

# Jonathan Cagan, Ph.D., P.E.

George Tallman and Florence Barrett Ladd Professor in Engineering  
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## Education

**Ph.D.** University of California, Berkeley, CA, April, 1990, Mechanical Engineering  
**M.S.** University of Rochester, Rochester, NY, January, 1985, Mechanical Engineering  
**B.S.** University of Rochester, Rochester, NY, December, 1983, Mechanical Engineering

## Positions Held

2/20-present **Co-Chair, Provost's Committee for Academic Matters**  
1/19-12/19 **Interim Dean**, College of Engineering  
9/18-12/18 **Chief Academic Officer**, College of Engineering  
4/17-12/18 **Associate Dean for Graduate and Faculty Affairs**, College of Engineering  
8/16-6/18 **Faculty Co-Director**, Swartz Center for Entrepreneurship  
7/16-10/17 **Head**, MS in Technology Ventures, Bi-Coastal Program  
9/15-3/17 **Associate Dean for Strategic Initiatives**, College of Engineering  
10/13-10/17 **Head**, MS in Software Management, Silicon Valley  
8/13-10/17 **Co-Director**, Integrated Innovation Institute  
7/13-9/15 **Director of Innovation and Entrepreneurship**, College of Engineering  
5/13-8/14 **Co-Chair of Strategic Planning**, College of Engineering  
5/08-12/11 **Co-Director**, Center for Product Strategy and Innovation  
11/07-present **George Tallman and Florence Barrett Ladd Professorship in Engineering**  
7/03-2/17 **Co-Director**, Master of Integrated Innovation for Products and Services (formerly MPD)  
7/99- present **Professor**, Dept. of Mechanical Engineering  
6/00 - present **Faculty Appointment**, School of Design  
9/97-6/99 **George Tallman and Florence Barrett Ladd Associate Professorship in Engineering**  
1/97-12/06 **Faculty Appointment**, Biomedical Engineering  
7/95-6/99 **Associate Professor**, Dept. of Mechanical Engineering  
12/93-12/13 **Courtesy Appointment**, Dept. of Computer Science  
7/90-6/95 **Assistant Professor**, Dept. of Mechanical Engineering  
Carnegie Mellon University, Pittsburgh, PA  
10/02-4/09 **Co-Founder and Chief Technologist**  
DesignAdvance Systems, Inc., Pittsburgh, PA [formerly called Desantage, Inc.]  
(*company acquired by EMA Design Automation*)  
11/84-7/86 **Applied Research Engineer**, Engineering Technology Laboratory  
5/81-10/84 **Cooperative Intern**  
Eastman Kodak Company, Rochester, NY

## Research Interests

*Design theory, methods, and automation; product design; concurrent engineering; problem solving, teams; spatial synthesis and layout, formal design synthesis, traditional, qualitative, and stochastic optimization techniques; computer-aided innovative and creative design; design representations; design grammars; product design methodologies; cognition and problem solving; agent-based design; machine learning; integrated product development; industrial and service*

design; entrepreneurship; strategic planning, brand strategy; design preference; design preference; neuroscience applied to design; internet of things; bio-based design synthesis.

## Teaching Experience

Graduate Courses:	AI in Design (introduced course) Optimization in Mechanical Engineering (introduced course) Healthcare Engineering for Independent Living (introduced course) Product Research and Conceptualization (introduced course) Emotion-based Product Research (introduced course) Design for Manufacturing and the Environment (introduced course) Grand Challenges: Technology Identification and Product Design (introduced course) Technology-based Product Innovation and Enterprise Creation (introduced course) Grand Challenge Innovation (introduced course)
Undergraduate Courses:	Introduction to Mechanical Engineering Statics and Dynamics Engineering Design Design for Manufacturing Manufacturing Sciences
Integrated Innovation Courses:	Integrated Product Development (graduates and seniors; co-taught with business school and industrial design) Integrated Product Development Methods (co-introduced course)
Professional Development:	User-Centered Integrated Product Development Faculty-to-faculty course: Designing for the Human Experience Executive and team training to: Jarden Corp., Ford Motor Company, Procter & Gamble, Navistar (International Truck), Alcoa Corp., Industrial Scientific Corp., Giant Eagle Corp., Respiration Corp., Lubrizol Corp., Dormont Manufacturing, HP, Bayer, MSA, Lockheed Martin, CMU Tepper Executive Education Program, CMU Carnegie Bosch Institute, Global Management for Engineers
Notes:	Several dozen US patent applications filed by Ford, Navistar/International Truck and Engine, Kennametal, Alcoa, Respiration, McKesson Automation, Jarden, from student project courses at Carnegie Mellon

## Awards

- *ASME Ruth and Joel Spira Outstanding Design Educator Award, 2020*
- *ASME Design Automation Award, 2019*
- *Reviewers' Favourite Award, 2019 International Conference on Engineering Design*
- *Robert A. Doherty Award for Sustained Contributions to Excellence in Education, Carnegie Mellon University, 2018*
- *Reviewers' Favourite Award, 2017 International Conference on Engineering Design*
- *ASME Design Theory and Methodology Award, 2016*
- *Best Paper Award in Design Computation, 2016 International Conference of Design Computation and Cognition*
- *Reviewers' Favourite Award, 2015 International Conference on Engineering Design (Two Awards given for separate papers)*
- *Best Paper Award, 2015 ASME Virtual Environments and Systems, CIE Conference*

- *Best Paper Award, 2014 ASME Design Theory and Methodology Conference*
- *Reviewers' Favourite Award, 2013 International Conference on Engineering Design*
- *Best Paper Award, 2012 ASME Design Theory and Methodology Conference*
- *Best Paper Award in Design Cognition, 2012 International Conference of Design Computation and Cognition*
- *Best Paper Award, 2011 ASME Design Theory and Methodology Conference*
- *Best Paper Award, 2010 ASME Design Automation Conference*
- *Best Paper Award, 2008 ASME Design Theory and Methodology Conference*
- *Carnegie Institute of Technology Outstanding Research Award, 2007*
- *George Tallman and Florence Barrett Ladd Professorship in Engineering, 2007*
- *ASME Curriculum Innovation Award, 2003 (w/ C. Vogel & L. Weingart)*
- *Winner, EnterPrize Business Plan Competition, 2003 (w/ R. Eager)*
- *B.R. Teare Teaching Award, Carnegie Institute of Technology, 2002*
- *In Appreciation Award, Mon Valley Initiative, 2002*
- *Fellow of the ASME, elected 2000*
- *Philip L. Dowd Fellowship Award, Carnegie Institute of Technology, 2000*
- *Xerox Best Paper Award, 1998 ASME Design Theory and Methodology Conference*
- *Professor of the Year, 1997 - voted on by CMU's Mechanical Engineering graduating class*
- *George Tallman and Florence Barrett Ladd Development Professorship in Engineering, 1997*
- *Distinguished Paper Award, 1996 ASME Design Theory and Methodology Conference*
- *SAE Ralph R. Teator Educational Award, 1996*
- *National Science Foundation Young Investigator Award, 1992*
- *National Science Foundation Research Initiation Award, 1991*

## Professional Associations and Service

- Fellow- *American Society of Mechanical Engineers (elected 2000)*
- Professional Engineer - *Pennsylvania license no. PE-040885-R*
- Chairperson- *External Advisory Board of Engineering Product Development Pillar at Singapore University of Technology and Design, 2013-2015*
- Member - *American Society of Mechanical Engineers; American Association for the Advancement of Science; Industrial Designer Society of America; Design Society; American Society for Engineering Education*
- Member- *Board of Directors, DesignAdvance Systems, Inc., Pittsburgh, PA, 2002-2009*
- Member- *Advisory Board, The Design Society, 2005-2011*
- Member- *Advisory Board, RedZone Robotics, Inc., Pittsburgh, PA, 2003-2006*
- Member- *Advisory Board, Pittsburgh Product Strategy Network, 2003-2005*
- Chair - *ASME Design Theory and Methodology Committee, 1996-1998*
- Member - *Phi Beta Kappa, Tau Beta Pi, and Sigma Xi National Honor Societies*
- Participant- *NAE/DFG First German-American Frontiers of Engineering Symposium, May 13-16, Dresden, Germany, 1998.*

## Selected Editorial Roles

### Major Roles

Associate Editor: *Journal of Engineering Design*, 2018 - present  
Associate Editor: *Design Science*, 2014 - present.  
Associate Editor: *Design Studies*, 2012 - 2018.  
Associate Technical Editor: *Transactions of the ASME Journal of Mechanical Design*, 1998-2001 and 2008 - 2014.  
Advisory Editor: *Research in Engineering Design*, 1999 - present.  
Advisory Board: *Artificial Intelligence in Engineering Design, Analysis and Manufacturing*, 2001-present.  
Editorial Board: *Journal of Engineering Design*, 2003 – present  
Editorial Board: *Design Studies*, 2008-2012  
Editorial Board: *Computer Aided Design*, 2002 - 2004  
Area Editor: *Transactions of the SDPS Journal of Integrated Design & Process Science*, 1996-1998.  
Advisory Board: Design Society, 2005-2011  
Workshop Co-chair: *NSF Workshop: Discussion on Individual and Team-Based Innovation*, Knoxville, TN, January 7, 2008.  
Organizing Committee: *NSF Workshop on Science of Innovation and Discovery*, Washington, DC, May 17-18, 2006.  
Steering Committee: *NSF Planning Workshop on Engineering Design in 2030*, Gold Canyon, AZ, March 26-29, 2004.  
Conference Chair: *ASME 1996 Design Theory and Methodology Conference*, Irvine, CA, August 18-21.

## Other Roles

Member - Program Committee: *AAAI Symposium on Design from Physical Principles*, Cambridge, MA, October, 1992.

Session co-organizer and chair: "*Quality and Tolerancing: The Link Between Design and Manufacturing*", *ASME Design Theory and Methodology Conference*, Minneapolis, September, 1994.

Session organizer and chair: "*Methodology for Design Automation: Application and Theory*", *ASME International Mechanical Engineering Congress and Exposition*, Chicago, November 6-11, 1994.

Review Coordinator: *ASME Design Theory and Methodology Conferences*.

Conference Vice-Chair and Member of Best Presentation Award Committee: *1996 International Conference on Artificial Intelligence in Design*, Palo Alto, CA, June, 1996.

Member, International Scientific and Advisory Board: *JSME International Symposium on Optimization and Innovative Design*, Tokyo, July 28-30, 1997.

Conference Vice-Chair and Member of Best Presentation Award Committee: *1998 International Conference on Artificial Intelligence in Design*, Portugal, July 19-21, 1988.

Conference Vice-Chair: *2000 International Conference on Artificial Intelligence in Design*, Worcester, MA, July, 2000.

Workshop Committee Member: *International Workshop on Agents in Design at MIT*, Cambridge, 28-30 August 2002.

Member, Scientific Advisory Panel: *ICED 03: International Conference on Engineering Design*, August 19-21, Stockholm, Sweden, 2003.

Member, Steering Committee: *Strategic Planning Workshop for NSF's Engineering Design Program*, March 26-29, AZ, 2004.

Conference Vice-Chair: *International Conference on Design Computing and Cognition, MIT, Cambridge, July 2004*

Member, Scientific Advisory Board: *ICED 07: International Conference on Engineering Design, August 28-31, Paris, France, 2007.*

Member, Advisory Board: *DCC 08: 3<sup>rd</sup> International Conference on Design Computing & Cognition '08, July 22-25, Atlanta, GA, 2008.*

Member, Advisory Board: *DCC 10: 5<sup>th</sup> International Conference on Design Computing & Cognition '12, June 7-9, College Station, TX, 2012.*

Proposal Reviews - *NSF, ASME, Ben Franklin Technology Center of Western PA, Georgia Tech, CMI (UK)*

Reviewer, *Graduate Program of the Design, Architecture and Planning School, the University of Cincinnati, 2008.*

Conference Vice-Chair: *International Conference on Design Computing and Cognition, Northwestern, Chicago, July 2016.*

Conference Vice-Chair: *International Conference on Design Computing and Cognition, Milan, Italy, July 2018.*

Journal Reviews - *ASME Journal of Mechanical Design; Research in Engineering Design; Artificial Intelligence in Design, Analysis, and Manufacturing; Computer Aided Design, AI Journal; AIAA Journal; IEEE Transactions on Components, Packaging, and Manufacturing Technology Society, International Journal of Design Computing, Environment and Planning B, ASME Journal of Computing and Information Science in Engineering, ASCE Journal of Structural Engineering, Design Studies, Journal of Engineering Design, Design Issues, Journal of Aerospace Engineering, ASME Journal of Energy Resource Technology, Design Science*

Conference Reviews - *International Conference on Artificial Intelligence in Design, ASME Design Theory and Methodology Conference,, IFIP WG 5.2 1991 Working Conference on Intelligent CAD, ASME Design Automation Conference, IJCAI-93, IFIP 1993 Conference Towards World Class Manufacturing, ASME International Mechanical Engineering Congress and Exposition, ASME Design for Manufacturing Conference, International Conference on Engineering Design, International Conference on Design Computing and Cognition*

## **Students Advised**

### **Postdoctoral Students/Research Scientists**

*Zachary Ball, Changing Teams in Industry (3/20-present)*

*Emrah Bayrak, Game Theory and Control Modeling of Problem Solving Processes (1/18-12/18) – now assistant Professor at Stevens Institute*

*Kenneth Brown, A Shape Annealing Approach to Process Planning (94-95) - now Lecturer at University of Aberdeen*

*Jay McCormick, Shape Grammar Interpreters for Product Design (6/03-5/04) - now Associate Professor at Rose-Hulman*

*Shraddah Joshi, Design of Connected Products (9/14 – 8/16)*

*Kosa Goucher-Lambert, Team-based Problem Solving (co-advised with K. Kotovsky) (7/17-12/18) – now Assistant Professor at UC Berkeley*

*Chris McComb, Computational Team Design (co-advised with K. Kotovsky) (8/16-8/17) – Now Assistant Professor at Penn State University*

*Jarrold Moss, Research on Open Goals in Creative Problem Solving (co-advised with K. Kotovsky) (6/06-5/07) - now Associate Professor at Mississippi State University*

*Ut Na Sio, Team-based Problem Solving (co-advised with K. Kotovsky) (9/12-8/17) – now Assistant*

*Professor at The Education University of Hong Kong*  
*Guanglu Zhang, Design Systems Modeling (7/19-present)*

## **Ph.D. Students**

- Manish Agarwal, Supporting Automated Design Generation: Function Based Shape Grammars and Insightful Optimization (9/99) - now Senior Vice President at AXA Equitable Life Insurance Co*  
*Chandankumar Aladahalli, Improved Pattern Search Algorithm Using an Objective Function Effect Based Move Schedule for 3D Component Layout (co-advised with K. Shimada) (12/04) – now Lead Engineer at GE India*  
*Bolutito Babatunde, Automated Generation of DNA Origami (5/24 est.) (co-advised with R. Taylor)*  
*Francisco Boschetti, TBD (5/25, est)*  
*Ethan Brownell, Identifying Real-Time Intervention Triggers in Team Problem Solving (5/23 est.) (co-advised with K. Kotovsky)*  
*Matthew Campbell, A-Design: An Agent-Based Conceptual Design Methodology (co-advised with K. Kotovsky) (7/00) – now Professor at Oregon State University*  
*Yu-Hsuan (Sean) Chen, TBD (5/25, est)*  
*Jack (Woncheol) Choi, Determination of Optimal Inspection Point Locations (co-advised with T.R. Kurfess; Kurfess primary advisor) (5/96) – now President and CEO of Anatomage*  
*Leah Chong, Exploration of Human-Computer Partnerships for Problem Solving Methodology (co-advised with K. Kotovsky) (5/22 expected)*  
*Daniel Clymer, Hierarchical Deep Learning for Disease Identification in High-Resolution Medical Imaging, (10/19) (co-advised with P. LeDuc) – now Data Scientist at BAE Systems*  
*Bryony DuPont, Exploring the Application of an Advanced Extended Pattern Search Algorithm within a Multi-Agent System to Wind Farm Optimization (5/13) – now Assistant Professor at Oregon State University*  
*Paul Egan, Emergent Computational and Cognitive Model of Multi-Scale BioMechanics Design (co-advised with P. LeDuc) (5/14) – now Assistant Professor at Texas Tech University*  
*Mitch Fogelson, Deep Learning of Physical Behaviors through Experience (co-advised with C. Tucker) (5/25, est)*  
*Katherine Fu, Discovering and Exploring Structure in Design Databases and Its Role in Stimulating Design (co-advised with K. Kotovsky) (5/12) – now Assistant Professor at Georgia Tech*  
*Joshua Gyory, Understanding Expertise in Design Team Management (co-advised with K. Kotovsky) (5/21 est)*  
*Ernest Kabuye, Virtual Surgical Training (5/23 est.) (co-advised with P. LeDuc)*  
*Kosa Goucher-Lambert, Investigating Decision Making in Engineering Design Through Complementary Behavioral and Cognitive Neuroimaging Experiments (8/17) – now Assistant Professor at UC Berkeley*  
*Lindsay Hanna Landry, Combinatory Adaptive Optimization with Multi-Agent Systems (12/09) – now engineer at United Technologies*  
*Chris McComb, Designing the Characteristics of Design Teams via Cognitively Inspired Computational Modeling, (8/16) (co-advised with K. Kotovsky) – now Assistant Professor at Penn State University – Winner, CMU Mechanical Engineering Doctoral Research Award, 2017*  
*Jay McCormick, Implementing Parametric Shape Grammars to Capture and Explore Product Languages (5/03) – now Associate Professor at Rose-Hulman*  
*Jarrold Moss, The Role of Open Goals in Noticing Relevant Information in Problem Solving (Psychology student, co-advised with K. Kotovsky) (5/06) – now Associate Professor at Mississippi State University*  
*Jesse Olson, The Collective Potential: Achieving Organizational Potential by Design (co-advised with K. Kotovsky) (6/06) – now Principal Technical Architect, USAA*  
*Seth Orsborn, Quantifying Aesthetic Preference Through Statistics Applied to an Agent-based Shape Grammar Implementation (11/07) – now Senior Portfolio Planning Strategist - Advanced Product Strategy, Toyota North America*  
*Lucas Puentes, Multi-tier Grammars, (Penn State University student; co-advised with C. McComb) (5/23 expected)*  
*Ayush Raina, Deep Learning of Problem Solving Strategy (5/22 expected)*  
*Sean Rismiller, Game Theory-based Control Strategies for Team-based Design (5/19 est.) (co-advised with C. McComb)*  
*Linda Schmidt, An Implementation Using Grammars of an Abstraction-Based Model of Mechanical Design for Design Optimization and Design Space Characterization (5/95) – now Professor at*

*University of Maryland at College Park*  
*Kristina Shea, Essays of Discrete Structures: Purposeful Design of Grammatical Structures by Directed Stochastic Search (8/97) – now Professor at ETH Zurich.*  
*Brian Sylcott, Understanding the Role of Aesthetic Judgment in Consumer Choice and Preference Modeling (5/13) – now Assistant Professor at East Carolina University*  
*Simon Szykman, Optimal Product Layout Using Simulated Annealing (5/95) – now Chief Technology Officer, Federal Services at Attain*  
*Ian Tseng, The Unification of Stylistic Form & Function (co-advised with K. Kotovsky) (5/11) – now Engineer at Nuclear Regulatory Commission*  
*Hubert Vasseur, Manufacturing Quality and Process Capability: a Cost-Based Analysis (co-advised with T.R. Kurfess) (8/94) – now Engineer at Renault*  
*Mark Whiting, Anomaly Classification Through Automated Shape Grammar Representation (Co-advised with P. LeDuc) (8/17) – now Post Doc at Stanford*  
*Matthew Wood, Problem Representation and Team Mental Model Development in Individual and Team Problem Solving Performance (Psychology student, co-advised with K. Kotovsky) (5/13) – now Research Scientist at US Army Corps of Engineers*  
*Xiangyang Xin, Product Innovation in A Cultural Context - A Method Applied To Chinese Product Development (Design student co-advised w/ C. Vogel) (8/06) – now Professor and Dean at Jiangnan University, China*  
*Ryan Yeh, Inducing Grammar Rules with Deep Learning (5/23 est.) (co-advised with P. LeDuc)*  
*Su Yin, A Pattern Search-Based Algorithm for Automated Product Layout (5/00) – now Principal Engineer at Parker Aerospace*

### **M.S. Project Students**

*Manish Agarwal, A Language of Coffee Makers (5/97)*  
*Ashwini Asokan Design Languages for Cultural Context (Design student, 5/05)*  
*Chandankumar Aladahalli, Characterizing Layout Spaces (co-advised with K. Shimada) (5/01)*  
*Matthew Campbell, A-Design: An Agent-Based Conceptual Design Methodology (co-advised with K. Kotovsky) (5/97)*  
*Hillary Carey, A Corporate Decision Model of the Product Design Process (Design student, C. Vogel primary advisor) (5/03)*  
*Steven (Pinzhi) Chen, fMRI Studies and Data Mapping of Form-Function Reasoning (12/13)*  
*Daniel Clymer, Process Specification Design for Additive Manufacturing (8/16) (co-advised with J. Beuth)*  
*Drew Degentesh, Effective Computational Structural Design and Analysis (co-advised with P. Steif) (5/96)*  
*Saurabh Deshpande, Agent-Based Optimal Process Planning (5/01)*  
*Quan Ding, Optimal Packing of Automobile Trunks (12/01)*  
*Ashish Kolli, Layout of Non-linear Shapes (5/96)*  
*Gyuhw Kwak, A User-Interactive Optimizing Routing Algorithm, (5/97)*  
*Rosa Lopez, Quality Estimation Through Neural Networks (5/94)*  
*Jay McCormick, Shape Grammars for Product Design (5/00)*  
*Jesse Olson, A Collaborative Approach to Agent-based Design (5/03)*  
*Luis Oms, Investigation of Hip Fractures in the Elderly and Hip Pad Solution (co-advised with P. Steif) (12/98)*  
*Seth Orsborn, Using Shape Grammars to Model Product Characteristics (5/05)*  
*Shashvat Prakash, Hierarchical Method for Approximating MEMS Analysis (12/99)*  
*Giridhar Reddy, Topological Generation of Truss Structures (8/93)*  
*Julie Reyer, Computer Aided Systems Simulation (co-advised with T.R. Kurfess) (5/93)*  
*Jamie Rugnetta, Innovative Design of Walkers for Elders (co-advised with K. Kotovsky) (5/00)*  
*Noah Tovares, Virtual Preference Function-based Design (5/14)*  
*Erika Wetzel, Understanding Chaos in the Design Process (5/04)*  
*Andrew Whittam, Formal Criteria for Robust Optimality (8/94)*

### **M.S. Coursework-based Project Students**

*Edwin Comparini, Development of a Curriculum in Green Design for the Mechanical Engineering Capstone Design Course (8/98)*  
*Kathy Constantine, Manufacturing Costs for Shape Grammar Design (5/97)*

*Mike Cummings*, Application of Taguchi Methods to Sheet Metal Stamping (8/92)  
*Michael DeGuire*, 3-D Layout of Electronic-Mechanical Designs (5/95)  
*David Eyvazzadeh*, Understanding the SET Factors in Industrial Products(5/03)  
*Mark Hamblin*, Social Impact Analysis in Product Development (12/03)  
*Jiun-Tza Han*, Applying Robust Activity Analysis to Bulk Manufacturing Process Planning (5/99)  
*Alan Leung*, Development of a Shape Grammar for Bulk Manufacturing Processes (5/99)  
*Simone Mauri*, Understanding the SET Factors in Industrial Products(5/03)  
*Michael Pugliese*, Modeling Complexities in the Product Development Process (6/01)  
*Jeff Tucker*, Dimension and Tolerance Selection for Minimal Manufacturing Costs (co-advised with T.R. Kurfess) (8/91)

## Undergraduate Students (Project Students)

*Mark Baptista*, A Utility Function for Value Opportunities (5/03)  
*Dan Boggard*, A Utility Function for Value Opportunities (5/03)  
*Brian Campbell (University of Virginia)*, REU project: Computer Aided Systems Simulator (8/92)  
*Matt Campbell*, Layout of 3-D Electronic Components (co-advised with C. Amon) (5/95)  
*Felix Chiu*, Computational Implementation of Multi-Scale Myosin-Based Design (5/13 est)  
*Alison Coleman (CFA)*, CASS: Computer Aided Systems Simulator (co-advised with T.R. Kurfess) (8/92)  
*Andrew Concilio*, Agent Models of Spacecraft (5/06)  
*Aubrey Donnellan*, Value of Product Packaging (5/07 est)  
*Jason Fung*, Product Opportunity Gaps in the Biomedical Field (5/03)  
*Stephen Goode*, Generation of Coffee Makers using the Coffee Maker Shape Grammar (5/00)  
*Tiffany Ho*, A Study of Multi-scale Myosin-based Design in Engineers and Medical Students (5/13)  
*Sydney Howard*, Neural Networks in Design (5/19 est)  
*Becky Lee*, A Kinect-based VR environment to Derive Consumer Preference (5/94 est)  
*Todd Jerry*, An Improved 3-D Tube Routing Algorithm with Shape Annealing (5/94)  
*Gary Liu*, An Implementation of the First Order Necessary Conditions of Robust Optimality (5/94)  
*Jeremy Michalek*, Implementation of the Coffee Maker Grammar (5/99)  
*Volus McKenna*, Understanding and Designing Walkers for the Elderly Population (5/98)  
*Klaus Moser*, Understanding and Designing Walkers for the Elderly Population (5/98)  
*Bijal Patel*, CASS: Computer Aided Systems Simulator (co-advised with T.R. Kurfess) (5/93)  
*Michael Pugliese*, The Development of Shape Grammars to model Engineering Artifacts (5/00)  
*Joe Sanders*, CASS: Computer Aided Systems Simulator (co-advised with T.R. Kurfess) (5/92)  
*Kristina Shea*, 3-D Tube Routing with Shape Annealing (5/93)  
*Guochen Shen*, Computational Modeling of Internet of Things Systems for Design (5/16)  
*Ed Wilcox*, Innovative design of a Bicycle Frame (5/94)  
*Emily Tolmer*, Assessing Manager Strategies (8/17)  
*Jenny Williams*, Component Selection During Product Layout (5/96)  
*David Wynne*, Mapping Design Organizations to Product Organization (5/04)  
*Wing Tong Wong*, Design Conceptualization Through Crowd Sourcing (5/16 exp)

## Patents

Cagan, J., A. Kolli, S. Szykman and R. Rutenbar, "Method of Optimizing Component Layout Using A Hierarchical Series of Models," United States Patent No. 5,825,660, issued October 20, 1998.

Yin, S. and J. Cagan, "Method of Optimizing Component Layout Using a Pattern Based Search," United States Patent No. 5,953,517, issued September 14, 1999.

McCormack, J., and J. Cagan, "Parametric Shape Grammar Interpreter," United States Patent No. 7,050,051, issued May 23, 2006.

McCormack, J., and J. Cagan, "Parametric Shape Grammar Interpreter," United States Patent No. 7,415,156, issued August 19, 2008.

McCormack, J., and J. Cagan, "Parametric Shape Grammar Interpreter," United States Patent No. 7,502,511 issued March 10, 2009.



Cagan, J., A. Concilio, L. Hoxie, F. Humbert, E. Kemner, N. Kim, M. Langdon, K. Shin, "Shopping Cart," United States Patent No. 8,066,291, issued November 29, 2011.

Byrne, D., J. Cagan, S. Krotseng, and S. Joshi, "Internet-Connected Storage Container and System and Method of Dispensing Articles," United States Patent application PCT/US17/47957, allowed July 10, 2020.

Cagan, J., P.R. LeDuc, and M. Whiting, "Searching of Data Structures in Pre-Processing Data for a Machine Learning Classifier," United States Patent Application 15/926,790, March 20, 2018.

## Publications

### Books

Cagan, J., and C. M. Vogel, *Creating Breakthrough Products: Innovation from Product Planning to Program Approval*, Financial Times Prentice Hall, Upper Saddle River, NJ, 2002. Translated to Finnish and Chinese. [second edition: *Creating Breakthrough Products: Revealing the Secrets that Drive Global Innovation*, Financial Times Press, 2012.]

Antonsson, E. K., and J. Cagan, eds., *Formal Engineering Design Synthesis*, accepted by peer review of proposal: Cambridge University Press, Cambridge, UK, 2001. Paperback version published in 2005.

Author of three chapters:

- Antonsson, E.K., and J. Cagan, *Introduction*.
- Cagan, J., "Engineering Shape Grammars: Where Have We Been and Where are We Going?"
- Cagan, J., Kotovsky, K., and H.A. Simon, "Scientific Discovery and Inventive Engineering Design: Cognitive and Computational Similarities."

Cagan, J., and C. M. Vogel, *Understanding the Value in Great Products*, e-doc for Amazon.com, Financial Times Prentice Hall, Upper Saddle River, NJ, 2002.

Vogel, C. M., J. Cagan and P. B. H. Boatwright, *The Design of Things to Come: How Ordinary People Create Extraordinary Products*, Wharton School Press/Prentice Hall, Upper Saddle River, NJ, 2005. Translated to Chinese, Korean, Japanese, Spanish, Italian.

Boatwright, P. B. H., and J. Cagan, *Built to Love - Creating Products That Captivate Customers*, Berrett-Koehler Publishers, San Francisco, 2010.

### Journal Papers

Cagan, J. and L. Taber, "Large Deflection Stability of Spherical Shells with Ring Loads," *J. of Applied Mechanics*, V. 53, No. 4, pp. 897-901, 1986.

Cagan, J. and V. Genberg, "PLASHTRAN - An Expert Consultant on Two-Dimensional Finite Element Modelling Techniques," *Engineering With Computers*, V. 2, pp. 199-208, 1987.

Cagan, J. and A.M. Agogino, "Innovative Design of Mechanical Structures from First Principles," *Artificial Intelligence in Engineering Design, Analysis, and Manufacturing*, V. 1, No. 3, pp. 169-189, 1987.

Cagan, J. and A.M. Agogino, "Inducing Constraint Activity in Innovative Design," *Artificial Intelligence in Engineering Design, Analysis, and Manufacturing*, V. 5, No. 1, pp. 47-61, 1991.

Cagan, J. and A.M. Agogino, "Dimensional Variable Expansion - A Formal Approach to Innovative Design," *Research in Engineering Design*, V. 3, pp. 75-85, 1991.

Aelion, V., J. Cagan, and G. Powers, "Inducing Optimally Directed Innovative Designs from Chemical Engineering First Principles," *Computers and Chemical Engineering*, V.15, No. 9, pp. 619-627, 1991.

- Aelion, V., J. Cagan, and G. Powers, "Input Variable Expansion - An Algorithmic Design Generation Technique," *Research in Engineering Design*, V. 4, pp. 101-113, 1992.
- Cagan, J., and W.J. Mitchell, "Optimally Directed Shape Generation by Shape Annealing," *Environment and Planning B*, V. 20, pp. 5-12, 1993.
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## Funding

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"Topological Generation of Quality Designs," National Science Foundation - Young Investigator Award (\$125,000 base, 8/92-7/97); matching funds (\$112,500, 8/92-7/95); REU (\$5,000, 5/93); supplemental Travel (\$3,870) (PI).

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"Robust Design Analysis," Xerox Corporation (\$26,500), 1/93-12/93 (PI).

"3-D Placement of HVAC Components with Shape Annealing," United Technologies Carrier (\$84,396), 5/93-4/94 (PI w/ T. Mitchell).

"Topological Generation of Network Flow Problems," National Science Foundation, (\$240,315) 9/93-8/96 (PI w/ W.J. Mitchell).

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“IPD Consortium Membership,” General Motors (\$40,000), 4/04-3/05 (PI).

“A Decomposition Based Approach to Optimal Layout of Complex Systems such as UAV’s and Satellites – Phase I”, STTR – AFOSR, subcontract to DesignAdvance Systems, Inc., (\$100,000), 9/04-3/05 (PI w/ J. McCormack).

“Mechanical Engineering Design Course Sponsorship” Alcoa (\$40,000), 8/04-12/04 (PI).

“Integrated Product Development mini-project,” International Truck & Engine Corporation (\$70,000), 8/04-12/04 (PI w/ P. Boatwright).

“Integrated Product Development Course Sponsorship,” International Truck & Engine Corporation (\$90,000),1/05-5/05 (PI w/ E. Anderson, P. Boatwright and L. Weingart).

“A Decomposition Based Approach to Optimal Layout of Complex Systems such as UAV’s and Satellites – Phase II,” STTR – AFOSR, subcontract to DesignAdvance Systems, Inc., (\$750,000), 9/05-6/07 (PI w/ J. McCormack).

“Mechanical Engineering Senior Design Course Sponsorship,” RedZone Robotics, (\$15,000) 8/05-12/05 (PI).

“Product Research and Conceptualization Course Sponsorship,” Respirationics, Inc., (\$25,000) 8/05-12/05 (PI).

“Product Research and Realization Course Sponsorship,” Respirationics, Inc., (\$15,000) 1/06-5/06 (PI).

“Integrated Product Development Course Sponsorship,” International Truck & Engine Corporation (\$90,000),1/06-5/06 (PI w/ E. Anderson, P. Boatwright and L. Weingart).

“IPD Consortium Membership,” General Motors (\$40,000), 4/05-3/06 (PI).

“IPD Consortium Membership,” General Motors (\$25,000), 4/06-3/07 (PI).

“Understanding the Role of Impasses and Representation Changes in Creative Design: An Initial Study,” NSF (\$153,702), 7/06-6/07 (PI w/ K. Kotovsky).

“Mechanical Engineering Senior Design Course Sponsorship,” International Truck and Engine (\$40,000), 8/06-12/06 (PI).

“Integrated Product Development Course Sponsorship,” Dormont Manufacturing (\$70,000), 1/07-5/07 (PI w/ E. Anderson, P. Boatwright and L. Weingart).

“A Geometry-based Approach to Scheduling and Packing Cargo Delivery.” AFOSR (\$177,872), 4/1/07-12/31/08 (PI).

“Overcoming Impasses in Design Problem Solving: Environmental Input and Sources of Design Breakthroughs,” NSF (\$499,999), 9/07-8/10 (PI w/ K. Kotovsky).

“Stimulating Creative Insight: A Cohesive Model of Design Innovation Across Individuals, Groups and Computer Agents,” NSF (\$212,000), 1/08-12/10 (PI w/ K. Kotovsky).

“Workshop: Discussion on Individual and Team-Based Innovation,” NSF (\$25,860), 9/07-8/08 (PI w/ K. Wood).

“Integrated Product Development Course Sponsorship,” International Truck (\$80,000), 1/08-5/08 (PI w/ P. Boatwright).

“Integrated Product Development Course Sponsorship,” MSA (\$100,000), 1/09-5/09 (PI w/ P. Boatwright).

Center for Product Strategy and Innovation – Basic Membership, International Truck (\$25,000), 9/08-8/09 (PI w/ P/ Boatwright).

Center for Product Strategy and Innovation – Basic Membership, MSA (\$25,000), 9/08-8/09 (PI w/ P/ Boatwright).

“Advanced Analogical Search With Integrated Function And Form: The Verrocchio Project,” NSF (\$237,107; CMU portion), 7/09-6/12 (collaborative project with K. Wood and C. Schunn); Graduate Research Student supplements \$65,138 and \$77,063 (PI).

“Integrated Product Development Course Sponsorship,” Nissan (\$30,000), 1/10-5/10 (PI w/ P. Boatwright).

GlaxoSmithKline gift, \$15,000, 1/10 (PI w/ P. Boatwright).

“EAGER: Innovative Energy Farm Design,” NSF (\$66,167), 7/09-2/11 (PI).

“Integrated Product Development Course Sponsorship,” P&G (\$35,000), 1/11-5/11 (PI).

“Integrated Product Development Course Sponsorship,” Navistar (\$40,000), 1/11-5/11 (PI w/ P. Boatwright).

GlaxoSmithKline gift, \$15,000, 1/11 (PI w/ P. Boatwright).

“Integrated Product Development Course Sponsorship,” Navistar (\$100,000), 1/11-5/11 (PI w/ P. Boatwright and E. Anderson).

“Computational Design of Complex Multi-Scale Systems: Design of synthetic muscle with shape grammars and agent-based search,” NSF (\$424,928), 7/12-6/14 (PI w/ P. LeDuc)

“The Cognitive and Computational Modeling of Team Problem Solving for Decision Making Under Complex and Dynamic Conditions,” AFOSR (\$598,920), 7/12-6/15 (PI w/ K. Kotovsky).

“Determining Consumer Preference Through an Interactive Virtual Reality Experience,” NSF (\$375,000), 9/12-8/14 (PI).

“An Integrated Leadership and Innovation Curriculum for Undergraduate Mechanical Engineering,” NSF (\$199,975), 10/13-11/15 (PI w/ J. Beuth, M. Lovett, M. Cofield).

“Integrated Product Development Course Sponsorship,” MSA (\$30,000), 1/13-5/13 (PI w/ E. Anderson and P. Boatwright).

“Integrated Product Development Course Sponsorship,” McKesson Automation (\$25,000), 1/13-5/13 (PI w/ E. Anderson and P. Boatwright).

“Integrated Product Development Course Sponsorship,” Jarden Consumer Products (\$50,000), 1/14-5/14 (PI w/ E. Anderson and P. Boatwright).

“Integrated Product Development Course Sponsorship,” Weatherford (\$33,333), 1/14-5/14 (PI w/ E. Anderson and P. Boatwright).

“Integrated Product Development Course Sponsorship,” Jarden Corp. (\$100,000), 1/15-5/15 (PI w/ E. Anderson and P. Boatwright).

“Integrated Product Development Course Sponsorship,” Opus Mach (45,000), 1/15-5/15 (PI w/ E. Anderson and P. Boatwright).

“Integrated Product Development Course Sponsorship,” Volvo Construction Equipment (\$45,000), 1/15-5/15 (PI w/ E. Anderson and P. Boatwright).

“Shelter Development,” gift from PJ Dick Inc., 5/15 (\$53,000) (PI)

“A Synergistic Partnership Between Human Teams and Computer Agents,” AFOSR (\$446,405), 11/15-10/17 (PI w/ K. Kotovsky).

“A synergistic engineered 3D tissue and computational approach to surgical training”, ONR (1,894,565), 6/1/17-5/30/20 (co-PI w P.R. LeDuc (PI), A. Feinberg, C. Schunn)

“A Hybrid Computer Platform to Design, Guide, and Partner with Humans in the Team Problem-Solving Process,” DARPA (\$6,076,939), 7/1/17-6/30/21 (PI w/ C. McComb)

“Empowering the problem solving team through a computer-human partnership,” AFOSR (\$1,430,217), 11/1/17-10/31/22 (PI w/ K. Kotovsky).

“Identification of Potential Placenta Abnormalities Using a Structure-based Convolutional Neural Network,” UPMC Enterprises (\$341,637), 4/1/19-3/31/20 (PI w/ P.R. LeDuc)

## Internal Funded

- "A Graph-Based Representation for Mechanical Design," CMU Faculty Development Fund (\$2500) (PI)
- "A Behavioral Grammar for Mechanical Design," CMU Adamson Faculty Award (\$4980) (PI)
- "Conceptual Design of Mechanical Systems," EDRC - CMU (\$55,021, 5/91-4/92; \$60,183, 5/92-4/93; \$63,286, 5/93-4/94; \$66,097, 5/94-4/95; \$69,454, 5/95-4/96; \$50,228, 5/96-4/97) (annual renewal) (PI)
- "The Process of Integrated Product Development – An Emphasis on Collaboration between Engineering and Design," UEC - CMU (\$10,000) (PI w/ C. Vogel)
- "Using Computational Approaches to Diagnose Labral Tears of the Shoulder through Morphological Shape Grammar Analysis of Unenhanced MRI with ANSYS," 7/16-6/17, PITA (CMU) (\$60,284), (PI w/ P. LeDuc)
- "Morphological Shape Grammar Analysis of Unenhanced MRI to Diagnose Labral Tears of the Shoulder," DHTI (\$50,000), 10/1/16-9/30/17 (PI w/ P. LeDuc; S, Akhavan, J. Long, and C. Latona (collaborators from AHN)

## University Committee Work

### University

Tuition Committee, 1/91-12/93  
Treasurer, Faculty Senate (Chair, Social and Welfare Committee), 5/95 - 5/97  
University Committee On Special Faculty Appointments, 1/97 - 12/99  
University Choice Program (Co-Director), 5/97 - 5/99  
Educational Affairs & Enrollment Committee of the Board of Trustees, 10/97 - 9/99  
Taskforce to Capitalize on the Strengths of the Fine Arts and Humanities at CMU, 8/98 - 10/98  
University Committee on Non-Tenure Appointments, 1998  
Innovation & Entrepreneurship Planning Committee, 2015  
Innovation Palooza, 2014 & 2015 (co-founder and co-organizer of annual event)  
Faculty Co-Director, Swartz Center for Entrepreneurship, 2016-present  
NDAs & Education Agreement Task Force, 2017

### Engineering College (CIT)

Program Coordinator - 1994 CIT Industrial Liaison Program  
Ad-Hoc Committee on Faculty Promotion and Tenure, 1999, 2000, 2002, 2009, 2011  
Ad-Hoc Committee to Plan BHE Major  
Chairman-Elect of the CIT Faculty, 2000-2001  
Chairman of the CIT Faculty, 2001-2002  
Co-Chair of Strategic Planning for CIT, 2013-2014  
Director of Innovation and Entrepreneurship, CIT, 2013-2015  
Co-Director of Integrated Innovation Institute, 2011-2017  
Head - MS in Software Management – Silicon Valley, 2013-2017  
Associate Dean for Strategic Initiatives, CIT, 2015-2017  
Head – MS in Technology Ventures - Silicon Valley, 2016-2017  
Associate Dean for Graduate and Faculty Affairs, CIT, 2017-2018  
Chair – Search Committee for Associate Dean for Diversity, Equity and Inclusion, 2020

### Department of Mechanical Engineering

Graduate Committee, 8/91-8/94, 9/95 – 5/00, 9/04-8/09 (Chair, 1998 – 2000)  
Undergraduate Committee, 8/90-7/91, 9/94 - 8/95, 8/02-5/08, 9/09-present  
Strategic Planning Agenda Committee: 10/96-2/97; Head - Information Technology Strategic Planning Committee, 3/97-4/97  
Department Head Search Committee, 2005  
Miscellaneous Committees including: Chairman, 1994 Qualifying Examinations; Computer Committee: 1993; Space Committee: 1993; Faculty Search Committee: 1994, 2001-2003; seminar organizer: 2003.

Advisor, ASME student section, 6/93 - 5/96  
Co-developer and co-director, Master of Integrated Innovation for Products and Services (renamed from Master of Product Development in 2011), 2003-2017  
Co-founder and Co-director, Center for Product Strategy and Innovation, 2008-2011

## Consulting

Timken Company  
Xerox Palo Alto Research Center  
ASME Press  
Daimler-Benz AG  
United Technologies Carrier  
Daimler-Benz AG/Freightliner  
Mine Safety Appliances (MSA)  
Ford Motor Company  
General Motors  
Crown Equipment Corporation  
University of Pittsburgh McGowan Center for Artificial Organ Development  
Close & Farles, Co.  
Southwestern Pennsylvania Industry Resource Council  
Philips Respironics  
Lubrizol  
Decision Coaches  
Alcoa  
Kennametal  
RedZone  
Procter & Gamble  
Industrial Scientific, Inc.  
Navistar International Truck  
DesignAdvance Systems  
Ansys  
Apple  
Hewlett-Packard  
Dormont Manufacturing  
Bayer MaterialScience  
GlaxoSmithKline  
Miscellaneous intellectual property and liability Expert Witness cases

## Significant Media Appearances

- The Sunday Business Page, KDKA TV, Pittsburgh, PA, November 11, 2001
- Morning Marketplace Report, NPR, January 19, 2002
- The Todd Mundt Show, NPR, February 11, 2002
- On Q, WQED TV, Pittsburgh, PA, March 2, 2002
- The Sunday Business Page, KDKA TV, Pittsburgh, PA, August 17, 2003
- The Sunday Business Page, KDKA TV, Pittsburgh, PA, August 21, 2005
- Our Region's Business, WPXI TV, Pittsburgh, PA, September 18, 2005
- Small Business, Bloomberg TV, September 23, 2005
- Tech Nation, NPR, September 27, 2007
- The Real Story, thestreet.com blog, October 1, 2010
- Thestreet.com, video: *Love the Product? Buy the Stock*, October 8, 2010
- WTOP radio: NAE interview on *Built to Love*, November 7, 2010
- WTAE television afternoon news: "Shoppers Let Emotions be Your Guide (Sometimes)", November 30, 2010

- Our Region's Business, WPXI TV, Pittsburgh, PA, December 26, 2010
- Blog Talk Radio with Wayne Hurlbert, Feb 4, 2011
- The Sunday Business Page, KDKA TV, Pittsburgh, PA, April 7, 2013
- Our Region's Business, WPXI TV, Pittsburgh, PA, April 14, 2013
- High, P, "Carnegie Mellon's Integrated Innovation Institute's Vision To Build Innovators Of Tomorrow," Forbes.com, May 27, 2014
- "Making a Muscle", NAE Engineering Innovation Podcast and Radio Series, October 1, 2017

## Significant Articles About Work

- Petroski, H., "Everyday Design", *American Scientist*, Vol. 89, No. 6, 2002, pp. 495-499.
- Sharke, P., "Seeing Eye to Eye", *Mechanical Engineering Design*, ASME, March, 2002, pp.6-10.
- Hammonds, K., "Chalk Talk, How to Design the Perfect Product", *Fast Company*, July, 2002, pp. 122-127.
- Yeomans, M., "Product Developers are Being Born at CMU", *Pittsburgh Tribune Review*, December 9, 2003, Business Page.
- Advanced Elastomer Systems, *The Inn Road*, Ray Lambert, Producer, 2004 – featured in documentary on innovation.
- Shropshire, C., "Speed {They Hope} Sells", *Pittsburgh Post-Gazette*, April 29, 2004, Business Page.
- Durr, K., and L. Sullivan, *International Harvester, McCormack, International – Milestones in the Company that Helped Build America*, Graphic Arts Center Publishing Company, 2007 – analysis of International Truck form language featured.
- Ivanoff, R. N., Interview in ETF Business Review, *FinancialProductsResearch.com*, Vol. 1, issue 47, Dec. 13, 2010
- Postrel, V., "Love and Money", *Entrepreneur*, February, 2011, p. 18
- Robson, D., "Why Getting Distracted Can be a very Good Thing", *BBC.com*, June 7, 2018