CURRICULUM VITAE

**Carl Thomas Michael Haas**

Ph.D., PEng, PE (inactive), FASCE, FCAE, FNAC

Professor and University Research Chair in Construction and Management of Sustainable Infrastructure

Chair of the Department of Civil and Environmental Engineering, University of Waterloo

Waterloo, Ontario, Canada

Phone 519-888-4567 x35492

http://www.civil.uwaterloo.ca/chaas/

August 2019

RESEARCH INTERESTS

Compound annual growth rates in productivity have exceeded 5% over the last decade in key construction sectors including industrial and multi-family residential. This is no accident. Advances in robotics, artificial intelligence, information technology automation and integration, new materials, and training have driven this outcome, and they in turn were driven by fundamental research advances. My research has contributed substantially to those advances and their implementation.

I am currently conducting research in construction automation, augmented reality, infrastructure computer vision, adaptive reuse, interface management and biomechanical applications in the construction trades. Past contributions include: (1) ***Information Technology for State Estimation*** through development of novel algorithms and automation systems for 3D scan-to-BIM, 3D scan-vs-BIM, object recognition and locating, and 4D materials tracking that contribute to the foundation for continuous and automated 3D process control, progress tracking, and as-built modeling, (2) ***Construction Robotics*** including automated fabrication control systems, biomechanical analysis, and an earlier career research phase culminating in the deployment of several full-scale robotic systems in the field, (3) ***Capital Projects Process Management*** including automated construction process management systems, formalized collaboration processes, database and document management systems, and cloud based computing networks to support capital project practices such as front end planning, workflow and document status detection, and interface management, (4) ***Construction Productivity*** such as multiskilling implementation methods, studies of the impact of technology, activity analysis to improve direct work rate and reduce waste, rework reduction, and best productivity-practices implementation, and (5) ***Infrastructure Sustainability*** including system adaptive reuse methods, circular economy principles for capital project planning, system dynamics models used for self-financing, strategic planning, and “cradle to grave” life cycle analysis of water and waste water networks; as well as models for re-use, recycling and repurposing of construction materials such as steel.

ACADEMIC, ADMINISTRATIVE AND PROFESSIONAL POSITIONS

* **University of Waterloo**
	+ Professor, 2005 to present
	+ Tier I Canada Research Chair, 2005 to 2019
	+ Interim Chair of Civil and Environmental Engineering Department, 9/1/17-4/30/18 and 5/1/16-12/31/16 and Chair from 5/1/19-10/31/22
	+ Over two dozen committee assignments at all university levels since 2005
	+ Director of Center for Paving and Transportation Technologies, 2005 to 2010
* **ETH Zurich** – visiting professor from 11/15/18-3/5/19
* **TUB Berlin** – visiting scholar from 3/5/19-4/30/19
* **Ecole Centrale de Lille** –brief visiting professorships in the summers of 2005, 2008, 2010, and 2012
* **University of Texas at Austin**
	+ Assistant Professor (1991-1996), Associate Professor and Liedtke Centennial Fellow (1996-2002), and Full Professor with Clyde E. Lee Endowed Fellow in Transportation Engineering (2002-2005)
	+ Over two dozen committee assignments from 1991 to 2005
	+ Director of Center for Construction Industry Studies (2004-2005)
	+ Construction Engineering and Project Management Area Coordinator (2002-2004)
* **Arizona State University** – invited as Visiting Eminent Scholar in July 2002
* **Computing Devices Corporation** as Defense Systems Engineer from 1986-1987

GRANTS AND CONTRACTS

Since 1991, I have held well over 80 significant grants and contracts from many granting agencies and companies. Significant highlights follow:

* Approximately **$26,500,000 of cash funding (in inflation adjusted dollars) jointly awarded since 1991**, excluding industry in-kind contributions, the annual Canada Research Chair contribution which goes entirely to support my salary, and scholarships of graduate students
* Approximately **$13,500,000 of that funding was my share since 1991**

EDUCATION

* University of Waterloo, Systems Design Engineering, BS, 1985
* Carnegie Mellon University, Civil Engineering, MASc, 1986
* Carnegie Mellon University, Civil Engineering, PhD, 1990

LEADERSHIP CONTRIBUTIONS

**Recent Internal UW CEE leadership contributions:**

Successfully leading a department experiencing 30-40% growth in staff, faculty, students and physical plant through improved revenue stream and addition of an Architectural Engineering undergraduate program launched in September 2018.

Continuing to direct a significant research program in construction automation, augmented reality, infrastructure computer vision, adaptive reuse, interface management and biomechanical applications in the construction trades.

* **People** – supporting wellness initiatives, positive values, and career development within CEE; personally leading collaborations on numerous proposals, funded projects, publications and initiatives; UW collaborators include Rayside (ECE), West (CEE), Walbridge (CEE), Narasimhan (CEE), Cascante (CEE), Hegazy (CEE), Knight (CEE), Unger (Earth Sciences), Abdulrahman (SYDE), Bachmann (CEE), Saari (CEE); international collaborations include Brilakis (Cambridge University in UK), Lee (U of Michigan), Adey (ETH in Zurich), Li at Hong Kong Polytech, Leite at UT Austin, and Hartmann (TU Berlin).
* **Diversity** – led by recruiting and promoting diversity including women in engineering, as evidenced by the fact that by this fall, 50% of our chaired professors will be female, over 40% of our undergraduates will be female, and almost 50% of my graduate students identify as female,
* **Values** – uphold transparency, as demonstrated by my assessment and communication of department revenue, costs and current financial position, as well as impact of new cost and income allocation model; focus on improved safety, risk management, and equity practices and outcomes; freely sharing proposals and budgets with colleagues, staff and senior HQP,
* **Processes** – implemented broad consultation through DACA chair assignments, executive advisory committee expansion, and senior staff consultation,
* **Infrastructure** – managing CEE investment in 2018-19 of $7M in renovated teaching and design studios, undergraduate computer labs and a maker space; personally leading sensing laboratory renewal through successful RTI grant proposals, investment of my own overhead, shared use of facilities, and broad distribution of research equipment inventory descriptions,
* **Morale** – supporting CEE Associate Chairs and Program Directors with radically increased budget to improve undergraduate student experience; personally demonstrated and encouraged positive and constructive response to operating environment and other changes, e.g. hosting many social events for students and colleagues such as curling and tobogganing days.

**External Leadership Contributions**

* As president of International Association for Automation and Robotics in Construction (IAARC - 34 years old), I am responsible for our activities which include sponsoring annual international conferences for 34 years, mounting freely distributed proceedings on our web site, and maintaining good relationships with several respected journals
* As member of several Construction Industry Institute (CII) Committees over the last 25 years, I am able to direct substantial resource allocation and support to emerging scholars in our North American community
* As ISARC 2013 conference chair – this conference in Montreal had 395 attendees and contributed substantially to the revival of the 36 year-old parent organization (IAARC)
* Curator of World Economic Forum web site on Future of Construction since 2016
* Guest Editor on three recent special issues and member of several Editorial Panels in various journals
* Writer of dozens of tenure, promotion, reference, and major faculty award letters per year
* Frequent publications and proposals reviewer and awards committees member

MAJOR AWARDS AND RECOGNITIONS

* **ASCE (American Society of Civil Engineers) Computing in Civil Engineering Award, 2019** – the award is made annually to a member of the American Society of Civil Engineers who has made an outstanding contribution to the application of computers to the practice of civil engineering
* **CSCE (Canadian Society of Civil Engineers) Alan Russell Award, 2019** – the award is in recognition of significant and lasting impact on the Canadian Construction Engineering and Management community
* **As co-founder of Glove Systems Ltd, top prize of 50K in the Velocity Fund Finals** (a start-up pitch competition), Kitchener, Ontario, March 29, 2019
* **The University of Waterloo Award of Excellence in Graduate Supervision for 2016-2017 –** the highest level graduate supervision award from all of the faculties
* **ASCE (American Society of Civil Engineers) Peurifoy Construction Research Award, 2015** – the premier international award in construction research, given annually for outstanding contributions to the advancement of construction engineering through research and development of new technology, principles or practices
* **CII (Construction Industry Institute) Outstanding Researcher of the Year Award, 2014** – given annually amongst the two dozen or so active funded researchers in North America for contributions to CII research of the highest quality and impact in the preceding few years
* **CSCE (Canadian Society of Civil Engineers) Walter Shanly Award, 2014** – for outstanding contributions to the development and practice of construction engineering in Canada
* **Fellow of the US NAC (National Academy of Construction), inducted in 2013** – with formal ties to the US National Academy of Engineering, the NAC elects less than one out of ten nominated fellows from all sectors of construction including industry leaders and academics (less than 15%)
* **Tishman Distinguished Lecturer, November 20, 2013** – one leading construction engineer or researcher is invited annually to the University of Michigan in Ann Arbor, MI to give this talk
* **Fellow of the ASCE (American Society of Civil Engineers), inducted in 2010** – election to fellow is based on an outstanding track record of accomplishments in the community including service such as journal and conference leadership as well as research
* **Co-Chair of 30th International Symposium on Automation and Robotics in Construction (ISARC), August 11-14, 2013** – with 395 registered participants, this conference held in Montreal, Quebec was a major success within the construction automation research community
* **CII (Construction Industry Institute) Annual Conference Best Poster Award, 2009** – given to graduate students under my supervision and direction (Duncan Young, Saiedeh Razavi, Hassan Nasir) and selected from approximately forty submitted and ten displayed during the conference
* **Fellow of the Canadian Academy of Engineering (CAE), inducted in 2009** – election to fellow is based on contributions to practice and to the profession over the course of a career
* **IAARC (International Association for Automation and Robotics in Construction) Tucker-Hasegawa Award, 2009** – IAARC has held conferences annually since the first one at Carnegie Mellon University in 1983, and it sponsors the Elsevier Journal of Automation in Construction; the award is given for cumulative contributions to the body of knowledge and to IAARC
* **CII (Construction Industry Institute) Outstanding Researcher of the Year Award, 2002** – given annually amongst the two dozen or so active funded researchers in North America for contributions to CII research of the highest quality and impact in the preceding few years
* **Outstanding Graduate Teaching Award, University of Texas at Austin, 2001** – this award is given annually to two or three professors out of over 2,000 across the campus who have demonstrated outstanding success in teaching and mentoring graduate students at UT Austin
* **Engineering Foundation Award, College of Engineering, University of Texas at Austin, 2000** – this award is given annually to a few professors out of over 300 in the college who have demonstrated outstanding success in research in the preceding year
* **National Research Council’s TRB (Transportation Research Board) D. Grant Mickle Award, 1998** – well over 10,000 people attend their annual meeting at which close to two thousand papers are presented annually and of which a few receive best paper awards; this was given for “A Life Cycle Cost-Benefit Model for Road Weather Information Systems,” published in 1999 in the Transportation Research Record
* **ASCE (American Society of Civil Engineers) Thomas Fitch Rowland Prize, 1995** – awarded to the best paper annually from the previous year’s journal articles in the ASCE Journal of Construction Engineering and Management, and in this case for "Computer Aided Planning of Heavy Lifts," published in 1993
* **Natural Sciences and Engineering Research Council of Canada, Scholarship (1988, '89, '90)**
* **Roads and Transportation Association of Canada (RTAC) Scholarship (1988, '89)**
* **3rd Place Award at Ontario Engineering Design Competition (1985)** – awarded for a machine vision based automated pavement crack detection and classification system produced as a fourth year design project that predated many dozens of articles and commercial developments in this area

SIGNIFICANT INVITATIONS TO SPEAK

In addition to hundreds of oral presentations given since 1984, there have been some significant invitations to speak. Travel was supported in most cases by the host organizations. A conference presentation list is available on request. Significant invitations to speak follow:

* Keynote Address, entitled, “Spatial States: some problems, tools, and applications in civil engineering,” at the 2019 ASCE International Conference on Computing in Civil Engineering, Georgia Institute of Technology, Atlanta, Georgia, U.S.A June 19, 2019.
* Keynote Address, entitled, “Construction and Deconstruction in a Circular Economy,” CSCE 2019 Annual Conference in Laval, 7th International Construction Conference Jointly with the Construction Research Congress (CRC 2019), QC, June 13th, 2019.
* Keynote Address, entitled, “Robotics, Risk and Rework”, for Workshop on Emerging Robotic Solutions for Infrastructure Management, Rutgers CAIT Auditorium, NJ, May 30, 2019.
* Invited seminar at EPFL, entitled, “Construction and Deconstruction in North America,” January 21, Freiburg, Switzerland, 2019.
* Invited seminar at ETHZ, entitled, “The Future of Construction Technology in North America,” November 18, Zurich, Switzerland, 2018.

• Keynote Address, entitled, “Reinforcing Productivity,” at Reinforcing Institute of Canada Annual meeting, Muskoka, Ontario, September 14, 2018.

• Keynote Address, entitled, “Adapting to New Technology and Innovation in Construction,” at Ontario Construction Secretariat’s 18th Annual State of the Industry and Outlook, Toronto, March 8, 2018.

* Plenary presentation, entitled, “Construction Productivity – Are We Flat-lining or Breaking Through?” Industry Innovations Forum, CSCE Annual Conference and Construction Specialty Conference, Vancouver, BC, June 2, 2017.

• Invited to speak to the US National Academies’ Committee for Study of Future Interstate Highway System on the subject of highway construction productivity, December 19, 2016, Washington, D.C.

* Keynote Address, entitled, “Construction Academic Life Cycle Management,” at CSCE Construction Specialty Conference (related to the receipt of the Peurifoy Award), Vancouver, British Columbia, June 9, 2015.

• Invited seminar at University of Alberta, entitled, “Improving Construction Productivity,” July 15, Edmonton, Alberta, Canada, 2013.

• Invited seminar at University of Michigan, entitled, “Improving Construction Project Performance,” October 11, Ann Arbor, MI, USA, 2012.

• Invited plenary presentation, entitled, “Construction Productivity Research in North America,” for Engineering Construction Industry Association (ECIA) Conference at the Supreme Court in Westminster, London, the UK, 27th of October, 2011.

• Invited seminar at McMaster University, entitled, “Automated Earned Value Tracking,” October 3, Hamilton, Ontario, 2011.

• Invited seminar at Carnegie-Mellon University, entitled, “Improving Construction Project Performance,” September 30, Pittsburgh, PA, USA, 2011.

• Invited plenary presentation, “Benchmarking and Metrics for Improving Construction Productivity,” Construction Productivity Symposium, Engineering Society of Detroit Headquarters, September 13, 2011.

• Invited seminar at Concordia University, entitled, “Benchmarking and Metrics Research in Construction,” May 16, Montreal, Quebec, Canada, 2011.

• Invited seminar at Queen’s University, entitled, “Infrastructure State Estimation,” March 15, Kingston, Ontario, Canada, 2011.

• Kick-off plenary presentation for the 27th Annual ISARC (International Symposium on Automation and Robotics in Construction) entitled, “An International Perspective on Technology & Productivity in Construction,” Bratislava, Slovakia, June 25, 2010.

• Invited Seminar at Georgia Tech, entitled, “Infrastructure State Estimation,” March 4-5, Atlanta, Georgia, 2010.

• Plenary Panel participant and presenter on June 27th for the joint 26th Annual International Symposium for Automation and Robotics in Construction (ISARC) and the ASCE Computing in Civil Engineering Conference in Austin Texas, June 24-27, 2009.

• Plenary Speaker for ExxonMobil Refining & Supply Worldwide Planning and Project Execution Leadership Team Meeting; talk entitled, “Improving Construction Productivity: What Role Does Technology Play?,” Washington, DC, February 5, 2009.

• Plenary Speaker for the US National Research Council Workshop on Advancing the Competitiveness and Productivity of the US Construction Industry; talk entitled, “An International Perspective on Construction Productivity and Competitiveness,” Washington, D.C., November 19, 2008.

• Plenary Speaker for 25th International Symposium on Automation and Robotics in Construction (ISARC), presentation entitled, “IAARC Impact on Knowledge and Practice in Construction,” Vilnius, Lithuania, June 27, 2008.

• Plenary Speaker for 21st International Symposium on Automation and Robotics in Construction (ISARC), presentation entitled “The Future of Construction Automation and Robotics,” Jeju, Korea, September 21-25, 2004.

• CERF Corporate Advisory Board Annual Meeting, plenary presentation entitled, simply, “Construction Productivity,” Washington, D.C., May 1, 2003.

• AIChE’s 34th Annual Engineering and Construction Contracting Conference, plenary presentation entitled, “Addressing the Skilled Workforce Shortage,” San Francisco, CA, Oct. 2002.

• Dupont’s Annual Internal International Construction and Engineering Meeting, plenary presentation entitled, “Alternative Workforce Management Strategies,” Wilmington DE, Fall 2000.

• Gas Research Institute's Robotics Workshop, presentation entitled, “Automated Clinker Clearing System,” Tarrytown NY, Nov. 4, 1997.

• Waseda University Construction Robot Research International Workshop, presentation entitled, “Construction robotics Advances in North America,” Tokyo, June 10, 1996.

COURSES TAUGHT IN CIVIL ENGINEERING

* Building Information Modeling (BIM)
* Machine Vision and Sensing in Civil Engineering
* Construction Automation and Robotics
* Modeling and Simulating Uncertainty in Construction
* Civil Engineering Systems
* Engineering Economics and Construction Project Management
* Heavy Construction Methods, Equipment, Modeling, and Simulation
* Design of Automated Construction Systems
* Graduate Seminar in Teaching and Research Skills

SHORT COURSES TAUGHT TO INDUSTRY

* Prefabrication, Preassembly, Modularization, and Offsite Fabrication (Indianapolis, July 21, 2014)
* Sensing and Detection for Building Security (UT Austin, Feb. 19, 2005)
* Prefabrication, Preassembly, Modularization, and Offsite Fabrication (Houston, Oct. 29, 2004)
* Innovative Construction Workforce Management Strategies (DTU in Denmark, October 19-21, 2004)
* Construction Safety: Zero Accidents (1996-2005 biannually)
* Project Schedule Optimization (1997-2001 biannually)
* Modularization and Preassembly (c. 1994-8 biannually)
* Project Time Management (c. 1994-7 biannually)

SUPERVISION OF HIGH QUALITY PERSONNEL

Our greatest accomplishments may be related to the people who we have mentored and helped to advance in their careers so that they can contribute to the welfare of society, the body of knowledge, and the engineering profession. While detailed lists of names, thesis titles, and last known employment positions are available on request, a summary of supervisory accomplishments, excluding those currently under supervision, is presented as follows:

* **43 PhD students directly supervised** (12 co-advised) to completion at UT Austin and UW – of those, 25 accepted tenure track faculty positions with 8 progressing through the ranks to full professor and 2 with chairs; 3 are in PDF positions; 14 moved directly into government organizations or private industry and have progressed to positions such as VP of Linbeck Construction – a detailed list of their most recent known positions is available on request
* **84 additional doctoral exam committees**, including acting as an external for:
	+ Chalmers University
	+ University of Toronto
	+ University of New South Wales in Australia (3)
	+ University of Aukland
	+ University of Illinois – Urbana Champlain
	+ Carlton University in Canada
	+ Concordia University in Canada (4)
	+ University of Alberta in Canada (3)
	+ IIT Madras in India
	+ Yonsei University in Korea
	+ Carnegie Mellon University in the USA
	+ University of Waterloo when at UT Austin
* **77 MASc students directly supervised**, all but 22 at UT Austin, and numerous masters committees as second or third reader
* **Dozens of Post-Doctoral Fellows (PDF’s), research scientists, and research engineers** supported and supervised over the years include twelve at University of Waterloo and at least a dozen at UT Austin – since these positions ranged from four months to several years in duration, a numerical summary is meaningless – most transitioned successfully into subsequent tenure track faculty positions
* **Over 65 undergraduate research assistants have been employed and supervised in the last ten years** alone at the University of Waterloo in capacities ranging from summer interns under various international exchange programs to co-op students employed full time on research

EDITORIAL ROLES

* **Editor**, Construction Innovation special issue on Innovations in Health, Safety and Environment, 2016
* **Co-Editor**, Advanced Engineering Informatics special issue on Infrastructure Computer Vision, 2015
* **Co-Editor**, Automation in Construction special issue on 30th Annual International Symposium on Automation and Robotics in Construction, 2014
* **Senior Specialty Editor** of ASCE Journal of Construction Engineering and Management - 2003 to 2012 – this was an executive committee position and required a significant time commitment including several face-to-face meetings per year
* **Associate Editor** of ASCE Journal of Infrastructure Systems - 1994 to 1999
* **Member** of:
	+ Editorial Board for Korea Institute of Construction Engineering and Management’s (KICEM) Journal of Construction Engineering and Project Management (JCEPM)- 2010 to present
	+ Editorial Panel for Construction Management and Economics, 2011 to present
	+ Editorial Panel for Engineering Construction and Architectural Management, 2006 to present
	+ Editorial Board of Automation in Construction – August 2007 to present
* **Chairman**, National Research Council's Transportation Research Board Committee on Applications of Emerging Technologies - A2F09 - 1996 to 2002 – this required annual management of review of articles for the US National Academies’ Transportation Research Record
* **Reviewer for many journals, including for example:**
	+ The Canadian J of Civil Engineering
	+ ASCE J of Construction Engineering and Management
	+ ASCE J of Infrastructure Systems
	+ ASCE J of Transportation Engineering
	+ ASCE J of Computing in Civil Engineering
	+ ASCE J of Management in Engineering
	+ National Research Council’s Transportation Research Record
	+ Transportation Research Part C
	+ Automation in Construction
	+ Construction Management and Economics
	+ J of Field Robotics
	+ Engineering, Construction, and Architectural Management
	+ Advanced Engineering Informatics
	+ J of Civil Engineering and Management
	+ Waste Management
	+ Construction Innovation

CONSULTING

Research has been my primary focus throughout most of my career, however consulting serves a vital role in transfer of knowledge and implementation of research findings. I have acted as a paid consultant for the following organizations:

* Building Trades Council of Ontario
* KLA Tencor
* GSE&C
* OPG
* GS Engineering & Construction Corp.
* National Academies’ National Research Council (USA)
* Software Innovation Inc.
* TU Denmark
* FIATECH
* Korean Institute of Construction Technology
* Construction Industry Institute
* Larry Laden Law Firm
* Dupont
* Rose Law Firm
* Malcolm Pirnie, Inc.
* Morrison & Foerster LLP Attorneys at Law
* Hilti Corporation
* National Taiwan Institute of Technology

REVIEW PANELS

Serving on peer review panels is a duty. I have conducted research proposal reviews and served on many research proposal review panels over the years for the following organizations:

* Construction Industry Institute
* US National Science Foundation
* National Research Foundation of Korea
* Singapore National Science Agency
* South African National Science Agency
* Lebanese National Science Agency
* Natural Sciences and Engineering Research Council of Canada’s programs
* Alfred P. Sloan Foundation
* Canada Foundation for Innovation (CFI)
* Mitacs
* Ontario Centers of Excellen

SIGNIFICANT PROFESSIONAL COMMITTEES

Contributions have been made through service on many dozens of professional and governmental committees since 1990. A complete list is available on request. Those not listed below include well over two dozen conference organizing teams, many awards committees, and many invited workshops. The remaining significant contributions are listed below:

* **Member of the NSERC Advisory Committee on University Industry Grants since 2018** – The Advisory Committee on University‑Industry Grants (ACUIG) is multidisciplinary, and it has broad experience in University-Industry interactions. The appointment of members conforms to Council standards with respect to stature and discipline representation, gender, sector, regional and linguistic considerations. Members are appointed for three-year terms. We review all large industry partnership grants and provide input into NSERC’s industry partners programs
* **Member** **and Academic Advisor** **of the Construction Industry Institute (CII) Funded Studies Committee since 2014** – this committee develops the multi-million dollar annual research projects slate for CII and selects research teams who are awarded research projects from the slate – it represents a commitment of at least two person-weeks per year and three in-person meetings in US locations
* **Member** **of American Society of Civil Engineers (ASCE) Construction Institute’s Awards Committee since 2011** – many nomination packages are reviewed annually for the various awards in this Institute, and final recommendations are made by this committee of five people
* **President** **2016-2019** **and Member since 1995 of the Board of Directors of the International Association for Automation and Robotics in Construction (IAARC)** – IAARC has held conferences (ISARC’s) annually since the first one at Carnegie Mellon University in 1983, and it sponsors the Elsevier Journal of Automation in Construction – its web site hosts over thirty years of freely accessible proceedings from past ISARC’s, and while it is not incorporated, it has made a substantial contribution to the body of knowledge since its inception
* **Member** **of Construction Industry Institute (CII) Breakthrough Committee – 1997 to 2014** – this committee develops and nurtures breakthroughs in technology, processes and perceptions that could improve substantially the performance of the construction industry – it typically meets several times per year in North American locations
* **Co-Chair** **for the 30th Annual International Symposium for Automation and Robotics (ISARC) held in Montreal in August, 2013** – co-chairing such a conference is a major time contribution distributed over two years prior to the conference and entailing many post-conference obligations - with over 400 participants, this conference was a major success, and that was partly a result of the extremely hard work of the organizing committee and hosts
* **Co-Chair** **of Construction Industry Institute (CII) Academic Committee – 2010 to 2012** – this committee manages the collaboration of the many dozens of academic research institutions and researchers who contribute to CII research teams, processes, strategic planning, and value system
* **Co-Chair** **of the 1st Canadian Graduate Student Colloquium on Computer-assisted Construction Technologies, London, Ontario, Canada, June 18-19, 2009** – since this first symposium, there have been three more associated with the bi-annual CSCE Construction Research Congresses
* **Member** **NSERC Civil Engineering Discovery Grant Selection Committee (GSC 1061) – July 2007 to June 2010** – former members of this committee are well aware that it requires a commitment of about four person weeks per year and is a significant responsibility
* **Member**, **National Research Council's Transportation Research Board’s (TRB) Group 2 Council on Design and Construction of Transportation Facilities – 2003 to 2006** – this council oversaw the activities of over fifty TRB committees, which each have 30-100 participants – a term on this council is the culmination of a career progression through committee membership, committee chair, section membership and chair, and council membership – TRB’s Annual Conference has for 95 years occurred every January in in Washington DC, results in many annual TRR journal issue publications, and attracts over 12,000 participants annually

MEDIA MENTIONS

Service to society and professional practice may sometimes include popular media contributions that expedite implementation in practice, improve awareness and reflect positively on the role of the host academic institution. Since 2003, such contributions have fallen into two general categories:

* **Research contributions featured in the popular media** – dozens of articles, including Globe and Mail, and ENR which has a circulation in the hundreds of thousands weekly, have described research to which I have contributed directly – a detailed citation list is available on request
* **Research contributions featured on YouTube** – six videos have been posted with about 9,000 views between them as of September 2019
* Editor and contributor to **World Economic Forum’s Future of Construction** web site

PATENTS

* Haas, C., Sreenivasan, S.V., Traver, A.E., Saidi, K.S., Seo, J., and Greer, R.L., “Pole Inserting Robotic Mechanism for Accessing the Interior of a Harsh Enclosure,” Patent Number 5,979,340, Nov. 9, 1999.

PUBLICATIONS ORGANIZATION

Publications are organized by category, subcategory, date, and then by archival journal articles, book chapters, conference papers, and technical reports. Graduate students are most often the first authors. Total publications exceed 400, including over 175 journal articles. Google Scholar H factor is 48+, Scopus H factor of 36+, and total citations exceed 8,600 with a current rate of over 1000/year. The publications ontology follows:

* **Sensing and state estimation**
	+ **3D modeling and analysis for capital facilities life cycle management**
	+ **Automated location and state estimation of onsite craft workers**
	+ **Object location estimation and tracking for capital projects construction**
	+ **Data fusion for state estimation**
	+ **Construction supply chain visibility**
	+ **Automated sensing and state estimation for infrastructure systems and materials**
	+ **Automated incident detection for traffic systems**
* **Human Centric Automated and Robotic Assisted Work Systems**
	+ **Biomechanical systems and ergonomics**
	+ **Fabrication control of piping and structural systems**
	+ **Workflow automation, verification, and diagnostics**
	+ **Site robotics** **control systems and design methodology**
	+ **Trenchless technologies**
* **Circular Economy of the Built Environment**
	+ **Water and waste water systems sustainability**
	+ **Pavement systems sustainability**
	+ **Reuse of buildings and materials**
	+ **Capital projects sustainability**
* **Capital projects processes**
	+ **Interface management for mega-projects**
	+ **Supply chain management**
	+ **Risk management**
* **Construction productivity improvement and economics**
	+ **Management of innovation**
	+ **Modularization and prefabrication**
	+ **Practices and processes**
	+ **Benchmarking and metrics**
	+ **Diagnostics**
* **Construction crafts training**
	+ **Health and safety**
	+ **Return on investment in training**
	+ **Organization of training systems**
* **Engineering research and practice issues**

PUBLICATIONS LIST

(excluding conference papers, technical reports, and software)

* **Sensing and state estimation**
	+ **3D modeling and analysis for capital facilities life cycle management**
		- Nahangi, M., Czerniawski, T., Walbridge, S., and Haas, C., “Pipe radius detection and estimation using Kinect range cameras,” Automation in Construction, 99, 197-205, 2019.
		- Czerniawski, T., Sankaran, B., Nahangi, M., Haas, C., and Leite, F.,“6D DBSCAN-based segmentation of building point clouds for planar object classification,” Automation in Construction 88, 44-58, 2018.
		- Czerniawski, T., Nahangi, M., Walbridge, S., and Haas, C., “Pipe radius detection and estimation capability of low-cost range cameras,” accepted by Automation in Construction, May, 2018.
		- Sharif, M., Nahangi, M., Haas, C., and West, J., “Automated Model‐Based Finding of 3D Objects in Cluttered Construction Point Cloud Models,” Computer‐Aided Civil and Infrastructure Engineering 32 (11), 893-908, 2017.
		- Czerniawski, T., Nahangi, M., Haas, C., and Walbridge, S., “Pipe spool recognition in cluttered point clouds using a curvature-based shape descriptor,” Automation in Construction, 2016.
		- Nahangi, M., and Haas, C., “Skeleton-based discrepancy feedback for automated realignment of industrial assemblies,” Automation in Construction, 2016.
		- Nahangi, M., Yeung, J., Haas, C., Walbridge, S., and West, J., “Automated Assembly Discrepancy Feedback Using 3D Imaging and Forward Kinematics,” Automation in Construction 56, 36-46, 2015.
		- Ghahremani, Safa, Yeung, Walbridge, and Haas, “Quality Assurance for Ultrasonic Impact Treatment of Welds using Handheld 3D Laser Scanning Technology,” Welding in the World, Volume 59, Issue 3 (2015), Page 391-400.
		- Patrauscean, V., Armeni, I., Nahangi, M., Yeung, J., Brilakis, I., and Haas, C., “State of Research in Automatic As-built Modeling,” Advanced Engineering Informatics special issue on Infrastructure Computer Vision, February, 2015.
		- Nahangi, M., and Haas, C., “Automated 3D compliance checking in pipe spool fabrication,” Advanced Engineering Informatics, in press, August, 2014.
		- Bosché, F., Ahmed, M., Turkan, Y., Haas, C., and Haas, R, “The value of integrating Scan-to-BIM and Scan-vs-BIM techniques for construction monitoring using laser scanning and BIM: The case of cylindrical MEP components,” Automation in Construction, in press, August, 2014.
		- Bosche, F., Guillamet, A., Turkan, Y., Haas, R., and Haas, C., “Tracking the built status of MEP works: Assessing the value of a Scan-vs-BIM system,” ASCE journal of Computing in Civil Engineering, 28 (4), 05014004, 2014.
		- Ahmed, M., Haas, R., and Haas, C., “Automatic Detection of Cylindrical Objects in Built Facilities,” Computing in Civil Engineering, 28 (3), 04014009, 2014.
		- Turkan, Y., Bosché, F., Haas, C., and Haas, R., "Tracking of secondary and temporary objects in structural concrete work", Construction Innovation: Information, Process, Management, Vol. 14 Iss: 2, pp.145 – 167, 2014.
		- Turkan, Y., Bosche, F., Haas, R., and Haas, C., “Towards Automated Earned Value Tracking Using 3D Imaging Tools,” ASCE Journal of Construction Engineering and Management 139 (4), pp. 423-433, 2013.
		- Cho, Y., Wang, M., Tang, P., and Haas, C., “Target-focused Local Workspace Modeling for Construction Automation Applications,” ASCE Journal of Computing in Civil Engineering, 26 (5), pp. 661-670, 2012.
		- Ahmed, M., Haas, C., Shahi, A., Aryan, A., West, J., and Haas, R., “Using Digital Photogrammetry for Pipe-Works Progress Tracking,” Canadian Journal of Civil Engineering 39 (9), pp. 1062-1071, 2012.
		- Turkan, Y., Bosche, F., Haas, R., and Haas, C., “Automated Progress Tracking Using 4D Schedule and 3D Sensing Technologies,” Automation in Construction 22 , pp. 414-421, 2012.
		- Bosche, F., Haas, C., and Akinci, B., “Automated recognition of 3D CAD objects in site laser scans for project 3D status visualization and performance control,” ASCE Journal of Computing in Civil Engineering, 23 (6), pp. 311-318, 2009.
		- Bosche, F., and Haas, C., “Rapid Automated Three-dimensional CAD Model Object Retrieval and Quality Control,” ITCon, March, 2008.
		- Bosche, F., Haas, C.T., "Automated Retrieval of 3D CAD Model Objects in Construction 3D Images", Journal of Automation in Construction, Elsevier, New-York, USA, Volume 17, Issue 4, pp 499-512, 2008.
		- Teizer, J., Kim, C., Haas, C.T., Liapi, K.A., and Caldas, C.H. (2005), “A Framework for Real-time 3D Modeling of Infrastructure,” National Research Council’s Transportation Research Board’s Transportation Research Record, No. 1913, Washington D.C., 2005, pp. 177-186.
		- Kim, C., Haas, C., and Liapi, K., “Rapid, On-Site Spatial Information Acquisition and its Use for Infrastructure Operation and Maintenance,” Automation in Construction, Vol 14/5, Oct. 2005, pp.666-684.
		- Bosche, F., Haas, C., and Caldas, C., “3D CAD Drawing as A Priori Knowledge for Machine Vision in Construction,” proc.s of 1st Annual Inter-university Symposium on Infrastructure Management, Waterloo, Ontario, Canada, August 6, 2005.
		- Teizer, J., Caldas, C.H., Haas, C.T., “Real-Time 3D Modeling of Infrastructure Using Emerging Technology,” Graduate Research and Industry Networking Conference, The University of Texas at Austin, Austin, Texas, April 28, 2005.
		- Kwon, Bosche, Kim, Haas, and Liapi, “Fitting Range Data to Primitives for Rapid Local 3D Modeling Using Sparse Range Point Clouds,” Automation in Construction 13, January 2004, pp. 67-81.
		- Cho, Y.K., and Haas C.T., “Rapid Geometric Modeling for Unstructured Construction Workspaces,” Computer-Aided Civil and Infrastructure Engineering, pp. 242-253, no. 18, 2003.
		- Kim, Y.S., and Haas, C., “A Model for Automation of Infrastructure Maintenance using Representational Forms,” Vol. 10/1, Automation in Construction, pp. 57-68, Sept. 2000.
		- Lin, K., and Haas, C., “Multiple Heavy Lifts Optimization,” ASCE Journal of Construction Engineering and Management, Vol. 122, No. 4, pp. 354-362, Dec. 1996.
		- Lin, K., and Haas, C., “An Interactive Planning Environment for Critical Operations,” ASCE Journal of Construction Engineering and Management, Vol. 122, No. 3, pp. 212-222, Sept. 1996.
		- Tucker, R., O'Connor, J., Gatton, T., Gibson, G., Haas, C., and Hudson, D., “The Impact of Computer Technology on Construction's Future,” Microcomputers in Civil Engineering, 9(1), pp. 3-11, Feb. 1994.
		- Hornaday, W., Haas, C., O'Connor, J., and Wen, J., “Computer Aided Planning for Heavy Lifts,” ASCE Journal of Construction Engineering and Management, 119(3), pp. 498-515, Sept. 1993.
	+ **Automated location and state estimation of onsite craft workers**
		- Teizer, J., Caldas, C.H., and Haas, C.T., “Real-time three-dimensional occupancy grid modeling for the detection and tracking of construction resources,” Journal of Construction Engineering and Management 133 (11), pp. 880-888, 2007.
	+ **Object location estimation and tracking for capital projects construction**
		- Shahi, A., West, J., and Haas, C., “Onsite 3D Marking for Construction Activity Tracking,” Automation in Construction 30 (2013) 136–143, 2013.
		- Shahi, A., Aryan, A., West, J., Haas, C., and Haas, R., “Deterioration of UWB positioning during construction,” Automation in Construction 24, pp. 72-80, 2012.
		- Razavi, S., Haas, C., Duflos, E., and Vanheeghe, P., “Dislocation detection in field environments : A belief functions contribution.” Expert Systems with Applications, on-line, doi:10.1016/j.eswa.2011.12.014, 2012.
		- Razavi, S., Haas, C., “Using Reference RFID Tags for Calibrating the Estimated Locations of Construction Materials,” Automation in Construction 20 (6), pp. 677-685, 2011.
		- Song, J., Haas, C., and Caldas, C., “A Proximity-based Method for Locating RFID Tagged Objects,” Journal of Advanced Engineering Informatics, (21), October, 2007, pp. 367-376.
		- Caron, F., Duflos, E., Haas, C., and Vanheeghe, P., “Application du TBM pour la localization de noeuds de communication a partir de measures de proximite - Application of the TBM to the communication nodes localization using proximity measurements,” Revue Traitement du Signal, Vol. 24, pp. 153-164, 2007.
		- Song, J., Haas, C., and Caldas, C., “Tracking the Location of Materials on Construction Job Sites,” Journal of Construction Engineering and Management, Volume 132, Number 9 (September 2006), pp. 911-918.
		- Caron, F., Razavi, S., Song, J., Vanheeghe, P., Duflos, E., Caldas, C., and Haas, C., “Locating Sensor Nodes on Construction Projects,” Autonomous Robots, 10.1007/s10514-006-9720-1, September, 2006.
		- Grau, D., Caldas, C., and Haas, C., “Using Global Positioning System to Improve Materials-Locating Processes on Industrial Projects,” ASCE J. of Construction Engineering and Management Volume 132, Issue 7, July 2006, pp. 741-749.
	+ **Data fusion for state estimation**
		- Shahi, A., Safa, M., Haas, C., West, J., “Workflow Based Data Fusion for Construction Progress Estimating,” ASCE Computing in Civil Engineering, September, 2014.
		- Razavi, S., Haas, C., “A Reliability Based Hybrid Data Fusion Method for Adaptive Location Estimation in Construction,” Journal of Computing in Civil Engineering 26 (1), pp. 1-10, 2012.
		- Shahandashti, S., Razavi, S., Soibelman, L., Berges, M., Caldas, C., Brilakis, I., Teizer, J., Haas, C., Garrett, J., Akinci, B., and Zhu, Z., “Data Fusion Approaches and Applications for Construction Engineering,” ASCE Journal of Construction Engineering and Management, 137(10), pp. 863-869, 2011.
		- Pradhan, A., Akinci, B., and Haas, C., “Formalisms for query capture and data source identification to support data fusion for construction productivity monitoring,” Automation in Construction 20 (4), pp. 389-398, 2011.
		- Razavi, S., Haas, C., “Multi-sensor Data Fusion for On-Site Materials Tracking in Construction,” Automation in Construction 19 (8), pp. 1037-1046, 2010.
		- Haas, C., “A Model for Data Fusion in Civil Engineering,” Intelligent Computing in Engineering and Architecture, Volume 4200/2006, ISBN 978-3-540-46246-0, 2006, pp. 315-319. (note: this is described as a chapter in a book, but it is really more a short journal article and was refereed in that fashion.)
		- Kim, C., Haas, C., Caldas, C., and Liapi, K.,“Erfassung raumlicher Daten, Integration und Modellierung fur Echtzeit-Projektlebenszyklus Anwendungen“, Thesis, Wissenschaftliche Zeitschrift der Bauhaus-Universitat Weimar, 1. Heft 2004 50. Jahrgang, pp. 30-37.
		- Haas, C., and Hendrickson, C., “Integration of Diverse Technologies for Pavement Sensing,” the National Research Council's Transportation Research Record, No. 1311, pp. 92-102, 1991.
		- Haas, C., McNeil, S., Hendrickson, C., and Haas, R., “A Pavement Surface Model for Integrating Automated Management Data,” Pavement Management Implementation, ASTM STP 1121, Frank B. Holt, Wade L. Gramling, Editors, American Society for Testing and Materials, Philadelphia, pp. 394-410, 1991.
		- Haas, C., and Hendrickson, C., “A Computer-Based Model of Pavement Surfaces,” the National Research Council's Transportation Research Record, No. 1260, pp. 91-98, 1990.
	+ **Construction supply chain visibility**
		- Young, D., Haas, C., Caldas, C., and Goodrum, P., “Modeling the Impact of Automated Materials Locating and Tracking Technology on the Construction Supply Network,” ASCE Journal of Construction Engineering and Management, 137(11), pp. 976-984, 2011.
		- Nasir, H., Haas, C.T., Young, D.A., Razavi, S.N., Caldas, C. and Goodrum, P. (2010). “An Implementation Model for Automated Construction Materials Tracking and Locating.” Canadian Journal of Civil Engineering, Vol. 37(4), pp. 588-599
		- Song, J., Haas, C., Caldas, C., Ergen, E., and Akinci, B., “Automating The Task of Tracking the Delivery and Receipt of Fabricated Pipe Spools in Industrial Projects,” Automation in Construction, Vol. 15/2, March 2006, pp 166-177.
	+ **Automated sensing and state estimation for infrastructure systems and materials**
		- Safa, M., Sabet , A., Ghahremani, K., Haas, C., and Walbridge, S., “Rail corrosion forensics using 3D imaging and finite element analysis,” published online by International Journal of Rail Transportation, June, 2015.
		- Vaziri, S.H., Haas, C.T., Rothenburg, L., Haas, R.C., “Investigation of the effect of weight factor on performance of piezoelectric weigh-in-motion sensors,” Journal of Transportation Engineering, 139 (9), pp. 913-922, 2013
		- Vaziri, S., Jiang, X., Haas, C., Haas, R., and Rothenburg, L., “Investigation of the Effects of Air Temperature and Speed on Performance of Piezoelectric Weigh-In-Motion Systems,” CSCE Civil Engineering Journal, 40 (10), pp. 935-944, 2013.
		- Ahmed, M., Haas, R., and Haas, C., “Toward Low-Cost 3D Automatic Pavement Distress Surveying: The Close Range Photogrammetry Approach,” Canadian Journal of Civil Engineering, 38(12), pp. 1301-1313, 2011.
		- Baiz, S., Tighe, S.L., Haas, C., Mills, B., and Perchanok, M., “Development of Frost and Thaw Depth Predictors for Decision Making About Variable Load Restrictions,” National Research Council’s Transportation Research Record, TRR 2053, pp.1-8, 2008.
		- White, R., Song, J., and Haas, C., “An Evaluation of Quartz Piezo Electric Weigh-in-Motion Sensors,” National Research Council’s Transportation Research Record, no. 1945, pp. 109-117, November, 2006.
		- Kim, H., Rauch, A.F., and Haas, C., “Automated Quality Assessment of Stone Aggregates Based on Laser Imaging and a Neural Network,” ASCE Journal of Computing in Civil Engineering, vol. 18, issue 1, January 2004, pp. 58-64.
		- Browne, C., Rauch, A. F., Haas, C. T., and Kim, H. (2003). “Performance evaluation of automated machines for measuring gradation of aggregates.” Geotechnical Testing J., ASTM, Vol. 26, No. 4, December, pp. 373-381.
		- Kim, H., Haas C.T., Rauch, A., and Browne, C., “3D Image Segmentation of Aggregates from Laser Profiling,” Computer-Aided Civil and Infrastructure Engineering, pp. 254-263, Vol. 18, No. 4, July 2003.
		- Kim, H., Haas, C.T., Rauch, A.F., and Browne, C., “Wavelet-based 3D Descriptors of Aggregate Particles,” National Research Council’s Transportation Research Board’s Transportation Research Record 1787, pp. 109-116, 2002.
		- Kim, H., Haas, C., Rauch, A., and Browne, C., “Dimensional Ratios for Stone Aggregates from Three-Dimensional Laser Scans,” ASCE Journal of Computing in Civil Engineering, Vol. 16, no. 3, pp. 175-183, July 2002.
		- Weissmann, J., Chun, H.T., and Haas, C., “Pilot Installation of a Bridge Scour Monitoring Site,” the National Research Council’s Transportation Research Board’s Transportation Research Record, No. 1749, pp. 68-72, 2001.
		- McKeever, B., Haas, C., Weissmann, J., and Greer, R., “Life Cycle Cost-Benefit Model for Road Weather Information Systems,” National Research Council's Transportation Research Record, No. 1627, pp.41-48, 1998.
		- Phelan, R.S., Radjy, F., Haas, C., and Hendrickson, C., “Computer Aided Concrete Placement Optimization,” ASCE Journal of Construction Engineering and Management, 116(1), pp. 172-186, Mar. 1990.
		- Haas, C., and McNeil, S., “Criteria for Evaluating Pavement Imaging Systems,” the National Research Council's Transportation Research Record, No. 1260, pp. 64-73, 1990.
	+ **Automated incident detection for traffic systems**
		- Khoury, J., Haas, C., Mahmassani, H., Logman,H., and Rioux, T., “Performance Comparison of Automated Vehicle Identification and Inductive Loop Traffic Detectors for Incident Detection,” ASCE Journal of Transportation Engineering, Vol. 129, no. 6, pp. 600-607, Nov/Dec 2003.
		- Tavana H., H.S. Mahmassani, and C. Haas, “Effectiveness of Wireless Phones in Incident Detection, Probabilistic Analysis,” National Research Council's Transportation Research Record, No. 1683, Washington DC, pp. 31-37, Nov. 1999.
* **Human Centric Automated and Robotic Assisted Work Systems**
	+ **Biomechanical systems and ergonomics**
		- Seo, Alwasel, Lee, Abdel-Rahman, and Haas, “A Comparative Study of In-field Motion Capture Approaches for Body Kinematics Measurement in Construction" Robotica 1-19, 2017.
		- Alwasel, Sabet, Nahangi, Abdel-Rahman, and Haas, “Identifying Safe and Productive Masons Using Machine Learning," Automation in Construction 84, 345-355, 2017.
		- Alwasel, Abdel-Rahman, Haas, and Lee, “Experience, Productivity, And Musculoskeletal Injury Among Masonry Workers" Journal of Construction Engineering Management, 2017.
	+ **Fabrication control of piping and structural systems**
		- Rausch, Nahangi, Haas, and Liang, “Monte Carlo Simulation for Tolerance Analysis in prefabrication and Offsite Construction,” Automation in Construction, 103, 300-314, 2019.
		- Shahtaheri, Y., Rausch, C., West, J., Haas, C., and Nahangi, M., “Managing Risk in Modular Construction Using Dimensional Tolerance Strategies,” Automation in Construction, 83, 303-315, 2017.
		- Rausch, C., Nahangi, M., and Haas, C., and West, J., “Kinematics chain based dimensional variation analysis of construction assemblies using building information models and 3D point clouds,” Automation in Construction, 75, 33-44, 2017.
		- Rausch, C., Nahangi, M., Perreault, M., Haas, C., and West, J., “Optimum Assembly Planning for Modular Construction Components,” ASCE Journal of Computing in Civil Engineering, 2016.
		- Nahangi, M., Czerniawski, T., Haas, C., Walbridge, S., and West, J., “Parallel Systems and Structural Frames Realignment Planning and Actuation Strategy,” Journal of Computing in Civil Engineering, Automation in Construction 61, 147-161, 2016.
		- Nahangi, M., Haas, C., West, J., and Walbridge, “Automatic realignment of defective assemblies using an inverse kinematics analogy,” Computing in Civil Engineering, January, 2015.
		- Safa, M., Shahi, A., Nahangi, M., and Haas, C., “Automating Measurement Process to Improve Quality Management for Piping Fabrication,” Structures, online in March, 2015.
	+ **Workflow automation, verification, and diagnostics**
		- Golzarpoor, B., Haas, C. T., Rayside, D., Kang, S., and Weston, M., “Improving Construction Industry Process Interoperability with Industry Foundation Processes (IFP),” Advanced Engineering Informatics in September, 2018.
		- Golzarpoor, B., Haas, C., and Rayside, D., “Improving Process Conformance with Industry Foundation Processes (IFP),” Advanced Engineering Informatics, 30(2), pp. 143-156, 2016.
		- Karimidorabati, S., Haas, C., and Gray, J., “Evaluation of Automation Levels for Construction Change Management,” Engineering, Construction and Architectural Management, 2016.
		- Chettupuzha, A., Gray, J., and Haas, C., “An Algorithm for Determining the Criticality of Documents within a Construction Information System,” J of Computing in Civil Engineering 04015039 July, 2015.
	+ **Site robotics control systems and design methodology**
		- Seo J.W. , Haas C., and Saidi K., “Graphical modeling and simulation for design and control of a tele-operated clinker clearing robot,” Automation in Construction, Volume: 16, Issue: 1, January, 2007, pp. 96-106.
		- Kim, C., Haas, C., Liapi, K., and Caldas, C., “Human-Assisted Obstacle Avoidance System Using 3D Workspace Modeling for Construction Equipment Operation,” ASCE J. Comp. in Civ. Engrg., Volume 20, Issue 3, (May/June 2006), pp. 177-186.
		- Cho, Y., Haas, C., Sreenivasan, S., and Liapi, K., “Position Error Modeling for Automated Construction Manipulators,” ASCE Journal of Construction Engineering and Management, vol. 130, no. 1, Jan/Feb 2004, pp. 50-58.
		- McLaughlin, J, Sreenivasan, S.V., Haas, C., and Liapi, K., “Rapid Human-Assisted Creation of Bounding Models for Obstacle Avoidance in Construction,” Journal of Computer-Aided Civil and Infrastructure Engineering, vol. 19, pp. 3-15, 2004.
		- Haas, C., and Kim, Y., “Automation in Infrastructure Construction,” Construction Innovation, Vol. 2, Issue 3, pp. 191-210, 2002.
		- Cho, Y., Haas, C., Liapi, K., and Sreenivasan, S., “A framework for rapid local area modeling for construction automation.” Journal of Automation in Construction, 11(6), pp. 629-641, 2002.
		- Kim, Y.S., Haas, C., “A man-machine balanced rapid object model for automation of pavement crack sealing and maintenance,” Canadian Journal of Civil Engineering, 29: pp. 1-16, 2002.
		- Seo, J., Haas, C., Saidi, K., and Sreenivasan, S.V., “Graphical Control Interface for Construction and Maintenance Equipment,” ASCE Journal of Construction Engineering and Management, Vol. 126, No. 3, pp. 210-218, May/June 2000.
		- Saidi, K.S., Seo, J., Sreenivasan, S.V., Haas, C.T., and Traver, A.E., “Design of a Tele-Operated Robot for the Maintenance of Boiler Hoppers in Electric Power Plants,” ASME Journal of Mechanical Design, Vol. 121, pp. 647-649, Dec. 1999.
		- LeBlond, D., Owen, F., Gibson, G., Haas, C., and Traver, A., “Control Improvement for Advanced Construction Equipment,” ASCE Journal of Construction Engineering and Management, Vol. 124, No. 4, pp. 289-296, Jul./Aug. 1998.
		- Kim, Y., Haas, C., and Greer, R., “Path Planning for a Machine Vision Assisted, Teleoperated Pavement Crack Sealer,” ASCE Journal of Transportation Engineering, Vol. 124, No. 2, pp. 137-143, Mar./Apr. 1998.
		- Greer, R., Haas, C., Gibson, G., Traver, A., and Tucker, R., “Advances in Control Systems for Construction Manipulators,” Automation in Construction, Vol. 6, No. 3, pp. 193-204, 1997.
		- Haas, C., “Evolution of an Automated Crack Sealer: A Study in Construction Technology Development,” Automation in Construction 4, pp. 293-305, 1996.
		- Osmani, A., Haas, C., and Hudson, W., “Evaluation of Road Maintenance Automation,” ASCE Journal of Transportation Engineering, Vol. 122, No. 1, Jan./Feb. 1996.
		- Haas, C., Skibniewski, M., and Budny, E., “Robotics in Civil Engineering,” Microcomputers in Civil Engineering, No. 10, pp. 371-381, 1995.
		- Hsieh, T., and Haas, C., “Determining Functional Requirements for Large Scale Manipulators,” Automation in Construction, 3, pp. 55-64, 1994.
		- Hsieh, T., and Haas, C., “Costs and Benefits of Automated Road Maintenance,” the National Research Council's Transportation Research Record, No. 1406, pp. 10-19, 1994.
	+ **Trenchless technologies**
		- Bauhan, T.L., Fowler, D.W., and Haas, C.T., “Wastewater Line Spot Repair: Two Trenchless Alternatives,” Journal of Protective Coatings and Linings, Vol. 17, No. 3, pp. 49-65, Mar. 2000.
		- Ueki, M., Haas, C., and Seo, J., “Decision Tool for Microtunneling Method Selection,” ASCE Journal of Construction Engineering and Management, Vol. 125, No. 2, pp. 123-130, Mar./Apr. 1999.
		- Bauhan, T., Fowler, D.W., and Haas, C., “Performance Testing of Trenchless Wastewater Line Spot Repairs,” ASCE Journal of Infrastructure Systems, Vol. 3, No. 1, pp. 40-48, Mar. 1997.
		- Haas, C., Fowler, D., Conegliano, B., Wright, C., and Bauhan, T., “Evaluation of New Underground Infrastructure Maintenance Technologies,” ASCE Journal of Infrastructure Systems, Vol. 1, No. 4, Dec. 1995.
* **Circular Economy of the Built Environment**
	+ **Water and waste water systems sustainability**
		- Ganjidoost, A., Knight, M., Unger, A., and Haas, C., “Benchmarking Performance Indicators for Utilities' Water and Wastewater Pipelines Infrastructure,” Journal of Water Resources Planning and Management, accepted in July, 2017.
		- Rehan, R., Unger, A., Knight, M., and Haas, C., “Water Utility Management and Financial Planning Using System Dynamics,” AWWA Journal, 107 (1), 87-88, 2015.
		- Shadpour, A., Unger, A.J.A., Knight, M.A., Haas C.T., and Forsyth, P.A., “A Numerical DAE Approach for Solving a System Dynamics Problem,” published online by ASCE Computing in Civil Engineering, August, 2014.
		- Rehan, R., M.A. Knight A.J.A. Unger, and C.T. Haas, “Financially sustainable management strategies for urban wastewater collection infrastructure - development of a system dynamics model, Tunneling and Underground Space Technology, 39, pp. 116-129, 2014.
		- Rehan, R., Unger, A.J.A.. Knight M.A.. and C.T. Haas, “Financially sustainable management strategies for urban wastewater collection infrastructure - Implementation of a system dynamics model,” Tunneling and Underground Space Technology, 39, pp. 102-115, 2014.
		- Rehan, R., Knight, M., Unger, A., and Haas, C., “Development of a system dynamics model for financially sustainable management of municipal watermain networks,” Water Research, online 23 October, 2013.
		- Rehan, R., Knight, M., Unger, A., and Haas, C., “Application of System Dynamics for developing financially self-sustaining management policies for water and wastewater systems,” Water Research 45 (16), pp. 4737-4750, 2011.
	+ **Pavement Systems Sustainability**
		- *Nasir H., Haas C., Casello, J., and Haas, R., “A STUDY OF ACCOUNTING AND REPORTING OF PUBLIC INFRASTRUCTURE IN CANADA,” CSCE 8th International Transportation Specialty Conference, Winnipeg, Manitoba, June 9-12, 2010*
		- *Tighe, S., Haas, R., Kennepohl, G., and Haas, C., “A Contribution to Knowledge Management Through a Canadian Research Initiative,” Annual Conf. of Transp. Assoc. of Canada, Charlottetown, PEI, Sept., 18-20, 2006.*
	+ **Reuse of buildings and materials**
		- Sanchez, B., Rausch, C., and Haas, C., “Deconstruction Programing for Adaptive Reuse of Buildings,” Automation in Construction 107, 102921, 2019.
		- Sanchez and Haas, “A novel selective disassembly sequence planning method for adaptive reuse of buildings,” Journal of Cleaner Production, 183, 998-1010, 2018.
		- Yeung, J., Walbridge, S., Haas, C., and Saari, R., “Understanding the total life cycle cost implications of reusing structural steel,” Environment Systems and Decisions, 37(1), pp. 101-120, 2017.
		- Yeung, J., Walbridge, S., and Haas, C., “The Role of Geometric Characterization in Supporting Structural Steel Reuse Decisions,” published online in Resources, Conservation and Recycling in September, 2015.
	+ **Capital projects sustainability**
		- Sanchez and Haas, “Capital project planning for a circular economy,” Construction Management and Economics, 1-10, 2018.
		- Safa, M., Safa, M., Allen, J., Shahi, A., and Haas, “Improving Sustainable Office Building Operation by Using Historical Data and Linear Models to Predict Energy Usage,” Sustainable Cities and Society, 29, 107-117, 2017.
		- Chong, W.K., Kumar, S., Haas, C.T., Beheiry, S.M., Coplen, L., and Oey, M., “Understanding and interpreting baseline perceptions of sustainability in construction among civil engineers in the United States,” ASCE Journal of Management in Engineering, Vol., 25, no. 23, pp. 143-154, July, 2009.
		- Beheiry, S. M., Chong, W., and Haas, C.T., “Examining Business Impact of Owner Commitment to Sustainability,” ASCE J. of Construction Engineering and Management Volume 132, Issue 4, April 2006, pp. 384-392.
* **Capital projects processes**
	+ **Interface management for mega-projects**
		- E Eray, B Sanchez, C Haas, “Usage of Interface Management System in Adaptive Reuse of Buildings,” Buildings 9 (5), 105, 2019
		- Shen, Choi, Lee, Tang, and Haas, “How to Improve Interface Management Behaviors in EPC Projects: The Roles of Formal Practices and Social Norms,” 34 (6), 04018032, ASCE JME, 2018.
		- Ahn, S., Shokri, S., Lee, S., Haas, C., and Haas, R., “Exploratory Study on the Effectiveness of Interface-Management Practices in Dealing with Project Complexity in Large-Scale Engineering and Construction Projects,” ASCE Journal of Management in Engineering, 2016.
		- Shokri, S., Ahn, S., Lee, S., Haas, C., and Haas, R., “Current Status of Interface Management in Construction: Drivers and Effects of Systematic Interface Management,” published online in Journal of Construction Engineering and Management, October 2015.
		- Shokri, S., Haas, C., Haas, R., and Lee, S., “An Interface Management Process for Managing Risks in Complex Capital Projects,” published online in Journal of Construction Engineering and Management, October 2015.
	+ **Supply chain management**
		- Safa, Shahi, Haas, and Hipel, “Construction Contract Management Using Value Packaging Systems,” International Journal of Construction Management, 17 (1), 50-64, 2017.
		- Safa, M., Reinsma, S., Haas, C., Goodrum, P., and Caldas, C., “A Decision Making Method for Choosing Concrete Forming Systems,” International Journal of Construction Management (IJCM), 1-12, IJCM-140955, 2016.
		- Safa, M, Yee, M., Rayside, D., and Haas, C., “Optimizing Contractor Selection for Construction Packages in Capital Projects,” ASCE journal of Computing in Civil Engineering, January, 2016.
		- Safa, M., Shahi, A., Haas, C., and Hipel, K., “Supplier Selection Process in an Integrated Construction Materials Management Model,” Automation in Construction 48, 64-73, 2014.
		- Safa, M., Haas, C., Gray, J., and Hipel, K., “Electronic Process Management System based Front End Planning Tool (FEPT),” Journal of Construction Engineering and Project Management., Vol. 3, issue 2, pp. 1-12, 2013.
	+ **Risk Management**
		- Shahtaheri, M., and Haas, C., “Applying VLSI Reliability Theory for Understanding the Impact of Type II Risks on Megaprojects,” accepted by ASCE Journal of Management in Engineering, August, 2016.
		- Shahtaheri, M., Haas, C., and Salimi, T., “A Multi-dimensional Joint Confidence Limit Approach to Mixed Mode Planning for Round-the-Clock Projects,” Engineering, Construction and Architectural Management, October, accepted in March, 2016.
		- Fiolet, J.C., Haas, C., and Hipel, K., “Risk-Chasing Behaviour in On-Site Construction Decisions,” Construction Management and Economics, August, 2016.
* **Construction productivity improvement and economics**
	+ **Management of innovation**
		- Safa, M., Shahi, A., Haas, C., Fiander-McCann, D., Safa, M., Hipel, K., and MacGillivray, S., “Competitive intelligence (CI) for evaluation of construction contractors," accepted by Automation in Construction, February and available online in March, 2015.
		- Goodrum, P., Haas, C., Caldas, C., Zhai, D., Yeiser, J., and Homm, D., “Model to predict the impact of a technology on construction productivity,” ASCE Journal of Construction Engineering and Management 137 (9), pp. 678-688, 2011.
		- Advancing the Competitiveness and Efficiency of the U.S. Construction Industry, Kennedy, T., et al, The National Academies Press, Washington, D.C., ISBN – 13:978-0-309-14191-8, “Appendix C: An International Perspective on Construction Competitiveness and Productivity”, by C. Haas, pp. 55-75, 2009.
	+ **Modularization and prefabrication**
		- Enshassi, M., Walbridge, S., West, J., and Haas, C., “Integrated risk management framework for tolerance-based mitigation strategy decision support in modular construction projects,” Journal of Management in Engineering, 35 (4), 05019004, 2019.
		- Shahtaheri, Y., Rausch, C., West, J., Haas, C., and Nahangi, M., “Managing Risk in Modular Construction Using Dimensional Tolerance Strategies,” Automation in Construction in November, 2017.
		- Shan, Y., Kim, Y., Caldas, C., Goodrum, P., and Haas, C., “Impact of Steel Quick Connection System on Steel Erection Labor Productivity: Case Studies and Simulation Based Analyses,” Canadian Journal of Civil Engineering, October, 2014.
		- Song, J., Fagerlund, W., Haas, C., Vanegas, J., and Tatum, C., “Considering Prework on Industrial Projects,” ASCE Journal of Construction Engineering and Management, Vol. 131, no. 6, June 2005, pp. 723-733.
	+ **Practices and processes**
		- Safa, M., Reinsma, S., Haas, C., Goodrum, P., and Caldas, C., “A Decision Making Method for Choosing Concrete Forming Systems,” International Journal of Construction Management 18 (1), 53-64, 2018.
		- Zhang, D., Nasir, H., and Haas, C., “Development of an Internal Benchmarking and Metrics Model for Industrial Construction Enterprises for Productivity Improvement,” CSCE Journal of Civil Engineering, 2017.
		- Nasir, H., Haas, C., Caldas, C, and Goodrum, P., “An Integrated Productivity Practices Implementation Index for Infrastructure Projects Execution Planning,” ASCE Journal of Infrastructure Systems, 2016.
		- Shan, Y., Zhai, D., Goodrum, P., Haas, C., and Caldas, C., "Statistical Analysis of the Effectiveness of Management Programs in Improving Construction Labor Productivity on Large Industrial Projects." J. Manage. Eng., 04015018, 2015.
		- Kim, Y., Caldas, C., Goodrum, P., Haas, C., and Zhang, D., “Method to Assess the Level of Implementation of Productivity Practices on Industrial Projects,” published online by ASCE Journal of Construction Engineering and Management, August, 2014.
		- Gouett, M., Haas, C., Caldas, C., and Goodrum, C., “Activity Analysis in Industrial Construction,” ASCE Journal of Construction Engineering and Management, 137(12), pp. 1117-1124, 2012.
		- Zhang, D., Haas, C., Goodrum, P., and Caldas, C., “Construction small-projects rework reduction for capital facilities,” ASCE Journal of Construction Engineering and Management 138 (12), pp. 1377-1385, 2012.
		- Shan, Y., Goodrum, P., Zhai, D., Haas, C., and Caldas, C., “The impact of management practices on mechanical construction productivity,” Construction Management and Economics 29 (3), pp. 305-316, 2011.
		- Zhai, D., Goodrum, P., Haas, C., and Caldas, C., “The Relationship between Automation and Integration of Construction Information Systems and Labor Productivity,” ASCE JCEM, Vol. 135, no. 8, August, 2009.
		- Grau, D., Caldas, C., Haas, C., Goodrum, P., and Gong, J., “Assessing the Impact of Materials Tracking Technologies on Construction Craft Productivity,” Automation in Construction Vol. 18, pp. 903-911, 2009.
	+ **Benchmarking and metrics**
		- Ganjidoost, A., Knight, M., Unger, A., and Haas, C., “Benchmarking Performance Indicators for Utilities' Water and Wastewater Pipelines Infrastructure,” Journal of Water Resources Planning and Management, 144 (3), 04018003, 2018.
		- Zhang, D., Nasir, H., and Haas, C., “Development of an Internal Benchmarking and Metrics Model for Industrial Construction Enterprises for Productivity Improvement,” Canadian Journal of Civil Engineering, 2017.
		- Safa, M. Sabet, A. MacGillivray, S. Davidson, M. Kaczmarczyk, K. Haas, C. T. Gibson, G. E. Rayside, D. “Classification of Construction Projects,” International Journal of Civil, Environmental, Structural, Construction and Architectural Engineering Vol:9, No:6, 2015.
		- Nasir, H., Eisa, H., Haas, C., and Goodrum, P., “An analysis of construction productivity differences between Canada and the United States,” Construction Management and Economics, 32 (6), pp. 595-607, 2014.
		- Nasir, H., Haas, C., Forgues, D., Fayek, A., Ruwanpura, J., and Rankin, J., “Development and implementation of a benchmarking and metrics program for construction performance and productivity improvement,” Canadian Journal of Civil Engineering 39 (9), pp. 957-967, 2012.
		- Hwang, B., Thomas, S., Haas, C., and Caldas, C., “Measuring the Impacts of Rework on Construction Cost Performance,” ASCE Journal of Construction Engineering and Management, Vol. 135, No. 3, pp. 187-198, 2009.
		- Rankin, J., Fayek, A., Meade, G., Haas, C., and Manseau, A., “Initial Metrics and Pilot Program Results for Measuring the Performance of the Canadian Construction Industry,” Canadian Journal of Civil Engineering, vol. 35, no. 9, Sept., 2008.
		- Goodrum, P., and Haas, C., “The Long Term Impact of Equipment Technology on Labor Productivity in the U.S. Construction Industry at the Activity Level,” ASCE Journal of Construction Engineering and Management, vol. 130, no. 1, Jan/Feb 2004, pp. 124-133.
		- Goodrum, P., and Haas, C., “Partial Factor Productivity and Equipment Technology Change at the Activity Level in the U.S. Construction Industry,” ASCE Journal of Construction Engineering and Management, Vol. 128, no.6, pp 463-472, Nov/Dec, 2002.
		- Goodrum, P., Haas, C., and Glover, R. "The Divergence in Aggregate and Activity Estimates of US Construction Productivity." Journal of Construction Management and Economics. Taylor and Francis. 20(5). pp. 415-423, 2002.
		- Allmon, E., Haas, C., Borcherding, J., and Goodrum, P., “U.S. Construction Labor Productivity Trends from 1970 - 1998,” ASCE Journal of Construction Engineering and Management, Vol. 126, No. 2, pp. 97-104, Mar./Apr. 2000.
	+ **Diagnostics**
		- Shahtaheri, M., Nasir, H., and Haas, C., “Setting Base-line Rates for On-site Work Categories in the Construction Industry,” Journal of Construction Engineering and Management 141 (5), 04014097, 2014.
		- Gouett, M., Haas, C., Caldas, C., and Goodrum, C., “Activity Analysis in Industrial Construction,” ASCE Journal of Construction Engineering and Management, 137(12), pp. 1117-1124, 2012.
* **Construction crafts training**
	+ Health and safety
		- Zhang, L., Ryu, J., Diraneyya, M., Haas, C., and Abdel-Rahman, E., “Jerk as an indicator of physical exertion and fatigue,” Automation in Construction, 104, 120-128, 2019.
		- Seo, Alwasel, Lee, Abdel-Rahman, and Haas, “A Comparative Study of In-field Motion Capture Approaches for Body Kinematics Measurement in Construction" accepted for Robotica Journal special issue in October 2017.
		- Alwasel, Sabet, Nahangi, Abdel-Rahman, and Haas, “Identifying Poses of Safe and Productive Masons Using Machine Learning," accepted by Automation in Construction in August 2017.
		- Alwasel, Abdel-Rahman, Haas, and Lee, “Experience, Productivity, And Musculoskeletal Injury Among Masonry Workers" Journal of Construction Engineering Management, 2017.
		- Alwasel, A., Yung, M., Abdel-Rahman, E., Wells, R., and Haas, C., “Fatigue Detection Using Phase-Space Warping,” ASME Journal of Biomechanical Engineering, 139(3), 2592750, 2017.
	+ Return on investment in training
		- Wang, Goodrum, Haas, Glover, and Vaziri, “Analysis of the benefits and costs of construction craft training in the United States based on expert perceptions and industry data,” Construction Management and Economics 28 (12), pp. 1269-1285, 2011.
		- Srour, I., Haas, C., and Morton, D., “Optimizing Investment in Construction Skills,” ASCE Journal of Construction Engineering and Management, Vol. 132, No. 11, November 2006, pp. 1158-1166.
		- Srour, I., Haas, C., and Borcherding, J., “What Does the Construction Industry Value in its Workers?” ASCE Journal of Construction Engineering and Management, Vol. 132, No. 10, October, 2006, pp. 1053-1058.
	+ Organization of training systems
		- Wang, Y., Goodrum, P., Haas, C., and Glover, R., “Analysis of observed skill affinity patterns and motivation for multiskilling among craft workers in the US industrial construction sector,” ASCE Journal of Construction Engineering and Management, Vol. 135, no. 10, pp. 999-1008, October, 2009.
		- Wang, Y., Goodrum, P., Haas, C., and Glover, R., “Craft Training Issues in American Industrial and Commercial Construction,” Journal of Construction Engineering and Management 134 (10), pp. 795-803, 2008.
		- Brandenburg, S., Haas, C., and Byrom, K., “Strategic Management of Human Resources in Construction,” ASCE Journal of Construction Engineering and Management, Vol. 22, Issue 2, April 2006, pp. 89-96.
		- Castenada, J., Tucker, R.L., and Haas, C., “Workers’ Skills and Receptiveness to Operate Under the Tier II Construction Management Strategy,” ASCE Journal of Construction Engineering and Management. Vol. 131, no. 7, July 2005, pp. 799-807.
		- Carley, L., Goodrum, P., Haas, C., and Borcherding, J., “Experiences with multiskilling among non-union craft workers in U.S. industrial construction projects,” Engineering, Construction, and Architectural Management, Loughborough Univ., U.K., vol. 10, no. 6, Dec., 2003, pp. 374-381.
		- Gomar, J., Haas, C., and Morton, D., “Assignment and Allocation Optimization of a Partially Multiskilled Workforce,” ASCE Journal of Construction Engineering and Management, Vol. 128, No. 2, pp. 103-109, March/April 2002.
		- Haas, C.T., Rodriguez, A.M., Glover, R., and Goodrum, P., “Implementing a Multiskilled Workforce,” Journal of Construction Management and Economics, 19(6), pp. 633-641, Aug. 2001.
		- Burleson, R., Haas, C., and Tucker, R., “Multiskilled Labor Utilization Strategies in Construction,” ASCE Journal of Construction Engineering and Management, Vol. 124, No. 6, pp. 480-489, Nov./Dec. 1998.
* **Engineering research and practice issues**
	+ - Liu,J., Shahi, A., Haas,C., Goodrum,P., and Caldas, C., “Validation Methodologies for Construction Engineering and Management Research,” published online by the ASCE Journal of Construction Engineering and Management, August, 2014.
		- Shahi, A., Haas, C., West, J., and Akinci, B.,”Workflow-Based Construction Research Data Management and Dissemination.” J. Comput. Civ. Eng., 28(2), 244–252, 2014.
		- Haas, C., Waugh, L., and Froese, T., “History and Renaissance of Construction Engineering and Management in Canada,” Journal of Construction Engineering and Management 133 (9), pp. 678-683, 2007.