

Biographical Information of Chris T. Hendrickson

Chris Hendrickson is the Duquesne Light Company Professor of Engineering and Co-Director of the Green Design Institute at Carnegie Mellon University. His research, teaching and consulting are in the general area of engineering planning and management, including design for the environment, system performance, construction project management, finance and computer applications. He has co-authored five books, 'Environmental Life Cycle Assessment of Goods and Services: An Input-Output Approach' (Resources for the Future, 2006), 'Project Management for Construction' (Prentice-Hall, 1989, updated on the web at <http://www.ce.cmu.edu/PMBook/>), 'Transportation Investment and Pricing Principles' (John Wiley & Sons, 1984), 'Knowledge Based Process Planning for Construction and Manufacturing' (Academic Press, 1989) and 'Concurrent Computer Integrated Building Design' (Prentice-Hall, 1994). In addition, he has published numerous articles in the professional literature. His education includes Bachelor and Master of Science degrees from Stanford University, a Master of Philosophy degree in economics from Oxford University, and a Ph.D. from the Massachusetts Institute of Technology. Prof. Hendrickson has been the recipient of the Turner Lecture Award of the American Society of Civil Engineers (2002), the Fenves Systems Research Award from the Institute of Complex Engineering Systems (2002), AT&T Industrial Ecology Fellowships (2000-2002), a Lucent/NSF Industrial Ecology Fellowship (1998), the ASCE Frank M. Masters Transportation Engineering Award (1994), the Outstanding Professor of the Year Award of the ASCE Pittsburgh Section (1990), the ASCE Walter L. Huber Civil Engineering Research Award (1989), the Benjamin Richard Teare Teaching Award from the Carnegie Institute of Technology (1987) and a Rhodes Scholarship (1973). He is a Fellow of the American Association for the Advancement of Science, an Honorary Member of the American Society of Civil Engineers and an Emeritus Member of the Transportation Research Board.

His professional career includes research contributions in computer-aided engineering, transportation systems, construction project management and environmental systems. Central themes in his work are a systems wide perspective and a balance of engineering and management considerations. His doctoral work included the development of a travel distance formula for random stops still in use for home service planning (1978). He pioneered models of dynamic traffic equilibrium, including time-of-day departure demand models. He was an early contributor to the development of probabilistic network analysis for lifeline planning after seismic events. His work in construction project management emphasized the importance of the owner's viewpoint throughout the project lifecycle, summarized in his text (with T. Au), 'Project Management for Construction,' now available on the web. With others at Carnegie Mellon's Engineering Design Research Center, he developed a pioneering, experimental building design system in the early 1990s that spanned initial concept through construction scheduling and animation. Since 1994, he has concentrated on green design, exploring the environmental life cycle consequences of alternative product and process designs. He has contributed software tools and methods for pollution prevention and environmental management, including life cycle analysis software (<http://www.eiolca.net>) and a widely cited analysis of the life cycle consequences of lead acid battery powered vehicles.

Dr. Hendrickson has been active in several professional and civic organizations. He has received teaching awards, published extensively on engineering education, and led the very successful undergraduate engineering curriculum reform at Carnegie Mellon in 1989/90.

ADDRESS

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VITAL STATISTICS

Born: March 31, 1950; Oakland, California
Married, three children

CURRENT AND PAST POSITIONS

1996-present Duquesne Light Company Professor of Engineering, Carnegie Mellon
1996-2006 Head, Dept of Civil and Environmental Engineering, Carnegie Mellon
1991-1996 Assoc. Dean for Academic Affairs, Engineering (CIT), Carnegie Mellon
1987-1996 Professor, Dept of Civil and Environmental Engineering, Carnegie Mellon
1989-1996 Education Director, Engineering Design Research Center, Carnegie Mellon
1983-1987 Associate Professor, Dept of Civil Engineering, Carnegie Mellon
1978-1983 Assistant Professor, Department of Civil Engineering, Carnegie Mellon
1978 (summer) Operations Research Analyst, Trans. Sys. Ctr, U.S. Dept of Transportation

EDUCATION

Ph.D., Civil Engineering; Massachusetts Institute of Technology, 1978
B. Phil.; (now renamed Master of Philosophy), Economics; Oxford University, 1975
MS, Civil Engineering; Stanford University, 1973
BS, General Engineering (Resources Strategy); Stanford University, 1973

PROFESSIONAL HONORS

- Honorary Member, American Society of Civil Engineers, 2007.
- Fellow, American Association for the Advancement of Science, 2006.
- Member Emeritus, Committee on Applications of Emerging Technology, Transportation Research Board, 2003.
- Turner Lecture Award, American Society of Civil Engineers, 2002.
- Steven Fenves Systems Engineering Research Award, Carnegie Mellon, 2002.
- AT&T Industrial Ecology Fellow – 2000, 2001
- Lucent and National Science Foundation Industrial Ecology Fellow - 1999
- Duquesne Light Company Professor of Engineering, Carnegie Mellon, 1997-
- EPA Regional Administrator's Environmental Excellence Award and the 1995 Texas Environmental News Award for Pollution Prevention Video Training, National Environmental Technology Network - Featured Participant
- Frank M. Masters Transportation Engineering Award, American Society of Civil Engineers, 1994
- Outstanding Paper of the Year, ASCE Journal of Transportation Engineering, 1992
- Outstanding Professor of the Year Award, ASCE Pittsburgh Section, 1990.
- Walter L. Huber Civil Engineering Research Prize, ASCE, 1989

- Benjamin Richard Teare Teaching Award, Carnegie Institute of Technology 1987
- Chi Epsilon 1986
- C.E. Ladd Research Award, Carnegie Institute of Technology 1979
- MIT Austin Fellowship 1976-1977
- Rhodes Scholar 1973-1975
- Phi Beta Kappa 1972
- Tau Beta Pi 1971

PROFESSIONAL AFFILIATIONS

American Association for the Advancement of Science

American Economic Association

American Society of Civil Engineers

Transportation and Development Institute, Board of Directors, 2006-present

Body of Knowledge Committee of the Task Committee on Academic Prerequisites for Professional Practice, 2003-2004

Chairman, Department Head's Executive Committee, 2000-2002

Member, Department Head's Council, 1998-2002

Managing Editor, Journal of Transportation Engineering, 1992-present

Member, Comm. on Social and Environmental Concerns in Construction, 2001-present

Chairman, Urban Transportation Division Executive Committee, 1989-1990

Member, Urban Transportation Division Executive Committee, 1988-1991

Secretary, Urban Transportation Division Executive Committee, 1985-1988

Chairman, Urban Transportation Economics Committee, 1982-1985

Faculty Advisor, Carnegie Mellon University ASCE Student Chapter, 1981-1984

American Society of Engineering Education

Association of Environmental Engineering and Science Professors

Construction Industry Institute

Member, Advanced Technology Task Force, 1988-1991

Member, Technology Task Force, 1986-1988

INFORMS, Transportation Science Section Board, 1984-1987

International Society for Industrial Ecology

National Research Council, National Academies, Panel Member:

Comm. on Assessing the Results of External Independent Reviews for US DOE Projects, 2006

Comm. on Independent Scientific Review of Everglades Restoration Progress, 2005-2008

Comm. on Review of Management Practices on the Boston Central Artery ('Big Dig') Project, 2004

Comm. on Estimating Demand for the National Adv. Driving Simulator, 2000.

Transportation Research Part C, Associate Editor, 1993-1996

Transportation Research Board

Group 5 Council, 2000-2004

Chairman, Committee A2H01, Applications of Emerging Technology, 1988-1995

University Representative, 1982-1988, 1999-2002

CIVIC AFFILIATIONS

Board of Trustees, St. Edmund's Academy, Pittsburgh, 1998-2004

Rhodes Scholarship Foundation

Secretary, PA State Selection Committee, 1996-2000
Secretary, District Selection Committee, 1996-1997
Member, PA and WV State Selection Committees, 1980-1995 (various)
Member, District IX Selection Committee, 2005.
FIFA Certified Soccer Referee, 1996-2000

PATENTS AWARDED

#5,448,484 "A Neural Network-based Vehicle Detection System and Method," September 5, 1995 (with Darcy Bullock and Jim Garrett)

COURSES TAUGHT

Undergraduate:

- Analysis, Synthesis and Evaluation
- Benefit-Cost Analysis
- Computer Aided Tools for Civil Engineers
- Engineering Economics
- Introduction to Civil and Environmental Engineering
- Introduction to Computer Methods in Civil Engineering
- Project Management for Construction
- Systems Engineering I (Deterministic Models)
- Systems Engineering II (Probabilistic Models)
- Traffic Flow Theory and Operations

Graduate:

- Advanced Project Management
- Analysis of Network Based Systems
- Civil Systems Investment and Planning
- Computer-Aided Engineering Tools
- Demand Analysis and Forecasting
- Management Principles and Practices for Environmental Engineering
- Probability and Estimation for Engineering Systems
- Risk and Reliability Analysis
- Special Topics in Engineering Planning and Management
- Special Topics in Transportation Modeling and Simulation

Continuing (courses exceeding two days):

- Green Engineering and Management (Tepper Business School Executive Education Program, CMU)
- Design Project Management and Design for Disposal (Carnegie Bosch Institute)
- Transportation Investment and Pricing (Transportation Research Institute, Carnegie Mellon University)
- Construction Project Investment and Management (Engineering Advancement Association of Japan)

SELECTED ADVISORY AND REVIEW BOARDS

Cornell University, Department of Civil and Environmental Engineering, 2006
University of California at Berkeley, Department of Civil and Environmental Engineering, 2005
University of Waterloo, Department of Civil and Environmental Engineering, 2005

Rensselaer Polytechnic Institute, Civil Engineering, 2002-2004
Civil Engineering Research Foundation, Strategic Planning Task Force, 2001.
Stanford University, Department of Civil and Environmental Engineering, Co-Chair, 2001.
University of Maryland, Department of Civil Engineering 2000.
National Science Foundation, Civil and Mechanical Systems, 1999.
West Virginia University, Department of Civil and Environmental Engineering, 1998-2004.
University of Minnesota, Department of Civil Engineering 1997.

BOOKS

1. Hendrickson, Chris T., Lester B. Lave, H. Scott Matthews, Arpad Horvath, Satish Joshi, Francis C. McMichael, Heather MacLean, Gyorgyi Cicas, Deanna Matthews and Joule Bergerson, 'Environmental Life Cycle Assessment of Goods and Services: An Input-Output Approach,' Resources for the Future, 2006.
2. Fenves, S., U. Flemming, C. Hendrickson, M. Maher, R. Quadrel, M. Terk, and R. Woodbury, Concurrent Computer-Integrated Building Design, Prentice-Hall, 1993. (Reviewed in ASCE J. of Architectural Engineering, Sept. 1995).
3. Hendrickson, C. and T. Au, Project Management for Construction, Prentice-Hall, New York, 1989. Other Editions and Authorized Translations:
 - a. Hendrickson, C.T., Project Management for Construction, (2nd edition), <http://www.ce.cmu.edu/PMBook/>, 2000.
 - b. Chinese Translation: Higher Education Press, 2005.
 - c. Farsi Translation: M.T. Bankie, 1995
 - d. Spanish Translation: Diego Arturo L. de Ortigosa, 1994.
4. Zozaya-Gorostiza, C., C. Hendrickson and D. Rehak, Knowledge Based Process Planning for Construction and Manufacturing, Academic Press, Cambridge, MA, 1989.
5. Wohl, M. and C. Hendrickson, Transportation Investment and Pricing Principles, John Wiley and Sons, New York, 1984.

EDITED VOLUMES

1. Hendrickson, C. and S.G. Ritchie, "Applications of Advanced Technologies in Transportation," ASCE Specialty Conference Proceedings, April, 1998.
2. Hendrickson, C. and K. Sinha, Pacific Rim TransTech Conference Proceedings, Volume I "Advanced Technologies," American Society of Civil Engineers, 1993.
3. Ritchie, S.G. and C. Hendrickson, International Conference on Artificial Intelligence Applications in Transportation Engineering, Conference Preprints, Engineering Foundation, San Buenaventura, CA, June, 1992.
4. Hendrickson, C. and K. Sinha, First International Conference on Applications of Advanced Technologies in Transportation Engineering, ASCE Specialty Conference, San Diego, CA, Feb. 1989.
5. Gadsden, J. and C. Hendrickson, "Special Issue: Planning," International Journal for Artificial Intelligence in Engineering, Vol. 4, No. 2, April 1988.
6. Bers, E. and C. Hendrickson, Managing Urban Transportation as a Business, Proceedings of an ASCE Specialty Conference, Orlando, Florida, 1987.
7. Hendrickson, C. (ed.) "Transportation Systems and Logistics", Transportation Research, Special Issue, Vol. 19B, No. 5, Oct. 1985.
8. Chatterjee, A. and C. Hendrickson (eds.) Innovative Strategies to Improve Urban Transportation Performance, Proc. of an ASCE Specialty Conference, Knoxville, TN, 1984.

ARTICLES AND OTHER PUBLISHED MATERIALS

1. Committee on Independent Scientific Review of Everglades Restoration Progress, 'Progress Toward Restoring the Everglades: The First Biennial Review,' National Research Council, National Academies Press, 2007.
2. Christini, Gwen, Montgomery Watson Harza, Deanna H. Matthews, and Chris Hendrickson, 'A Comparison of Environmental Management Systems Components and Practices,' in *Strategic Sustainability: The State of the Art in Corporate Environmental Management Systems*, Greenleaf Publishing, Sheffield, UK, 2007.
3. Hawkins, Troy, Chris Hendrickson, Cortney Higgins, H. Scott Matthews and Sangwon Suh, 'A Mixed-Unit Input-Output Model for Environmental Life-Cycle Assessment and Material Flow Analysis,' *ES&T*, 2007, <http://dx.doi.org/10.1021/es060871u>
4. Higgins, Cortney, H. Scott Matthews, Chris T. Hendrickson and Mitchell Small, 'Lead Demand of Future Vehicle Technologies,' *Transportation Research Part D*, 2007.
5. Hendrickson, Chris, H. Scott Matthews and Eric Williams, 'Experience with the Economic Input-Output Life-Cycle Assessment Website (www.eiolca.net)' Seventh International Conference on EcoBalance, Proceedings, Tsukuba, Japan, November, 2006.
6. Peters, Gibson, A.M. Digioia Jr., J. Apt, and Chris Hendrickson, 'Transmission Line Reliability: Climate Change and Extreme Weather,' *Proc. ASCE Electrical Transmission Line Conference*, 2006.
7. C. T. Hendrickson, H. S. Matthews, and G. Cicas: Analysis of Regional Supply Chain Economic and Environmental Effects of Expansion of the U.S. Freight-Rail System, *ASCE Proceedings of the Applications of Advanced Technology in Transportation Conference*, Chicago, IL, 2006.
8. C. T. Hendrickson, G. Cicas, and S. Matthews, "Transportation Sector and Supply Chain Performance and Sustainability", *Transportation Research Record No. 1983*, 2006.
9. Cliff Davidson, Chris Hendrickson, and H. Scott Matthews, "Sustainable Engineering: A Sequence of Courses at Carnegie Mellon", *International Journal of Engineering Education*, 23(2), 287-293, 2007.
10. Hendrickson, Chris, 'Florida University High School and Diploma Mills,' *Letter to the Sports Editor, New York Times*, January 8, 2006.
11. Hawkins, Troy, H. Scott Matthews and Chris Hendrickson, 'Closing the Loop on Cadmium: An Assessment of the Material Cycle of Cadmium in the U.S.,' *International Journal of Life Cycle Assessment*, 11(1), pp. 38-48, 2006 (<http://www.scientificjournals.com/sj/lca/abstract/ArtikelId/7784?PHPSESSID=dd363000c89e045c77239f370f4b5eca>).
12. Hendrickson, Chris and Deborah Lange, 'Falling gas prices mask a critical issue: Energy,' *Op/Ed, Pittsburgh Post-Gazette*, Sunday, December 4, 2005, p. c-2.
13. Ochoa, Luis, Chris Hendrickson, Scott Matthews, and Robert Ries, 'Life Cycle Assessment of Residential Buildings,' *Proc. ASCE Construction Research Congress*, San Diego, 2005.
14. Hendrickson, Chris, "Discussion of 'Is Construction Labor Productivity Really Declining?'" *ASCE J. Construction Engineering and Management*, February, 2005.
15. Chester, Mikhail and Chris Hendrickson, "Cost Impacts, Scheduling Impacts and the Claims Process During Construction," *ASCE J. Construction Engineering and Management*, 131(1), pp. 102-107, January 2005.
16. Sinha, Kumares C., Chris T. Hendrickson, Edward C. Sullivan, Eva Lerner-Lam and Louis F. Cohn, "Applications of Advanced Technologies in Transportation: Lessons

- Learned and Future Directions,” Proc. Of the Eight International Conference on Application of Advanced Technologies in Transportation Engineering, ASCE, May, 2004.
17. Hendrickson, Chris, “Applications of Advanced Technologies in Transportation Engineering,” ASCE J. Transportation Engineering, 130(3), 272-273, May/June 2004.
 18. Body of Knowledge Committee of the Task Committee on Academic Prerequisites for Professional Practice, “Civil Engineering Body of Knowledge for the 21st Century,” American Society of Civil Engineers, January, 2004.
 19. Matthews, Deanna H., Gwen C. Christini and Chris Hendrickson, ‘Five elements for Organizational Decision-Making with an Environmental Management System,’ Environmental Science and Technology, 39, 1927-1932, 2004.
 20. Akinci, Burcu, Mikhail Chester, Chris Hendrickson, H. Scott Matthews, and Kevin McCloskey, “Automated Photologging and Retrieval for a Digital Photograph Library,” Proc. Of the Transportation Research Board Annual Meeting, 2003 (cd rom).
 21. Hendrickson, Chris, H. Scott Matthews, Jonathan Cagan and Francis C. McMichael, “Design Engineering,” *Business Aspects of Closed-Loop Supply Chains*, Carnegie Mellon University Press, 2003.
 22. Matthews, H. Scott and Chris T. Hendrickson, “The Economic and Environmental Implications of Centralized Stock Keeping,” J. Industrial Ecology, 6(2), pp. 71-81, Spring 2002.
 23. Hendrickson, Chris and Sue McNeil, “Project Selection from Alternatives,” *Engineering Handbook, 2nd ed.*, CRC Press, 204(1-6), 2005.
 24. Hendrickson, Chris and Tung Au, “Depreciation and Corporate Taxes,” *Engineering Handbook, 2nd ed.*, CRC Press, 205(1-9), 2005.
 25. Christini, Gwen, Michael Fetsko and Chris Hendrickson, 2004. “Environmental Management Systems and ISO 14001 Certification for Construction Firms,” ASCE J. Construction Eng. And Mgmt., 130(3), 330-336, May/June 2004.
 26. Akinci, Burcu, Chris Hendrickson and Itir Karaesman, “Exploiting Motor Vehicle Information and Communications Technology for Transportation Engineering,” ASCE J. Transportation Engineering, 129(5), pp. 469-474, Sept/Oct. 2003.
 27. Ochoa, Luis, Chris Hendrickson, and H. Scott Matthews, “Economic Input-Output Life-cycle Assessment of U.S. Residential Buildings,” ASCE J. of Infrastructure Systems, 8(4), pp. 132-138, Dec. 2002.
 28. Latimer, DeWitt IV and Chris Hendrickson, “Digital Archival of Construction Project Information,” Proceedings of the International Symposium on Automation and Robotics for Construction, 2002.
 29. Sinha, Kumares C., D. Bullock, C.T. Hendrickson, H.S. Levinson, R.W. Lyles, A. E. Radwan and Z. Li, “Development of Transportation Engineering Research, Education and Practice in a Changing Civil Engineering World,” ASCE J. of Transportation Engineering, 128(4), 301-313, 2002.
 30. Borg, Robert F., J. Gambatese, K. Haines, Jr., C. Hendrickson, J. Hinze, A. Horvath, E. Koehn, S.L. Moritz, M. Mass and R.A. Haughney, “Rebuilding the World Trade Center,” ASCE Practice Periodical on Structural Design and Construction, (also available at www.constructioninst.org), 8(3), 137-145, August 2003.
 31. H. Scott Matthews, Chris T. Hendrickson, Hui Min Chong, and Woon Sien Loh, “Energy Impacts of Wired and Wireless Networks,” Intl. Symp. On Electronics and the Environment, IEEE, 2002.
 32. Hendrickson, Chris T., “Encouraging Multi-Disciplinary Education and Inter-disciplinary Research,” Civil Engineering Education Issues 2001, Proceedings of the Third National Congress, American Society of Civil Engineers, pp. 1-5, 2001.

33. Kapila, Prashant and Chris T. Hendrickson, "Exchange Rate Risk Management in International Construction Ventures," *ASCE J. of Construction Engineering and Management*, 17(4), 186-191, October 2001.
34. Hendrickson, Chris T., A. Horvath, L.B. Lave and F.C. McMichael, "Industrial Ecology and Green Design," Chapter 36 (457-466) in Ayres, R. and Ayres, L., "A Handbook of Industrial Ecology," Edward Elgar Publishing, 2001.
35. Conway-Schempf, Noellette and Chris Hendrickson, "Life Cycle Assessment: A Synopsis," Chapter 2 (pgs. 27-42) in Hundal, M.S. (ed.), *Mechanical Life Cycle Handbook: Good Environmental Design and Manufacturing*, Marcel Dekker, Inc, 2001.
36. Januschowitz, Antje, Chris T. Hendrickson and J.H. Garrett, Jr., "System Models for Combining Enterprise Resource Planning Systems and Life Cycle Assessment Software", *EcoBalance 2000 - The Fourth International Conference on EcoBalance*, October 31 - November 2, 2000, Epochal Tsubuka, Tsubuka, Japan.
37. Matthews, H. Scott, Chris T. Hendrickson and Denise L. Soh, "Environmental and Economic Effects of E-Commerce: A Case Study of Book Publishing and Retail Logistics," *Transportation Research Record* 1763, pp. 6-12, 2001.
38. Matthews, H. Scott, Chris Hendrickson, and Arpad Horvath, "External Costs of Air Emissions from Transportation Equipment, Materials and Services Production," *ASCE J. of Infrastructure Systems*, 7(1), pp. 13-17, March 2001.
39. Lester Lave, Heather MacLean, Chris Hendrickson, and Rebecca Lankey, "Life-Cycle Analysis of Alternative Automobile Fuel/Propulsion Technologies," *Environmental Science & Technology*; 34(17); 3598-3605, 2000.
40. Matthews, H. Scott, Chris Hendrickson and Lester Lave, "Harry Potter and the Health of the Environment," *Spectrum*, 20-22, November 2000.
41. Klausner, Markus and Chris T. Hendrickson, "Reverse-Logistics Strategy for Product Take-Back," *Interfaces*, 30(3), pp. 156-165, May-June 2000.
42. Rosenblum, Jeffrey, Arpad Horvath and Chris Hendrickson, "Environmental Implications of Service Industries," *Environmental Science & Technology*; 34(22); 4669-4676, 2000. .
43. Januschowitz, Antje and C.T. Hendrickson, "Use of Enterprise Resource Planning Systems for Life Cycle Assessment and Product Stewardship: State of the Art and Current Deficiencies," *Helsinki Symposium on Industrial Ecology and Material Flows (HelSIE)*, Helsinki, Finland, August, 2000.
44. Januschowitz, Antje and Chris T. Hendrickson "Environmental Comparison by Industry Sector of United States and Germany," *SETAC 20th Annual Meeting*, Philadelphia, PA, November 14-18, 1999.
45. Hendrickson, Chris, N. Conway-Schempf, H. Scott Matthews, and F.C. McMichael, "Green Design Educational Modules and Case Studies," *Proceedings of the ASEE Conference*, St. Louis, 2000.
46. Lave, L. B., C. T. Hendrickson, N. Conway-Schempf, and F.C. McMichael, "Municipal Solid Waste Recycling Issues," *ASCE J. Environmental Engineering*, 125(10), pp. 944-949, October, 1999.
47. Kimoto, Kenji and C.T. Hendrickson, "The Application of Computer Aided Engineering for Construction Planning: Case Study for High-Rise Building Construction Project," *15th Symposium on Organization and Management of Building Construction*, Architectural Institute of Japan, (in Japanese), 1999.
48. Hendrickson, C.T. and A. Horvath, "Resource Use and Environmental Emissions of U.S. Construction Sectors," *ASCE J. of Construction Engineering and Management*, 126(1), pp. 38-44, Jan/Feb 2000.
49. Hendrickson, C. T., "Computing and Engineering Education," *Bridging the Generations: The Future of Computer-Aided Engineering*, Department of Civil and Environmental Engineering, Carnegie Mellon University, pp. 9-12, 1999.

50. Juarez O., Hendrickson C., Garrett J. "Visualization of Economic Input-Output Data," Proc. Of the 1999 International Conference on Information Visualization Proceedings, IEEE Computer Society, pp. 44-52, July 1999.
51. Juarez O., Hendrickson C., Garrett J. "Domain Analysis: A Technique to Design a User-Centered Visualization Framework," IEEE InfoVis 99 Proceedings, October 1999, San Francisco, California.
52. Juarez O., Hendrickson C., Garrett J. "Using Visualization for Teaching," Proceedings SPIE Electronic Imaging 2000, San Jose California, January 2000.
53. Horvath, A. and C. Hendrickson, "Steel vs. Steel-Reinforced Concrete Bridges: An Environmental Assessment," ASCE J. of Infrastructure Systems, 4(3), pp. 111-117, September, 1998.
54. McMichael, F.C. and C. Henderson (should be C. Hendrickson), "Recycling Batteries," IEEE Spectrum, pp. 35-42, Feb. 1998.
55. Klausner, M., W.M. Grimm, and C. Hendrickson, "Case Study on the Reuse of Electric Motors for Consumer Products," J. of Industrial Ecology, (2)1, 1998. See: http://mitpress.mit.edu/journals/JIEC/JIE2.2_Klausner.pdf
56. Klausner, M., W.M. Grimm, C. Hendrickson and A. Horvath, "Sensor-Based Data Recording of Use Conditions for Product Takeback," Proc. Of the IEEE Symposium on Electronics and the Environment, Chicago, IL, pp. 138-143, 1998.
57. Hendrickson, C., A. Horvath, S. Joshi and L.B. Lave, "Introduction to the Use of Economic Input-Output Models for Environmental Life Cycle Assessment," ES&T, 32(7), pp. 184A-191A, April 1998.
58. Lave, L., C. Hendrickson, F.C. McMichael, S. Matthews and N. Conway-Schempf, "The Role of Social Pricing and Full Cost Accounting in Motivating Environmentally-Conscious Product and Process Design," Proc. Of the NSF Design and Manufacturing Grantees Conference, Monterrey, Mexico, pp. 601-603, January 1998.
59. Horvath, A. and C.T. Hendrickson, "A Comparison of the Environmental Implications of Asphalt and Steel-Reinforced Concrete Pavements," Transportation Research Record # 1626, pp. 105-113, 1998.
60. Hendrickson, C. and S. McNeil, "Project Selection from Alternatives," The Handbook of Technology Management, CRC Press, pp. 8-89/8-93, 1998.
61. Lave, L.B., C.T. Hendrickson, and F.C. McMichael, "Clean Recycling of Lead-Acid Batteries for Electric Vehicles – A Reply to Socolow and Thomas," Industrial Ecology, 1(2), 1997.
62. Juarez, Octavio, J. Garrett and C.T. Hendrickson, "A Software Tool for Economic Input Output Environmental Life Cycle Assessment," Proc. of the ASME Annual Conference, " Concurrent Product Design and Environmentally Conscious Manufacturing, pp. 215-224, 1997.
63. Hendrickson, C.T., A. Horvath, S. Joshi, M. Klausner, L.B. Lave and F.C. McMichael, "Comparing Two Life Cycle Assessment Approaches: A Process Model vs. Economic Input-Output Based Assessment," Proc. of the IEEE Intl. Sym. on Electronics and the Environment, San Francisco, CA, May 1997.
64. Garrett, J. Jr., C.T. Hendrickson, A. Horvath, S. Joshi, O. Juarez and F.C. McMichael, "General Purpose Computer-Aided Engineering Tools for Environmental Software Systems," Proc. of the Second Intl. Sym. on Environmental Software Systems, Whistler, British Columbia, April 1997.
65. Lave, L.B., E. Cobas-Flores, F.C. McMichael, C.T. Hendrickson, A. Horvath, and S. Joshi, "Measuring the Environmental Impacts and Sustainability of Automobiles," Sustainable Individual Mobility - Critical Choices for Government and Industry Conference, Zurich, Switzerland, Nov. 4-5, 1996.

66. Lave, L.B., A.G. Russell, C.T. Hendrickson and F.C. McMichael, "Battery-Powered Vehicles: Ozone Reduction versus Lead Discharges," *Environmental Science and Technology*, 30(9), pp. 402A-407A, September 1996. Reprinted in *The Future of the Electric Vehicle*, H. Kukuck (ed.), Amerika Haus, Frankfurt, Germany, 1996.
67. Hendrickson, C., A. Horvath, L. Lave and F. C. McMichael, "New Markets for Old Materials," *TR News*, pp. 32-35, May-June 1996.
68. Hendrickson, C., E. Cobas-Flores, L. Lave and F. McMichael, "Life-cycle Analysis of Batteries Using Economic Input-Output Analysis," 1996 IEEE International Symposium on Electronics and the Environment, Dallas, TX, May 1996.
69. Horvath, A., H. MacLean, Hendrickson, C., L. Lave and F. McMichael, "International Environmental Performance Measurement in the Electronics Industry," 1996 IEEE International Symposium on Electronics and the Environment, Dallas, TX, May 1996.
70. Ruff, Cynthia M., David A. Dzombak and Chris T. Hendrickson, "Owner-Contractor Relationships on Contaminated Site Remediation Projects," *ASCE J. of Construction Engineering and Management*, 122(4), p. 348-353, Dec. 1996.
71. McMichael, F.C., L.B. Lave and C.T. Hendrickson, "Electric Vehicles May Not Be Ready to Roll," *TR News* 181, p. 14, Nov-Dec. 1995.
72. McMichael, F.C., C.T. Hendrickson, and L.B. Lave, "Environmental Implications of Battery Powered Vehicles," *Proc. of the Future of the Electric Vehicle Conference*, Amerika Haus, Frankfurt, Germany, October 1996.
73. Director, Stephen W. and Chris Hendrickson, "An Assessment of the Carnegie Mellon Electrical and Computer Engineering Curriculum," *The Interface*, IEEE Education Society and ASEE Electrical Engineering Division, Vol. 3, pp. 1-4, November 1995.
74. Director, S., C. Hendrickson, R. Kail and P. Laughlin, "Undergraduate Curriculum Revision Assessment," *Carnegie Mellon Engineering*, Carnegie Institute of Technology, Technical Report, 1995.
75. Lave, L., E. Cobas-Flores, C. Hendrickson, and F. McMichael, "Generalizing Life-Cycle Analysis: Using Input-Output Analysis to Estimate Economy-Wide Discharges," *Environmental Science & Technology*, 29(9), 420A-426A, September 1995.
76. Horvath, A., C. Hendrickson, L. Lave and F. McMichael, "Performance Measurement for Environmentally-Conscious Manufacturing," *ASME Manufacturing Science and Engineering Symposium*, ASME Intl. Mechanical Engineering Congress and Exposition, Vol. 2, pp. 847-854, 1995.
77. Lave, L., C. Hendrickson, and F. McMichael, "Environmental Implications of Electric Vehicles," *Science*, pp. 993-995, May 19, 1995. Reprinted in *The Future of the Electric Vehicle*, H. Kukuck (ed.), Amerika Haus, Frankfurt, Germany, 1996.
78. Lave, L., C. Hendrickson, and F. McMichael, "Environmental Implications of Electric Vehicles - Response to Letters," *Science*, pp. 744-745, August 11, 1995.
79. Cobas, E., C. Hendrickson, L. Lave and F. McMichael, "Economic Input/Output Analysis to Aid Life Cycle Assessment of Electronic Products," *Proc. IEEE International Symposium on Electronics and the Environment*, Orlando, Florida, pp. 273-278, May, 1995.
80. Hendrickson, C., L. Lave and F. McMichael, "Time to Dump Recycling?," *Issues in Science and Technology*, pp. 79-84, Spring 1995. Reprinted as "Reconsider Recycling," *Chemtech*, 25(8), pp. 56-60, August 1995.
81. Hendrickson, C., "Automation and Robotics: Past Present and Future," in *Automation and Robotics in Highway Design, Construction and Maintenance*, Special Issue *TR News*, No. 176, pp. 2-3, Jan/Feb 1995.
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183. Wilson, N.M.H. and C. Hendrickson, "Performance Models of Flexibly Routed Transportation Services," *Transportation Research*, 14B (1/2), pp. 67-78, March/June, 1980.
184. Hendrickson, C. and J. Pucher, "Distribution of Costs: Who Pays the Public Costs of Urban Transportation?" *Proceedings of the ASCE Urban Transportation Financing Specialty Conference*, Bucknell University, pp. 81-99, 1979.
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186. Daganzo, C.F., C. Hendrickson and N.M.H. Wilson, "An Approximate, Analytic Model of Many-to-One Demand Responsive Transportation Systems," *Proceedings of the Seventh International Conference on Transportation and Traffic Theory*, Kyoto, Japan, 1977.

EXAMPLE RESEARCH PROJECTS

1. MUSES: Material Resources and Environmental Impacts for Transportation Fuels Infrastructure (with M. Griffin, L. Lave, S. Matthews, and J. Michalek), NSF 2006, \$ 1,500,000.
2. MUSES: Tacking Heavy Metal Life Cycle Pathways with Input-Output Methods (with L. Lave, S. Matthews and M. Small), NSF, 2003, \$ 1,200,000.
3. Assessment Tool and Visualization for Regional Supply Chain Impacts (with S. Matthews), NSF/EPA, 2003, \$ 375,000.

4. Automated Archiving and Retrieval of Construction Site Photographs (with B. Akinci), PITA, \$ 37,308.
5. Analyzing Critical Infrastructure Dependencies: Security and Survivability Effects in the Service Sector (with J. Garrett), NSF, \$ 149,000.
6. "Exploiting Motor Vehicle Information for Social Benefit," NSF/DOT (with B. Akinci), 2002, \$ 100,000.
7. "Environmental Management Systems: Informing Organizational Decisions," EPA (with L. Lave), 2001-2003, \$ 350,000.
8. "Computer-Aided Hybrid Models for Environmental and Economic Life Cycle Assessment," EPA, (with A. Horvath and S. Matthews), 2001-2003, \$ 305,000.
9. "Life Cycle Product Information Systems for Scalable and Sustainable Enterprises," NSF, 2001, \$ 100,000.
10. "The Net Effect: Environmental Implications of E-Commerce," AT&T Foundation, 1999-2001, \$ 75,000.
11. "Life Cycle Assessment in the Service Industries," Lucent and National Science Foundation Industrial Ecology Fellowship (Co-PI with Arpad Horvath and Lester Lave), 1998-2000, \$ 100,000.
12. "Economic Input-Output for Life Cycle Assessment," Environmental Protection Agency and National Science Foundation Environmental Technology Program, 1998-99, \$ 290,000.
13. "Motivating Environmentally Conscious Products and Processes: The Role of Social Pricing and Full Cost Accounting," National Science Foundation, 1996-1999, Co-Principal Investigator with Noellete Conway-Schempf and Lester Lave. \$ 475,000.
14. "Environmental Life Cycle Analysis of Construction Materials," National Science Foundation, 1997-1999, Principal Investigator, \$ 250,000.
15. "Curriculum and Educational Materials for Environmentally Conscious, Green Products and Processes," National Science Foundation, \$ 250,000, 1997-2000.
16. "Life Cycle Assessment using Economic Input-Output Models," Department of Energy, 1996-1998, Co-Principal Investigator with Noellete Conway-Schempf and Lester Lave. \$ 250,000.
17. "Informing the Product Designer About the Environmental Implications of Design Choices," National Science Foundation, 1993-96, Co-Principal Investigator with Linda Argote, Lester Lave and Francis McMichael.
18. "Evaluation of Owner-Contractor Organization Integration for Site Remediation Projects," Construction Industry Institute, 1993-94, Co-Principal Investigator with Dave Dzombak.
19. "Development of Software Standards for Advanced Transportation Control Systems," California Department of Transportation (with U. California at Irvine), 1991-1993.
20. "Investigation of an Automated Pavement Crack Filler," Strategic Highway Research Program, National Academy of Sciences, 1989-1991, Co-Principal Investigator with Sue McNeil.
21. "Design of Computer-Based Facilities Management System," Duquesne Light, 1989-1990, Co-Principal Investigator with Sue McNeil.
22. "Economic Optimization Module for Concrete Placement," Western Pennsylvania Advanced Technology Center and Digital Site Systems, 1987-1989.
23. "Prototype Integrated Design Environment," Carnegie-Mellon Engineering Design Research Center, 1986-1991, Co-Principal Investigator with S. Fenves and M. Maher.
24. "Research in Cognitive Excavation Automation," National Science Foundation, 1986-1988, Faculty Associate.
25. "Knowledge Based Expert Systems for Retaining Wall Rehabilitation Design and Cost Estimation," National Science Foundation, 1986-1988, Principal Investigator.

26. "Innovative Financial Strategies During Facility Construction," Urban Mass Transportation Administration, 1985-1986, Co-Principal Investigator with Tung Au.
27. "Knowledge Based Expert Systems Aids for Construction Project Planning," National Science Foundation, 1985-1987, Co-Principal Investigator with Daniel R. Rehak.
28. "Instructional Software for Construction Project Planning and Management," Mellon-Stuart Company, Inc., 1984-85, Principal Investigator.
29. "Investigation of an Optimization Method to Estimate, Update or Expand Matrices," National Science Foundation, 1982-84, Principal Investigator.
30. "User Response to Time of Day Variations in Transit Service Level and Reliability," Urban Mass Transportation Administration, 1980-81; Co-Principal Investigator with Daniel Nagin (1980-81); Principal Investigator (1981-82).
31. "Study of Alternative Transportation Strategies for the Parkway East (I-376-1(37)5) Reconstruction", Pennsylvania Department of Transportation (under sub-contract to GAI Consultants, Inc.), 1981-82, Principal Investigator.
32. "Equity in Transit Financing," Urban Mass Transportation Administration (under sub-contract to Rutgers University), 1980-81, Co-Principal Investigator with J. Pucher (Rutgers University).

EXAMPLE CONSULTING ASSIGNMENTS

- External Panel Review, Upper Ohio Navigation Study, US Army Corps of Engineers, 2007.
- Program Assessments, SEI and NSF, 1996-2002.
- Construction Productivity Analysis, Michael Baker Corporation, 1996.
- Statistical Analysis of Task Productivity Differences, Statistical and Total Project Quality Control (Pittsburgh Corning Corporation, 1986-1989).
- Investment Financing Alternatives for the Pittsburgh Airport Expressway (GAI Consultants for Pennsylvania Department of Transportation, 1985).
- Investigation of Port Authority of Allegheny County Operating Efficiency (Pennsylvania House of Representatives, 1985).
- Cost Allocation for Rail Rate Setting (Connecticut Department of Transportation, 1984).
- Public Transportation Database and Decision Making Support (NOVA Consulting, 1982).
- Economic Impact of Rail Short Line Abandonment (CONSAD for US Rail Administration, 1981).

GRADUATE STUDENT THESIS SUPERVISION

Doctoral Students

1. Hawkins, Troy, 'A Mixed Unit Model for Life Cycle Assessment,' PhD 2007 (Co-advised by Scott Matthews, now employed by Norwegian University of Science and Technology).
2. Cicas, Gyorgyi, 'Regional Economics Input-Output Analysis Based Life Cycle Assessment,' PhD 2005 (employed by Carnegie Mellon University).
3. Ochoa Franco, Luis, "Life Cycle Assessment of Residential Buildings," PhD 2005, (employed by Universidad Michoacana, UMSNH, Mexico).
4. Reyna-Caamano, Ruth, "Comparing the Performance of Manufacturing Plants in Mexico and the United States," PhD 2002, (co-advised by Lester Lave, employed by ITESM, Monterrey, Mexico).

5. Januschkowetz, Antje, "Use of Enterprise Resource Planning Systems for Life Cycle Assessment and Product Stewardship," Ph.D. 2002, (employed by Robert Bosch GmbH).
6. Matthews, Deanna, "Assessment and Design of Industrial Environment Management Systems," Ph.D. 2001 (awarded the 2001 Carnegie Mellon William Cooper Award for the Best Dissertation in Management or Management Science, currently Post-Doctoral Research, Carnegie Mellon).
7. Juarez-Espinosa, Octavio Hector, "Development of User Centered Environmental Software Systems," Ph.D. 1999 (co-advised with James Garrett, Jr., employed by Carnegie Mellon, Robotics Institute)
8. Matthews, H. Scott, "External Air Pollution Costs of Industrial Production," Ph.D. 1999 (co-advised with Lester Lave, employed by Carnegie Mellon).
9. Klausner, Markus, "A Framework for Product Takeback Systems," Ph.D., 1998 (employed by Robert Bosch GmbH).
10. Horvath, Arpad, "Estimation of the Environmental Implications of Construction Materials and Designs using Life Cycle Assessment Techniques," Ph.D., 1997 (employed by U. CA Berkeley)
11. Cobas-Flores, E. Elisa, "Life Cycle Assessment Using Input-Output Analysis," Ph.D., 1996. (co-advised with Lester Lave, employed by ITESM, Monterrey, Mexico.)
12. Hussain, Mansur, "Constraint-Based Project Scheduling," Ph.D., 1993. (employed by Indonesian Ministry of Transport)
13. Bullock, Darcy, "A Model for Roadway Traffic Control Software," Ph.D., 1992. (employed by Purdue University)
14. Morse, David, "Communication in Automated Interactive Engineering Design," Ph.D. 1990 (employed by IBM)
15. Haas, Carl, "A Model of Pavement Surfaces", Ph.D., 1990 (employed by U. Waterloo)
16. Adams, Teresa, "RETAIN: An Integrated Knowledge Based System for Retaining Wall Rehabilitation Design", Ph.D., 1989 (employed by Univ. Wisconsin, Madison).
17. Zozaya-Gorostiza, Carlos, "Knowledge-Based Planning for Construction Projects," Ph.D., 1988 (employed by INAM, Mexico City).
18. Skibniewski, Miroslaw, "Engineering and Economic Analysis of Robotics Application Potential in Selected Construction Operations," Ph.D., 1986 (employed by Purdue University)
19. McNeil, Sue, "Quadratic Matrix Entry Estimation Methods," Ph.D., 1983 (employed by U. Delaware)
20. Kocur, George, "Optimal Design of Urban Bus Systems with Demand Sensitive to Service Levels," Ph.D., 1981 (employed by MIT)

Master of Science Theses

1. Christini, Gwen, "Environmental Management Systems Case Studies," MS 2003 (employed by MWH).
2. Horney, Cheryl, "Integrating Environmental Costs in a Management Information System: A Full Cost Accounting Case Study of a Manufacturing Plant" MS 1998 (employed by Xerox Corporation).
3. Hart (now Matthews), Deanna, "Identification and Specification of Recycled Materials: A Case Study of Post-Consumer Carpets," MS, 1995. (employed by IBM)
4. Kameda, Hirofumi, "Assessment of Foreign Aid Development Projects," MS, 1995.
5. Horvath, Arpad, "Toxic Emissions Indices for Environmental Management," MS, 1995.
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