A hurricane shouldn't bankrupt your insurance company.

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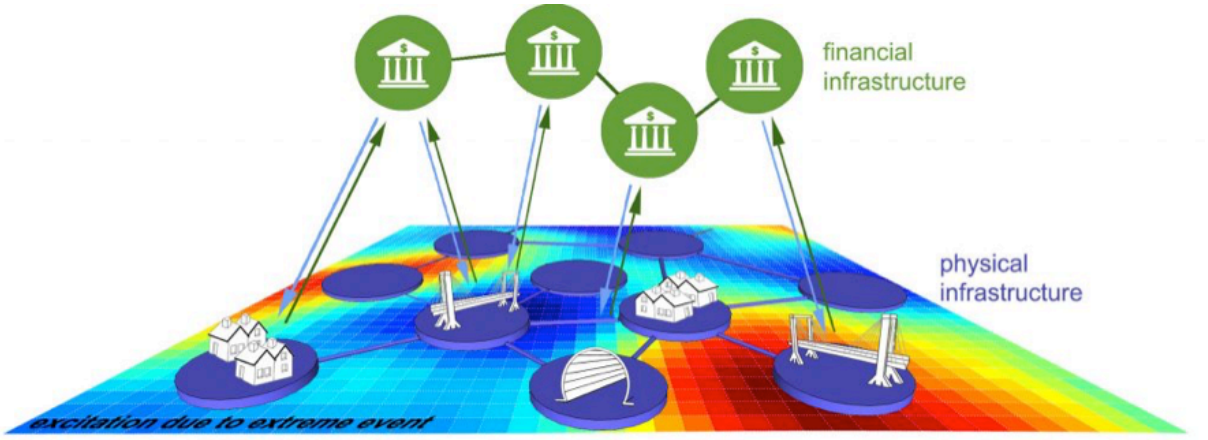

Illustration of the interplay between physical and financial infrastructure during an extreme event. Credit: Carnegie Mellon University, Department of Civil and Environmental Engineering

When a storm puts a tree branch through your roof, or a flood damages your foundation, you turn to your insurance company to pay for the repairs. And when it's only one, or two, or even 10 claims, insurance can cover the costs, no problem. But when it's an entire city? An entire state? The price of paying all of those claims at once can sometimes be enough to not only bankrupt the company, but to collapse the economy of an entire region.

Understanding the circumstances that lead to these financial disasters is fundamental to learning how to stop them from happening—and that's exactly what researchers in Carnegie Mellon University's College of Engineering are trying to do.

Civil and Environmental Engineering Assistant Professor Matteo Pozzi and Electrical and Computer Engineering Associate Professor Bruno Sinopoli, along with Assistant Professor Andreea Minca from the Department of Operations Research and Information Engineering at Cornell University, have recently received funding from the National Science Foundation's Critical Resilient Interdependent Infrastructure Systems and Processes (CRISP) program to study the intersection between financial and physical infrastructure in response to disasters. What they're looking for? How financial and physical systems need to be arranged to prevent failures cascading from one system to the next, and promote a fast recovery after an extreme event.

"When you have a shock that affects physical infrastructure, the recovery process depends on the activities of the financial systems, because you need investment to fund the recovery," Pozzi says. "But this demand can put a stressor on the financial system itself. An insurance company, for example, can be put in danger by this obligation to pay back the damage that has been caused to the physical infrastructure."

The process begins by developing an understanding just how and where the financial system is coupled to certain physical infrastructure systems—such as bridges, company headquarters, or telecommunication networks—by running computer models that simulate disasters with specific criteria. From there, the team will be able to pinpoint not only where these interdependencies lie, but also how fragile they are, and how big a disaster would have to be in order to cause a cascading failure from one system to another.

Armed with that understanding, they will then be able to develop strategies for reshaping those dependencies; frameworks that can be used to help cities and regions make their next disaster less disastrous.

"Take the example of power and communication systems, for instance," explains Sinopoli. "Especially these days, if communication goes down the smart grid isn't going to work, but if the power grid goes down then communication won't work either. So you can't decouple them, but perhaps you can put generators in key areas so that if power does go down, at least for a certain amount of time you can keep functionality of communication going until you can get the power grid back online."

From there, physical infrastructure managers can devise the optimal combination of insurance purchasing and decoupling elements to maximize resilience for minimum cost. Financial institutions, on the other hand, can leverage decoupling elements to lower their risk in case of an extreme event—and with it, their premium.

The team hopes that once the framework is built, they will be able to use it to examine past disasters—the Northeast blackout of 2003 for instance, or Hurricane Katrina—to understand exactly what went wrong, and what decoupling efforts could have been made to prevent these disasters from going over the edge. All of this knowledge will help future city planners and disaster response crews ensure that large-scale financial and physical infrastructure breakdowns such as these never happen again.

More information: For more information, please visit: faculty.ce.cmu.edu/pozzi/finan … nder-extreme-events/

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