TAKING THE LONG VIEW ON INFRASTRUCTURE

The philosophy behind life-cycle engineering holds that decisions about investing in bridges, buildings and other infrastructure should maximize the benefits of the investments over the lifetime of a structural system while adequately serving the needs of society. This is accomplished by finding the optimum balance among the requirements of safety, serviceability, economy, resiliency and sustainability—despite imperfect information and knowledge.

In other words, “How can policy makers and engineers be encouraged to take the long view rather than focus on the upfront sticker price?”

Dan M. Frangopol, the Fazlur R. Khan Endowed Chair of Structural Engineering and Architecture, has spent most of his career asking that question. Last fall, he posed the question to educators and industry leaders at the annual convention of the American Society of Civil Engineers (ASCE).

Frangopol began studying life-cycle engineering while writing the paper “Life-Cycle Cost Design of Deteriorating Structures.” Published in 1997 in ASCE’s *Journal of Structural Engineering*, and co-authored by his former Ph.D. advisees, Kai-Yung Lin and Allen C. Estes, the paper addressed the civil engineering industry’s short-sightedness in weighing costs and benefits.

“People at the time weren’t realizing that they could make investments and decisions that minimized the cost over the time horizon of a structure or infrastructure system,” Frangopol says. Cost must include the expense not just of creating a structure, but also of inspecting, maintaining, repairing and replacing it. Cost must also account for

natural and man-made hazards, climate change and other factors which change over time and are highly uncertain.

“The goal of life-cycle engineering should be to minimize the price [of a structure] and maximize the structure’s performance” over its lifetime,” says Frangopol. “We as civil engineers have been moving in that direction.”

Engineers, says Frangopol, should consider many factors before making the most informed decision regarding the life-cycle management of deteriorating structures under uncertainty. These include environmental impact, social and political implications, recovery after disasters, and availability of resources. To find optimal solutions, engineers can use probabilistic modeling and analysis, as well as computer simulation.

Story by John Gilpatrick ’10

By: Kurt Pfitzer
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The goal of life-cycle engineering, says Frangopol, is to maximize the initial investment in a structure by considering the cost not only of building the structure but also of maintaining it over its expected lifetime.

FRANGOPOL RECEIVES INTERNATIONAL ACCOLADES

Dan Frangopol has received half a dozen international honors in recent months for lifetime achievements. Earlier this month, he was selected to be the inaugural recipient of the Alfredo Ang Award on Risk Analysis and Management of Civil Infrastructure from the American Society of Civil Engineers (ASCE).

Frangopol was cited for “exceptional efforts in advancing, advocating and persistently promoting the life-cycle cost analysis of structures and structural systems, and their integration into reliability-based structural analysis and design.” He will receive the award this fall at the ASCE Annual Convention in Portland, Oregon.

On April 11, Frangopol received an honorary doctorate from the Polytechnic University of Milan, Italy's largest technical university. During the awards ceremony, before 250 participating faculty members and students from Italian universities, Frangopol presented a lecture titled "Life-Cycle Civil Engineering: Accomplishments and Challenges." Frangopol is one of four civil engineers to receive an honorary doctorate from the Polytechnic University, whose civil engineering program is ranked among the top 14 in the world and the top five in Europe. The honorary doctorate was the fourth Frangopol has received in his career.

Last fall, Frangopol was one of four foreign members elected into the Physics and Engineering Sciences section of the Academia Europaea. The Academia, a nongovernmental European association of scientists and scholars, was founded in 1988 to promote promotes a wider appreciation of European scholarship and research and to advise governments and international agencies on matters related to science, scholarship and academic life. Frangopol was cited for his achievements in structural reliability and risk. Of the Academia's 3,400 current members, 52 are Nobel laureates.

In the past year, Frangopol has also received honorary professorships from the Royal Melbourne Institute of Technology (RMIT), Hunan University, Beijing Jiaotong University and Chongqing Jiaotong University.

In March, Frangopol received the OPAL (Outstanding Projects and Leaders) Award for lifetime achievement in civil engineering education from the American Society of Civil Engineers (ASCE). In May, he received the 2016 Hillman Award for Excellence in Graduate Advising from Lehigh.

Also in May, Frangopol accepted an invitation to join the ASCE Industry Leaders Council to help identify tactical actions for ASCE and the civil engineering profession.

Frangopol has helped shaped design, assessment, and maintenance specifications as well as management methods and optimization approaches in the field of structural engineering. A Fellow of ASCE's Structural Engineering Institute, Frangopol is credited on SEI's website with conducting research that "has not only saved time and money, but very likely also saved lives."

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