Meeting of the Committee on Geological and Geotechnical Engineering

April 29-30, 2021

Virtual Meeting

Public Meeting Briefing Materials

The National Academies of

SCIENCES • ENGINEERING • MEDICINE

BEFORE THE MEETING

Run a Test

- If you have a moment today, please test your Zoom connection, video, and audio by clicking here: http://nasem.zoom.us/test

AUDIO

Use computer audio with a headset if possible

- The best audio is achieved with a headset, but if you don't have one, it still may be fine to use your computer mic/speaker. Please test it in advance or dial in a few minutes early for a sound check.
- If internet speed is an issue where you are, or if your sound becomes garbled, switch to the telephone.

Tips for using a telephone

- If you need to use a telephone for audio, please login on the computer first, and click the button for phone audio. It will then provide a long list of phone numbers and a participant ID, which will link your name in the participants menu to your phone.
- Please call a local number from the Zoom number options. The toll free numbers are often overloaded. If you get a recording saying your meeting number is not recognized and you know you typed it correctly, you can click the "Call Me" option and Zoom will call you. When dial in numbers fail, the "call me" option has always worked (so far).

Muting your microphone

- Please mute your line when you aren't speaking. You can do this on your end or use the participants' panel.
- If we hear noise or feedback from your line, we may mute you on our end, and you will need to use the participants' panel to unmute.

VISUALS

Webcam

- We would like everyone to use a Webcam when they are speaking during the meeting to keep everyone engaged. Once you are done speaking, please turn your camera off.
- If you don't want to share your home with everyone, feel free to use a Zoom background. (Click the up arrow next to your Video icon and click "Choose Virtual Background". You must have the current version of the Zoom application to use this.)

Side-by-side Mode

- You can see a shared screen and all the webcam feeds side-by-side by clicking "View Options" when someone is sharing their screen and clicking "Side-by-side Mode". There is a sizing handle in the middle to make one larger than the other. We will walk everyone through this at the start of the meeting. You can also turn it off the same way if you'd like to see the shared screen in a larger format.

Sharing screens

- **Courtney DeVane** will plan to share her screen so we can view the presentations.

DURING DISCUSSIONS: USING THE PARTICIPANTS PANEL

Raise Hand

- We will use the Raise Hand feature as we use tent cards during an in-person meeting, so we can keep track of who has something to say. When you have a comment/question/etc., please use the "Raise Hand" feature. This is located at the bottom right corner of the screen either in the Participants panel or the Reactions panel.

Status Icons

- Across the bottom of the participants' panel or within the Reactions panel (depending on your version of Zoom) you will see various icons like "Raise Hand" – "Yes" – "No". These will add icons next to your name for all to see. If you click "More" there is an option for "Need a break" and other options. Please use these icons to communicate that you need a break, you are away, etc. We may also use the "Yes" and "No" icons if we need consensus around the committee.

HOW TO GET TECHNICAL HELP

Contact the Project Assistant

- You can contact Calla Rosenfeld and Mandy Enriquez by chat or email (crosenfeld@nas.edu, menriquez@nas.edu) if you're having serious technical challenges and need their assistance.

Contact Zoom: 888-799-9666

Committee on Geological and Geotechnical Engineering
Board on Earth Sciences and Resources
National Academies of Sciences, Engineering, and Medicine

April 29, 2021
11:00 – 3:30 PM Eastern
OPEN SESSION—to be held remotely
Advancing Geo-Professional Perspectives in Risk-Informed Decision Making

Session Objective: Identify issues to which COGGE can respond and determine COGGE's next steps

Risk-informed methods increasingly influence decision making across numerous sectors. Risk analyses that support decision making typically answer three fundamental questions: what events could affect performance and safety?; how likely are those events to occur?; and what are their consequences? To consider the activities COGGE might undertake to help advance geoprofessional risk analyses, participants in the April 29, 2021 meeting of the Committee on Geological and Geotechnical Engineering (COGGE) will discuss:

- The adequacy of how inherent randomness in demand (loads, environmental factors), capacities (resistance), system performance, and consequences are considered in risk analyses.
- How uncertainties in risk analyses results are presented to decision makers.
- What is needed to expand traditional analyses of technical engineering performance, monetary loss, and public health consequences, to a more comprehensive framework that also addresses social and environmental risks and consequences, including those that encompass social and environmental justice and climate change.

All times are Eastern Daylight

11:00 **Introductions, description of session objectives**
Martin McCann, Chair, COGGE

11:25 **Keynote Presentation: Lessons learned in Risk-Informed Decision Making**
Thomas Denis O'Rourke, Cornell University (emeritus)

11:50 **A series of short talks providing different viewpoints of the meeting theme will be followed by a panel discusion**
Moderator: John Stamatakos, COGGE Member

11:50 **Uncertainty and the Value of Geotechnical Engineering**
Steve Kramer, University of Washington (emeritus)

12:05 **Risk and Uncertainty: An Owner's Perspective**
Kevin Marshall, Grant County (Washington) Public Utilities District

12:20 **Beyond Protecting the Public from Risk**
Robert Gilbert, University of Texas at Austin

12:35 **Thinking Holistically and Engaging Stakeholders in Risk-Informed Decision Making**
Laurie Johnson, Laurie Johnson Consulting/Research

12:50 **Ethics for the Geoprofessional: Risk Analysis and Other "Actors" in a Larger Socio-Technical System**
Rosalyn Berne, University of Virginia

1:05 **Break**

1:30 **Moderated panel discussion**
Discussion moderator: Allen Marr, COGGE member

2:30 **Break**

2:40 **Moderated disucussion: key takeaways and how can COGGE help?**
Moderator: Marty McCann, COGGE chair

3:25 Closing comments

3:30 Open session adjourns, break

Committee on Geological and Geotechnical Engineering

Statement of Task

The Committee on Geological and Geotechnical Engineering (COGGE) is the focal point within the Board on Earth Sciences and Resources for scientific, technical, and public-policy issues pertaining to the engineering applications of Earth Sciences. The committee's scope encompasses Earth processes and materials, including the mechanics of rock and soil, and focuses on safe and responsible human development, risk assessment, and mitigation of natural and anthropogenic hazards. The committee organizes and oversees studies:

1) to identify, investigate, and report on questions related to geological and geotechnical engineering to government, industry, academia, and the public;
2) to provide scientific and technical information to inform public policy on geological and geotechnical engineering issues;
3) to identify new technologies and potential applications; and
4) to promote the acquisition and dissemination of knowledge.

In addition, the committee provides a forum for discussion among academic and professional groups, government agencies, and private industry to enhance national and international cooperation and exchange of information.

COMMITTEE ON GEOLOGICAL AND GEOTECHNICAL ENGINEERING

Committee Member Biographies

MARTIN W. MCCANN (chair) is president of Jack R. Benjamin and Associates, Inc. and is also a consulting professor of civil and environmental engineering at Stanford University. At Stanford, he is a former chair of the National Performance of Dams Program, which created a national network to report dam safety incidents and to archive this information for use by the geotechnical and seismic engineering communities. Dr. McCann's professional background and research have focused on probabilistic hazards analysis including hydrologic events, risk assessment, reliability and uncertainty analysis, and systems analysis. He has been a consultant to several government and private sector groups in the U.S. and abroad and has served on three NRC committees including the Committee on Integrating Dam and Levee Safety and Community Resilience. Dr. McCann received a B.S. in civil engineering from Villanova University and an M.S. in structural engineering and a Ph.D. in civil engineering from Stanford University.

SCOTT A. ANDERSON is a principal geotechnical engineer at BGC Engineering in Golden Colorado. He has wide ranging geotechnical design and construction experience in the transportation, water resources, mining, and pipeline industries. His experience includes earthwork—retaining structures, foundation design and construction, and ground modification techniques. He is experienced in remote sensing, geophysical and drilling site characterization, and the determination of soil and rock properties and design parameters. He has provided oversight and review of design and construction as well as contributed to research and deployment of training and new technology in many areas of practice. Prior to joining BGC Engineering, Dr. Anderson was the Geotechnical Services Team Leader for the Federal Highway Administration (FHWA) Resource Center from 2008 to 2017; and prior to that, he held geotechnical leadership roles for the Federal Lands Highway Division of FHWA for 6 years. He was awarded the FHWA Engineer of the Year in 2014, he was the recipient of the K.B. Woods Award in 2016 from the Transportation Research Board for contribution to the design and construction of transportation facilities, and he served as the 2017 Jahns Distinguished Lecturer for the Association of Engineering Geologists and the Geological Society of America. Dr. Anderson holds a B.A. and M.S. in engineering geology from the University of Colorado, Boulder and Colorado State University, respectively. He received an M.S. and Ph.D. in civil engineering from the University of California, Berkeley.

PEDRO ARDUINO joined the geotechnical group in the University of Washington's Department of Civil and Environmental Engineering (UW DCEE) in 1997. His primary research interests are in computational geomechanics with emphasis in constitutive modeling of soils, finite element analysis, meshless techniques, soil structure interaction, and hazard analysis. Much of his current research is in the area of landslide and debris flow simulation, soil-structure interaction, and performance-based earthquake engineering. He has conducted research for the National Science Foundation, the Pacific Earthquake Engineering Research (PEER) Center, and the Washington State Department of Transportation (WSDOT). Dr. Arduino held the Ray Bowen Professorship for Innovation in Engineering Education from 2003 - 2007 and received the Outstanding Teaching Award from the UW DCEE in 2009. Dr. Arduino was a visiting professor at the Universidad Nacional de Córdoba, Argentina in 2004 and 2008 and at the Universidad de los Andes in Colombia also in 2008. He is a member of the ASCE EM Inelasticity and ER Earth and Retaining Structures committees and served on the editorial board of the *Journal of Geotechnical and Geo-environmental Engineering*. Dr. Arduino is a member of Geotechnical Extreme Events Reconnaissance Association and was part of the reconnaissance teams that visited Chile after the 2010 Maule earthquake, Japan after the 2011 Tohoku earthquake, and Mexico after 2017 Morelos-Puebla Mexico earthquake. He has also served as a consultant to private firms and government agencies in the U.S. and abroad. He earned his B.S.C.E.

from the Universidad Nacional de Cordoba, his M.S.C.E. from the University of Puerto Rico, and his Ph.D. from the Georgia Institute of Technology.

JAMI G. DWYER is a licensed professional engineer with 27 years of experience in the mining industry specializing in rock mechanics, blasting, operational efficiency, health and safety, maintenance strategies, mine design, and mine planning. Most recently, she was recruited by Barr Engineering to assist with business development in the mining sector for their Engineering and Design Business Unit. Previous to that, Mrs. Dwyer worked for Barrick Gold Corporation for nearly 11 years where she served in a variety of roles including management of engineering, maintenance, and mine operations departments. While with Barrick, she was also selected to lead a special interdisciplinary project team to develop software applications leveraging big data, machine learning, advanced analytics, and predictive analytics to predict failures of mining equipment components. Mrs. Dwyer spent 15 years employed by the National Institute for Occupational Safety and Health Office of Mine Safety and Health Research in Spokane, Washington, where she led and developed several rock mechanics research projects related to innovative geotechnical monitoring technologies, blast damage assessments, and evaluation of ground support. She was also instrumental in developing early versions of software to locate and analyze mine seismicity and rock bursts in deep underground hard rock mines. Mrs. Dwyer has served on the board of directors for the American Rock Mechanics Association and is a past chair of the Society of Mining, Metallurgy, and Exploration's Mining & Exploration Division's Executive Committee. She holds B.S. degrees in applied computer science and mining Engineering from Montana Technological University, and an M.S. degree in mining engineering from the University of Missouri-Rolla.

CRAIG A. DAVIS is a professional consultant on geotechnical, earthquake, and lifeline infrastructure system resilience engineering. During his 31.5 year career at the Los Angeles Department of Water and Power (LADWP) he worked as the departmental chief resilience officer, resilience program manager, seismic manager, geotechnical engineering manager and trunk line design manager. Dr. Davis developed a comprehensive LA water system resilience program and is involved in creating policy for improving infrastructure systems to threats and hazards. He has investigated and evaluated numerous dams and tunnels, managed several multimillion dollar projects, and implemented unique and innovative designs while aiding the development of new technologies and their applications. Dr. Davis served on the National Earthquake Hazards Reduction Program (NEHRP) Advisory Committee on Earthquake Hazards Reduction (ACEHR) for 6 years. He is the founding executive committee chairperson for the ASCE Infrastructure Resilience Division. Dr. Davis was honored with the ASCE's 2016 Le Val Lund Practice Award for Lifeline Risk Reduction. Dr. Davis has published over 125 technical papers and also organized and coordinated numerous international workshops and symposiums on geotechnical engineering and lifeline system resilience. Dr. Davis is a California licensed civil and geotechnical engineer and received a B.S. in Civil Engineering from the California Polytechnic State University in San Louis Obispo, an M.S. in civil engineering with emphasis in structural earthquake engineering from the University of Southern California, and a Ph.D. in civil engineering with emphasis in geotechnical earthquake engineering from the University of Southern California.

WILLIAM H. HANSMIRE (NAE) is a senior vice president in WSP's Geotechnical and Tunneling Technical Excellence Center in Los Angeles with expertise in project management, and geotechnical and tunnel engineering. His 40-year career has encompassed roadway, heavy rail, transit, water, and wastewater projects—mostly tunnels. He is the underground design manager for the Los Angeles Metro Regional Connector Transit Corridor Project—a 2-mile tunnel with 3 underground transit stations connecting two existing light rail lines in the heart of downtown Los Angeles. He holds a B.S. degree in civil engineering from the University of Nebraska-Lincoln, M.S. and Ph.D. degrees in civil engineering from the University of Illinois at Urbana-Champaign, and is a licensed professional engineer in several states. He is an

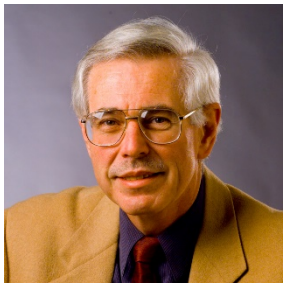
emeritus member of the TRB Committee on Tunnels and Underground Structures and a member of ASCE (fellow) and the NAE.

W. ALLEN MARR, JR. (NAE) is the founder and chief executive officer of Geocomp Corporation, one of the United States' foremost providers of real-time, web-based performance monitoring of civil engineering structures. Among his technical contributions during his 45-year professional career are the development of techniques for monitoring the stability, movement, and pressure in earthwork projects using sensors, wireless communications, automated analysis, and visualization of data. By applying these techniques, Dr. Marr enabled full-scale construction projects to be built more safely and efficiently and at a lower cost. Dr. Marr and his Geocomp colleagues also developed and use the concept of Active Risk Management to help clients identify and proactively manage risks associated with construction and operation of infrastructure. Over the past 30 years, he has consulted on a number of major projects in the United States and abroad including Boston's Central Artery Tunnel, Dulles International Airport, the new World Trade Center, and projects in The Netherlands, Japan, Venezuela, and Korea. He was elected to the National Academy of Engineering for his innovative applications of numerical methods, risk analysis, advanced laboratory techniques, and field instrumentation to geotechnical engineering and construction. In 2018 he serves as president of the ASCE's Academy of GeoProfessionals. Dr. Marr received a B.S. degree in civil engineering from the University of California at Davis and M.S. and Ph.D. degrees in civil engineering from the Massachusetts Institute of Technology.

JAMES K. MITCHELL (NAS/NAE) is a University Distinguished Professor Emeritus at Virginia Tech. Prior to joining Virginia Tech in 1994, he served on the faculty at the University of California, Berkeley, where he held the Edward G. Cahill and John R. Cahill Chair in the Department of Civil and Environmental Engineering until the time of his retirement in 1993. His primary research activities focused on experimental and analytical studies of soil behavior related to geotechnical problems, admixture stabilization of soils, and soil improvement and ground reinforcement, among other topics. He has authored more than 400 publications, including the graduate level text and geotechnical reference *Fundamentals of Soil Behavior*. A licensed civil engineer and geotechnical engineer in California and professional engineer in Virginia, Dr. Mitchell has served as chairman or officer for numerous national and international organizations including chairman of the U.S. National Committee for the International Society for Soil Mechanics and Foundation Engineering. His awards include the Norman Medal, the Walter L. Huber Research Prize, the Terzaghi Lecture Award and the Outstanding Projects and Leaders Award from the American Society of Civil Engineers, and the NASA Medal for Exceptional Scientific Achievement. He was elected to the National Academy of Engineering in 1976 and to the National Academy of Sciences in 1998. Dr. Mitchell received a B.C.E. degree from Rensselaer Polytechnic Institute, and S.M. and Sc.D. degrees in civil engineering from the Massachusetts Institute of Technology.

JOHN STAMATAKOS is a geologist and geophysicist with extensive domestic and international research experience. His areas of expertise include structural geology, earthquake seismology, tectonics, paleomagnetism, and exploration geophysics. He is currently an institute scientist at Southwest Research Institute (SwRI). During his 25-year tenure at SwRI, he has provided technical support for seismic hazard assessments of critical nuclear facilities, principally in support of U.S. Nuclear Regulatory Commission (NRC) programs. He also supported technical and research activities on a variety of other natural hazard assessments including fault displacements, tsunamis, volcanoes, tornadoes, and other severe storms, floods, and landslides. Dr. Stamatakos has also served as an NRC expert witness in the Atomic Safety Licensing Board's adjudicatory process hearings on volcanic and seismic contentions for several NRC licensing actions. He is currently a member of the participatory peer review panel for the seismic hazard re-evaluation of Spanish nuclear power plants. Dr. Stamatakos is past associate editor of the Geological Society of America Bulletin and EOS and has served as a regular reviewer of papers for many leading scientific journals. Dr. Stamatakos earned his B.A. in geology from Franklin and Marshall College, and his M.S. and Ph.D. from Lehigh University in geology and geophysics. He also completed a two-year post-doctorate study at the Eidgenössische Technische Hochschule, Institut für Geophysik in Zürich, Switzerland and a three-year research and faculty position at the University of Michigan.

Speaker Biographies



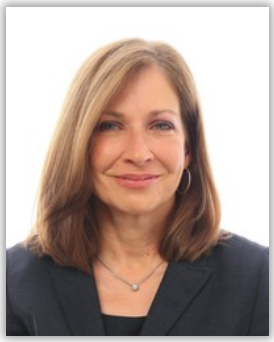
Thomas Denis O'Rourke is the Thomas R. Briggs Professor of Engineering in the School of Civil and Environmental Engineering at Cornell University. He holds a Ph.D. and M.S. degree in geotechnical engineering from the University of Illinois at Urbana-Champaign and a B.S.C.E. from Cornell. Professor O'Rourke has been a member of the teaching and research staffs at Cornell University and the University of Illinois at Urbana-Champaign. His teaching and professional practice include geotechnical engineering for earth retention systems, foundations, and soil/structure interaction; earthquake engineering; underground construction technology, and engineering of large, geographically distributed systems, such as water supplies, gas and liquid fuel systems, electric power, and transportation facilities. He authored or co-authored over 400 publications on geotechnical, underground, earthquake engineering, and impact of extreme events on civil infrastructure. He was principal or co-principal investigator on more than 75 research projects, and has supervised 24 Ph.D. and 22 M.S. theses. Since 1995, he delivered 200 invited lectures, keynote, and conference presentations worldwide. He is a member of the U.S. National Academy of Engineering, International Fellow of the Royal Academy of Engineering, Mexican Academy of Engineering, Distinguished Member of the American Society of Civil Engineers (ASCE), and Fellow of the American Association for the Advancement of Science. He received numerous awards from professional societies, including ASCE, Institution of Civil Engineers (United Kingdom), and the American Society for Testing and Materials. He has served as chair or member of the consulting boards of many large underground construction projects, as well as the peer reviews for projects associated with highway, rapid transit, water supply, and energy distribution systems. He holds US Patent No. 5713393 for "frictionless pipe", February 1998, and jointly holds U.S. Patent No. 8701469 for flexible substrate sensor system for environmental and infrastructure monitoring, April 2014.

Steve Kramer is Professor Emeritus of Civil and Environmental Engineering at the University of Washington in Seattle. His primary research interests include soil liquefaction, site response analysis, seismic slope stability, and hazard analysis. He has worked on the coupling of probabilistic seismic hazard and response analyses within performance-based earthquake engineering frameworks, particularly with respect to soil liquefaction. Kramer is author of the textbook, *Geotechnical Earthquake Engineering* (Prentice-Hall). Kramer has been the recipient of the Presidential Young Investigator Award from the NSF, the Arthur Casagrande Professional Development Award from ASCE, a Walter Huber Research Prize from ASCE, and the ASCE Norman Medal (in 2009 and 2017). He received the 2016 M.J. Nigel Priestley Prize from the European Centre for Training and Research in Earthquake Engineering, the 2018 H. Bolton Seed Medal from ASCE, and the 2018 Nabor Carrillo Lecturer Award from the Mexican Society of Geotechnical Engineering. Most recently, he was named as a Distinguished Member of ASCE and elected to the National Academy of Engineering. Kramer was a Senior Research Scientist in the International Centre for Geohazards at the Norwegian Geotechnical Institute (NGI) in 2003 and is also a member of the

faculty of the European School for Advanced Studies in the Reduction of Seismic Risk (the ROSE School) at the University of Pavia in Italy.

Kevin Marshall is a licensed civil structural engineer. He has 44 years of experience including 36 years in the electric utility business with the last 28 years in the hydro industry. He has worked in consulting engineering, on staff for a private utility, and has spent the last 13 years with Grant County Public Utility District (PUD). He is "officially" retired but still works on a part-time basis. Mr. Marshall's career assignments include 20 years as a staff/civil structural engineer; 5 years as a civil/structural engineering manager; 15 years as a generation engineering manager; service as the hydro director for Grant County PUD; and service as the chief operations officer for the Grant County PUD overseeing approximately 2000 Mw on the mid-Columbia River, safety and training, power delivery, and the PMO department. Mr. Marshall's power plant project experience on nuclear, natural gas, hydro, coal, and wind generation includes fisheries projects, dam removal, seismic upgrades, and green field power plant construction.

Robert B. Gilbert is chair of the Department of Civil, Architectural and Environmental Engineering at The University of Texas at Austin. He joined the faculty in 1993 after practicing as a geotechnical engineer for five years with Golder Associates Inc. His technical focus is the assessment, evaluation and management of risk for civil engineering systems. Recent activities include analyzing the performance of offshore platforms and pipelines in Gulf of Mexico hurricanes; managing flooding risks for levees in Texas, California, Washington and Louisiana; and performing a review of design and construction for the new Bay Bridge in San Francisco. Dr. Gilbert has been awarded the Norman Medal from the American Society of Civil Engineers and an Outstanding Civilian Service Medal from the United States Army Corps of Engineers. He is a member of the National Academy of Engineering.



Laurie Johnson is an internationally-recognized urban planner specializing in disaster recovery and catastrophe risk management. For over 30 years, she has combined her unique blend of professional practice and research in earth science, urban planning, and public policy to help communities address the complex urban challenges posed by natural hazards and disasters. Much of her post-disaster recovery work is captured in her recent book, *After Great Disasters: An In-Depth Analysis of How Six Countries Managed Community Recovery* (2017). In June 2020, she assumed a new role of chief catastrophe response and resiliency officer for the California Earthquake Authority and the newly-established California Wildfire Fund. She is the 2019-2020 president of the Earthquake Engineering Research Institute (EERI), on the steering committee of the Geotechnical Extreme Event Reconnaissance (GEER) organization, and a 2018 inductee into the College of Fellows of the American Institute of Certified Planners. She holds a Doctor of Informatics degree from Kyoto University and a Master of urban planning and Bachelor of Science in geophysics, both from Texas A&M University.

Rosalyn W. Berne is associate professor in the School of Engineering and Applied Sciences in the University of Virginia's (UVA's) Department of Engineering and Society, where her research and teaching is focused on engineering ethics. Dr. Berne is also director and PI of the NSF supported Online Ethics Center (OEC). Published under her name are two academic books, *Nanotalk: Conversations with Scientists and Engineers about Ethics, Meaning, and Belief in the Development of Nanotechnology* (2006) and *Creating Life from Life: Biotechnology and Science Fiction* (2014); numerous conference papers and journal articles; *Waiting in the Silence* (a SF novel with an ethics focus (2012)); and two award-winning non-fiction books, *When the Horses Whisper* (2013) and *Waking to Beauty* (2016). Berne served from 2018-2020 as director of the Center for Engineering Ethics and Society at the National Academy of Engineering while on leave from UVA. She is advisor to "Engineering One Planet," a project of the Lemelson Foundation; advisor to the Kern Family Foundation's Kern Engineering Entrepreneurship Network (KEEN) project, "Educating the Whole Engineer: Engineering Fundamentals, Character Education, and Entrepreneurial Mindset; a member of the ethics committee of the American Society for Engineering Education; and a member of the education committee of Institute of Electrical and Electronics Engineers' (IEEE's) Global Initiative on Ethics of Autonomous and Intelligent Systems.