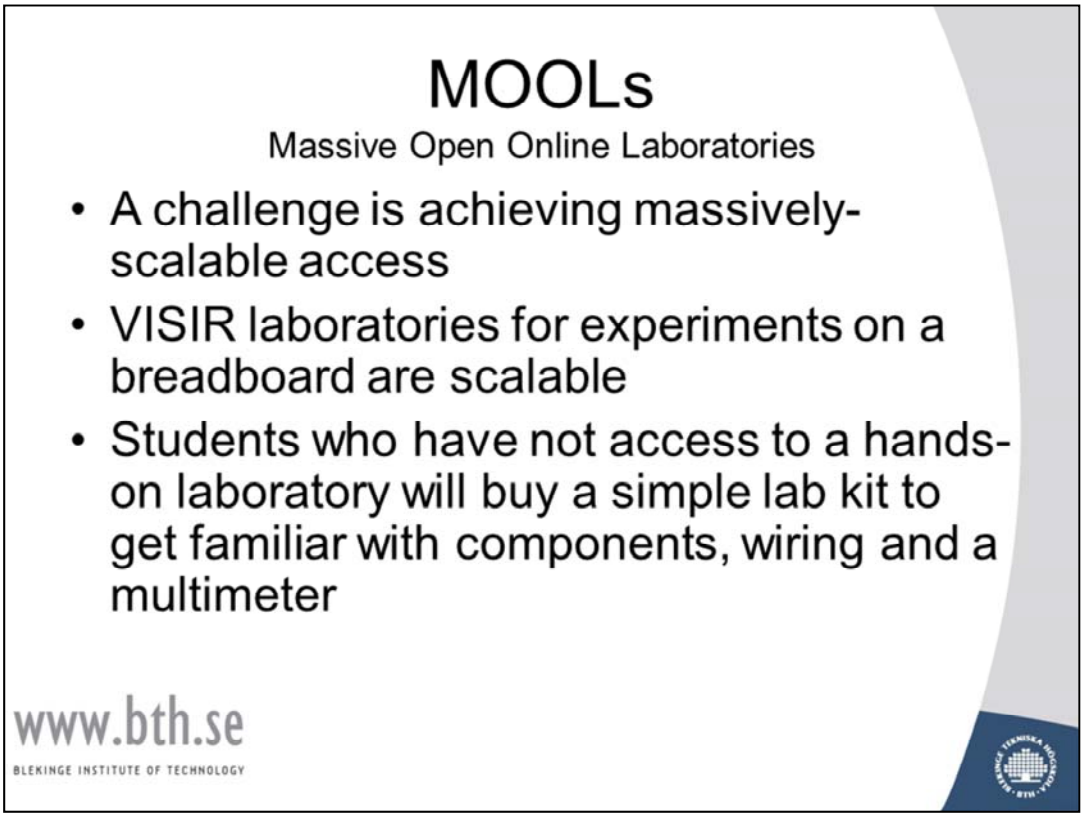
The workbench can now be controlled from client machines over the Internet.

The client software is automatically downloaded from a web server. The client computers show photos of the front panels of the instruments or a virtual breadboard.

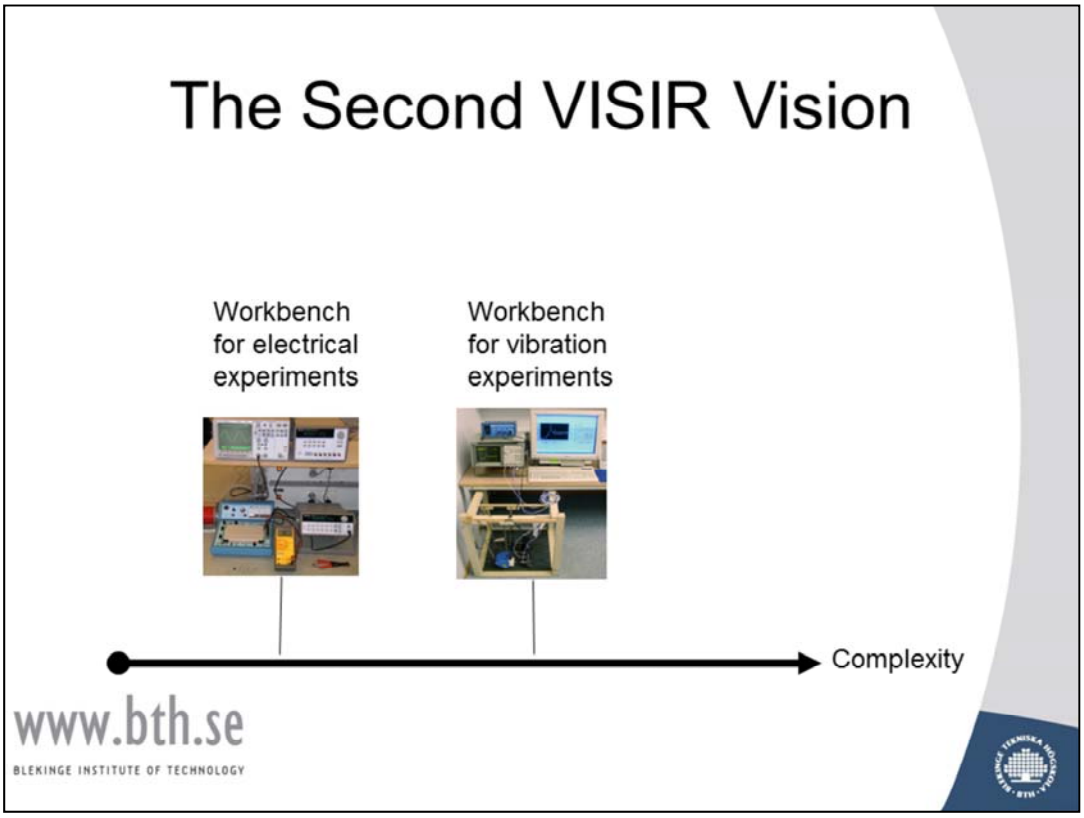
The demonstrations are Camtasia video clips. The op amp clip starts with an almost completed inverting op amp circuit to save time but two wires remain. These two wires are added and the instruments are set. When the circuit and the settings are ready the experimenter presses the Perform Experiment button to send them to the server. The workbench creates the circuit, set the instruments, activates the circuit and performs the measurements requested. Finally the result is returned to the client computer and the oscilloscope traces are displayed.



G.R. Alves, M.A. Marques, C Viegas, M.C. Costa Lobo, R.G. Barral, R.J. Couto, F.L. Jaob, C.A. Ramos, G.M. Vilao, I. Gustavsson, "Using VISIR in a large undergraduate course: Preliminary assessment results", Proceedings of the EDUCON 2011 Conference, pp 1125-1132, Amman, Jordan, 2011. The existing VISIR laboratories are not yet optimized for a large number of simultaneous users. Furthermore, the capacity can be increased by adding more workbenches.



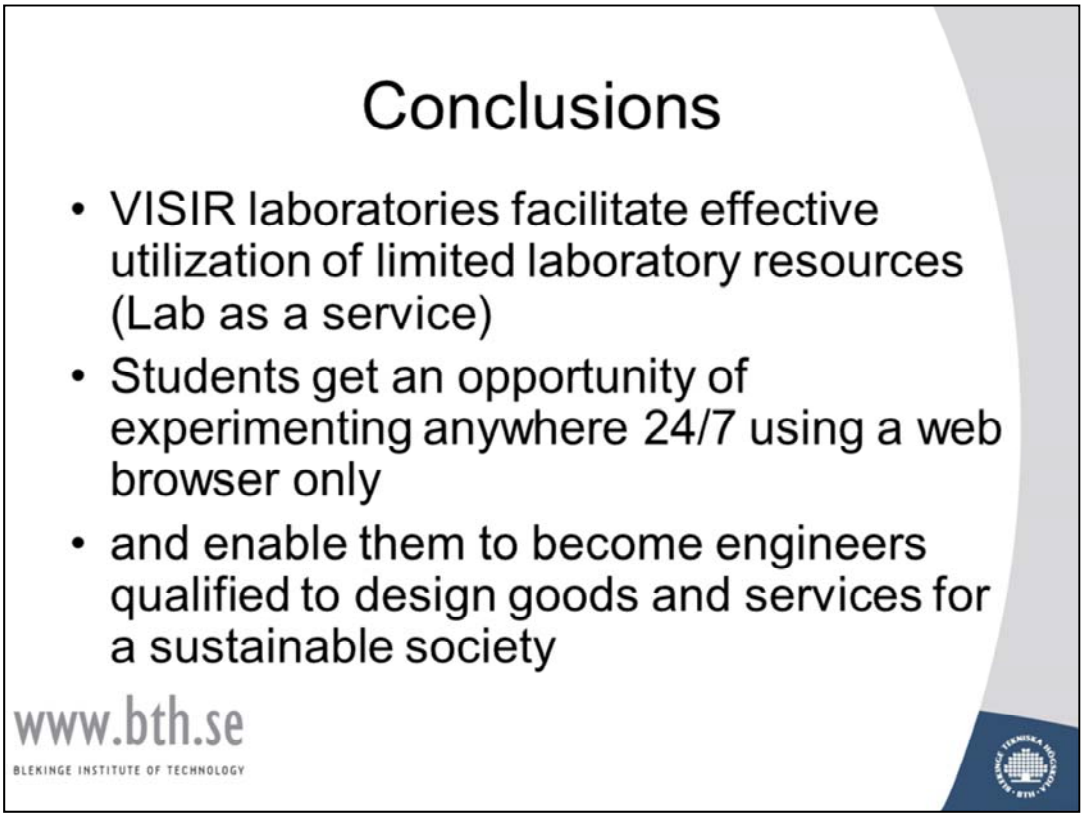
The acronym MOOL is introduced in D. Lowe, “MOOLs: Massive Open Online Laboratories: An Analysis of Scale and Feasibility”, Proceedings of the REV 2014 Conference, Porto, Portugal, February 26 - 28, 2014.



The second vision is expanding the VISIR platform into other subject fields then the electrical. The first new field is mechanical vibration experiments. The degree of complexity is mostly the complexity of the telemanipulator. Computer controlled and computer mediated experiments needs no telemanipulator.

1. Extend the room in order to expand the laboratory globally and include online workbenches at other universities – especially VISIR ones – as well as online instructor desks.
2. Use video conferencing tools supporting shared desktop such a Adobe Connect, for example, to organize supervised experiment sessions where the students in a session can see each other and communicate.
3. Organize a repository of learning material especially laboratory instruction manuals. The repository will mainly be composed of existing material from collaborating teaching organizations.

The third vision is an additional vision. The second vision is still valid.



VISIR laboratories supplement hands-on laboratories or extend simple physical experiments at home and enable students to become true experimentalists meeting the fundamental objectives of engineering instructional laboratories defined on an ABET initiative i.e. to be able to design goods and services, which are in tune with nature and a sustainable society

Thank you for your attention

www.bth.se

BLEKINGE INSTITUTE OF TECHNOLOGY