



STEM Education & Modeling Project

The Business-Higher Education Forum (BHEF) is leading a groundbreaking STEM Education & Modeling Project to help increase the number of students who pursue majors and careers in the fields of science, technology, engineering, and mathematics (the disciplines collectively known as STEM). The project's impetus is BHEF's STEM Initiative, which seeks to double the number of U.S. students who graduate in STEM fields. The project builds on a system dynamics model of the U.S. STEM education system (the "U.S. STEM Education Model") developed by the Raytheon Company and gifted to BHEF. It is being advanced through the STEM Research and Modeling Network (SRMN), an open innovation network hosted by BHEF and dedicated to fostering the development and use of the model and similar complementary tools.

The goals of the project are to:

- Provide an organized and comprehensive approach to viewing and understanding the complex, multi-level nature of the U.S. and STEM education system.
- Identify potential solutions that can help strengthen U.S. STEM education and workforce outcomes.
- Differentiate among the most effective alternatives for investing in STEM education.

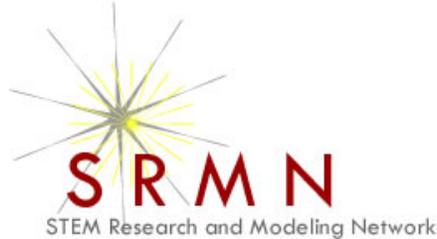
A Unique Modeling Effort

System dynamics is a powerful technique that uses computer simulation to help frame, understand and analyze the behavior of complex systems. The technique was developed during the 1950s as a tool to help understand the reasons why business would succeed or fail. It is currently widely used in engineering-related industries, and has also been applied in numerous other contexts, including the study of complex, adaptive systems in fields ranging from climatology to urban planning to energy policy. Despite its potential to help analyze and solve the complex systemic problems that face education, to date it has not been applied to study the U.S. education system.

The U.S. STEM Education Model is the first simulation model to examine the U.S. education system using system dynamics principles and tools. Specifically, the model allows users to simulate various scenarios to determine whether they have the potential to increase the number of students choosing to major and graduate in STEM disciplines. The model uses census data and standardized test scores to track the flow of students through the K-16 education system and into careers in STEM teaching or STEM industries. To capture some of the nuances of persistence in STEM disciplines, the model sorts students by gender into high and low levels of STEM interest and math proficiency.

Many factors affect the number of students who ultimately pursue STEM careers. The model attempts to capture these factors through a series of dynamic hypotheses and feedback loops that together determine the behavior of the system. Raytheon engineers worked with BHEF and other education experts to review published causal research to identify variables and develop and test several dynamic hypotheses that could result in increased numbers of students who graduate in STEM majors.

The STEM Research and Modeling Network (SRMN)



The STEM Research and Modeling Network (SRMN) is hosted by BHEF and plays a central role in advancing the U.S. STEM Education Model. The SRMN brings together researchers, policymakers, practitioners, corporations, and funders who all share the goal of using simulation modeling and other tools to strengthen student interest, participation, and achievement in the STEM fields. The SRMN was founded in 2008 by BHEF, Raytheon Company, and The Ohio State University (OSU), with additional partners joining the group as work progressed. Using the model as a starting point, the SRMN provides an open innovation platform for developing a common set of STEM education and research priorities. By bringing together multiple stakeholders, the SRMN fosters dynamic collaboration around modeling and research to improve practice and policy.

Because open innovation techniques and tools such as system dynamics modeling are new to the field of education, a major focus of the SRMN will be to introduce these techniques and tools, as well as their benefits and opportunities, to the diverse range of stakeholders who are concerned about improving education and workforce outcomes. The SRMN has already attracted several thought leaders, funders, and other potential partners to the effort. For example:

- Multidisciplinary teams of faculty and graduate students based at The Ohio State University and Arizona State University have begun coalescing to create state-based models.
- A Nobel-Prize winning physicist has participated in the SRMN because of its potential to spur innovation in education R&D.
- The President's Council of Advisors on Science and Technology, the National Science Board, and the NSF Engineering Directorate have been briefed on the project.
- The Bill & Melinda Gates Foundation and Kauffman Foundation have provided initial support to launch the SRMN.
- IBM and Sun Microsystems have provided in-kind technical assistance regarding the development of an open innovation network.

Please visit the SRMN website, www.STEMnetwork.org, for additional information about the project and to learn how to become involved.

Next Steps

Since completing a beta version of the model in 2008, Raytheon has worked with BHEF and other experts to test and refine the model's assumptions. Based on this work, a second version of the model is being released on July 8, 2009. This new version of the model, which is free and available in open source for use by the public, is being managed by a partnership among BHEF, Raytheon and The Ohio State University's Battelle Center for Mathematics and Science Education Policy.

BHEF and its partners seek additional organizations to be National Partners in this project. These National Partners will help to advance the overall effort through in-kind and/or financial support for ongoing refinement and further build out of the model; the development of a user interface to address key policy questions; training and supporting users in the use of the model; and further development of the SRMN to advance a research and policy agenda to improve STEM education.