Dr. Hugh L. McManus

Summary

Hugh McManus develops, teaches and applies advanced methods in lean process improvement, systems engineering and preliminary design, and composite materials and structures, for a variety of corporate, government, and university clients. His current emphasis is on adapting lean methods to the needs of complex health care processes in order to lower costs, increase quality, and improve customer satisfaction.

Experience

Loyola Marymount University, Los Angeles CA (Since 2013) *Lecturer, SELP 535 Lean Healthcare*
Teaches and refines a unique class which uses active learning and simulations to teach adaptations of lean methods that address complex healthcare system problems. Aided in development of the certificate program in Lean Healthcare Systems and the new MS degree program in Healthcare Systems Engineering.

Northeastern University, Boston MA (Since 2008) *Lecturer, IE 5617 Lean Applications and Methods*
Teaches and refines graduate class based on the LAI Lean Academy.

Metis Design Corporation, Cambridge MA (Since 2002) *Senior Special Projects Engineer*
Develops, deploys and facilitates lean methods for healthcare, product development, and manufacturing enterprises. Creates and deploys courses and training featuring unique educational simulations. Develops proprietary training for large corporations, and course materials for both client universities and for open-source distribution. Past work as the Co-Director of the Lean Advancement Initiative (LAI) Educational Network (EdNet) included co-creating the Lean Healthcare Academy; helping create and refine the LAI Lean Academy, available open-source through MIT OpenCourseWare; and creating courses and teaching simulations for lean product development and enterprise transformation. Also supported research in complex system architecture and preliminary design, and original test and analysis programs for composite structure durability.

Massachusetts Institute of Technology, Cambridge MA (1991-2002) *Various Positions*
As *LAI Product Development Co-lead* investigated application of lean (Toyota Production System) principles to engineering and product development. As *SSPARC Executive Director*, developed advanced system architecture and preliminary design methods. Contributed to courses, training, and consortium administration. As *Assistant and Associate Professor, Aeronautics and Astronautics Department*, did research in advanced composite materials and aerospace structures, and taught mechanics, materials, and system design courses.

Lockheed Missiles and Space Company, Sunnyvale CA (1984-1990) *Structures Engineer*
Analyzed, designed, and tested space structures and rocket motors. Developed new composite materials and associated design, manufacture, analysis and test techniques.

Kaman Avidyne, Burlington MA (1981-1984)
Analyzed and designed aerospace systems for severe thermal environments.

Other Work Experience
Consulting and service work (ongoing). Research and Teaching Assistant, Stanford University (1987-1990). Research Assistant, MIT (1978-1981). Programming, house painting, taxi driving, newspaper delivery.

Education

Stanford University, Mechanical Engineering Ph.D. June 1990.

Massachusetts Institute of Technology, Aeronautics and Astronautics S.B. June 1980, S.M. June 1981.

Background

Associate Fellow of the American Institute of Aeronautics and Astronautics; member, Institute of Industrial and Systems Engineering, and Society for Health Systems.

Born Boston, MA; raised in East Lansing, MI. Married, two children. Little League coach, community supported agriculture member, handyman; paint, run, cycle and ski.

Contact

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Dr. Hugh L. McManus

Biography

Hugh McManus, a Senior Special Projects Engineer at Metis Design, and Adjunct Faculty at Northeastern and Loyola Marymount Universities, develops, teaches and applies advanced methods in lean process improvement, systems engineering and preliminary design, and composite materials and structures. His current emphasis is on adapting lean methods to the needs of health care processes to lower costs, increase quality, and improve customer satisfaction.

Dr. McManus has done pioneering work in the adaptation of lean techniques to the complex healthcare industry. He co-lead the development of the *Lean Healthcare Academy™* with MIT's Lean Advancement Initiative (LAI) and its Educational Network (EdNet). The EdNet university consortium, along with the launch customer, the Veterans Administration (VA) VISN 1, created a three-day course incorporating the latest in both lean healthcare knowledge and educational techniques. Dr. McManus developed a learning simulation that allows students to experience lean transformations in a realistically represented patient value stream. He has participated in the creation of both a certificate program in Lean Healthcare Systems and the new MS degree program in Healthcare Systems Engineering at Loyola Marymount; an expanded version of the course serves as a cornerstone of both programs. The learning simulation has been disseminated to more than a dozen sites, and is used in training and courses, most notably as an integral part of the Green Belt training at VA's VISN 8.

Dr. McManus has also served as the LAI product development lead, and as the associate director of EdNet. He has done original work in lean applications to product development and complex enterprises, and has created courses, training materials and simulations for these applications. Courses include the *LAI Lean Academy®* and *Lean Healthcare Academy™*, comprehensive enterprise-level courses for technical and healthcare personnel respectively; the *Lean Enterprise Value Seminars*, advanced courses for lean leaders; and *Lean Enterprise Product Development*, a course in applying lean to product development processes and organizations. Dr. McManus has led or participated in lean transformation events for many corporate and government clients, applying value stream mapping and other lean techniques to product development organizations, maintenance facilities, and program and acquisition enterprises. Recent teaching includes graduate classes Northeastern and Loyola Marymount universities, and professional development classes at MIT, the Veterans Administration, and other organizations. Recent application projects include compiling lean best practices for a large multinational corporation, aiding the transformation of government acquisition practices, and applying lean concepts to healthcare systems.

Dr. McManus is also developing, and working with, advanced tools for complex system architecture and preliminary design. These tools and conceptual frameworks deal with the uncertainties and opportunities of the very early stages of the design of complex systems. They include methods for understanding the trades between user desires, technical possibilities, and cost constraints very early in design; tools for analyzing, visualizing, and interpreting these trades; a framework for understanding and exploiting the uncertainties in complex system design; and work on the role of the "ilities" (flexibility, versatility, survivability, etc.).

Dr. McManus has a background in advanced structures and materials. He was a structural engineer at Lockheed Missiles and Space Company (now a division of Lockheed Martin), and at Kaman Aerospace for a total of 10 years, and taught structures and materials courses at MIT for 7 years. He remains actively interested in aerospace structural engineering, composite materials, structural health monitoring, and high-temperature polymer materials.

Dr. McManus co-authored a book on lean methods in the aerospace industry, *Lean Enterprise Value,* and published several major tools and reports, including the LAI *Product Development Value Stream Mapping (PDVSM) Manual*. He has also co-edited a book on applications of polymer composite materials, has been an associate editor for the *AIAA Journal of Spacecraft and Rockets*, and a guest editor for the *Journal of Enterprise Transformation,* is a reviewer for many publications, and has published over 60 peer-reviewed journal and conference publications.

Dr. McManus received a Ph.D. degree in Mechanical Engineering from Stanford University in 1990, and S. B. and S. M. degrees in Aeronautics and Astronautics from MIT in 1980 and 1981. He has worked at Kaman Aerospace (1981-84) and Lockheed Missiles and Space Company (1984-1990), on the faculty of the MIT Aeronautics and Astronautics Department (1991-98), and on MIT's research staff (1998-2002). He is an Associate Fellow of the American Institute of Aeronautics and Astronautics and a member of the Institute of Industrial and Systems Engineers and the Society for Health Systems.

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Selected Publications and Presentations –
Lean Applications and Enterprise Transformation

metis design

Murman, E., Allen, T., Bozdogan, K., Cutcher-Gershenfeld, J., McManus, H., Nightingale, E., Rebentisch, E., Shields, T., Stahl, F., Walton, M., Warmkessel, J., Weiss, S., and Widnall, S., *Lean Enterprise Value*, Palgrave, London, 2002.

McManus, H. L., "Product Development Transition to Lean (PDTTL) Roadmap, Release Beta," MIT Lean Aerospace Initiative, September 2004.

McManus, H. L., "Product Development Value Stream Mapping (PDVSM) Manual, Release 1.0," MIT Lean Aerospace Initiative, September 2005.

McManus, H. L. and Hastings, D. E., "A Framework for Understanding Uncertainty and its Mitigation and Exploitation in Complex Systems," *IEEE Engineering Management Review*, Vol. 34, No. 3, Third Quarter 2006, pp. 81-94. (Originally published in the proceedings of the Fifteenth Annual International Symposium of the INCOSE, Rochester, NY, July 2005.)

McManus, H.L., Haggerty, A. and Murman, E., "Lean engineering: a framework for doing the right thing right," *The Aeronautical Journal*, Vol. 111, No. 1116, February 2007, pp. 105-114. (Originally published in slightly different form in Proceedings of the 1st International Conference on Innovation and Integration in Aerospace Sciences, Queen's University Belfast, Northern Ireland, UK, August 2005.)

McManus, H. L., Rebentisch, E., Murman, E., and Stanke, A., "Teaching Lean Thinking Principles Through Hands-on Simulations," Proceedings of the 3rd International CDIO Conference, MIT, Cambridge, Massachusetts, June 11-14, 2007.

Murman, E., McManus, H. L. and Candido, J., "Enhancing Faculty Competency in Lean Thinking Bodies of Knowledge," Proceedings of the 3rd International CDIO Conference, MIT, Cambridge, Massachusetts, June 11-14, 2007.

Candido, J., Murman, E. and McManus, H. L., "Active Learning Strategies for Teaching Lean Thinking," Proceedings of the 3rd International CDIO Conference, MIT, Cambridge, Massachusetts, June 11-14, 2007.

McManus, H. L. and Rebentisch, E., "Experiences in Simulation-Based Education in Engineering Processes," 38th ASEE/IEEE Frontiers in Education Conference, Saratoga Springs, NY, Oct. 2008.

McManus, H., "Deploying the LAI Lean Academy at Northeastern University," LAI Annual Meeting, Baltimore MD, April 2009.

McManus, H., "Simulating Health Care Value Streams," LAI Annual Meeting, Dana Point CA, March 2010.

McManus, H., "Ten Years of Progress in Lean Product Development," Lean Management Summit, ETH Zurich, Zurich, Switzerland, May 2011.

McManus, H., Murman, E., Johnson, S., and Willis, D., "A One-Day Introductory Lean Healthcare Course," Lean Educator Conference, Huntsville AL, Oct. 2011.

Mayrl, P., Boutellier, R.and McManus, H. L., "Eliciting Product Development Knowledge Using Value Stream Mapping," *International Journal of Product Development*, 2013, Vol. 18, No.6, pp. 492-511.

McManus, H., "Progress in Lean Product Development," Product Development Lecture Series, Wrocław University of Technology, Wrocław Poland, June 2013.

McManus, H., "Lean Education and Training for Health Care," IIE Engineering Lean Six Sigma Conference, Orlando FL, Sept. 2014.

Murman, E., McManus, H., and Weigel, A., "The LAI Lean Academy Experience: Introductory Lean Curriculum," *Journal of Enterprise Transformation*, 2014, Vol. 4, No. 3, pp. 205-225. (Originally published in Proceedings of the 2013 Industrial and Systems Engineering Research Conference, San Juan, Puerto Rico, June 2013)

Benedict, A. J., McManus, H., *et al.*, "Integrating a Lego Simulation into a Lean-Six Sigma Belt Training," accepted for presentation at the Healthcare Systems Process Improvement Conference, Orlando, FL, March 2017.

Dr. Hugh L. McManus

Selected Publications –
Tradespace Exploration and Product Design

McManus, H. L. and Schuman, T. E., "Understanding the Orbital Transfer Vehicle Trade Space," AIAA Paper 2003-6370, Sept. 2003.

McManus, H. L., Hastings, D. E. and Warmkessel, J. M., "New Methods for Rapid Architecture Selection and Conceptual Design," *Journal of Spacecraft and Rockets*, Vol. 41, No. 1, Jan.-Feb. 2004, pp. 10-19.

McManus, H. L. and Warmkessel, J. M., "Creating Advanced Architectures for Space Systems: Emergent Lessons from New Processes," *Journal of Spacecraft and Rockets*, Vol. 41, No. 1, Jan.-Feb. 2004, pp. 69-74.

McManus, H. L. and Hastings, D. E., "Space System Architecture- Final Report of SSPARC: the Space Systems, Policy, and Architecture Research Consortium (Thrust II and III)," MIT Lean Aerospace Initiative, September 2004.

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McManus, H. L., Richards, M. G., Ross, A. M. and Hastings, D. E., "A Framework for Incorporating "ilities" in Tradespace Studies," Proceedings of AIAA Space 2007 Conference & Exposition, Long Beach, CA, AIAA Paper 2007-6100, Sept. 2007.

Ross, A. M., McManus, H. L., Long, A., Richards, M. G., and Hastings, D. E., "Responsive Systems Comparison Method: Case Study in Assessing Future Designs in the Presence of Change," Proceedings of AIAA Space 2008 Conference & Exposition, San Diego, CA, Sept. 2008.

Ross, A. M., McManus, H. L., Rhodes, D. H., Hastings, D. E. and Long, A., "Responsive Systems Comparison Method: Dynamic Insights into Designing a Satellite Radar System," Proceedings of the AIAA Space 2009 Conference & Exposition, Pasadena, CA, Sept. 2009.

Ross, A. M., McManus, H. L., Rhodes, D. H., and Hastings, D. E., "Role for Interactive Tradespace Exploration in Multi-Stakeholder Negotiations," AIAA Space 2010, Anaheim, CA, September 2010.

Ross, A. M., McManus, H. L., Rhodes, D. H., and Hastings, D. E., "Revisiting the Tradespace Exploration Paradigm: Structuring the Exploration Process," AIAA Space 2010, Anaheim, CA, September 2010.

Dr. Hugh L. McManus

Selected Publications –
Composite Materials and Structures

metis design

McManus, H. L., and Springer, G. S., "High Temperature Thermomechanical Behavior of Carbon-Phenolic and Carbon-Carbon Composites, I. Analysis and II. Results," *Journal of Composite Materials*, Vol. 26, No. 2, 1992, pp. 206-255.

McManus, H. L., "Probabilistic Methods for the Calculation of Laminate Properties," *Journal of Reinforced Plastics and Composites*, Vol. 12, June 1993, pp. 712-722.

McManus, H. L., Bowles, D. E., and Tompkins, S. S., "Prediction of Thermal Cycling Induced Matrix Cracking," *Journal of Reinforced Plastics and Composites*, Vol. 15, No. 2, 1996, pp. 124-140.

Park, C. H., and McManus, H. L., "Thermally Induced Damage in Composite Laminates: Predictive Methodology and Experimental Investigation," *Composites Science and Technology*, Vol. 56, No. 10, 1996, pp. 1209-1219.

McManus, H. L. and Maddocks, J. R., "On Microcracking in Composite Laminates under Thermal and Mechanical Loading," *Polymers and Polymer Composites*, Vol. 4, No. 5, 1996, pp. 304-314.

McManus, H. L., and Cunningham, R., "Coupled Materials and Mechanics Analyses of Durability Tests for High Temperature Polymer Matrix Composites," *ASTM STP 1302: High Temperature and Environmental Effects on Polymeric Composites*, American Society for Testing and Materials, West Conshohocken PA, 1997, pp. 1-17.

McManus, H. L., and Chamis, C. C., "Stress and Damage in Polymer Matrix Composite Materials Due to Material Degradation at High Temperatures," NASA Technical Memorandum 4682, January 1996.

Michii, Y., and McManus, H. L., "Prediction of Microcracking Distributions in Composite Laminates using a Monte-Carlo Simulation Method," *Journal of Reinforced Plastics and Composites*, Vol. 16, No. 13, 1997, pp. 1220-1230.

Crews, L. K., and McManus, H. L., "Modeling the Effects of High Temperature Exposure on the Mechanical Material Properties of Graphite/Epoxy," Proceedings of the American Society for Composites 13th Annual Technical Conference on Composite Materials, September 21-23 1998, Baltimore, Maryland, pp. 416-426.

McManus, H. L., Foch, B., and Cunningham, R., "Mechanism-Based Modeling of Long-Term Degradation," *Journal of Composites Technology and Research*, Vol. 22, No. 3, July 2000, pp. 146-152.

Tsuji, L. C., McManus, H. L., and Bowles, K. J., "Mechanical Properties of Degraded PMR-15 Resin," *Time Dependent and Nonlinear Effects in Polymers and Composites, ASTM STP 1357*, R. A. Schapery and C. T. Sun, Eds., American Society for Testing and Materials, West Conshohocken PA, 2000, pp. 3-17.

Reynolds, T. G., and McManus, H. L., "Accelerated Test of Environmental Degradation in Composite Materials," *Composite Structures: Theory and Practice, ASTM STP 1383*, P. Grant and C. Q. Rousseau, Eds., American Society for Testing and Materials, West Conshohocken PA, 2000, pp. 513-525

Kessler, S. S., Matuszeski, T., and McManus, H. L., "Cryocycling and Mechanical Testing of CFRP for the X-33 Liquid H2 Fuel Tank Structure," Proceedings of the 16th Annual Technical Conference of the American Society for Composites, Blacksburg Virginia, Sept 10-12 2001, Paper ASC-2001 #093.

McManus, H. L., Faust. A., and Uebelhart, S., "Gas Permeability of Thermally Cycled Graphite-Epoxy Composites," Proceedings of the 16th Annual Technical Conference of the American Society for Composites, Blacksburg Virginia, Sept 10-12 2001, Paper ASC-2001 #087.

Kessler S. S., McManus, H. L., and Hyer, M. W., "Service Life Assessment Methodology for Composites," Proceedings of the 22nd Annual Technical Conference of the American Society for Composites, Seattle Washington, Sept 17-19 2007, Paper ASC-2007 #020.

McManus, H. L., Kessler S. S., Raghavan, A., Hyer, M. W., Case, S., and Cain, J., "Service Life Assessment Methodology for Composites (SLAM-C): Models, implementation, and experimental calibration," International Conference on Fiber Reinforced Polymer (FRP) Composites for Infrastructure Applications, San Francisco, CA, November 2009.