

**DANIEL A. EISENBERG**

School of Sustainable Engineering and the Built Environment
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EDUCATION

Arizona State University (ASU)

Ph.D., Civil, Environmental, and Sustainable Engineering May 2018

Dissertation Title: How to Think about Resilient Infrastructure Systems

Advisors: Thomas P. Seager (ASU), Jeryang Park (Hongik University)

M.S.E., Civil, Environmental, and Sustainable Engineering May 2016

University of California, Davis

B.S., Chemical Engineering with Honors, Minor in Music Dec 2010

RESEARCH OVERVIEW

My research focuses on the design, operation, and adaptation of resilient infrastructure systems with emphasis on integrating knowledge from engineering and social science together to improve crisis management policies. The resilience of infrastructure systems depends upon the physical limitations of built technologies under stress and human actions to manage unforeseen adverse events. Still, there is limited knowledge of how both systems respond when faced with catastrophic failures. My work advances novel theory and modelling tools to assess technological and social systems together, and reveals ways in which built systems and management policies can be improved to adapt to unforeseen threats. Specific areas of expertise include:

Resilience Engineering: Resilience theory, agility, sociotechnical systems science

Critical infrastructure: Electric power, water, transportation, and communication systems

Complex Systems: Network science, optimization, risk analysis, life-cycle assessment

HONORS & AWARDS (funded research fellowships in bold)

NSF Graduate Research Fellow (\$132,000) 2015-2018

Resilience Week Student Competition (3rd place) 2016, 2017

Resilience Engineering Association Symposium, Young Talents Program 2017

International Symposium for Sustainable Systems & Technology (ISSST),

Outstanding Sustainability Scholar 2016

Society for Risk Analysis Annual Conference, Best Poster and Travel Award 2016

NSF IGERT Fellowship in Solar Energy Utilization (\$84,000) 2013-2015

NSF East Asia and Pacific Summer Institutes Fellow, South Korea (\$5,000) 2014

Ira A. Fulton Schools of Engineering Dean's Fellow 2013

Fulbright Research Fellowship: Brazil (\$17,000) 2012-2013

Faculty Award in Music Performance, UC Davis Music Dept. 2011

GRANTS***Principal Investigator***

IGERT Competitive Innovation Fund: Navajo Tribal Energy Project (\$23,626) 2015

NSF Graduate Research Opportunities Worldwide: South Korea (\$5,000) 2015

GRANTS (continued)

Written / Supported

RIPS: Resilience Simulation for Power, Water, and Road Networks (\$1,949,788)	2014-2017
WSC: Water-Sustainability-Climate (\$719,934)	2014-2018

PEER REVIEWED PUBLICATIONS

Resilience and Critical Infrastructure:

- R1. **Eisenberg, D.A.**, Hinrichs, M.M., Seager, T.P., Chester, M.V., Kim, Y., Markolf, S., Woods, D.D., Park, J., Alderson, D.L., Thomas, J.E., "Robustness and Extensibility in Infrastructure Systems," *Reliability Engineering and System Safety*. –*In Review*
- R2. Alderson, D.L., **Eisenberg, D.A.** (co-first author), Seager, T.P., "Pathways to Resilience: Analytics and Heuristics," *Risk Analysis Special Issue on Resilience Analytics for Cyber-Physical-Social Networks*. –*In Review*
- R3. Spierre Clark, S., Chester, M.V., Seager, T.P., **Eisenberg, D.A.**, "The Vulnerability of Interdependent Urban Infrastructure Systems to Climate Change: Could Phoenix Experience a Katrina Of Extreme Heat?" *Sustainable and Resilient Infrastructure*. –*In Review*
- R4. Liu, R-R., **Eisenberg, D.A.**, Seager, T.P., Lai, Y-C., "Mixed percolation transitions in multilayer networked systems," *Scientific Reports*. –*In Review*
- R5. Kitsak, M., Ganin, A., **Eisenberg, D.A.**, Krapivsky, P.L., Krioukov, D., Alderson, D.L., Linkov, I., "Stability of a Giant Connected Component in a Complex Network," *Physical Review Letters*. –*In Review*
- R6. Thomas, J.E., **Eisenberg, D.A.**, Seager, T.P., Fischer, E., "Integrating the capacities of individual people and sociotechnical systems for national infrastructure resilience," *Journal of Homeland Security and Emergency Management*. –*In Review*
- R7. **Eisenberg, D.A.**, Park, J., Seager, T.P., (2017) "Sociotechnical Network Analysis for Power Grid Resilience in South Korea," *Complexity*, 2017, 1-14.
- R8. Kim, Y., **Eisenberg, D.A.**, Bondank, E.N., Chester, M.V., Mascaro, G., Underwood, B.S., (2017) "Safe-to-Fail climate change adaptation strategies for Urban Flooding," *Climatic Change*. –*In Press*
- R9. Kim, D.H., **Eisenberg, D.A.**, Chun, Y.H., Park, J., (2017) "Network topology and resilience analysis of South Korean power grid," *Physica A: Statistical Mechanics and its Applications*, 465, 13-24.
- R10. Bartos, M., Chester, M., Johnson, N., Gorman, B., **Eisenberg, D.**, Linkov, I., Bates, M., (2016), "Impacts of rising air temperatures on electric transmission ampacity and peak electricity load in the United States," *Environmental Research Letters*, 11(11), 114008
- R11. Larkin, S., Fox-Lent, C., **Eisenberg, D.A.**, Trump, B.D., Wallace, S., Chadderton, C., Linkov, I. (2015), "Benchmarking agency and organizational practices in resilience decision-making," *Environment Systems and Decisions*, 35(2), 185-195.
- R12. Zhang, S.P., Huang Z.G., Dong, J.Q., **Eisenberg, D.A.**, Seager, T.P., Lai, Y.C. (2015), "Optimization and resilience of complex supply-demand networks," *New Journal of Physics*, 17(6), 063029.
- R13. Chen, Y.Z., Huang, Z.G., Zhang, H.F., **Eisenberg, D.A.**, Seager, T.P., Lai, Y.C. (2014) "Extreme events in multilayer, interdependent complex networks and control," *Scientific Reports*, 5, 17277-17277.

- R14. **Eisenberg, D.A.**, Park, J., Chang, D., Bates, M.E., Seager, T.P., Linkov, I. (2014) “Resilience metrics: Lessons from military doctrines,” *The Solutions Journal*, 5, 76-87.
- R15. Linkov, I., **Eisenberg, D.A.**, Plourde, K., Seager, T.P., Allen, J., Kott, A. (2013) “Resilience metrics for cyber systems,” *Environment Systems and Decisions*, 33(4), 471-476.
- R16. Linkov, I., **Eisenberg, D.A.**, Bates, M.E., Chang, D., Convertino, M., Allen, J.H., Flynn, S.E., Seager, T.P. (2013) “Measurable Resilience for Actionable Policy,” *Environmental Science & Technology*, 47, 10108-10110 –*Editorial & Commentary*

Sustainability and Design for the Environment:

- R17. Wender, B.A., Foley, R.W., Hottle, T.A., Sadowski, J., Prado-Lopez, V., **Eisenberg, D.A.**, Laurin, L., Seager, T.P. (2014), “Anticipatory life-cycle assessment for responsible research and innovation,” *Journal of Responsible Innovation*, 1(2), 200-207.
- R18. Wender, B.A., Foley, R.W., Prado-Lopez, V., Ravikumar, D., **Eisenberg, D.A.**, Hottle, T.A., Sadowski, J., Flanagan, W.P., et al. (2014), “Illustrating anticipatory life cycle assessment of emerging photovoltaic technologies,” *Environmental Science & Technology*, 48(18), 10531-10538.
- R19. **Eisenberg, D.A.**, Yu, M., Lam, C.W., Ogunseitan, O.A., Schoenung, J.M. (2013) “Comparative alternative materials assessment to screen the toxicity hazards in the life cycle of CIGS thin film photovoltaics,” *Journal of Hazardous Materials* 260, 534-542.

Fluid Mechanics and Rheology:

- R20. **Eisenberg, D.A.**, Deschamps, C.J., (2015), “Experimental investigation of pressure distribution in turbulent radial flow between parallel and inclined disks,” *Journal of Fluids Engineering*, 137(11), 114501
- R21. **Eisenberg, D.A.**, Klink, I., Phillips, R.J., (2013) “Axisymmetric sedimentation of spherical particles through a viscoelastic fluid: sphere-wall and sphere-sphere interactions,” *Journal of Rheology*, 57, 857.

BOOK CHAPTERS

Resilience and Critical Infrastructure:

- B1. Seager, T.P., Spierre Clark, S., **Eisenberg, D.A.**, Thomas, J.E., Hinrichs, M.M., Kofron, R., Norgaard Jensen, C., McBurnett, L.R., Snell, M., Alderson D.L., (2017) “Redesigning Resilient Infrastructure Research,” in: *Resilience and Risk: Methods and Application in Environment, Cyber and Social Domains*, Linkov, I., Palma Olivera, J. (eds.), Ch. 3, Springer
- B2. Snell, M.L., **Eisenberg, D.A.**, Seager, T.P., Clark, S.S., Oh, Y.J., Thomas, J.E., McBurnett, L.R., (2016) “A multidimensional review of resilience: Resources, processes, and outcomes,” in: *The International Risk Governance Council Resource Guide on Resilience*, IRGC, online: <https://www.irgc.org/wp-content/uploads/2016/04/Seager-et-al.-A-Multidimensional-Review-of-Resilience.pdf>

Sustainability and Design for the Environment:

- B3. **Eisenberg, D.A.**, Grieger, K.D., Hristosov, D.R., Bates, M.E., Linkov, I. (2015) “Risk assessment, life cycle assessment, and decision methods for nanomaterials,” in: *Nanomaterials in the Environment*, ASCE press, 382-419. – **Winner of the American Society of Civil Engineers (ASCE) State-of-the-Art Engineering Award**
- B4. Tatham, E.K., **Eisenberg, D.A.**, Linkov, I., (2014) “Sustainable urban systems: A review of how sustainability indicators inform decisions,” in: *Sustainable Cities and Military Installations*, Linkov, I. (ed.), Springer Netherlands, 3-20.

OTHER PUBLICATIONS

01. **Eisenberg, D.A.**, Park, J., Kim, D., Seager, T.P. (2014), "Resilience analysis of critical infrastructure systems requires integration of multiple analytical techniques," Urban Sustainability and Resilience Conference, London, U.K., doi: dx.doi.org/10.6084/m9.figshare.3085810.v1
02. **Eisenberg, D.A.**, Bates, M.E., Seager, T.P., Linkov, I. (2013) "Resilience metrics of coupled coastal-energy systems," ANS Transactions, Risk Management Topical Meeting, American Nuclear Society, Washington D.C.
03. **Eisenberg, D.A.**, Yu, M., Lam, C.W., Ogunseitan, O.A., Schoenung, J.M. (2012) "Overcoming the difficulties of accurate hazard assessment for electronic devices: A life cycle hazard projection approach," Presented at Electronics Going Green 2012+, Berlin, Germany.

TEACHING

Arizona State University, Tempe, AZ, USA

Resilient Infrastructure Research Seminar: Lecturer

Fall 2017

Resilience Engineering: Lead TA

Spring 2015

Sustainable Civil & Environmental Systems Engineer: Lead TA

Spring 2015

ADVISING

Master's students

Jordan Rodriguez – *Degree: Civil Engineering, Research Topic: Water Distribution Resilience*

Marcus Snell – *Degree: Civil Engineering, Research Topic: Levee Failures and Urban Development*

Ryan Kofron – *Degree: Business Management, Research Topic: Resilience and Simulation Games*

Undegraduate students:

Trevor Dean Arnold – *Degree: Sustainability, Research Topic: Multidisciplinary Resilience Review*

Lucien Hollins – *Degree: Aerospace Engineering, Research Topic: Oroville Dam Failure*

PROFESSIONAL EXPERIENCE

Arizona State University, Tempe, AZ, USA

Ph.D. Student and Graduate Research Fellow

Aug 2013 – Present

Advisor: Thomas P. Seager

Using power grid and social network models to study the resilience of the South Korean power grid. Formed a cross-university team for advancing the theoretical and applied techniques used to assess the resilience of built infrastructure systems, including: electric power, water distribution, wastewater sewer, and transportation systems. Measuring the impacts of more frequent extreme events due to climate change on US-based infrastructure. Assessing the successes and failures experienced during the near-breaching the largest dam in the US, the Oroville Dam, in Feb 2017.

Hongik University, Seoul, South Korea

International Research Fellow in South Korea

Summer 2014 & 2015

Advisor: Jeryang Park

Worked with researchers to acquire infrastructure data for a sociotechnical network model of power grid blackout management in South Korea. Interviewed experts from companies across the South Korean power industry and emergency management agencies.

PROFESSIONAL EXPERIENCE (continued)

US Army Engineer Research and Development Center, Concord, MA, USA

Sustainability Research Engineer

Jan 2013 – Present

Directors: Igor Linkov & David Alderson

Creating sociotechnical network models to study the agility of military, emergency management, and civil infrastructure systems. Designed a metrics framework now used across the US Army Corps of Engineers to measure the resilience of coastal, energy, and cyber systems to unforeseen threats.

Polo National Laboratories, Florianópolis, SC, Brazil

Fulbright Scholar to Brazil

Mar 2012 – Dec 2012

Advisor: Cesar Deschamps

Facilitated collaboration between compressor manufacturer Embraco and Polo Labs to introduce sustainable materials into refrigeration compressor designs. Analyzed turbulent flow through compressor valves and measured the temperature profile of refrigeration mufflers. Learned Brazilian Portuguese and traditional music.

University of California, Davis, Davis, CA, USA

Research Scientist

Jan 2011 – Mar 2012

Advisors: Julie Schoenung & Ronald Philips

Developed a hazard-based methodology to assess the impacts of emerging technologies and to design low-hazard thin film solar panels. Conducted fluid mechanics research on the reversible and irreversible interactions of sedimenting particles in non-Newtonian, shear thinning fluids.

São Paulo State University, Ilha Solteira, SP, Brazil

International Research Intern

Jun 2010 – Aug 2010

Advisor: Dr. José Luis Gasche

Measured the interrelationship between orifice geometry, fluid velocity, and valve opening distance on the static pressure of compressor valves.

ADDITIONAL TRAINING

Liege, Belgium

Resilience Engineering Association Young Talents Program

Jun 2017

Invited workshop to review and train future scholars in resilience engineering

Korea University, Seoul, South Korea

Synthesis Workshop on Complex Networks

Jun 2015

Two week training and workshop on network science applied to infrastructure systems.

Washington D.C., USA

Science Outside the Lab

Jun 2014

Two week workshop on science policy and funding in the US Federal government.

LANGUAGES & PROGRAMMING

English (native), Brazilian Portuguese (medium proficiency: spoken and written), Korean (medium proficiency: written, low proficiency: spoken); Matlab (high proficiency), ArcGIS & QGIS (medium proficiency), Python (low proficiency)

ACADEMIC SERVICE**Urban Resilience Network Board Member**

Nov 2014 – Present

Website: urbanresilienceresearch.net

Organizing a global group of urban resilience researchers to facilitate research discussion, provide guidance to new comers, and publish new ideas/blogs from respected academics.

ACADEMIC SERVICE (continued)

Workshop Organizer

Naval Postgraduate School

Making Infrastructure Work

Sept 2016

Two day intensive with 9 experts on resilience across academia and homeland security industries

International Symposium on Sustainable Systems and Technology (ISSST)

Resilient Infrastructure Perspectives Workshop

May 2016

One day workshop to bring together over 25 experts on resilience and discuss the future of the field.

Reviewer*Journals:* PLOS One, Risk Analysis, INFORMS Journal on Computing, Environment Systems and Decisions, ASCE Journal of Infrastructure Systems*Conferences:* International Symposium on Sustainable Systems and Technology (ISSST)

PRESENTATIONS & POSTERS

Invited Talks:

- P1. **Eisenberg, D.A.**, (Jun 2017) "Robustness and extensibility in infrastructure systems," Resilience Engineering Association Young Talents Program, Liege, Belgium
- P2. **Eisenberg, D.A.**, (Jan 2017) "Bridging social and infrastructure networks for resilience: South Korean case study," Hongik University, Seoul, South Korea
- P3. **Eisenberg, D.A.**, Seager, T, Park, J, (Dec 2016) "Bridging social and technical networks for critical infrastructure resilience," Society for Risk Analysis Annual Meeting, San Diego, CA, USA
- P4. **Eisenberg, D.A.**, Seager, T., Park, J., (Aug 2016) "Bridging social and technical networks: South Korean case study," Resilience Week, Naperville, IL, USA
- P5. **Eisenberg, D.A.**, Seager, T.P., Clark, S.S., (Dec 2015) "Critical infrastructure resilience – interdependencies," Invited Panel and Oral Presentation given at the Defense Energy Innovation Summit, Austin, Texas, USA
- P6. **Eisenberg, D.A.**, Park, J., (Jun 2015) "Resilience analysis: Linking actors and infrastructures," Presented at the Water, Feedbacks, and Complexity workshop, Korea University, Seoul, Korea
- P7. **Eisenberg, D.A.**, (Mar 2015) "Resilient Infrastructure Research at Arizona State University: Bringing the Social and Technical Together," Invited talk by the Naval Postgraduate School's Center for Infrastructure Defense, Monterey, CA
- P8. **Eisenberg, D.A.**, (Dec 2014) "Measuring sensing for critical infrastructure resilience: A case study of electric power systems," Presented at the Agent-Based Modelling Open House, Arizona State University, Tempe, AZ, USA

Conference Presentations:

- P9. **Eisenberg, D.A.**, Seager, T.P., Park, J., (Jun 2017) "Social and infrastructure networks in South Korea," Resilience Engineering Association Symposium, Liege, Belgium
- P10. **Eisenberg, D.A.**, Seager, T.P., Park, J., (Jan 2017) "Bridging social and infrastructure networks for power grid resilience," INFORMS Computing Society Annual Meeting, Austin, TX, USA

- P11. **Eisenberg, D.A.**, Park, J., Kim, D., Seager, T.P. (May 2016). Bridging sociotechnical networks for critical infrastructure resilience: South Korean Case Study. Oral Presentation given at the International Symposium on Sustainable Systems and Technology (ISSST), Phoenix, AZ, USA.
- P12. **Eisenberg, D.A.**, Thomas, J.E., Arnold, T.D., Seager, T.P. (May 2016). Understanding resilience across disciplines: A literature review. Poster Presentation given at the International Symposium on Sustainable Systems and Technology (ISSST), Phoenix, AZ, USA.
- P13. **Eisenberg, D.A.**, Park, J., Bartos, M.D., Chester, M.V., Seager, T.P., (Jul 2015) "Interdependent Critical Infrastructure Systems and Networks: Water, Electric Power, and Roads," Presented at the World Congress on Risk Analysis, 2015, Singapore
- P14. **Eisenberg, D.A.**, Park, J., Kim, D., Seager, T.P., (May 2015) "Resilience of Electric Grids to Disasters: Socio-Technical Model Development and Case Study," Presented at the International Symposium on Sustainable Systems and Technology, Dearborn, Michigan, USA
- P15. **Eisenberg, D.A.**, (Apr 2015) "The different perspectives of resilience among federal agencies," Presented at the Integrated Network for Social Sustainability Annual Conference, Arizona State University, Tempe, AZ, USA
- P16. **Eisenberg, D.A.**, Park, J., Kim, D., Seager, T.P. (Nov 2014) "Resilience analysis of critical infrastructure systems requires integration of multiple analytical techniques," Presented at the Urban Sustainability and Resilience Conference, University College London, London, U.K.
- Posters:**
- P17. **Eisenberg, D.A.**, Seager, T.P., Park, J., (Dec 2016) "Sociotechnical implications of power grid criticality measures in South Korea," Institute for Social Science Research, Tempe, AZ, USA
- P18. **Eisenberg, D.A.**, Kitsak, M, Ganin, A, Linkov, I, Alderson, D, (Dec 2016) "Multilayer Command and grid Control (C2)," Society for Risk Analysis Annual Meeting, San Diego, CA
- P19. **Eisenberg, D.A.**, Seager, T., Park, J., (Aug 2016) "Bridging social and technical networks: South Korean case study," Resilience Week, Naperville, IL
- P20. **Eisenberg, D.A.**, Seager, T, Park, J, (Aug 2016) "Bridging social and technical networks: South Korean case study," Defense Threat Reduction Agency Annual Review Meeting, Springfield, VA, USA