

# New approach needed to prevent major 'systemic failures'

January 31 2011

---

A Purdue University researcher is proposing development of a new cross-disciplinary approach for analyzing and preventing systemic failures in complex systems that play a role in calamities ranging from huge power blackouts to the BP *Deepwater Horizon* disaster and the subprime mortgage crisis.

"The striking similarities in such catastrophes necessitates a broader perspective to better understand such failures," said Venkat Venkatasubramanian, a professor of chemical engineering. "In the history of systemic failures, a few disasters have served as wake-up calls. The Flixborough chemical plant accident in the United Kingdom in 1974, where a Nypro UK plant explosion killed 26 people, was one such call."

Other such major catastrophes, he said, include a 1984 Union Carbide accident in Bhopal, India, which killed more than 2,000 and injured more than 100,000, and the 1988 failure of an [oil platform](#) operated by Occidental Petroleum in the North Sea, which resulted in 167 deaths and about \$2 billion in losses.

"Such systemic failures are not limited to the chemical and petrochemical industries," Venkatasubramanian said. "The Northeast electrical power blackout in 2003 and a recent massive recall of drug products are both systemic failures. Financial disasters such as Enron, WorldCom, the subprime mortgage derivatives crisis and the Madoff Ponzi scam also belong to the same class."

The need for a new cross-disciplinary framework to address such systemic failures was introduced in an article appearing in the January 2011 issue of the *AICHE Journal*.

"We must study all disasters from a common systems engineering perspective so that one can thoroughly understand the commonalities as well as the differences in order to better design and control such systems in the future," Venkatasubramanian said. "There is an important role for universities here, as well, in creating and disseminating knowledge about abnormal-events management in complex engineered systems and their public and corporate policy implications."

Such studies need to be carried out, he said, with public policy experts so that the scientific and engineering lessons get translated into effective policies and regulations.

"Typically, systemic failures occur due to fragility in complex systems," Venkatasubramanian said. "Modern technological advances are creating a rapidly increasing number of complex engineered systems, processes and products, which pose considerable challenges in ensuring their proper design, analysis, control, safety and management for successful operation over their life cycles."

The sheer scale and complexity of interactions between elements, including people, in such systems-of-systems make them fragile.

"In particular, the nonlinear interactions among a large number of interdependent components and the environment can lead to what we call 'emergent' behavior," Venkatasubramanian said. "In other words, the behavior of the whole is different than the sum of its parts and can be difficult to anticipate and control. This is further compounded by human errors, equipment failures and dysfunctional interactions among components and subsystems that make systemic risks even more likely if

one is not vigilant all the time."

Postmortem investigations have shown that major disasters rarely occur due to a single failure of equipment or personnel. Instead, layers of failures of equipment, systems, processes, regulations and people usually are at fault, he said.

Often, Venkatasubramanian said, the responsibility for an accident rests with the top levels of company management and a poor corporate culture regarding safety.

"Professor Venkatasubramanian's article in AIChE discusses the surprising commonalities of systemic failures that lead to disasters, such as the Gulf of Mexico oil spill, and outlines a role that academic institutions can play to prevent such destructive events from happening in the future," said John W. Bickham, director of Purdue's Center for the Environment and a professor in the Department of Forestry and Natural Resources. "The highly interdisciplinary field of systems engineering will play a key role in the development of policies and procedures that can protect the environment and human health and safety in the future."

Provided by Purdue University

Citation: New approach needed to prevent major 'systemic failures' (2011, January 31) retrieved 22 June 2024 from <https://phys.org/news/2011-01-approach-major-failures.html>

<p>This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.</p>
--