Utah Engineers Council

JOURNAL

2020

PIONEERS OF PROGRESS

Utah Engineers Council
JOURNAL

UTAH ENGINEERS COUNCIL
4049 South Highland Dr
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801-676-9722
www.utahengineerscouncil.org

Our mission statement:

The UEC advances the art and science of engineering for the general welfare of the people of Utah by promoting cooperation among and beyond our 18 member societies.

This journal is an annual publication of the Utah Engineers Council. The Utah Engineers Council Journal is produced for and by the engineering community in Utah. Copies are provided to each of the 18 societies that make up the UEC, other Utah engineers, high school students and counselors, members of the Utah Legislature, and interested corporate entities. The UEC invites your interest, participation and feedback in this endeavor. Contributions and advertisements for future issues are welcome. Statements or opinions expressed by contributors are not necessarily those of the UEC, its member societies, or the publisher. Likewise, advertisements in the journal are not to be considered an endorsement of the product or service advertised. Any editorial published in the Utah Engineers Council Journal should not to be taken as legal advice; specifically, it is not to any editorial coming from a law firm. The authors, the UEC and the publisher encourage all readers to seek appropriate legal counsel about the application of the law as it pertains to their individual activities and circumstances.

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Gary Richard Herbert

Governor

Declaration

Whereas, engineers apply their skills and knowledge to further society's technological process, strength, health, and prosperity in creative and innovative ways;

Whereas, engineers work to solve major industrial challenges, improving our quality of life and revolutionizing the way we learn, work and communicate;

Whereas, engineers encourage students in STEM fields to realize the practical power of their skill and knowledge to meet present and future challenges; and,

Whereas, we recognize the importance of engineers to our state's continued growth and prosperity, and express our appreciation for their efforts to engage our youth in the exciting, ever-expanding fields of science, technology, engineering, and math;

Now, Therefore, I, Gary R. Herbert, governor of the great State of Utah, do hereby declare February 16-22, 2020, as

Engineers Week in Utah

Gary R. Herbert

Gary R. Herbert
Governor

Chairman's Message

Jacob Browning — ASHRAE

As I finish up my year as the UEC chairman, I am reflecting on the past three years, and I am even more convinced of the importance of what we do as engineers. Engineers are active, not passive. They are creative, innovative and knowledgeable, and they have an enormous impact on the world.

As our world changes, many of the positive changes have been brought about by engineers who see a way to improve the lives of other people. The majority of today's services and products started because of an engineering problem that needed to be solved. The solutions that engineers create are the basis for improved quality of life throughout the world.

Engineers must balance competing needs. They are curious and capable, but they have to be critical as well, and they need to understand where their solutions can go wrong in an ever-changing technological world. They are our best hope of solving the technical problems that will determine our future.

Do you enjoy creating, building, designing and tinkering? Engineering includes so many disciplines that it offers worthwhile work in many different industries. No matter what interests you have, there's bound to be one problem or subject that catches your attention because of the potential you see in it.

Engineering school graduates have a remarkably large choice of career directions to explore. For example, aerospace engineers create and test aircraft and aerospace products. Civil engineers may find themselves repairing and expanding U.S. infrastructure by building bridges. Computer software engineers may combine a love for movies and games with a career that allows them to create special effects and interactive media. Electrical engineers may be asked to improve refugee camps by developing electrical sockets. Engineers can find jobs in almost every industry imaginable.

Engineers put their skills to work in diverse and exciting ways, but they are all working toward the same common goal: building a sustainable world. Everyone dreams of leaving the world a better place. Engineers accomplish that goal by using their imaginations to dream and then pulling their dreams into the real world. That may look like magic. It isn't. But it does require the mastery and application of many different technical skills.

Thank you to all of those that have given freely of their time and energy this year. I appreciate you.

UEC MEMBER SOCIETIES

AAEES
American Academy of Environmental Engineers and Scientists

ACEC Utah
American Council of Engineering Companies of Utah

AIAA
American Institute of Aeronautics and Astronautics

ASCE Utah Section
Utah Section of the American Society of Civil Engineers

ASHRAE
American Society of Heating, Refrigerating and Air-Conditioning Engineers

ASM
American Society of Metals

ASPE
American Society of Plumbing Engineers

GSL-EWB
Great Salt Engineers Without Borders

IEEE
Institute of Electrical and Electronics Engineers

INCOSE
International Council on Systems Engineering

ITE
Institute Of Transportation Engineers Utah Chapter

SAME
Society of American Military Engineers

SAMPE
Society for the Advancement of Material Process Engineering

SEAU
Structural Engineer's Association of Utah

SWE
Society of Women Engineers

UCEA
Utah City Engineers Association

UCLS
Utah Council of Land Surveyors

USPE
Utah Society of Professional Engineers

UEC SPONSORS

Northrop Grumman

BAE Systems

Midgley-Huber, Inc.

Nate Walkingshaw

Gerald H. Piele Family

Charlie and Nita Vono

Van Boerum & Frank Associates

AIAA

ASPE

INCOSE

APS

Greenheck Fan Corporation

FLSmidth

Gritton Associates

Long Building

Wheeler Machinery

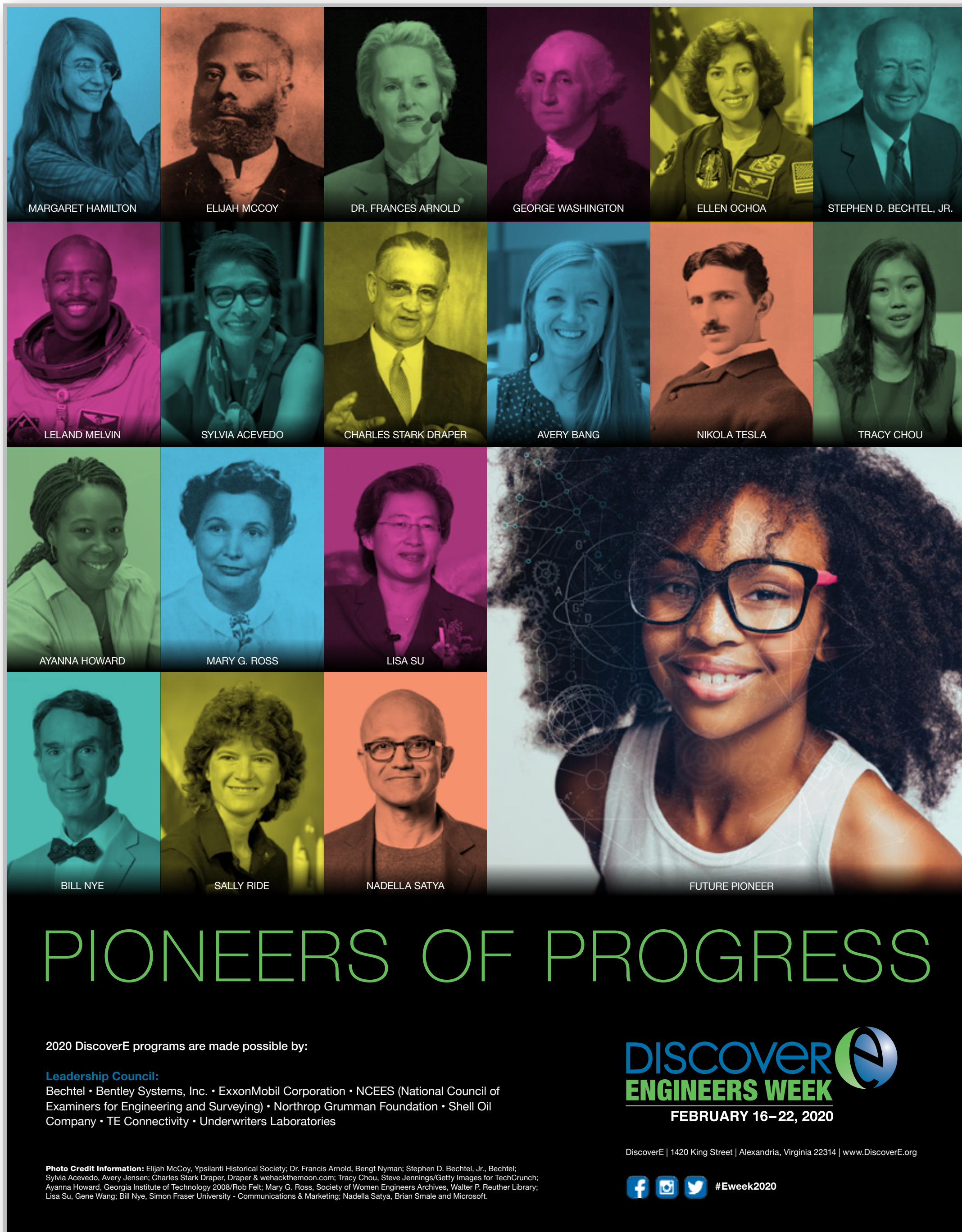
Monsen Engineering

The newsLINK Group, LLC

THE THEME OF EWEEK 2020

"ENGINEERS: PIONEERS OF PROGRESS"

INCLUDES ...



"Engineers — like all pioneers — use their knowledge, creativity, and sense of adventure to cross frontiers. Engineers have led us into space and deep below the ocean's surface. They have connected millions of people through advances in communications and transportation."

FEATURED SPEAKER OF THE ENGINEERS WEEK 2020 BANQUET

BLAINE D. LEONARD, P.E., F.ASCE

TRANSPORTATION TECHNOLOGY ENGINEER, UTAH DOT

Blaine Leonard is employed by the Utah Department of Transportation (UDOT) in Salt Lake City, where he is the transportation technology engineer and leads the IntelliMoveUtah program. In this role, he is responsible for traffic management technologies, and leads the planning and deployment of connected and automated vehicles. He has chaired the American Association of State Highway and Transportation Officials (AASHTO) Connected and Automated Vehicles Working Group, is currently co-chair of the AASHTO Technology Subcommittee, and leads the SPaT Challenge Tactical Working Group, an effort encouraging transportation agencies around the country to deploy connected vehicle technology. Prior to joining UDOT in 2001, Blaine spent 20 years in the consulting engineering business. He was a partner at Van Boerum & Frank, owner of Strata Consultants prior to that, and a geotechnical engineer at R&M Consultants.

Mr. Leonard served as the president of the American Society of Civil Engineers in 2010. He has received the AASHTO Alfred E. Johnson Achievement Award, the American Society of Civil Engineers William Wisely American Civil Engineer Award, and has been named the 2009 Utah Engineer of the Year. He chaired the Utah Engineers Council in 1992 and was the founding editor of the Utah Engineers Council Journal. He is a licensed engineer in six western states and is the vice chair of the Utah Professional Engineers and Professional Land Surveyors Licensing Board.

Congratulations UEC 2020 Award Winners!

Jed Lyman with Award Winner David L. Pierson

ENGINEER OF THE YEAR

David L. Pierson, P.E., S.E.

SEAU

- Principal and vice president of ARW Engineers in Ogden, Utah
  - Structural Engineers Association of Utah (SEAU)
  - Legislative committee chair, 2013-Present
  - Past president, 2012-2013
  - President, 2011-2012
  - Vice president, 2010-2011
  - Golf tournament chair, 2001-2008
  - Board of directors, 1999-2001
  - Technical committee chair, 1997-1999
- Adjunct professor at Utah State University
- Community service
  - Treehouse Children's Museum, Board of Trustees
  - Cub Scouts and Boy Scouts of America
  - Youth Coach
  - Ecclesiastical leader
  - USU College of Engineering, senior design project mentor

Jed Lyman with Award Winner Dr. Nick Safai

ENGINEER EDUCATOR OF THE YEAR

Dr. Nick Safai, Ph.D., MSE, MSR,

ASCE

- Fellow (Educator of America): American Society for Engineering Education Fellow, inducted to hall of fame of ASEE in June 2018 in a ceremony at the 2018 ASEE Annual Conference.
- Recognition awarded by the American Society of Civil Engineers for the most activity and service events, May 2018.
- B.S., Michigan State
- Four M.S., Princeton
- Ph.D., Princeton

Jed Lyman with Award WInner John P. McCrea

FRESH FACE OF ENGINEERING

John P. McCrea, ASEP

INCOSE

- Lead engineer, Flight Destruct System on the Minuteman III Flight Test, Telemetry, and Termination (FT3) system
- Coordinated the 2019 FanX STEM Booth as a hands-on activity center and engaged over 5000 people, kids and adults alike, to learn about STEM in the valley.
- INCOSE director-at-large, social media
- AIAA communications officer, social media
- INCOSE Digital Engineering Information Exchange Working Group (DEIX-WG) member
- Participated in the Hill AFB Mission to Mars event at Weber State University.

Lareen Radle receives the MESA Teacher of the Year Award

MESA TEACHER OF THE YEAR

Lareen Radle

- Master's degree project, "Girls in Science Where are They?"
- Teacher at Weber High for 30 years in Science and Health Sciences department
- First female science teacher hired at Weber High
- MESA Advisor for 24 years
- Teams have placed first in state and national competitions.
- Former students are current colleagues in Weber High's Science Departments.

Jed Lyman, Roberta Schlicher, and Jacob Browning

DISTINGUISHED SERVICE AWARD

Roberta P. Schlicher

- Director and executive vice president, Matrix Environmental Services
- A registered Professional Engineer with 38 years experience in public and private sectors for environmental engineering and public works.
- Serves on the Utah Engineers Council as 1st past chair representing the Society of American Military Engineers.
- Serves on the Board of Trustees for the Ririe-Woodbury Dance Co.
- Serves on the Board of GWJ Charitable Foundation Inc., a nonprofit focused on helping disadvantaged young people pursuing technical college careers.

Congratulations UEC 2020 Award Nominees!

Jed Lyman with Wade W. Bennion

ENGINEER OF THE YEAR NOMINEE

Wade W. Bennion, P.E.

ASHRAE

- Wade Bennion has been providing engineering services for more than 43 years. Wade is VBFA's chairman of the board and has been with the firm in various leadership roles since 2006.
- Licensed professional engineer
  - Utah
  - Arizona
  - Washington
- Professional Affiliations
  - Member, American Council of Engineering Companies (ACEC)
  - Member, American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)
  - Firm member, U.S. Green Building Council (USGBC)
- Utah Energy Champion, Innovation 2014. Awarded by the AEE (The Association of Energy Engineers, Utah Chapter) for Davis School District, Odyssey Elementary.

"Wade is a man of impeccable honesty and integrity. He demonstrates professionalism in all of his dealings with clients, with our employees, with our clients and contractors."

Jed Lyman with John C. Metcalf, CSEP

ENGINEER OF THE YEAR NOMINEE

John C. Metcalf, CSEP

INCOSE

- Program manager, systems engineering support subcontract. Program manager on a several-million-dollar subcontract, leading a small team of systems engineers who are evaluating preproduction engineering changes to the MM III Payload Transporter (PTR), a nuclear design certified semi-truck trailer.
- B.S. Physics, Weber State University
- M.S. Physics, University of Utah
- Ph.D. student, Colorado State University
- International Council on Systems Engineering (INCOSE), member, December 2018-Present
- Wasatch chapter, INCOSE ASEP/CSEP NGC study cohort lead, summer 2017 and 2018
- American Institute of Aeronautics and Astronautics (AIAA)
  - Senior member
  - Utah section leadership council
    - ◊ Treasurer, July 2019-Current
    - ◊ Honors and Awards Officer, Aug 2018-Current
    - ◊ Section Chair, June 2016-July 2018

Leslie Morton

Jed Lyman with Mark L. Christensen P.E., M. ASCE

ENGINEER OF THE YEAR NOMINEE

Leslie Morton, P.E., ENV SP

ACEC

- Leslie served as civil engineer of record for the Winter Olympic Games in 2002, and was project manager on over 16 venues.
- In 2009 Leslie received recognition from Utah Business magazine. She was included on their 40 Under 40 list of Utah's rising stars
- She has been involved in over 60 projects at the University of Utah.
- She was one of the first female principals at Psomas, a top 150 Design Firm.
- Engineering team leader for the State of Utah
- Regional manager for Psomas in Utah

ENGINEER OF THE YEAR NOMINEE

Melvin Clay Rumsey

AIAA

- Engineering Lead for Emergency Power systems for the United States Intercontinental Ballistic Missile (ICBM) ground support (Missile silos and command centers), and until very recently, he was the functional manager for a team of electrical engineers
- Mathematics instructor, Eagle Gate College. Subjects include linear equations, exponents and polynomials, rational expressions and functions, roots and radicals, systems of equations, quadratic equations, logarithmic functions, conversions, etc.
- Clay is known as the "rocket man" to students of schools in the Davis and Weber School District due to his engineering talks and rocket outreach projects

ENGINEER OF THE YEAR NOMINEE

Mark L. Christensen, P.E., M. ASCE

ASCE

- Twenty-seven years of engineering experience with public infrastructure
- American Society of Civil Engineers (ASCE)
- Utah City Engineers Association (UCEA)
- American Council of Engineers Companies (ACEC) of Utah, Ethics Committee
- National Council of Examiners for Engineering and Surveying (NCEES), P.E. Civil Exam Committee
- Past chair of Mountainland Association of Governments Technical Advisory Committee

"Mark is a great teacher, but I am more impressed with him as a great learner. He is confident in his abilities, yet humble and quick to admit, and resolve, a rare mistake. He is a patient coach and mentor, having shaped the careers of many young professionals."

Jed Lyman with Melvin Clay Rumsey

Jed Lyman with Scott Stevenson, P.E.

ENGINEER OF THE YEAR NOMINEE

Scott Stevenson, P.E.

ITE

- Transportation engineer, 14 years of experience
- Works in the UDOT Traffic Operations Center

"Scott's knowledge of the history and current operations of every system utilized by UDOT is unparalleled."

"Recently, a small plane crashed on the freeway in Weber County, closing the freeway southbound and causing significant delays in the northbound direction. This happened on a Sunday about 3:30 p.m., and Scott was notified as the de facto on-call signals engineer. He had his computer up mitigating impacts and adjusting traffic signals on detour routes before most of the other TOC staff were even aware of the crash. To this day, most of the TOC and UDOT region staff would be surprised to learn of the work he did and its impact to the traveling public. The effort he put in on his day off to Keep Utah Moving is just one evidence of a pattern typical to Scott: rise to the occasion and provide excellent service whenever possible, regardless of personal gain or accommodation."

Jed Lyman with Lt. Col. Paul J. Waite, P.E., USAF, Ret.

Jed Lyman with Jerome S. Berg, SAMPE

ENGINEER OF THE YEAR NOMINEE

Jerome S. Berg

SAMPE

- Senior manager for the Technology Group at the Aerospace Structures Business Unit (ASBU) of Northrop Grumman. He leads the technical team of R&D, inspection, manufacturing, and design and analysis engineers, which supports the 2100-employee ASBU, producing structures for the F-35, A350, 787, Rolls Royce aircraft engines, various launch vehicles and numerous classified programs.
- Currently serves as the executive vice-president for SAMPE North America, and will be the president next year, representing 5,000 professional members
- Served as the chair for the Society of Manufacturing Engineers, and chaired four major conferences
- Serves as the chair of the Ogden City Trails network, and on the board of the Ogden Nordic Alliance

ENGINEER OF THE YEAR NOMINEE

Lt. Col. Paul J. Waite, P.E., USAF, Ret.

SAME

- Chief of project execution at Hill AFB, he directs engineers to manage a current program of 40+ projects through planning, design and construction valued over $175 million.
- Retired lieutenant colonel USAF
- SAME Great Basin Post
  - June 2019-Present, outreach and communications chair
  - June 2017-June 2019, president
  - January 2016-Jun 2017, vice president
  - November 2008-January 2016, awards and streamer awards chair
- Youth leader, Church of Jesus Christ of Latter-day Saints, 2004-Present

David K. Wetzel

Jed Lyman with Scott Munro, Ph.D.

ENGINEERING EDUCATOR NOMINEE

David K. Wetzel, Ph.D., MBB

INCOSE

- One of the original Six Sigma Master Black Belts
- Recognized in Who's Who among America's Teachers, Engineering Management Professor of the Year, and, the Golden Catapult Award, UTC Engineering Student Body.
- Worked with companies in Japan, Canada, Korea, Kosovo, Ireland, Mexico, China, UAE, Macedonia, and the U.S. He has mentored over 300 project teams.
- B.S., The Ohio State University
- M.S., Rensselaer Polytechnic Institute
- Ph.D., The Ohio State University

ENGINEERING EDUCATOR NOMINEE

Dr. Scot Munro, Ph.D.

AIAA

- Has excellent rapport with students.
- Has extensive experience as a practicing engineer.
- "Flipped" teaching: He exposes basic concepts before class, then brings the students to higher cognitive levels in class through application, analysis, and design.
- Developed a technical project management course
- Advisor to SUU rocket club (RocketBirds).
- B.S., M.S. Purdue; Ph.D., Georgia Tech; Naval Air Warfare

Jed Lyman with Joe Touhuni

ENGINEERING EDUCATOR NOMINEE

Inoke Joe Touhuni

ASHRAE

- Courses taught
  - › Careers in the HVAC Industry
  - › University of Utah Ethics Seminar Class, ME Program (2010-2018)
- Basics of HVAC Systems
  - › University of Utah Student Chapter (2016)
  - › Brigham Young University Construction Facility Management Class (2016-2018)
- B.S. Mechanical Engineering, University of Utah
- Volunteer coach in youth sports for 20 years

Jed Lyman with Jacob Hopkins

FRESH FACE OF ENGINEERING NOMINEE

Jacob Hopkins

AIAA

- B.S. cum laude, Mechanical Engineering, University of Utah
- Structural analysis engineer at Northrop Grumman in Promontory, Utah for 3.5 years
- Northrop Grumman STAR for exceptional support of NASA's Space Launch System (SLS) Aft Skirt
- Northrop Grumman Bright Spot for exceptional support of the structural testing of the Omega 2nd Stage Aft Skirt Extension
- AIAA — Young professionals chair
- During his undergraduate career, he designed and fabricated a pediatric adaptive skiing mechanism for the National Abilities Center in Park City.

"His knowledge and expertise continually impress his peers, and he handles himself like an engineer who has many more years of experience."

Jed Lyman with Layton Barlow Asmus

FRESH FACE OF ENGINEERING NOMINEE

Layton Barlow Asmus

ASCE

- B.S. Civil Engineering, University of Utah
- Responsible for assisting professional engineers in structural design. The designs commonly include steel, timber, concrete, as well as other materials as required. The designs typically follow the requirements of the IBC and ASCE 7. Occasionally the designs fall under other various code requirements such as OSHA or AASHTO and he completes the designs accordingly.
- Rapid Cycling Road Ambassador

"He is willing to put in extra time to meet project deadlines and to expand his knowledge to increase efficiency."

Jed Lyman with Marie VanderVliet

FRESH FACE OF ENGINEERING NOMINEE

Marie VanderVliet

ASHRAE

- B.S. Mechanical Engineering, University of Utah
- Chair, Young Engineers in ASHRAE (YEA)
- Attends the student branch activities to help promote to the younger generation and educate them on their options with YEA as they graduate.
- Volunteer at the STEM FEST for the ASHRAE Booth
- Gymnastics coach

Jed Lyman with Cayla Naylor

FRESH FACE OF ENGINEERING NOMINEE

Cayla Naylor

ITE

- B.S., Brigham Young University
- Works at the signal desk at the UDOT Traffic Operations Center.
- Responds to public calls and emails in a professional and knowledgeable manner.
- Diagnoses signal system issues and resolves them quickly.

"Cayla exercises sound engineering judgement and has easily learned the vast, technical software that is used to manage the traffic signal network."

Jed Lyman with Austin J. Loveless

FRESH FACE OF ENGINEERING NOMINEE

Austin J. Loveless

SAMPE

- B.S., Manufacturing Engineering, Weber State University. Austin Maintained a 4.0 GPA while working full-time for Boeing in production.
- Manufacturing engineer for Boeing
- Serves as the youngest member on the board of the SAMPE Utah chapter.
- Hosts Boeing STEM activities at local schools, and mentors women engineers from Boeing partners in the United Arab Emirates.
- Holds an FAA Private Pilot's License.
- Speaks fluent French.

FRESH FACE OF ENGINEERING NOMINEE

Alex Karras, P.E.

SEAU

- B.S., Civil Engineering, Utah State University
- M.E., Structural Engineering plus Mechanics, Utah State University
- Utah Professional Engineer
- Member of Earthquake Engineering Research Institute (EERI), Utah

"Through dedication to his craft, on-going technical training programs, and mentoring from Calder Richard's senior engineering Principals, Alex has risen to the challenge of working on increasingly challenging projects as demonstrated by his current involvement on the new Hillcrest High School. This 415,000-sf project includes a cantilevered balcony and full-scale performance auditorium. The high school incorporates a steel brace framing system along with masonry construction and was delivered under an incredibly demanding design schedule."

Jed Lyman with Alex Karras, P.E.

Congratulations UEC Scholarship Winners!

Scott Pedler with Joshua Ward

Joshua Ward

Civil Engineering
Utah State University
Nate Walkingshaw Scholarship

- Joshua currently conducts transportation research with Dr. Patrick Singleton and serves as a tutor in the USU Engineering Tutor Center, both of which have been highlights of his college experience.
- He has worked on municipal engineering projects at Ogden City Engineering for two consecutive summers.
- In his free time, Joshua enjoys reading fantasy novels, watching movies with his wife, and learning tools to make really cool spreadsheets.
- Joshua plans to earn a master's degree with an emphasis in water or transportation engineering.

Scott Pedler with Andrew Kjar

Andrew Kjar

Biological Engineering
Utah State University
Nate Walkingshaw Scholarship

- Andrew was born in Kearns, Utah.
- He loves research and is the recipient of over $6000 in funding for his undergraduate research projects.
- His current projects involve developing cytomegalovirus treatments and working with stem cell brain models.
- He considers himself a musician-turned-engineer (he performed with Utah Symphony in high school), and still accompanies the Logan Institute Choir on piano and organ.

Richard Beck (right)

Richard Beck

Electrical Engineering
Utah State University
Northrup Grumman Scholarship

- Richard works as an electrician apprentice for TEC Electric in Logan, Utah, with the goal of obtaining his journeyman electrician license.
- His main interests lie in power systems and construction electrical design.
- A native to Pleasant Grove, he spent much of his childhood raising dairy goats and practicing the violin and piano at the command of his mother
- He enjoys backpacking, fishing, hiking, running, working with livestock, and watching Star Trek. The most exciting thing he ever did was marry his wife, Misty.

Dallin Wiberg (right)

Dallin Wiberg

Mechanical and Aerospace Engineering
Utah State University
BAE Ben Van De Graaf Memorial Scholarship

- Dallin is from Coon Rapids, Minnesota.
- He currently works under Dr. Doug Hunsaker in the USU AeroLab researching optimized wing geometries for constant and linearly swept wings.
- His involvement in the USU chapters of Engineers Without Borders and Design Build Fly (AIAA) have provided him many leadership and design opportunities.
- He is passionate about all things aviation and space and looks forward to taking on the exciting challenges of the aerospace industry.

BAE Systems-Sponsored Memorial Scholarship

This BAE Systems-Sponsored scholarship is awarded in honor of the late Ben Van De Graaff, the son of Wayne and Vickie Van De Graaff. Ben was a BAE Systems intern who was eight weeks away from earning his Mechanical Engineering degree when he passed away Feb. 11, 2018. He overcame great odds in surviving and recovering from neurological injuries suffered in a car accident in 2004. His unconquerable determination, love of sport and learning, passionate nature, deep loyalty, and infinite compassion were a blessing to his family and friends, and to our BAE Systems Team for the short time we knew him.

Dellan Fielding with Dallen Romiell P.E.

Dellan Fielding

Mechanical and Biological Engineering
Utah State University
ASHRAE Scholarship

- Dellan is a member of USU ASHRAE Student Chapter.
- He is an avid guitar player.
- He loves to participate in any sport.

Cara Frischkorn

Cara Frischkorn

Mechanical Engineering
Utah State University
Midgley-Huber, Inc.

- Cara is passionate about space exploration and rocketry and plans to go into propulsion and help design the rockets to take humanity to Mars.
- She currently works for the USU Propulsion Laboratory researching 3D printed hybrid thruster technology and will intern this summer with Northrop Grumman.
- In her spare time, she loves rock climbing, skiing, biking, and hiking.

Brandon Stolworthy

Brandon Stolworthy

Mechanical Engineering
Utah State University
ASHRAE Scholarship

- Brandon is also pursuing a minor in Electrical Engineering.
- In his spare time, he enjoys pulling the motor out of its original vehicle and putting in one that doesn't belong.
- He has experience in suction dredge gold mining.
- He recently spent 13 months with USU's HVAC facilities department.

Jed Lyman with Elizabeth Chamberlain

Elizabeth Chamberlain

Mechanical Engineering
Utah State University
Van Boerum & Frank Associates, Inc. Scholarship

- Elizabeth is interning at Northrop Grumman and working as an undergraduate researcher at the USU Mechanics at Extreme Temperatures Lab.
- Currently, she is the vice president of the College of Engineering Ambassadors and the USU chapter of Engineering Council.
- She has a passion for promoting STEM to K-12 students and volunteers at robotics competitions, STEM nights, and industry outreach events to encourage the next generation of engineers.

Kyler Reinhold

Kyler Reinhold

Mechanical Engineering
Southern Utah University
Wheeler Machinery Company and
Monsen Engineering Scholarship

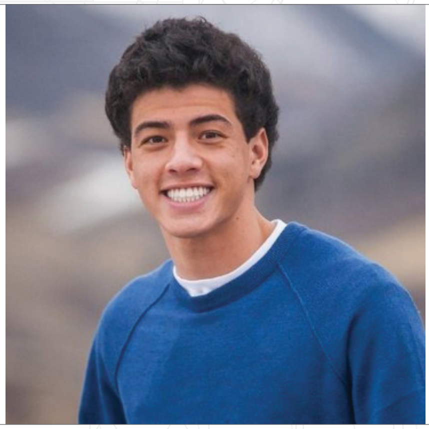
- Kyler is an airframe team lead of the SUU Rocketbirds, which placed 7th out of 107 teams at IREC (Intercollegiate Rocket Engineering Competition).

Daniel Cox with Andy C. George

Daniel Cox

Mechanical Engineering
Brigham Young University
SAMPE Scholarship

- Daniel is currently employed in the plastics and composites lab at BYU, and is also working as an early morning custodian on campus.
- He is invested in advancing materials and leading the future in aerospace vehicles.



Jacob Buhler

Rebekah Yamashita (right)

Jacob Buhler

Chemical Engineering
Brigham Young University
Nate Walkingshaw Scholarship

- Crocker Innovation Fellow, BYU
- Incoming Global Operations Intern, Nike
- Venture Partner, Contrary
- Co-president, BYU Engineers in Business Club
- Vice president, Social Venture Academy, the Ballard Center for Economic Self-Reliance
- Executive director of Scenic View Academy at Y-Serve, BYU

Rebekah Yamashita

Mechanical Engineering
Southern Utah University
Northrup Grumman Scholarship

- Rebekah is incredibly motivated to succeed and works hard as she continues her education.
- She enjoys capturing moments of her life through photography.

Tyler Bodily

Sabrina Kim

Tyler Bodily

Chemical Engineering
University of Utah
Nate Walkingshaw Scholarship

- Chemical Engineering, University of Utah
- From Holladay, Utah
- His interests include rock climbing, mountain biking, basketball, the Korean language and good food, including Korean.

Sabrina Kim

Mechanical Engineering
Southern Utah University
BAE Scholarship

- From Herriman, Utah
- Has enjoyed building lasting relationships with professors and peers.
- Engineering has allowed Sabrina to have a newfound passion for innovative thinking, and she is excited for the opportunities to further her career.

Jeniffer Limondo and David Piele

Jeniffer Limondo

Electrical Engineering
Weber State University
Piele Memorial Scholarship

- From the Philippines
- Jeniffer's grandpa in the Philippines started her interest in engineering. When she was very young, he taught her how mechanics work and to take things apart and put them back together. She told her grandpa that she wanted to be an engineer when she grew up, but she didn't know what type of engineer.
- When she moved here to the United States, she and her dad would spend the evenings doing math together. He tutored her through subjects such as algebra, calculus and statistics. Jeniffer said, "Who does not like math? Math is so fun and I really enjoy solving problems."

Abram Bowen

Manufacturing Systems Engineering
Weber State University
AIAA / INCOSE Scholarship

- The Manufacturing Systems Engineering Degree at Weber State University is a new degree. Abram will be one of the first to graduate with it.
- As an officer for the Society of Manufacturing Engineers (SME) club, for the past two years, he has enjoyed providing barbeques, annual chili cook-offs, and other activities for the students.
- He was accepted into the Tau Alpha Pi Honor Society for excellence in academic achievements.
- Abram grew up on a little hobby farm raising cows, horses, goats, sheep, chickens, pigs, and even honey bees. He enjoys working hard and being productive. At an internship at Futura Industries last summer, he learned that often you will not be an expert at an assigned task. But with help from others, research, and determination, you can solve anything!

Piele Memorial Scholarship

Henry Petruski said that "science is about knowing; engineering is about doing," and when it comes to Gerald Piele, no words were more true. Jerry, like most engineers, was a big thinker. He was an expert on many subjects but was most interested in using his knowledge to do good work that would benefit others.

Jerry was well respected in the communications and defense industries for his mathematical and engineering ability. His extraordinary mathematical intuition enabled him to grasp and solve exceptionally difficult problems with elegance and finesse. He made many noteworthy contributions in the area of microwave communications that resulted in numerous design awards and three patents. As part of his life work with microwave communications and antenna design, he also worked with satellite communication systems. He found practical solutions for the use of frequencies that were beyond normal use and were considered novel at the time. Other applications, such as pioneering methods to provide secure control of, and communications with, remotely piloted vehicles were developed. These methods are still in use in Department of Defense black boxes, as well as cell and landline telephone devices. His attention to detail proved that even the smallest detail mattered.

Gerald Piele passed away Sept. 26, 2018 at the age of 91.

The Gerald H. Piele scholarship at Weber State University, announced annually by the Utah Engineers Council, encourages others to join the profession.

Abram Bowen

Sarah Roberts (right)

Jayden Smith (right)

Sarah Roberts

Mechanical Engineering
University of Utah
Northrup Grumman Scholarship

- Sarah is currently an Intern at CCI Mechanical, Inc.
- While she enjoys CCI, she hopes to one day work as an aerospace engineer.

Jayden Smith

Electrical Engineering
Weber State University
Northrup Grumman Scholarship

- From Ogden, Utah
- He graduated as valedictorian of Bonneville High School in 2015.
- He has four older brothers and one younger sister.
- He loves to run and play any and every sport he possibly can. His two favorites are basketball and the rapidly growing sport of spikeball. He is a huge fan of the Utah Jazz.
- Jayden is fluent in Czech and Slovak.

Justin Tanner with Colonel Charlie Vono

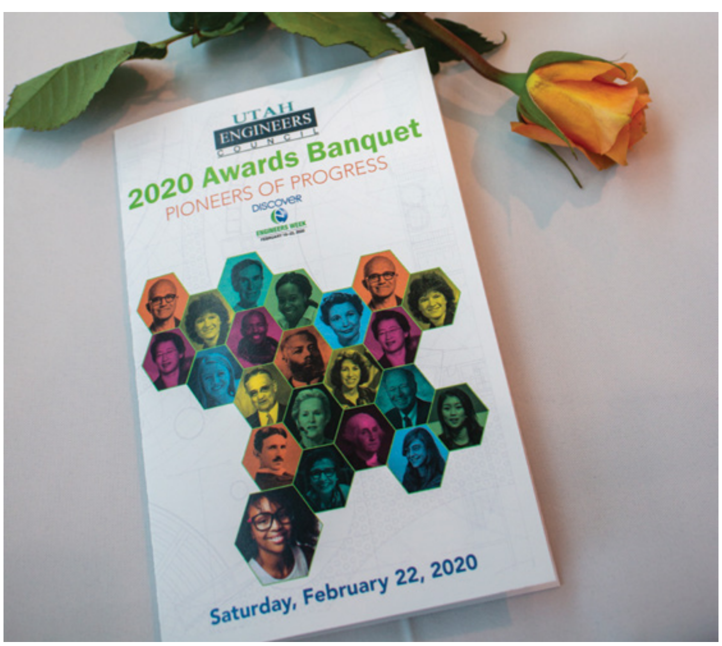
Justin Tanner

Electrical Engineering
Weber State University
Colonel Charlie and Nita Vono Scholarship

- Justin has been awarded the high honors award each semester he has attended at Weber State.
- His interest in solving complex problems as well as helping those around him led him to electrical engineering.
- Justin is interested in the medical field hoping to design devices that help save people's lives and improve their quality of life.
- Outside of school, Justin enjoys 3D printing, reading, and volunteering at animal shelters.

Colonel Charlie and Nita Vono

UEC Celebrates Engineers Week



PIONEERS OF PROGRESS

The Utah Engineers Council (UEC) celebrated Engineers Week with its annual awards banquet. The banquet was held on Saturday evening, Feb. 22, 2020, at FLSmidth in Midvale. Jacob Browning, UEC Chair, served as master of ceremonies, with 194 people — professionals and students — in attendance.

The first hour of the evening began with some light networking. Ample snacks and drinks were available, and attendees were welcomed with the live music of Take Three, a smooth jazz quartet featuring saxophone, keyboards, bass and percussion. A buffet-style dinner with coffee and desserts followed.

The formal program included:

- The Utah Governor's Proclamation of Engineering Week was read by Val Hale from the Office of Economic Development.
- UEC scholarship awards for $1,500 each were presented to 19 junior engineering undergraduates studying in accredited programs from Brigham Young University, Southern Utah University, the University of Utah, Utah State University, and Weber State University.
- The annual awards were made for Engineer of the Year; Engineering Educator of the Year; Fresh Face of Engineering; and Mathematics, Engineering, and Science Achievement (MESA).

Blaine Leonard, Transportation Technology Engineer from the Utah Department of Transportation (UDOT),

with 2020 Awards Banquet

delivered a dynamic keynote address entitled, "When Cars Start Talking to Each Other, What Will They Say?" He outlined six trends that are increasing the need for automated transportation; namely, he discussed demographic shifts, increasing availability of data, mobility as a service, advances in vehicle propulsion, network connections between vehicles, and automation through computers. He proposed that driverless cars will fundamentally impact transportation across our great state by increasing safety and reducing road fatalities.

Blaine enumerated several efforts by UDOT to advance driverless cars. First, he mentioned how UDOT is promoting federal and state legislation, such as groundbreaking laws that allow autonomous driving in Utah. Second, he discussed automated shuttle piloting initiatives that have been successful in Salt Lake City, Sandy, Farmington, and the Canyons Resort. Third, he outlined studies to improve communication technology between Utah Transit Authority (UTA) buses and traffic signals. He showed how these efforts are paving the way toward bringing automated vehicles to Utah.

Blaine began a career that has led to his expertise in automated vehicles by obtaining a Bachelor of Science (B.S.) and Master of Science (M.S.), both in Civil Engineering, from the University of Utah. He worked for several consulting firms, including one he started, for 20 years. He moved to UDOT in 2001 and has worked on a wide variety of projects that include land development, office buildings, prisons, landslides, earth dams, pipelines, roads and a cemetery. At the state, he is involved with research and technology about intelligent transportation systems.

"My current role allows me to look to the future and envision, plan and deploy transportation technologies that will transform how we move. As I do that, I stand on the shoulders of those who have brought us to this point," said Blaine. "Our legislature, state agencies, our universities, and local tech companies are all engaged. It is daunting, it is confusing, it is promising, it is disruptive, and it is exciting. It is a global movement, and it is poised to transform our lives."

Blaine expressed great admiration for the UEC and its contributions to engineering in our state. "The unique opportunity that the UEC provides is to gather a cross section of engineers from multiple disciplines to celebrate achievement and inspire young students. It was great to see so many forward-looking engineers of the next generation, and to have UEC-supporters provide scholarships to help them meet their goals," observed Blaine.

The UEC extends its gratitude to Blaine Leonard, our keynote speaker, and to our committee members whose hard work — and dedication to the industry — helped make our 2020 Awards Banquet a success. For their extraordinary efforts, the UEC recognizes Jacob Browning, Paul White, Scott Pedler, Roberta Schlicher, Jed Lyman, Chris Perry, Carla Humes, JuliAne Burton, Cambria Flowers and Molly Stephens.

Finally, the UEC extends a special thanks to our scholarship and banquet sponsors, namely: Nate Walkingshaw, Northrop Grumman, BAE Systems, FLSmidth, The newsLINK Group, VBFA, Charles Vono, Wheeler Machinery and Monsen Engineering, Midgley Huber, AIAA/INCOSE, Greenheck, Gritton Associates, APS, ASPE, and Long Building.

UEC Celebrates Engineers Week

with 2020 Awards Banquet Photos

IBC 2018/ASCE 7-16 Seismic Code Changes

Byron Foster

On July 1, 2019, Utah adopted the 2018 IBC (based on ASCE 7-16), which brought with it several very significant changes to local seismic practice. These changes, which are summarized below, are impacting geotechnical and structural engineers and their clients. They were discussed in greater detail by several presenters at a continuing education workshop on June 10, 2019, at SLCC.

When you become familiar with these changes, you need to make sure that you are looking at the final version of ASCE 7-16 and also the December 2018 supplement.

The primary changes include:

- A penalty for not having detailed site investigations
- Changes to the site factor (Fa and Fv) tables
- Near-fault site definitions
- A vertical ground motion approach (where site-specific procedures are not used)
- Site-specific seismic assessments for Site Class D or E when $S_1 > 0.2$ and for Site Class E when $S_S > 1.0$ unless exceptions are taken. There is a significant impact for longer period structures.

From discussions with local engineers who have started to use the new code, it appears the largest changes may be:

- Penalties for assuming a Site Class D, or not having measured site properties to define the Site Class, should drive projects to obtain good measured properties routinely.
- From structural engineers who have locally compared ASCE 7-10 and the old seismic maps to ASCE 7-16 and the new seismic maps, the ground motions seemed to have increased significantly.
- However, since the intent of the code change was to address the unconservative estimates of ground motions for longer periods (taller buildings), it is not clear yet what the impact of the exceptions will be on building design/cost.
- Cost increases from the new ground motions used for design could be as high as about 5% of the building costs.
- The most significant change will probably be that for almost all of the populated areas of Utah (which are typically Site Class D or E with $S_1 > 0.2g$), the owner will have to have either a site-specific seismic assessment conducted, or the structural engineer will have to use one of the three "exceptions" (potentially penalizing building costs).

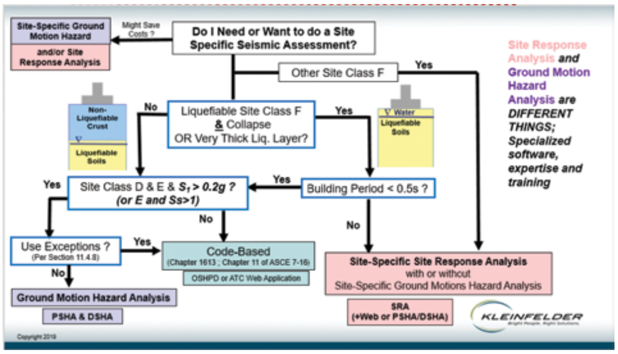
There has been some confusion in Utah regarding what constitutes a "site-specific seismic assessment." For example, the spectral acceleration values obtained from the USGS website do NOT constitute a site-specific assessment. Similarly, a Deterministic Seismic Hazard Analysis (DSHA), by itself, is not a site-specific assessment. A DSHA is only a check on the Probabilistic Seismic Hazard Analysis (PSHA).

There are two types of site-specific assessments defined under the Code:

- A Ground Motion Hazard Analysis, which is composed of both a PSHA and a DSHA for a check, and
- A Site Response Analysis (SRA)

Site Response Analysis and Ground Motion Hazard Analysis are two very different analyses, and each requires

specialized software, expertise and training. ASCE 7-16 attempts to point us to the correct method (see the figure below). Although the code allows an SRA for any site, its



The June 10th Continuing education seminar was sponsored jointly by local chapters of ASCE, DFCM, EERI, GI, SEAU, SEI and the UGS.

applicability should be assessed on a project-by-project basis by considering the pros and cons of both methods. For competent soil conditions, a Ground Motion Hazard Analysis tends to be more appropriate than an SRA. The bottom line is that a specialist in this type of work needs to determine which method is applicable.

In deciding which method is needed and who should do the work, you should consider the following factors:

- What is required by IBC 2018 and ASCE 7-16?
- What is the importance of the structure? Hospitals, police stations, and other important public buildings should receive particular attention.
- Is the building period > site period?
- Do you have measured values for the shear wave velocities in the soil?
- Is the rock depth several thousand feet deep, but you only have information on what the soils are in the upper 100 feet or so?
- Does the firm conducting the work have experience passing rigorous peer review by seismic experts for the method that will be conducted?

While IBC 2018/ASCE 7-16 provides detailed design approaches, we are still learning from designing and pricing alternatives so that we can know when it will make sense for the structural engineer to use an exception versus using the results of a site-specific seismic assessment. In the meantime, given the potential for significate schedule delays and added costs from the exceptions, we must all continue to inform our clients about the need for these new studies.

Byron Foster is a geotechnical engineer at Kleinfelder and a Ph.D. candidate in Civil Engineering (geotechnical and structural emphasis) at the University of Utah.

Wildfires and Civil Engineering

Ben Willardson, PE, Ph.D. — CWE and Mike Rau — CUWCD

Fire plays an important role in most wildland ecosystems. Vegetation often depends on fire to create a period of rebirth by removing dead materials and releasing nutrients back into the environment (Ainsworth and Doss, 1995). Across the United States, wildfires burn more than 4 million acres annually, costing Federal agencies above $768 million a year (1994-2002) in suppression alone (Butry et al., 2008). Some of the most well-known fires have burned large sections of famous national parks such as Yellowstone and Yosemite.

Utah was impacted by several fires in 2018, including the Dollar Ridge, Bear Trap, Coal Hollow, Pole Creek, Notch, and Willow Creek Fires. Estimates of the burned watershed areas are over 200,000 acres, or over 300 square miles of forest lands. These fires have impacted many watersheds that provide water supplies for cities and towns throughout Utah. These fires set the stage for impacts to highways, drinking water systems, and dwellings. The impacts to the Duchesne Valley Water Treatment Plant operated by the Central Utah Water Conservancy District is provided as an example of the impacts faced by civil engineers after a fire. See Figure 1.

Figure 1 - Dollar Ridge Fire

Between the 1930s and 1970s, firefighting tactics and equipment became increasingly more sophisticated, effective fire suppression efforts increased dramatically, and the annual acreage consumed by wildfires in the lower 48 states dropped from 40 to 50 million acres a year (Laverty, 2001). Across the Western United States, the aggressive fire-suppression policies appeared to be successful. However, these policies have set the stage for the intense fires experienced over the last few decades.

Many fires are caused by lightning. Others are human-made.

Full fire suppression allowed forests and wildlands to grow without the effects of fire, disrupting ecological cycles and changing the structure and makeup of the forests (Laverty, 2001; Pierson, Jr. et al., 2003). Other vegetation that had been regularly eliminated from forests by periodic, low-intensity fires, became a dominant part of the forest. This vegetation became susceptible to insects and disease, which left dead trees, mixed brush, and downed material to fill the forest floor. The accumulation of materials, when dried by extended periods of drought, creates the fuels that allow extremely large fires to burn across large areas of forest and wildland (Laverty, 2001).

Changes to Vegetation and Soils During Fires

Fire in forested areas is an important natural disturbance mechanism that plays a role of variable significance depending on climate, fire frequency, and geomorphic conditions. The role of fire is particularly important in regions where frequent fires, steep terrain, vegetation, and post-fire seasonal precipitation interact to produce dramatic impacts (USDA, 2005). The amount of vegetation consumed by a fire depends on the fire regime and fire severity (USDA, 2005). The USDA (2005) provides an in-depth discussion of fire regimes and severities. Low-severity fires rarely produce adverse effects on watershed hydrologic conditions, while high-severity fires generally result in higher runoff and erosion.

Wildfires can leave large areas devoid of vegetation and vulnerable to producing large volumes of runoff, leading to flash floods, floods, or mudslides (NOAA, 2004). The high rate of runoff following brush fires may result from the combined effects of denudation and formation of a water-repellent soil layer beneath the ground surface (Nasseri, 1988). The type of vegetative cover on soil changes the infiltration rates. The change is due to the effects of vegetation on slowing surface runoff velocities. Loss of surface litter, vegetative basal cover, and the associated microtopographic relief also reduce surface storage of water crucial for reducing runoff and increasing infiltration (Pierson, Jr. et al., 2003). The removal of vegetation due to fires increases runoff as surface runoff velocities increase, decreasing the time available for infiltration. Fires also change soil characteristics.

Fires induce temperatures at ground level, reaching 600 to 700 degrees centigrade. Burning vegetation, especially chaparral, releases oils, resins, and waxy fats stored in plants and plant litter as intense heat vaporizes the vegetation (McPhee, 1989). The soil acts as an insulator, keeping temperatures a few centimeters below the surface much cooler. This temperature difference allows condensation of vaporized substances, forming a hydrophobic layer. This layer is impermeable and prevents water from reaching all but the first few inches of soil. It also slows evaporation through the soil (Ainsworth and Doss, 1995). The extent and depth of a hydrophobic layer both depend on the type of soil, the fire intensity, and antecedent soil moisture. Clay soils tend to resist the formation of a hydrophobic layer. Sandy and sandy loam soils are far more susceptible to hydrophobic conditions (DeBano 1987).

If a drop of water is placed on a pre-burn sample of sandy loam soil, the water will all but disappear. If the same water drop is placed on a post-burn sample, the drop will ball up and may remain there for hours. Water quickly saturates the thin layer of permeable soil above the hydrophobic zone because a vegetative canopy is not slowing it down. Slower infiltration rates result in an increased intensity of surface runoff and erosion. These changes to the soil and vegetation lead to higher soil erosion rates. Figure 2 shows the expected probabilities of debris flow in watershed areas due to impacts from the Dollar Fire area above Starvation Reservoir.

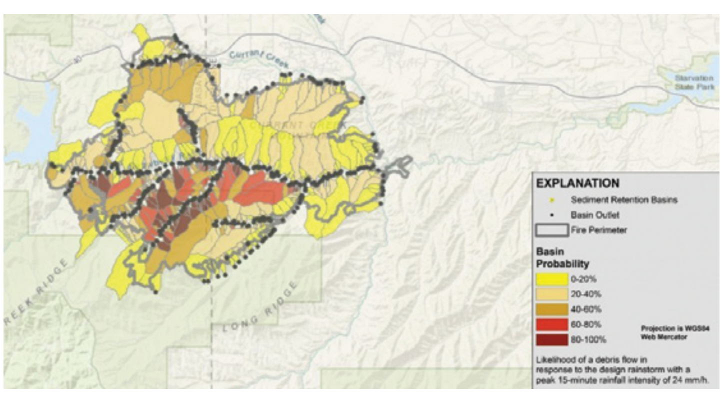


Figure 2 - Expecter Change to Soil Erosion and Debris Flows - Dollar Fire

Changes to Runoff After Fires

Fire changes the soil and vegetation characteristics of a watershed. The changes result in higher runoff rates and more erosion within the watershed. Erosion of sediment leads to bulking of flows, where entrained sediment increases the volume of runoff. Vegetation, litter, rocks, and other forms of ground cover create barriers that slow and spread water movement across the soil surface, allowing more time for water to infiltrate over a larger surface area. Fire removes most of these barriers and allows the water to concentrate into rills. Rills allow increased flow depth and velocity. Higher flow depths and velocities significantly decrease runoff response time and increase runoff volume in streams (Pierson, Jr. et al., 2003). Several studies have been conducted to determine the influence of fire on the volume and peak runoff from watersheds.

Work by Davis (1977) suggests that many post-fire flows are debris flows. In the watersheds that Davis studied, he found that bulking ratios in runoff ranged from 0.5% to 2.5% by volume for normal flows to 40% to 60% by volume for post-fire flows. Bulking can increase runoff volumes and peaks significantly. However, it will not be evaluated further in this study.

Veenhuis (2002) studied two burned watersheds in New Mexico. He noted that storm flows increased dramatically after the wildfire. Peak flows in each of these two watersheds increased to about 160 times the maximum-recorded flood before the fire. As vegetation reestablished itself in the second year, the annual maximum peak flow was reduced to approximately 10 to 15 times the pre-fire annual maximum peak flow. During the third year, maximum annual peak flows were reduced to about three to five times the pre-fire maximum peak flow. In the 22 years since the La Mesa wildfire, flood magnitudes have not completely returned to pre-fire magnitudes. The number of larger than normal peak flows seems to be most pronounced for three years after the fire. (Veenhuis, 2002). Other studies also indicate significant increases in the runoff after a fire (Pierson, Jr. et al., 2003; Nasseri, 1988; Wondzell et al., 2003). Figure 3 shows sediment deposited in the Strawberry River floodplain after rainfall in July 2018.

Figure 3: Sediment in Strawberry River Below Timber Canyon after Dollar Fire — July 2018

Watershed Recovery From Fires

The vegetation of chaparral communities has evolved to a point where it requires fire to spawn regeneration. Many studies have shown an increase in runoff and erosion rates the first year following a fire, with recovery to pre-fire rates generally within five years (Wright and Bailey 1982). The timing and extent of recovery are highly dependent on precipitation, slope, and vegetation type (Branson et al. 1981, Wright et al. 1982, Knight et al. 1983, Wilcox et al. 1988). Pierson, Jr. et al. (2003) noted that water repellency of the hydrophobic water layer deteriorates over time, resulting in a gradual recovery in the infiltration capacity of the soil.

Other studies have numerically quantified the Ainsworth and Doss (1995) qualitative summary. Pierson, Jr. et al. (2003) studied two watersheds in Idaho that were severely burned. They note that virtually all vegetation and litter was consumed during the fire. Bare ground for all burned sites was greater than 95% resulting in increased soil exposure to the erosive forces of raindrop impact and overland flow. It took two growing seasons and three winters for litter accumulation to reduce the amount of bare ground on the burned sites to near 50%. Watershed vegetation recovers to 90% of the pre-fire condition after five years. These results are consistent with the results of the other researchers, both quantitatively and qualitatively.

Local Impacts and Civil Engineering

Fires and post-fire impacts often impact built infrastructure and utility systems that are operated by civil engineers. These impacts include higher runoff volumes, debris flows, and impacts on water quality. One example of impacts to facilities in Utah in 2018 includes impacts on watersheds and water supply systems.

Figure 4 shows debris from the fire was washed down to the culvert during a summer thunderstorm.

Figure 4 — Impacts to Culvert on Strawberry River

Another impact with long-term implications is the generation of higher than normal sediment loads in the flows from the watershed. The Dollar Ridge Fire burned the watershed tributary to Starvation Reservoir. The Central Utah Water Conservancy District operates the Duchesne Valley Water Treatment Plant (DVWTP) that draws water from Starvation Reservoir for treatment and distribution. The plant is the only water supply for parts of Duchesne County.

After the fire and initial assessment, CUWCD was concerned with the operation of the plant in the impacted system. The pollutants of concern included turbidity, nutrients, algae growth, organics, disinfection byproducts (DBPs) and dissolved oxygen. Turbidity from increased sediment has the potential to impact the treatment and filtration systems, as well as impact fish within the reservoir. Nutrients, such as phosphorous, increase the potential for algae growth, which then interferes with the filtration processes and has the potential to cause cyanobacteria blooms. Increased organics in the water cause more disinfectant demand, which leads to increased disinfection by-products (DBPs), and can also change both the taste and odor of the water delivered to end-users. Increases in suspended solids can cause lower dissolved oxygen, reducing the oxygen available for fish within the reservoir. Figure 5 shows the results of sampling on several days at one of the monitoring locations in the Starvation Reservoir.

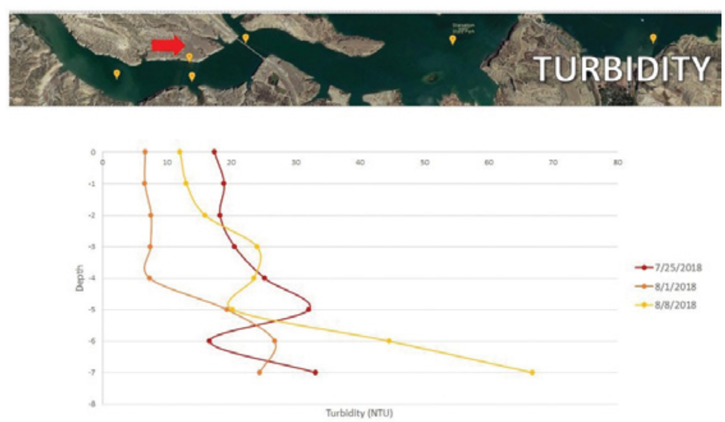


Figure 5 — Turbidity Monitoring Locations and Results on Starvation Reservoir

The water intake from Starvation Reservoir near the DVWTP intake is usually less than 3.0 NTU. As a direct filtration plant, the DVWTP cannot treat high turbidity water under Utah rule R309-530-5.3.g. The rule requires that the plant be designed and operated so that it will automatically shut down when source water turbidity is 20 NTU for more than three hours, or when source water turbidity exceeds 30 NTU at any time.

After the fire and resulting debris flows, high turbidity water channeled across the bottom of the reservoir following the prior river channel and came through the Starvation Dam outlet at more than 1000 NTU. This type of flow through the reservoir had never been observed historically. See Figure 6. During this condition, the water near the intake, 2 meters above the bottom of the reservoir, was 61 NTU, with approximately 6 to 8 NTU coming into the plant. The CUWCD mobilized a sampling and monitoring team to evaluate turbidity within the lake. The team sampled several areas at several depths on various days. Figure 5 shows the locations and the turbidity at various depths in the reservoir at one of the sampling locations. The turbidity was impacted by thunderstorms that washed down significant sediment during a storm that produced over 2,000 cubic feet per second in the Strawberry River. Figure 6 shows the flows coming out of Starvation Reservoir when the high turbidity water was channeling through the reservoir and coming out of the dam. This sediment has the potential to shut down this water supply to parts of the Duchesne Valley.

Figure 6 - Turbid Water Channeled Through the Reservoir and Flowed Through the Outlet of the Dam at >1000 NTU

As discussed above, watershed recovery takes five to 10 years to complete. The size of the fire limits the effectiveness of erosion mitigation measures. The ability of the CUWCD to deploy standard mitigation measures is hampered by geology, terrain, and highly erosive soil. There will be some seeding this year to encourage revegetation within the burned area.

Water quality impacts could likely continue for the foreseeable future as the watershed slowly recovers. Although there were a few thunderstorms after the fire, there is still sediment within the watershed with no vegetation to hold it in place. Due to the nature of burned watersheds, it is expected that average storms will produce higher flow rates with larger loads of sediment, organics, and debris. These impacts will taper off as the watershed recovers.

The DVWTP process is not designed to treat high turbidity and is restricted by law. The current process was designed based on past water quality, which was stable for 40 years, and has now been impacted for years to come. These changes will require changes in the treatment process to meet the impacted conditions. The changes may include clarification, with flocculation/sedimentation processes, and may also require alternative water sources.

There may be a potential for emergency funding through the Federal Emergency Management Agency to implement watershed recovery programs or fund plant upgrades to handle the changed conditions. Civil engineers will be considering many of these choices to come up with the solution that will best meet the needs of the community served by the DVWTP in the coming years.

Wildfires are natural disasters that cause impacts to the communities we live in and work with. They increase the chances of flooding, debris flows, and impacts on utility systems like the WVWTP. Civil engineers need to consider the risks of fire and after-effects when designing the systems that serve our communities.

Ben Willardson, Ph.D., P.E., D.WRE, ENV SP, QSD/P

Dr. Ben Willardson has 19 years of professional experience in the development and review of hydrologic, hydraulic, and sediment transport models. During that time, he has managed roadway and pavement improvement projects, pedestrian facility upgrades, and drainage improvement projects. Ben has worked for both the public and private engineering sectors. While working for the Los Angeles County Flood Control District, he oversaw the operation of 14 dams and 27 spreading ground facilities for flood control and water conservation within the complex flood control system serving Los Angeles County. He has conducted asset assessment for programs related to flood-control channels and pavements.

No picture available

Mike Rau, CUWCD

Mike Rau is the Water Quality Manager for Central Utah Water, where he has been employed since 2009. He has a B.S. in Physiology and Developmental Biology from Brigham Young University, and has grade IV certifications in drinking water treatment and distribution. He is from Mapleton, Utah where he enjoys all things outdoors and spending time with his wife and 5 children.

Failure Analysis — What to Do When a Part Breaks

Amber Dalley, 2019-2020 chair of the Utah Chapter of the ASM International Materials Education Society

Living in a material world, as we do, means that some of the physical objects surrounding us will break or change in a manner that renders them unusable: gear teeth wear, house pipes burst, car parts corrode, plastic becomes brittle, elastic stretches, and bolts shear, to name just a few. If the consequences of failure are minor, such as a light bulb burning out or tires wearing out, they are replaced and the old parts recycled or discarded. However, other failures have high potential to cause significant damage or injury: a crane hook fractures suddenly and drops a suspended load; an oil pipeline ruptures and spews oil, contaminating the surroundings and posing a threat of fire; a medical implant erodes and releases particulates affecting the health of the body; a fan rotor breaks and stops the production line. It is the task of failure analysts to study these broken and malfunctioning parts to 1) understand the root cause(s) of failure and 2) recommend actions/changes to prevent its recurrence.

"Failure analysis is a systematic investigative procedure using the scientific method to identify the causes of a failure. 'Forensic engineering' is often used as a synonym, but this term is more appropriate for litigation-based investigations." (Wulpi, third edition). A thorough failure analysis requires examining factors such as the design of a component, the materials selected and their properties, the fabrication process, environmental conditions in service, use or abuse in service, safety factors, and planned lifetime. One basic rule must be followed: Never take the two pieces of a fracture and touch them together to see if they match. The contact between the surfaces can damage key features that are necessary to distinguish an overload fracture from fatigue or ductile failure. In a failure analysis investigation, it is important to examine and photographically document features of interest. Is there unbroken material from the same batch as the broken part that can be analyzed? These "exemplar" pieces can be destructively tested, perhaps under varying conditions, to see which lab-created failure most closely matches the failure event.

Destructive methods such as grinding or cutting should only be done after all possible data have been gathered nondestructively.

When a part breaks, a person familiar with the equipment or process may be able to assess the cause of damage. Many resources are available to assist. Something as simple as a magnifying glass or stereomicroscope may reveal a fracture origin. In more serious cases, the services of professionals may be needed, perhaps even for a litigation case. The following resources can provide the methodology for a failure investigation, give examples and case studies, and identify local laboratories and resources with specialized electron microscopes, chemical analysis and mechanical testing equipment.

ASM International, a professional engineering society, is dedicated to the study of materials and offers several excellent resources. These include the ASM International Handbook Volume 11 Failure Analysis and Prevention, the book Understanding How Components Fail by D. Wulpi, and the Journal of Failure Analysis and Prevention, published by Springer. Should additional expertise be required, the Failure Analysis Society, an affiliate society of ASM International, can recommend commercial laboratories and professionals to perform more detailed evaluations. Also, ASM International offers the "Principles of Failure Analysis" course several times a year. You can find information about this course and others at www.asminternational.org.

A failure analyst can see many unusual cases. A commercial dishwashing detergent was found to etch glassware that was being washed. At the Bureau of Engraving and Printing in Washington, D.C., a master money plate made of steel cracked and was leaving lines on the printed dollar bills. Fatigue cracks were found to initiate at contaminants in powdered metal that were being used in additive manufacturing for aerospace components. Steel piping used in down-hole oil field applications broke a mile underground, and work stopped until the pipe could be pulled back to the surface. Unknown black specks were found in a pharmaceutical product and had to be identified.

It has been said that people don't hire failure analysts because they want to, but because they need to.

Amber Dalley is a senior metallurgical engineer and failure analyst. She is currently the 2019-2020 chair of the Utah Chapter of the ASM International Materials Education Society.

Convergence

Daniel N. Donahoe — IEEE

INTRODUCTION

Around 1950, common career and business interests caused several professional societies to form the Utah Engineers Council (UEC). UEC currently consists of 18 member societies. This article focuses on the consequences of today's driving forces.

Engineering has undergone a transformation caused by "technological convergence" (or convergence). Convergence is a phenomenon in which professional practice, as defined at the beginning of the 1900s as disparate technical fields, has grown to be more similar. This convergence has implications for leaders because of an increasing congruence of technical skills among members in different industries. Managers may find that some technical employees are role-substitutable in a manner that was rarely possible in 1950.

How convergence occurred over the last 70 years is not obvious and is the subject of ongoing analysis by top economists. Although economists and engineers do not view changes in the same way, this article will outline what drove these changes via recent, primarily economic publications. Since UEC members may not be familiar with these economists, I included a short introduction about them to provide a sense of the gravitas of these people and ideas. The following paragraphs outline (1) a decline in U.S. productivity due to diminishing innovation, (2) leading to growth of the financial sector of the economy as a policy alternative, (3) resulting in reduced economic reliance on science and engineering, and (4) causing career impacts to UEC members.

ECONOMICS AND THE MOTIVATION OF CAREER CHANGES OVER MANY DECADES

The United States had 40 million automobiles on the road in 1950 [1], and the U.S. population was 150 million [2]. Simple division yields 0.27 cars per capita. Today, the population has grown to 330 million [4], and there are 0.83 cars per capita [3]. The question is, why isn't the number of cars per capita number higher now? Many other similar observations can be raised about expected progress over 70 years.

Robert Gordon provides his own answers to those questions in his recent book [5]. Gordon is a professor of economics at Northwestern University. He earned a Ph.D. at MIT under the direction of the distinguished economist Robert Solow. Solow was himself awarded the Nobel Prize, the National Medal of Science, and the Presidential Medal of Freedom.

Gordon says that U.S. economic productivity (known as Total Factor Productivity) was its greatest around 1950, and has dropped by 80%. To summarize, current innovations (such as Information Technology) don't provide the economic utility of other inventions in the 1900s that drove America's Golden Age (1950-1970).

Brown and Linden provided a more classical economic viewpoint than Gordon in their narrative of technologically driven economic changes specific to the semiconductor industry [6]. Tassey follows the same traditional arguments but with an opposing thesis [7]. I have only mentioned these books to provide a balanced and complete narrative for readers who are motivated to learn more than what this article covers.

If Gordon's sacrilege is correct, then what is driving our economy now? According to a sociologist named Gretta Krippner, the answer is "financialization" (also loosely called either "services" or" outsourcing"). Krippner says that the financial sector of the U.S. economy was around 10% to 15% of U.S. profits in 1950 or 1960 and climbed to at least 40% by 2001 [8]. Krippner's book, from the viewpoint of a sociologist, is primarily a view on the origin of this unintended economic transformation (that is, policymakers working to keep the economy growing by any means) and should interest readers who want to learn about the origins of public policy.

Consequences of the growth of financialization, in turn, are described by a husband and wife, Abhijit Banerjee and Esther Duflo, who are two of three laureates granted the 2019 Nobel Prize in Economics. Both are economics professors at MIT. Banerjee and Duflo claim that financial sector workers are now paid 50 to 60% more than other workers with similar skills, but that differential was not true in 1950 or for two decades after. This added income originates by way of what economists term "rents" (a second economics term, in this instance referring to pay not originating from labor skills). In this fashion, the explosion of the financial sector has distorted labor markets for engineers. Christophe Lècuyer is a historian who wrote about the early origins of the growth of Silicon Valley [10]. His primary thesis is that innovation is driven through manufacturing, a skill set that financialization sends offshore. Scott Patterson, a financial journalist and staff reporter at The Wall Street Journal, wrote a book that continues the discussion about the disruption of science and engineering careers raised by Banerjee and Duflo. His book outlines how new technical graduates were wooed into finance and the 2008 economic collapse [11].

The disk-drive industry was famously used as a "fruit fly" metaphor by Clayton Christensen to describe the business of innovation [12]. The learning curve (sometimes referred to as the experience curve) predicts that unit prices drop as manufacturing volume increases. This shift in prices and volume eventually results in a mature technology, assuming no disruption by revolutionary innovation, with large manufacturing volumes and reduced profit margins. This competitive combination of large-scale investment with low margins leads to industry consolidation. The disk-drive industry is now reduced to only three worldwide suppliers.

These three books outline the effect of financialization on engineering and science careers, but the best summary is in the Department of Labor Bureau of Labor Statistics Occupational Handbook, which predicts slow job growth in all engineering fields.

TECHNICAL ORIGINS OF CONVERGENCE

The transistor was a novelty when UEC began in 1950. In 1950, only 80% of rural farms had electric power, and less than 30% had telephone service [13]. Available and useful integrated circuit components produced by Fairchild's planar process were a decade away. Today, cheap and reliable electric power is now available everywhere in the continental United States and the integrated circuit has made its way into almost every imaginable product.

In economics, the term for technology penetrations into everyday life is diffusion. Thanks to the diffusion of mature electronics, technical professionals now share common skills and training in mathematical programming (such as MATLAB) and user-enabling laboratory equipment (such as equipment interconnected through National Instruments' LABVIEW). Nowhere is this more profoundly demonstrated than in a materials science laboratory. Complex concepts are now readily demonstrated, simply reproduced, and clearly represented on graphical displays. The ubiquity of advanced electronics reduces the knowledge gap between degreed graduates in different disciplines. Managers within large companies do not fully comprehend this convergence of skill sets among disciplines.

CONCLUSION

In the past, people with broad knowledge were either labeled as Renaissance men or savants, so we should forgive employers who do not see today's convergence. Rather than prescribe what UEC members might conclude about convergence, the following corollaries list possible directions:

- Students and early professionals who do not invest time in career development can expect to pursue less technically rewarding careers.
- Students and young professionals who understand current economic trends may seek careers in the financial sector (for example, as program managers or in sales) and benefit more than their more technically dedicated peers.
- Managers seeking success in leadership careers must understand that better technical employees offer more breadth of performance than ever before, but these same employees have motivations to move away from a long and productive technical career.
- The ever-present risk of economic calamity should drive citizens, especially engineers, to build strong institutions such as UEC's member societies.

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Daniel N. Donahoe,
IEEE Utah Section

Family of Measures:

A Method to Examine and Improve Metric Systems

Dr. David Wetzel — INCOSE

A common image of metrics on posters and the internet is of a triangle with "Good," "Fast," and "Cheap" on each side and the saying "Pick Two" in the middle. The implication is that if you pursue any two of them, then the third one suffers. For example, if you want good and fast, then it costs more. The biggest issue with this triangle-view of metrics is that "good" usually means yields, defects per million, or failure rates, which are all productivity rate metrics and not quality metrics. We need a more robust model to untangle quality metrics from productivity, timeliness, and financial metrics. We call this model the "Family of Measures." We have used this model over the past three decades to help organizations evaluate existing metric systems; differentiate order winners from market entry metrics; evaluate trends, articles, books, and claims; illustrate the Deming chain reaction and Taguchi loss function; explain why reliability metrics are quality metrics; create truly balanced scorecards; and even illustrate history. The sincere hope is that the Family of Measures reveals fresh insights into metric development and gives you an additional tool to make better data-based decisions.

Four Distinct Metrics

Organizational performance metrics are like the periodic table in chemistry (Figure 1).

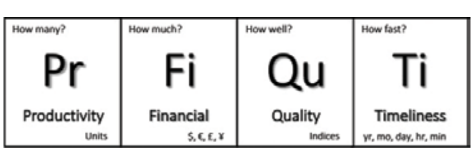

Figure 1 Periodic Table of Business Metrics

There are base elements, or metrics: productivity, financial, quality, and timeliness. These building blocks can be used as standalone metrics or combined to form compounds (i.e., rates and percentages). There are two easy ways to identify and separate the four metrics. Each metric answers a different question and has a different unit-of-measure. For example, if the unit-of-measure is currency (e.g., dollars, yen, euro), then the metric type is financial. If the unit-of-measure is an index (e.g., customer satisfaction, process capability index), then the metric type is quality. If the unit-of-measure is time (e.g., seconds, days, years), then the metric type is timeliness. If the unit-of-measure is units, (e.g., counts, °F, grams), then the metric type is productivity. The second way to differentiate the four metrics is to understand what question is being asked. Financial metrics ask, "How much?" Productivity measures ask, "How many?" Timeliness metrics ask, "How fast?" Quality metrics ask, "How well?" All four base metrics can be either counts (attributes) or measures (variable). Table 1 is a summary of the two ways to differentiate the four metrics, including examples and definitions.

Of the four metrics, financial and timeliness metrics are the most intuitive. We have been counting money and telling time since grade school. It is the other two, productivity and quality, that give organizations trouble. Two interrelated problems exist. First, there is the common practice of defining quality with productivity, financial, or timeliness metrics. These substitutions and misconceptions hinder the creation of true quality metrics. Especially, they hinder the development of leading indicators of process quality that would improve variability, stability, and capability.

Table 1 Family of Measure Definitions

Family of Measure	Question	Unit of Measure	Examples	
			Count	Measure
Productivity (units)	How many?	Units (calorie, meter, °C, liter, amp, cm3, psi, volt, kg, mole)	Scrap, rework, repair, pass, fail, throughput, waiting calls, returns, call abandonment, load, available rooms, fill level, capacity, available seat miles	Weight, height, length, temperature, volt, area, volume, pressure, distance, power, fuel economy, mass, energy, illumination, force, stress, current
Financial (currency)	How much?	$, €, ¥	Cost, profit, budget, assets, revenue, debt, income, sales, expenses	Taken to decimals (often treated as variable but remains an attribute for determining sample size)
Quality (Index)	How well?	Index	Survey scales (1, 2, 3, 4, 5) Customer satisfaction, employee satisfaction, patient satisfaction, student grades	Satisfaction survey slider scales (1-5) Control plan indices, patient safety index, blood pressure, process capability indices, Cp & Cpk
Timeliness (time units)	How fast?	sec, min, hour, day, week, month, year	Counts of whole months, weeks, days, or hours (1, 2, 3, …) Age, days late, seniority, tenure, block hours	Cycle time, handle time, duration, intervals, queue time, shipping time, response time, MTTF, MTBF, MTTR, lead time, delay, call time, setup time
Combinations (%)	At what rate?	rate, %	Labor rate, yield, return rate, load factor, return on assets, payout ratio, gross margin, mortality rate, occupancy %, average daily rate, revenue per room, advertising ROI, average daily rate, domestic book rate, website conversion rate, asset turnover ratio, stage length, profitability ratio, inventory turnover, speed	

A Universal Concept

The four metrics are represented in many fields of study. Project management embeds the Family of Measures in its core knowledge areas: scope management, time management, cost management, and quality management (Project Management Institute, 2008). Scope, activity planning, and the work breakdown structure are productivity elements. Timeliness is represented by the schedule, displayed with Gant charts and networks. The project budget is the financial portion. Variance indices represent quality efforts. Project risk management (FMEA) also contains the family of measures embedded in severity (quality), detection (productivity), and occurrence (timeliness or productivity, depending on the scale). Logistics is another example of this universal concept. Logistics has five objectives: right product and place, right time or faster, right price/cost, and right condition (Stock and Lambert, 2001). The Family of Measures is a reoccurring schema that appears in all disciplines, although each may be worded differently.

Productivity versus Quality Metrics

The Taguchi Loss Function (Deming, 2000) is probably the best illustration of the difference between productivity and quality. A simple loss function is a step function between two states of a switch (on/off). The light is either on or off. Figure 2 illustrates production yields as a loss function.

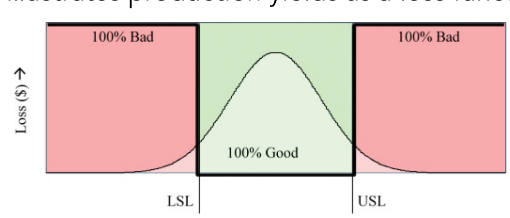

Figure 2 Traditional View of Loss

Production, viewed in this way, is either on (100% good) or off (100% bad). We use the following questions to explore this widely-held view of production:

- Is there a "happy" zone?
- Is there a sense of loss all the time?
- Which Family of Measure is illustrated in the figure?
- What question does this metric answer?

There is absolutely a "happy zone" when things are deemed 100% good. No process improvement efforts will be taken under these "happy" conditions. There is no feeling of loss under these conditions. When the product or service is deemed bad, a feeling of 100% loss exists, and problem-solving techniques are employed to regain control. This feeling of 100% good or 100% bad is binomial. It is a productivity metric. What we produced is either good or bad. How many good or bad? Yields are either calculated directly from counts; or measured, dispositioned, and then totaled as good or bad. Two problems occur as a result of this version of process management: (1) productivity yield metrics are used to monitor the process, masquerading as quality metrics; and, (2) problem solving is the predominant method used to "improve the process" when things are bad.

An alternative to this process management strategy is illustrated in Figure 3.

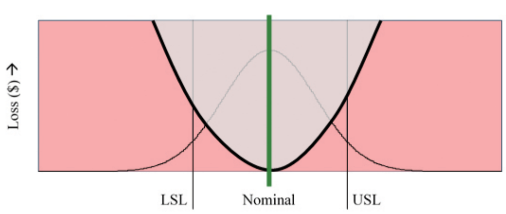

Figure 3 Alternate View of Loss

Let us apply the same series of questions. There is no "happy zone" because the process aims to meet nominal. The odds of being exactly on nominal are small; thus, a sense of loss always exists and increases as we stray from nominal. This feeling leads to continuous process improvement efforts to center the process better and continuously reduce variability.

Most importantly, improvement efforts continue even when the product or service is within tolerance (deemed good). The primary question is, "How good or bad?" This question is a true quality metric. What we produce may be either good or bad, but we also want to know the degree of goodness or badness or to answer the question, "How well?" To do this, we measure variability, central tendency, and the stability of a process. We compare our process to customer specifications and calculate process capability and process management indices. The idea is not to reach an arbitrary goal, but to continuously improve the process.

Two profound differences occur as a result of this version of process management: (1) quality indices are used to monitor the health of the process (with throughput, yields, cycle time, costs, and other metrics), and, (2) continuous improvement is the method used to improve the process. To appreciate the difference between the two competing views of process management, one would need to understand all the organizational factors that promote the traditional productivity-focused step function version (the "hero" mentality, competitive reward systems, discomfort with statistics, overreliance on audits and inspections); a discussion of which is well beyond the scope of this article.

Need for Order Winners

Most companies operate on a half-set of metrics (productivity and financial), sprinkling in some operational-level timeliness indicators, but mostly excluding quality altogether. They think they are measuring quality, mostly with yields, and then wonder why customer complaints and warranty costs are rising, while market share and repeat business are declining. The ever-increasing presence of global competition is not going away. Our needs are urgent: the need to stop degrading rich timeliness and quality metrics into simple percentages; the need to differentiate between productivity and quality; and the need to develop leading indicators of quality. Family of Measures is a tool that helps address these needs through the reexamination and delineation of metrics into distinct metric families.

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Dr. David Wetzel
Dave Wetzel is a Lean Six Sigma Master Black Belt with over 30 years of work experience in the industrial, service, and public sectors as a process improvement engineer, facilitator, trainer, and course developer. He has a Ph.D. in Industrial and Systems Engineering from The Ohio State University, an M.S. in Engineering Management from Rensselaer Polytechnic University, and a B.S. in Chemical Engineering, also from OSU. Dave has held several different ASQ certifications: quality engineer, black belt, and quality technician.

Dave has worked in Europe, Asia, the Middle East, and the Americas with such organizations as Dell, TVA, IBM, GE, Chemetall, RIT, Nationwide Insurance, Samsung, Eli Lilly, DeCA, the George Group, McKee Foods, the U.S. Army, and Xerox. Dave is responsible for the Manufacturing Systems Engineering program at Weber State University. Dave can be reached at dwetzel73@gmail.com or 585.752.2758.

INCOSE
The International Council on Systems Engineering (INCOSE) fosters world-class systems engineering environment for its current and future membership. The local Wasatch chapter was chartered in January 1997 to serve the Utah systems engineering community.

We believe that systems engineering principles and practices offer the best solution for Utah companies and organizations competing in our present-day global marketplace, and that the proper application of systems engineering can contribute to the overall betterment of the social, economic, and environmental condition of our area. When the aim is to improve cost, quality, and schedule performance — whether in industry, government, or education — we believe that systems engineering provides the most viable structured approach for doing so.

Autonomous Shuttle Demonstration Project

Chris Siavrakas, P.E., PTOE, Technology Project Manager — The Institute of Transportation Engineers, Utah Chapter

Achieving zero fatalities and crashes of automobiles has been a long-term but seemingly unreachable goal. Few people can imagine a complete solution, so the short-term goal has been to mitigate vehicular crashes instead.

The usual "E's" of Traffic Safety involve Engineering, Enforcement, Education, and (more recently) Emergency Response. Some people have suggested adding a fifth "E": Everyone. That is, traffic safety is the responsibility of everyone on the road. All of these strategies are partially effective, but they still come short of the ultimate goal of zero. Instead of adding another numbered "E," I would suggest an alternative that is perhaps the final "E": Emerging Technology.

The rapid emergence of new technology with connected and autonomous vehicles (CAV), or highly autonomous vehicles (HAV), is our future path to achieve zero crashes. These steps are coming in a variety of small, incremental advances with each version of emerging technology, both with vehicles and Intelligent Transportation System (ITS) applications.

The Utah Department of Transportation (UDOT), with our transit partner, the Utah Transit Authority (UTA), has deployed a Level 4 Autonomous Shuttle for a one-year demonstration project. This shuttle is capable of transporting up to 10 riders comfortably in a fixed route, pre-determined path that is no more than 2 miles long. UTA is interested in learning about ways to connect riders for their first and last mile to existing transit routes. UDOT is researching how the general public accepts and understands what a CAV/HAV does and does not do.

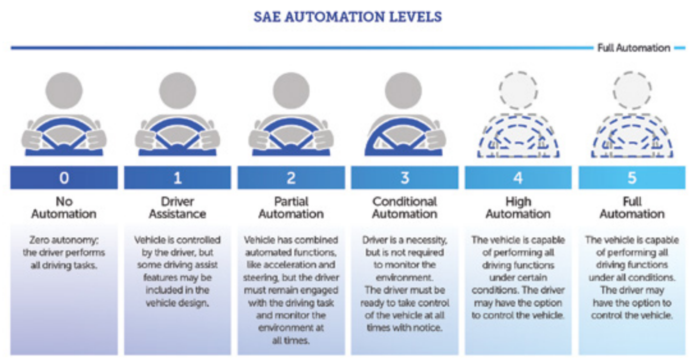


Figure 2. Levels of Vehicle Automation, Society of Automotive Engineers (SAE)

This all-electric vehicle requires approval, at each venue, from the National Highway Traffic Safety Administration (NHTSA), since it does not have seat belts, a steering wheel, brake pedals, mirrors nor the driver control cockpit. The operating speed is not to exceed 15 MPH, and it cannot operate on multilane roads or with posted speeds above 35 mph. Our project will have an onboard operator to ensure safe operation and to override control due to random impediments to the route, like a delivery truck or other incident on the path. The onboard operator can use a remote handheld controller to override control and then steer and operate the vehicle.

We are deploying the shuttle at a variety of venues with different use cases. Some of these include a college campus, a hospital, a business park, and entertainment and shopping venues. At each of these venues, we will learn about ridership needs and experiences with ambassadors who will engage the public and ask them to answer survey questions.

Figure 1. Shuttle Stop at the Station Park Shops, Farmington

Figure 3. Business Park Route, 1950 W in Salt Lake City

Figure 4. State Capitol Legislative Engagement Event

We will also explore the vehicle to infrastructure capability of this shuttle in dealing with signal, phase, and timing data. This learning step helps us plan infrastructure enhancements and understand the state of maturity of CAV/HAVs.

Figure 5. National Highway Traffic Safety Administration, Automated Vehicles 3.0, Preparing for the Future of Transportation. Vision for Vehicle to Infrastructure/Vehicle Connectivity

An added feature to our project is specialized University research to study, anonymously, how humans interact with the shuttle during their ride. A special onboard camera will be used as well as incognito observers. Our initial research report yielded some interesting observations that will lay the groundwork for a more comprehensive research analysis with subjects to get a deeper understanding of their perception and reaction to rider experiences.

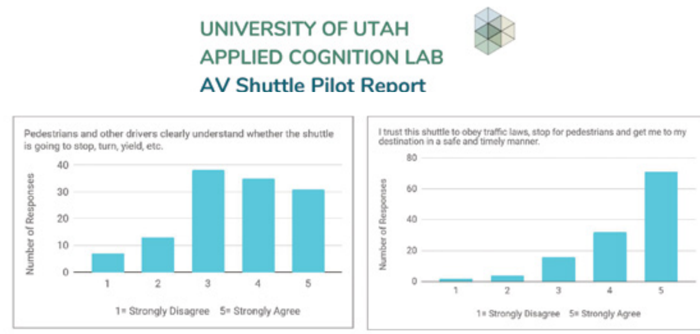


Figure 6. Phase 1 AV Shuttle User Survey, University of Utah Applied Cognition Lab

Using CAV/HAVs brings other efficiencies in vehicle platooning and speed harmonization that can optimize the fixed capacity of our roadways.

This project will help both our agencies understand where the state of technology is and where we need to move next to change the landscape of transportation.

More information can be found on the project website at www.AVShuttleUtah.com.

Chris Siavrakas has worked for the Utah Department of Transportation for almost 20 years as a traffic engineer in the Traffic Operations Center in Salt Lake City, Utah. He is currently a technical project manager for the Transportation Technology Group leading the yearlong autonomous shuttle demonstration project. Previously, Chris planned and deployed devices for advanced traffic management systems, such as traffic cameras, traffic sensors, electronic message signs, traffic signal communication, fiber optic lines and other traveler information devices into roadway projects.

Chris was also the control room engineer and emergency management coordinator who managed the traffic operators and monitored freeway operations, coordinated with border states, counties, and local cities in a variety of major incidents and planned special events around the state.

Chris is a licensed professional engineer in Utah and has an advanced certification by the Institute of Transportations Engineers as a professional traffic operations engineer.

Chris earned the degree of Bachelor of Science in civil engineering from the University of Arizona and has completed independent graduate coursework in civil engineering at both the University of Arizona and the University of Utah.

Professional Engineer (Licensed), State of Utah, #4759661-2202

Professional Traffic Operations Engineer, Transportation Professional Certification Board, Institute of Transportation Engineers.

Implementing Critical Systems Heuristics and Soft Systems Methodology on Ogden Downtown Alliance's Recycling Program

Claudia Arenas-Guerrero, Caite Beck, Vlad Bleoca, Jacob Dahlberg, Elle Stephan and David Templeton
Purdue University

The overarching objective of the Ogden Downtown Alliance (ODA) is to bolster the city center through community engagement. The organization supports the growth of downtown Ogden by "increasing economic vitality and community vibrancy throughout Ogden's Central Business District" (Ogden Downtown Alliance, 2018). Their most popular event is the farmers market in Downtown Ogden. Due to its size and popularity, it has become a testbed for some of the ODA's other initiatives, such as its recycling improvement program (Bowsher, 2019). The recycling initiative is where the team focused their efforts.

Currently, Ogden City does not have a viable recycling program due to the continual contamination of recycling bins with nonrecyclable materials. This contamination greatly affects the labor and equipment needed to process the materials, driving up cost and exceeding the city's budget. The ODA is acutely experiencing these consequences through the public events that they host, resulting in recycling bins being removed altogether until the issue is resolved (Bowsher, 2019). Ultimately, the ODA's objective is to reinstate recycling bins at all public events through increased community education and awareness about Ogden's recycling program as well as create a streamlined recycling process during these events. The ODA created a Recycling Task Force, but their meetings have been limited and have seen little progress.

After the team's application of the Viable System Model (VSM), the team redirected its focus specifically to the educational outreach opportunities that would allow for a more viable recycling program. Within this paper, the team addresses how the communication and engagement systems were further defined and what recommendations can be implemented to be effective while accommodating budgetary and resource limitations within the ODA.

Methods (Tables and figures are contained in the full article that can be accessed on page by using 46 I R code.)

Step 1: Description of the Situation Considered Problematical

The team began by asking the sponsor questions that would fully define the problematic situation. The questions asked and sponsor's responses are summarized in Table 1.

Step 2: Expression of the Situation as a Rich Picture

The team created a rich picture (Figure 1) to depict the current situation.

Step 3a: Identification of the Relevant Systems

The idea for a communication system emerged, which was solidified by identifying symbols synonymous with communication in the rich picture. The specific items contributing to the communication system are circled in red in Figure 2.

After the team identified the communication system, the team evaluated the remaining items in the rich picture and decided that they would focus primarily on human interaction. The public's interactions with the recycling program and the ODA and its stakeholder's interactions with the public establishes the engagement system, circled in blue in Figure 2.

Step 3b: Answering Ulrich's Boundary Questions

The team worked with the ODA's director, Kim, to answer the set of 24 questions defined by Critical Systems Heuristics (CSH). This exercise was completed to help the team further understand the current situation (reference system), identify any existing conscious/unconscious judgments, and design an improved scenario based on how the team envisions the system to work (Ulrich & Reynolds, 2010). The questions are listed along with the answers for the two relevant systems in Table 2.

Step 3c: Root Definitions of the Relevant Systems

When defining the root definitions, the team applied the Customer, Actor, Transformation, Weltanschauung, Owner and Environment (CATWOE) approach developed by the INCOSE UK (Emes, et al., 2012). The goal was not only to describe what the system does, but also how and why it is important for the customers who benefit from the change in state, the actors that enable the transformation, the aspects that make the change meaningful and how it affects and can be affected by the environment (Williams & Hummelbrunner, 2010).

For the communication system, an effective distribution of knowledge was identified as the key transformation. This root definition for the Communication System, made up of Customers, Actors, Owner and Environment, is depicted in Figure 3.

For the Engagement System, the team identified the promotion of enthusiasm for recycling as the key transformation due to the lack of interest that Ogden residents, businesses and officials have shown to get actively involved with proper recycling efforts. The root definition for the Engagement System is depicted in Figure 4.

Step 4: Conceptual Models of the Relevant Systems (Holons) Named in the Root Definitions

The conceptual model for the Communication System is shown in Figure 5. The conceptual model for the Engagement System is shown in Figure 6.

Step 5: Comparison of Models and the Real World

The Burge tables for the communication and engagement systems are summarized in Table 3 and Table 4, respectively.

Step 6: Identification of Changes

The changes identified in the Burge tables, as well as the scores for the Ease-Benefit matrix, are summarized in Table 5 for the Communication System and Table 6 for the Engagement System. The Ease-Benefit bubble charts for the Communication and Engagement Systems are depicted in Figure 7 and Figure 8, respectively.

Team Recommendations

The team recommends that the ODA should pursue the following changes for the Communication System

To create meaningful changes that are both impactful and are relatively easy to implement, the group recommends four suggestions based on the Ease-Benefit Matrix outlining the potential benefits of the Communication System.

The first recommendation is to translate the recycling requirements into laymen's terms that can be easily distributed to the public. Research has shown that there is already a generally high awareness by the general public on the benefits of recycling, and efforts should thus be focused on effectively educating the public on proper recycling habits that will enhance recycling performance (Timlett & Williams, 2008). The first step in achieving this is to illustrate the capabilities of the private recycling company effectively. When outlining this information, the ODA should focus on what specifically can be recycled and the different recycling collection locations that exist within ODA-sponsored events (Kaplowitz, Yeboah, Thorp, & Wilson, 2009). The team recommends this action because it has a high level of benefit despite its mediocre level of ease. It would require some research to fully develop the requirements of the recycling program into an easy-to-digest platform for the end-user, but the payoffs would be worth the effort. The most important point to this translation is that the result should cater to the specific needs of the Ogden citizens. Research suggests that the effectiveness of persuading the population to adopt an effective recycling program can be "enhanced by the inclusion of information from reference groups relevant to the individual" (Burn & Oskamp, 1986). Ultimately, the ODA should stray from focusing on overwhelming the citizens with vast knowledge about the larger system and should instead focus on the environmental content and how the effective recycling program specifically benefits the citizens of Ogden (Kaplowitz, Yeboah, Thorp, & Wilson, 2009).

The second recommendation to the ODA by the team is to define a succinct mission, goals, roles and responsibilities of the members of the Recycling Task Force. By defining a mission statement, goals and roles for the members of the task force, the team will be able to maintain momentum and see tangible steps forward toward the implementation of a successful recycling program within the community. The definitions can be completed with relative ease and would have a high benefit for the recycling program moving forward.

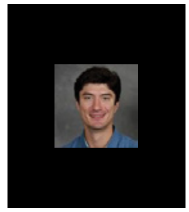
The third recommendation to the ODA by the group is to identify effective ways to interact with patrons during events. The interactions with patrons will be most effective if the personal contacts that are identified by the ODA "possess adequate knowledge regarding the operations" or the ODA's recycling program in addition to the "benefits of recycling as a whole" (Kaplowitz, Yeboah, Thorp, & Wilson, 2009). Having subject matter experts near recycling bins at ODA events can assist patrons in making correct recycling choices and can provide that personal interaction that research has shown to be successful. Also, the impact of communication efforts depends upon the credibility of the person performing the communication (Burn & Oskamp, 1986). Thus, having subject matter experts would improve the impact that the communication would have on the attendee.

The fourth and final recommendation to the ODA is to use a broader spectrum of easily accessible and obtainable mediums to communicate the recycling program to the attendees of ODA events. These additional mediums could include pictures on bins, billboards and “word-of-mouth” by event vendors as well as other forms of media. The use of a large variety of mediums allows for recycling information to be effectively communicated across different groups and be catered to whatever method is most effective for the target audience (Kaplowitz, Yeboah, Thorp, & Wilson, 2009). While the largest hindrance to a large-scale education or advertising campaign is usually related to monetary limitations, implementing small-scale improvements to the Communication System can also be effective.

Scan the QR code to read more.

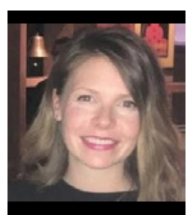
Claudia Arenas
Claudia Arenas works as a Six Sigma Master Black Belt for Cummins Inc. She has over 10 years of experience in the manufacturing industry spanning from controls, process engineering and new product introduction to quality assurance and project management. She has led a wide range of process improvement projects in manufacturing, sales and service areas. She graduated with a master’s in electrical engineering from the University of Kentucky in 2010 and a master’s in interdisciplinary engineering with a concentration in business management from Purdue University and the Kelley School of Business in 2019.

Caite Beck
Caite Beck has worked for Northrop Grumman as a structural design engineer for the metals, seals and joints group for one year in Promontory, Utah. Her previous role was as a supply chain quality engineer for Northrop Grumman for 2.5 years. During these two roles, Caite has worked on NASA, commercial and government aerospace programs. Originally from Houston, Texas, Caite moved to Utah by way of Illinois after receiving her B.S. in aerospace engineering from the University of Illinois at Urbana-Champaign in 2016. She completed her M.S.E. with a concentration in aerospace engineering from Purdue University in 2019 and is currently pursuing her MBA from the Kelley School of Business at Indiana University.

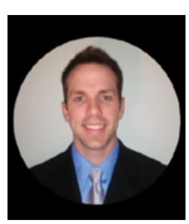


Vlad Bleoca
Vlad Bleoca has been a designer at General Motors for the past five years. During this time, he has obtained a DFSS Green and Black Belt certifications and also began his master’s in systems engineering at Purdue University. Prior education includes a bachelor’s in engineering technology from the University of Windsor and an associate degree in mechanical engineering automotive product design from St. Clair College. Vlad resides in Windsor and commutes to the General Motors Corp. Warren Tech Center in Warren, Michigan. In his free time, he enjoys backcountry camping, traveling, wrenching on cars, playing sports and staying active.

Jacob Dahlberg
At the time of writing this paper, Jacob was a senior pursuing a B.S. in aerospace engineering from Purdue University. He has participated in the American Institute of Aeronautics and Astronautics (AIAA), Purdue Automotive Performance Association (PAPA), Purdue Club Tennis, and a five-session co-op with Gulfstream Aerospace Corporation in Savannah, Georgia. He started full time as a service engineer with Gulfstream in January 2020.



Elle Stephen
For the last three years, Elle has been working at Los Alamos National Lab in New Mexico as an R&D engineer developing machining processes for nuclear material. Before that, she lived in Indiana (born and raised) and spent 4.5 years working for Honeywell Aerospace as a product design engineer qualifying aircraft fuel controls. She obtained her B.S. in aerospace engineering from Purdue and is currently pursuing an M.S.E. focused on systems engineering.



Dave Templeton
Dave has been a lead ground test engineer at Sikorsky Aircraft (part of Lockheed Martin) in Stratford, Connecticut, for six years. He was previously a rotors and blades structural analysis engineer at Sikorsky for five years. He received his B.S. in mechanical engineering from Cornell University. He has also obtained his MBA from the University of Connecticut and an M.S. in aerospace engineering from Purdue University.

Yesterday's Flour Mill, Tomorrow's Orbital Factory Floor, and the New USA Space Forces

Charles T. Vono — SAME

How an Oliver Evans' Mill Produces Flour From Grain

Oliver Evans was an inventor and genius who designed mills and steam engines. The first Evans' mill was built in the late 1700s and is often used as a convenient starting point for the First Industrial Revolution. In his mill designs, his big idea was setting up innovative machines as a continuous collection of processes to create improvements in the final product and economies of scale — producing better flour at a lower cost. An essential characteristic of his mills is also seen in modern factories:

- Machines are arranged to systematically support a process.
- There is easy access to a central power source.
- The factories accomplish specific missions.
- Economies of scale create better products and reduce costs.
- Easy transportation is needed because efficient output forces the mill owner beyond local markets.
- Division of labor in the factory and among factories creates specialized tasks, such as mills making flour bags for flour mills.

The section provides detailed descriptions of the product flow from grain to flour in an Evans' mill and, using that description, summarizes the key characteristics of a modern factory.[1]

1. A farmer or miller places grain in the mill. The farmer might add the grain to be held in the hopper below until the miller releases the grain down to the bucket elevator. Grain was then carried upward for processing. Sometimes iron combined with grain during harvest or transportation, so magnets were used to separate iron from grain.
2. The miller uses machines, hoppers, gates, and gravity to move grain to the appropriate machines.
3. At the top of the bucket elevator, the grain drops and is then cleaned by screens, tumblers, agitators and blowers.
4. The cleaned grain can be shuttled to one of three millstones, each one tuned to a specific type of grain or grinding.
5. Once the product is ground into flour, it takes a ride on another bucket elevator. A machine rakes the flour in a spiral specially sized and timed so that it is cool and dry by the time the flour tumbles through the hole in the middle.
6. As the flour falls, it runs through a sifter for more cleaning before being packaged and shipped.

The Essence of a Modern Factory

Many characteristics of Evans' mills are the same as modern factories. Machines are arranged to create an efficient and effective system that no longer requires employing many workers with specialized skills. Instead, a single power source, the water wheel, runs the entire enterprise. The whole factory has one purpose; for mills, the purpose is creating a final product like flour from an initial harvest like grain. The efficiencies of the machines, speed, and cleanliness lead to large quantities of a superior product and must be transported to ensure that the product can reach its market. The mill also opens up space in the market for factories that supply items used in the mill.

Commercial Space

So how does all the above affect 21st century factory floors, some of which will be in Earth orbit? (See figure 1.)

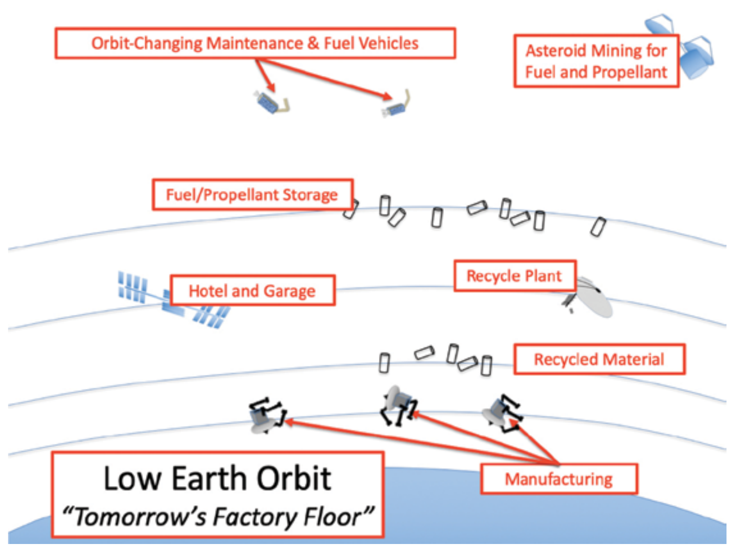


Figure 1: Tomorrow's Factory Floor

Many characteristics of commercial factory space will be the same as Evans' mill:

- Machines will be arranged systematically to support a process:
  - They will be arranged in orbit according to the need.
  - Orbital trajectories will be set up to intercept promising asteroids.
  - There will be terrestrial support systems.
  - Some materials will be parked in space for future reuse.
- There will be easy access to a central power source. These could include solar power, onboard nuclear decay, or volatile material from asteroids.
- The space factories will accomplish a mission. For example, the mission might be tourism, satellite maintenance, or unique microgravity manufacturing.[2]
- Economies of scale will be used to produce better products at less cost. Once proven, use of commercial space will grow exponentially.
- Easy transportation will be required since efficient output forces owners to go beyond local markets:
  - Delivery to Earth is easy because of Earth's gravity well.
  - Some products will be created inexpensively and sent to interplanetary space.

- Division of labor:
  - Government agencies such as NASA will perform FAA-type functions.
  - Orbital debris will be swept off the "factory floor."
  - Organizations to recycle material, maintain factories, provide fuel, or take care of other needs will operate as separate enterprises.

The U.S. Air Force and the U.S. Space Forces

It is an old joke that mechanical engineers create weapons, and civil engineers create targets. During the first Industrial War, the U.S. Civil War, both sides targeted mills whether they were highly automated or not. Even when they were not formal targets, they were buildings of great interest. Almost every community had a mill, and Confederate military leaders often used mills as meeting places.

Many battles are named after the mills nearby, which were important community landmarks. General Sherman's March to the Sea destroyed mills in support of his strategy of leaving behind no resources that could be used by the South. There is a famous story of Roswell, Georgia, where many mills were destroyed. Hundreds of suffering workers had to move north.[3]

In the 1930s, the U.S. Army Aviation Signal Corps created a new military air doctrine based on the experiences of the Civil War, the Great War and the Spanish Civil War.[4] Military forces attacked another nation's industrial strength by flying over entrenched front lines and dropping bombs. General Curtis LeMay played a crucial role in realizing this doctrine in Europe and Japan during World War II and as commander of the Strategic Air Command after the war.

Will commercial space enterprises be like a nation's industrial strength after the Industrial Revolution? Will it help form the basis for a new Space Military Doctrine that will be the focus for a new U.S. Space Force? (See figure 2.)

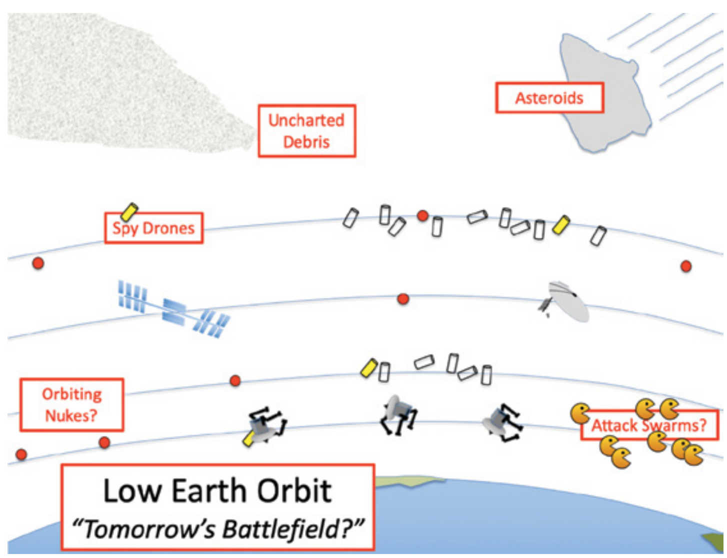


Figure 2: Tomorrow's Battlefield?

We don't know, but here are a few points to consider.

- Maneuvering in space is not the same as the aeronautical flight of a strategic bomber. Orbital dynamics will undoubtedly play as key a role as aerodynamics.
- We do not yet have effective and affordable methods to clear orbital debris. As a result, nations with the ability to wage war in space or near space will have a massive stake in not destroying the industry of their adversaries if that means destroying the use of space for themselves as well.
- Robots are well-suited to working in space: they don't die. However, the fear of space debris and costs associated with life support will force a more subtle approach of spying and pilfering robots. More aggressive robots might take the form of destructive swarms that clean up after themselves.
- Will some nations choose to hide nuclear bombs among the teeming streets of tomorrow's orbital commerce? Previous national security calculations made by governments suggest not.
- Natural dangers such as incoming asteroids will spark a large buildup of orbital and terrestrial defenses that will look a lot like today's global ground-based missile defense system, GMD. Some of these, based on the potential asteroid target, must carry nuclear weapons. But it is most likely these would be launched from the ground using sensors in space to aid targeting.

This article offers no real answers about the future, but I hope it inspires the reader to think about commercial space as the U.S. Space Forces become real.

Charles is an engineer and a pilot who was also a USAF colonel and defense contractor senior manager for several decades. Charles has presented and written extensively on SR-71 inflight refueling, the USAF Space Program, ICBMs, and sustaining complex systems. If you would like more information about Charles or the information in this article, or if you would like him to speak at your event, refer to charlesvono.com.

[1] Oliver Evans and Cadwallader Evans, The Young Mill Wright and Millers Guide (Classic Reprint Series, Andesite Press 2015). The easiest way to find this book is on Amazon.com.

[2] For instance, fiber optic cables with vastly improved range.

[3] See the following link: arkansascivilwar150.com/historical-markers/wartime-gristmill-destruction.

[4] U.S. Government, The Development of Air Doctrine in the Army Air Arm 1917-1941 — Hap Arnold, Chennault, Douhet, Mitchell, Foulois, Drum Board, Alexander de Seversky, General Eaker, World War I and II (USA, independently published in 2017 and sold on Amazon.com).

Innovations in Transportation: Changing Everything About How We Move

Susan Morgan — The newsLINK Group, LLC

Blaine Leonard started his presentation about autonomous cars with the title and subtitle from an editorial that appeared in The Washington Times on Tuesday, May 7, 2019: "Here come the driverless cars. The big question is whether humans are ready to hand over the keys."

The issues, according to the editorial, involve safety and employment. Autonomous cars promise to bring a massive improvement in transportation safety as traffic accidents are reduced, but what will happen to work for people such as truckers and taxi drivers? And will the promised increase in safety be as good as its advocates promise? The U.S. Congress has been slow to act, but states have been working actively to bring smart navigation systems to their streets and highways.

Blaine sees several trends that are transforming transportation:

- The first is a shift in demographics. The population in the U.S. is aging, and millennial attitudes toward driving are often indifferent, with many young people postponing getting a driver's license until they are sometimes much older than 16.
- Big data, and the analytics that make sense of them, are having an impact. Data generally comes from two sources, either from the agency that generated it or as aggregated data from outside sources.
- Mobility as a service is becoming increasingly common throughout the U.S. in the form of ride-sharing, on-demand vehicle rental, and new services such as bicycle or scooter rentals and trip bundling.
- Vehicle propulsion is also changing. The most common is a shift from gas-powered vehicles to electrification and wireless charging, but researchers are also working on alternatives such as hydrogen-powered cars.
- Several forms of connection have become increasingly important. It is now possible for cars to talk vehicle to vehicle (V2V), vehicle to infrastructure (V2I), or vehicle to some other entity (V2X). The other entity could be a bicyclist or a pedestrian.
- Manufacturers are continuing to move incrementally toward driverless cars. Driver assistance (ADAS) is now standard; partial automation and full automation are also becoming more common, either in testing situations or in actual real-world applications.
- Urban air mobility involves the use of flying taxis and autonomous passenger drones.

Automated vehicles use sensor technologies to sense their surroundings and take some (or all) driving functions from the human driver by applying technologies that allow a vehicle to use sensors to gather and analyze data. That is, autonomous cars can "see" thanks to the following:

- GPS
- Radar sensors
- LiDAR
- Digital imagery (cameras)

All these technologies help drivers avoid hazards and drive more efficiently because of what their vehicle has been able to learn about the surrounding environment.

As noted above, the promise of automated driving is fewer crashes, but it also promises increased access to transportation and more efficient freight movement. That is why 80 companies are testing automated driving systems in 36 states.

Improved safety is especially important. Between 2000 and 2018, there have been a total of 37,000 roadway deaths. In 2018, there were 264 deaths. From 2000 to 2012, the number of deaths seemed to be decreasing fairly steadily, but then the trend reversed itself — probably because of an increase in distracted driving.

It's common to see people eating and talking on a cell phone, and although there are many ways to prevent deaths and injuries, most of them require at least a little cooperation on the part of the driver. Nevertheless, many people are doing what they can. Car manufacturers are building structurally safer cars, cities are putting in guardrails at dangerous spots and putting up signs for drivers such as DON'T LOVE YOUR PHONE TO DEATH; DRIVE FOCUSED, and an obviously impaired driver risks being pulled over by a police officer.

The move to autonomous cars is a logical way to prevent people from harming themselves or others while driving. Of the models that can be easily found on the internet, one involves six levels:

- 0: No automation
- 1: Driver assistance
- 2: Partial automation
- 3: Conditional automation
- 4: High automation
- 5: Full automation

Utah is one of the states that has moved aggressively to allow autonomous driving.

When talking about regulation, it's useful to separate it into two parts, the aspects that are controlled on a federal level and those that are controlled on a state level. The federal government is primarily responsible for motor vehicle safety standards (FMVSS), including recalls for malfunctions. In contrast, the state has jurisdiction over laws of operation, such as the speed limit, and matters such as vehicle registration and inspection and emissions tests. The state also controls driver training and licensing and enforcement.

UDOT and UTA have worked together on an automated shuttle pilot program that has been deployed in several locations. The goal has been to give people the chance to see and ride on or in an automated vehicle. Those who have seen the shuttle in action have had a positive experience and therefore trust autonomous vehicles more as a result.

The state is already moving to make roads safer by making the roads smarter. For example:

- UDOT has a successful project on a section of Redwood Road that has been operational since Nov. 2017. The goal is to help buses do a better job of staying on schedule. To accomplish the goal, UDOT has DSRC communication technology on 24 intersections. It uses 802.11 technology in a dedicated 5.9 GHz band. Ten UTA buses also have DSRC. If a bus is five minutes or more behind schedule, the lights can give the bus conditional priority to help the bus move faster and get back on schedule.
- Another project does essentially the same thing for snowplows on five corridors and 55 intersections in the Salt Lake valley. The system has been operational since March 2019. UDOT is currently evaluating the program's effectiveness.
- The Provo-Orem BRT project (UVX) has been implemented on a 10.5-mile corridor. DSRC has been put in place on 47 intersections and 25 buses, and the whole system has been operational since Dec. 3, 2108.

The full deployment of a data ecosystem for connected vehicles won't happen immediately. It is going to take place in distinct phases:

- Phase 1: Data collection
  - Crash/incident detection
  - Weather event data
  - Data visualization
  - Deploy along I-80
- Phase 2: V2I applications
  - Spot weather impact warning
  - Curve speed warning
  - Deploy on:
    - Interstate curves
    - Big Cottonwood curves
    - Near Park City

Roads are currently designed for drivers. Blaine expects that to change as more and more autonomous vehicles are being used. Instead of signs using language and numbers to convey information, signs may eventually move to machine languages such as binary.

Someday it won't matter if someone is eating and talking in the car. They won't even have to be paying attention to what is happening around the vehicle.

That is going to be a good thing.

Blaine D. Leonard, P.E., F.ASCE
Transportation Technology Engineer, Utah DOT. Blaine was the featured speaker of the Engineers Week 2020 Banquet. Read more about him on page 9.

Protecting Innovation Through Patents

Thomas Lingard, J.D.

During World War I, Lieutenant Ernest Tribe of the British Royal Engineers noticed that conventional pipe joints tended to fail at critical times, putting his soldiers in danger. To solve these problems, he devised the grooved pipe coupling. When he returned home in 1919, he filed, in the United States, Great Britain, Canada, and other countries, a patent for a "Pipe Joint," or an early version of the Victaulic coupling, which is the foundation upon which Victaulic was founded. Over the last 100 years, Victaulic has continued to innovate. Indeed, the United States Patent and Trademark Office has issued over 300 patents to Victaulic and its successor companies. Today, many industries around the world use both Victaulic's initial and new coupling designs, including underground mines, surface mines, shaft sinking operations, heavy civil construction, fire suppressant systems, skyscrapers, schools, and many others.

Based at least in part on its patent strategy, Victaulic is a recognized leader in the pipe connection industry. Understanding patents is critical to understanding the success of innovative companies like Victaulic. Business owners, especially in technologically-intensive fields, should understand what can be patented and what should be patented.

What Can Be Patented?

A patent provides the owner with the legal right to exclude others from selling the invention in the nation filed. Poor patent coverage can result in a competitor encroaching on the intended market of the patent. However, before filing a patent, an inventor should know what inventions qualify for patent protection.

The United States Patent Act states that a patent may be granted for "any new and useful process, machine, manufacture, or composition of matter." 35 U.S.C. § 101. This description includes any tangible product, methods to make a product or perform a function, some computer algorithms, and other inventions. A patent application is examined and enforced based on descriptive claims, which describe the metes and bounds of the invention, similar to a mining claim that prevents others from mining inside the staked area. However, much like a bad survey can lead to a mining claim that misses a large portion of an ore deposit, patent claims should be carefully drafted to ensure that the patent covers the entirety of the invention. During patent examination, the claims must describe the invention in a way that it is both novel and nonobvious.

A novel invention has never been disclosed in its exact form before. For example, a patent filed for a "Pipe Coupling" that only includes the features of Victaulic's "Pipe Joint" is not novel based on the "Pipe Joint" patent. Furthermore, any obvious variations on an invention are not patentable. Obvious variations often include combining two known elements into a single product, substituting one known part for another, and finding optimum operating parameters.

Should Be Patented?

Individuals and business owners file patents for many different reasons. Some file patents with an eye toward enforcement through litigation. Others file patents to show investors how innovative their company is. And some simply file patents for the satisfaction and recognition that they were the first to think of an idea. In the end, filing a patent is a business decision, based on the goals, needs, and market of the business. A clear patent strategy will help companies to decide which discoveries they should protect. Two patent strategies are revenue- and investment-focused patent strategies.

A revenue-focused patent strategy directs a company to file patents based on the anticipated revenues of the invention relative to the cost of filing a patent. Patent revenues may come from direct sales of a product associated with the invention. However, other patent revenue paths exist. For example, licensing a patent to a third party will generate revenue through royalties. A revenue-focused patent strategy is typically effective for inventions in emerging markets, where the inventor can sell the invention himself, or where the inventor can license the invention to a third party.

In other examples, as soon as a patent is granted, the owner may sue a competitor that is making, using, selling, or importing the patented invention and receive damages for patent infringement. However, patent infringement litigation is often expensive, with costs regularly reaching hundreds of thousands, or even millions, of dollars. Therefore, a revenue-focused patent strategy is also effective for inventions that have a high market value which can offset the high costs of litigation.

An investment-focused patent strategy directs a company to file patents based on the perceived value by investors. For example, startup companies looking for venture funding may advertise to investors the number of patents, both granted and pending, held by the company. Granted patents indicate to investors that the company has a product that is unique and that competition can be limited. Pending patents indicate to investors that the company is serious, willing to invest in its future, and that the company has a good-faith indication that some portion of the product is novel. Therefore, an investment-focused patent strategy is effective for startups looking to distinguish themselves to receive venture funding.

Additionally, inventions are not new forever. A patent expires 20 years from its filing date. After the patent expires, any person or company may make and sell the invention described in the patent. But, knowing that patents expire, during the patent term, many companies continue to improve upon existing products and develop new technologies. By continued development, an innovative company may continue to establish itself in the market, which can result in the company becoming a leader in the industry for years after the initial patent expires. Established companies may indicate to investors patent filing metrics, including the number of patents owned, filed, and granted during a quarter or year. Patent filing metrics provide investors a measure of the innovativeness of the company. More innovative companies are often viewed as more profitable, which attracts investors. Thus, an investment-focused patent strategy is effective for quickly evolving industries, where innovation is a key driver of success.

Business owners should have an understanding of what can be patented, and have a clear patent strategy to achieve their business' needs and goals. Filing a patent can be the first step in the journey from turning an idea into a multi-national corporation.

Enforcing Patents

The United States Patent and Trademark Office issues patents for new inventions, giving an inventor exclusive rights to market and sell their inventions for up to 20 years. The United States Patent Act states that a patent may be granted for "any new and useful process, machine, manufacture, or composition of matter." (35 U.S.C § 101)

To obtain a patent, an inventor files an application with the United States Patent and Trademark Office. The application includes a set of claims outlining the legal scope of the patent. A patent examiner then examines the claims and compares them to other patents, publications, and other disclosures to determine whether the invention (as described in the claims) is patentable.

If the examiner does not determine that the claimed invention is patentable, the claims may be amended with further clarifications and limitations. The examiner will then review the amended claims, compare them to the prior art, and make a determination regarding patentability. The process may then be repeated until one or more claims are determined to be patentable, and a patent is granted.

After spending the time and money to receive a patent, an inventor may ask: Now what? Many patent owners choose to enforce their patent to prevent others from making and selling their invention.

Patent enforcement comes down to safeguarding the patent owner's market share. This may help to recover the money and effort used to develop the patented invention. Going through the proper processes to establish an effective patent and enforcing it allows the patent owner to be sure that competitors do not reap the rewards of someone else's hard work.

However, patents are not automatically enforced. The patent owner has the responsibility to enforce their patent against infringers, which includes identifying infringers and enforcing the patent against those infringers. First, the patent owner needs to identify potential infringers. Patent owners identify potential infringers in different ways, depending on the market. Infringers of patents for heavy mining equipment may be relatively easily identified, because relatively few companies sell similar pieces of equipment. However, infringers of lower priced goods, such as those sold on Amazon or eBay, may be harder to identify and locate because of the anonymous nature of online sales. Regardless of the market and the nature of the goods protected by the patent, a patent owner can identify potential infringers by monitoring competitors and sales outlets for infringing products.

After identifying the infringer, the patent owner needs to decide what relief they want. For example, the patent owner may require the infringer to pay monetary damages. Monetary damages may allow the patent owner to receive the profit that they would have realized if they had sold the same amount of the patented invention.

Another route is requiring a license from infringers. A license grants another person or business permission to sell the licensed product, in return for a fee or a portion of the profits of the sales. An additional enforcement option is an injunction. An injunction prevents the infringer from selling the patented product. In some situations, enforcement may include a combination of monetary damages, licenses, and injunctions.

In practice, there are several tactics used in patent enforcement, including take-down procedures, cease and desist letters, and patent infringement lawsuits. These tactics may result in one or more of the reliefs discussed above, including monetary damages, licenses, and injunctions. Understanding which enforcement option makes the most sense for the business allows the patent owner to tailor patent enforcement to their individual needs.

1. Take-Down Procedures

   Business owners selling items online through retailers such as Amazon and eBay may file requests with the retailer to take down infringing products. Some retailers require the patent owner to register the patent with the retailer, and to submit a form for each allegedly infringing product. An employee will then compare the allegedly infringing product with the patent, and determine if the product should be banned from being sold on their website. While not official court proceedings, the take-down procedures for online retailers are often a first step in patent enforcement, especially for small business owners.

2. Cease and Desist Letter

   In some situations, take-down procedures from online retailers may be insufficient to stop infringement or may not be effective for certain infringers, such as those selling the infringing product from their own website or a brick-and-mortar retail store. A cease and desist letter sent to the company selling the infringing goods is an informative letter. The letter gives the competitor the benefit of the doubt while simultaneously serving as a warning of legal consequences if they do not comply. This option can work well for patent owners hoping to avoid costly legal battles.

3. Filing a Lawsuit

   A patent infringement lawsuit may be filed against the infringing company. Lawsuits are expensive and time consuming. As such, they may provide the most value when based on a patent with high profits, so that the damages and/or licensing revenue is greater than the cost of the lawsuit. Furthermore, large companies are typically more able to afford an expensive and lengthy litigation. However, the relief offered by lawsuits has the full weight and force of the law behind it. This means that a judgment from a lawsuit (after appeals are exhausted) is final, and the infringing company has to abide by the judgment, or face legal penalties.

In summary, enforcement is crucial to maintaining patent rights. Furthermore, patent enforcement allows the patent owner to maintain full control of their proprietary invention throughout the entire life of the patent.

Thomas Lingard, a registered patent attorney at Ray Quinney & Nebeker, specializes in preparing and prosecuting domestic and foreign patent applications in a variety of technological areas, including heavy material handling equipment, drill bits, metallurgical engineering, materials science, additive manufacturing, rotary steerable systems, downhole power generation and distribution, medical devices, and exercise equipment. Thomas has experience in identifying products that potentially infringe his client's patents, as well as preparing patentability and patent infringement opinions. Prior to becoming an attorney, Thomas worked at several mines across the United States and Canada in underground tunneling, shaft sinking, and heavy civil construction.

PAGES FROM UEC HISTORY

YEAR	ENGINEER OF THE YEAR	ORGANIZATION	NOMINATING SOCIETY
1962	JOHN SIMONSEN	VALTEK, INC.	
1962	KEN PAULSON	CONSULTING ENGINEER	
1969	ALLEN HUNTER	UTAH POWER & LIGHT	
1969	ART V. MAXWELL	MAXWELL CONSULTING ENGINEERS	
1972	RALPH ROLLINS	BRIGHAM YOUNG UNIVERSITY	
1973	R. GILBERT MOORE	THIOKOL CORP.	
1974	EDWARD G. DORSEY	THIOKOL CORP.	
1975	SIDNEY J. GREEN	TERRA TEK, INC.	
1976	JOHN C. LARSON	KENNECOTT CORP.	
1977	CHARLES L. BATES	VALTEK, INC.	
1978	LESLIE D. LASH		
1979	DAVID C. EVANS	EVANS & SUTHERLAND	
1980	D. ALLEN FIRMAGE	BRIGHAM YOUNG UNIVERSITY	
1981	ALBERT RICHARDS	CRS CONSULTING ENGINEERS	
1982	KAY D. BAKER	UTAH STATE UNIVERSITY	
1983	E. BILLINGS PATTEN	GENEVA STEEL	
1984	L. R. (REX) MEGILL	UTAH STATE UNIVERSITY	
1985	EDMUND WILLIAM ALLEN	E. W. ALLEN & ASSOCIATES	
1986	THOMAS STOCKHAM	UNIVERSITY OF UTAH	
1987	ALLAN J. MCDONALD	THIOKOL CORP.	
1988	JACK KELLER		
1989	FRANKLIN D. WAREHAM	ENERGY NATIONAL, INC.	
1990	DR. LAWRENCE D. REAVELEY	REAVELEY ENGINEERS & ASSOCIATES	
1991	DAVID ECKHOFF	ECKHOFF, WATSON, & PREATOR ENGINEERING	
1992	WALTER V. JONES, P.E.	TERRACON CONSULTANTS, WESTERN INC.	
1993	J. HOWARD VAN BOERUM, P.E.	VAN BOERUM & FRANK ASSOCIATES, INC.	
1994	ROBERT VAN ORMAN, P.E.	OGDEN AIR LOGISTICS CENTER	
1995	ROGER BOISJOLY, P.E.	BOISJOLY ENGINEERING. LTD.	
1996	DR. STEPHEN C. JACOBSEN	SARCOS, INC.	
1997	BRUCE BARRETT, P.E.	U. S. BUREAU OF RECLAMATION	
1998	CARL H. CARPENTER, P.E.	GROUND WATER CONSULTANT	
1999	JAMES BAILEY, S.E.	ALLEN & BAILEY ENGINEERS	
2000	WILLIAM LUCE, P.E.	HANSEN, ALLEN & LUCE, INC.	
2001	RONALD REAVELEY, S.E.	REAVELEY ENGINEERS	
2002	C. LEWIS WILSON, P.E.	HEATH ENGINEERING COMPANY	
2003	ERIC M. KANKAINEN, P.E., S.E.	CALDER-KANKAINEN ENGINEERS	
2004	RACHEL A. B. MCQUILLEN, P.E.	URS CORPORATION	
2005	MICHAEL W. COLLINS, P.E.	BOWEN, COLLINS & ASSOCIATES	
2006	PAUL C. SUMMERS, P.E.	MWH AMERICAS, INC.	
2007	BARRY K. ARNOLD	ARW ENGINEERS	
2008	JULIE OTT	ABSG CONSULTING, INC.	
2009	BLAINE LEONARD	STATE OF UTAH	
2010	DAN CHRISTENSON	HILL AFB	
2011	V. JOHN MATHEWS	IEEE	
2012	BRENT MAXFIELD	THE CHURCH OF JESUS CHRIST OF LATTER-DAY SAINTS	
2013	JIM SCHWING	CH2MHILL	
2014	CYNTHIA FURST		
2015	DR. DAVID WILLIS		

YEAR	ENGINEER OF THE YEAR	ORGANIZATION	NOMINATING SOCIETY
2016	JEFFREY T. MILLER, SE	REAVELEY ENGINEERS	SEAU
2017	JUSTIN NASER		SEAU
2018	BRENT WHITE	ARW ENGINEERS	SEAU
2019	GEORGE HANSEN	CONDUCTIVE COMPOSITES	SAMPE

YEAR	EDUCATOR OF THE YEAR	ORGANIZATION	NOMINATING SOCIETY
1969	DR. DEAN K. FUHRIMAN	BRIGHAM YOUNG UNIVERSITY	
1973	DR. WAYNE S. BROWN	UNIVERSITY OF UTAH	
1975	DR. L. DOUGLAS SMOOT	BRIGHAM YOUNG UNIVERSITY	
1976	DR. L. M. OLSEN	UNIVERSITY OF UTAH	
1987	DR. LAVERE MERRITT	BRIGHAM YOUNG UNIVERSITY	
1988	DR. ROBERT F. BOEHM	UNIVERSITY OF UTAH	
1989	DR. KENNETH L. (LARRY) DEVRIES	UNIVERSITY OF UTAH	
1990	DR. CARL H. DURNEY	UNIVERSITY OF UTAH	
1991	DR. STANLEY W. CRAWLEY	UNIVERSITY OF UTAH	
1992	DR. GARY SANDQUIST	UNIVERSITY OF UTAH	
1993	DR. A. WOODRUFF MILLER	BRIGHAM YOUNG UNIVERSITY	
1994	DR. LOREN ANDERSON	UTAH STATE UNIVERSITY	
1995	DR. T. LESLIE YOUD	BRIGHAM YOUNG UNIVERSITY	
1996	DR. HOSIN LEE	UNIVERSITY OF UTAH	
1997	DR. LAWRENCE D. REAVELEY	UNIVERSITY OF UTAH	
1998	DR. CHRIS P. PANTELIDES	UNIVERSITY OF UTAH	
1999	DR. CHRIS P. PANTELIDES	UNIVERSITY OF UTAH	
2000	DR. KYLE ROLLINS	BRIGHAM YOUNG UNIVERSITY	
2001	DR. JOANN S. LIGHTY	UNIVERSITY OF UTAH	
2002	DR. DAVID W. PERSHING	UNIVERSITY OF UTAH	
2003	DR. J. CLAIR BATTY	UTAH STATE UNIVERSITY	
2004	DR. DAVID P. WIDAUF	UTAH STATE UNIVERSITY	
2005	DR. EVERT C. LAWTON	UNIVERSITY OF UTAH	
2006	DR. CHRISTINE E. HAILEY	UTAH STATE UNIVERSITY	
2007	DR. MARC BODSON	UNIVERSITY OF UTAH	
2008	DR. PAUL TIKALSKY	UNIVERSITY OF UTAH	
2009	STEPHEN ANTHONY WHITMORE	UTAH STATE UNIVERSITY	
2010	DR. BRIAN DAVID JENSEN	BRIGHAM YOUNG UNIVERSITY	
2011	DR. JOHN E. SOHL	WEBER STATE UNIVERSITY	
2012	PAUL TIKALSKY	UNIVERSITY OF UTAH	
2013	JERRY BOWMAN	BRIGHAM YOUNG UNIVERSITY	
2014	KIMBERLY ROBINSON		
2015	DR. KEVIN FRANKE, P.E.	BRIGHAM YOUNG UNIVERSITY	
2016	AMANDA D. SMITH, PH.D.	UNIVERSITY OF UTAH	ASHRAE
2017	DR. PAUL BARR		ASCE
2018	DR. MASOOD PARVANIA	UNIVERSITY OF UTAH PROFESSOR	IEEE
2019	DR. GRANT SHULTZ	BYU PROFESSOR & ASSOCIATE CHAIR,	ITE

YEAR	UEC SERVICE AWARD	ORGANIZATION
1972	J. DEAN HILL, SR.	TERRA ENGINEERING, TERRACOR, INC.
1975	KENNETH W. RANDLE	SPERRY CORP.
1976	GRANT K. BORG	UNIVERSITY OF UTAH
2013	JIM THACHER	
2018	CHARLES VONO	

YEAR	UEC CHAIRPERSONS	ORGANIZATION	MEMBER SOCIETY
1950-1951	J. VERNON SHARP	SHARP ELECTRIC CO.	
1956-1957		U.S. BUREAU OF RECLAMATION	
1957-1958	R. L. SLOAN		
1958-1959	CLEM FERGUSON		
1959-1960	MILTON B. THACKER		
1960-1961	DAVID CURTIS	CONSULTING ENGINEER	
1961-1962	VERN PROCTOR	CONSULTING ENGINEER	
1962-1963	FLOYD GARN HATCH	SPERRY CORP.	
1963-1964	BLAINE BRADFORD	KENNECOTT CORPORATION	
1965-1966	HAROLD TADJE	AMOCO OIL COMPANY	
1966-1967	JOHN LIMBURG	AMOCO OIL COMPANY	
1971-1972	REUBEN BARIL	HERCULES	
1972-1973	JERALD HARVEY	UTAH POWER & LIGHT	
1973-1974	D. ALLEN FIRMAGE	BRIGHAM YOUNG UNIVERSITY	
1974-1975	KENNETH W. RANDLE	SPERRY CORP.	
1975-1976	G. REED MARCHANT	KENNECOTT CORP.	
1976-1977	WILLIAM J. (BIFF) KENNEDY	UNIVERSITY OF UTAH	
1977-1978	MAHONRI FABER ELECTED (DID NOT SERVE)	MOUNTAIN FUEL SUPPLY	
1977-1978	WILLIAM J. (BIFF) KENNEDY SERVED SECOND YEAR	UNIVERSITY OF UTAH	
1978-1979	GEORGE C. TOLAND	DAMES & MOORE	
1979-1980	WELDON L. DAINES	HERCULES	
1980-1981	MARLO MENLOVE	UTAH POWER & LIGHT	
1981-1982	EUGENE CHANTRY	NAVAL PLANT BRANCH-HERCULES	
1982-1983	GEORGE ROTH	UTAH POWER & LIGHT	
1983-1984	J. FRANK (TAD) BONELL	ESI ENGINEERING	
1984-1985	JOSEPH MCBRIDE	UTAH DEPT OF TRANSPORTATION	
1985-1986	W. CLEON ANDERSON	SPERRY CORP.	
1986-1987	JAMES DENNEY	BUSH & GUDGELL	
1987-1988	DEAN L. WEBB	DEAN L. WEBB & ASSOCIATES	
1988-1989	TIMOTHY P. HARPST	SLC CORP DIV. OF TRANSPORTATION	
1989-1990	GEORGE H. CONOVER	FORD, BACON, & DAVIS	
1990-1991	MICHAEL COLLINS	CH2M HILL	
1991-1992	DIETRICH K. GEHMLICH	UNIVERSITY OF UTAH	
1992-1993	GREG SWARTZ ELECTED (SERVED FIRST MEETING AND MOVED OOT OF STATE)	FORD, BACON, & DAVIS	
1992-1993	BLAINE LEONARD ELECTED TO FILL VACANCY	STRATA CONSULTANTS	
1993-1994	KIRAN BHAYANI	STATE OF UTAH, DIV. OF ENV. QUALITY	
1994-1995	BRUCE SPIEGEL	UTAH STATE RISK MANAGEMENT	
1995-1996	RONALD K. WOODLAND	LORAL CORPORATION	
1996-1997	JAMES L. SZATKOWSKI	J. L. SZATKOWSKI CONSULTING ENGINEERS	
1997-1998	DAVID B. MERRILL	THE CHURCH OF JESUS CHRIST OF LATTER-DAY SAINT, A&E SERVICES	
1998-1999	NORM BENNION	R&M ENGINEERING CONSULTANTS	
1999-2000	SAM LOVE	LOVE ENGINEERING	
2000-2001	BEN DAVIS	VAN BOERUM & FRANK ASSOCIATES	
2001-2002	SARAH WINKLER	EASE, INC.	
2002-2003	CARL COOK	RB&G ENGINEERING, INC.	
2003-2004	JEFF WATKINS	VAN BOERUM & FRANK ASSOCIATES	
2004-2005	LINDA BACHMEIER	CHEVRON TEXACO COMPANY	
2005-2006	PAUL OESTREICH	MORRISS O'BRYANT COMPAGNI	
2006-2007	DALE BENNETT	BENCHMARK ENGINEERING & LAND SURVEYING	

YEAR	UEC CHAIRPERSONS	ORGANIZATION	MEMBER SOCIETY
2007-2008	MICHAEL NORRIE	MWH AMERICAS, INC.	
2008-2009	TRENT HUNT	TRANE	
2009-2010	MICHAEL BUEHNER	REAVELEY ENGINEERS & ASSOCIATES	
2010-2011	JOSEPH MARTONE	HILL AIR FORCE BASE	
2011-2012	PETER TANG	UTAH DEPT OF TRANSPORTATION	
2012-2013	JOHN RICHARDSON	VARIAN	
2013-2014	DAVID CLINE	UINTA ENVIRONMENTAL	
2014-2015	ROBERT KESLER	HEATH ENGINEERING	ACEC
2015-2016	BRIAN WARNER	MCNEIL ENGINEERING	ASCE
2016-2017	CHARLES VONO	RETIRED	AIAA
2017-2018	JED LYMAN		ASPE
2018-2019	ROBERTA SCHLICHER		

YEAR	ENGINEERS WEEK SPEAKER	ORGANIZATION
1961	DR. J. D. WILLIAMS	UNIVERSITY OF UTAH, PROFESSOR OF POLITICAL SCIENCE
1962	CLEON SKOUSEN	FORMER SLC CHIEF OF POLICE, LECTURER
1963	ELMER J. TANGERMAN	PRODUCT ENGINEERING, EDITOR
1971	DR. SIMON RAMO	THOMPSON, RAMO, & WOOLRIDGE (TRW)
1972	DR. RICHARD E. CHADDOCK	HERCULES, EXECUTIVE COORDINATOR OF ENVIRONMENTAL HEALTH
1973	THOMAS M. FISCHER	GENERAL MOTORS, EXECUTIVE ENGINEER
1974	DR. WILLIAM NORDBERG	NASA GODDARD SPACE FLIGHT CENTER CHIEF, LABORATORY FOR METROLOGY AND EARTH SCIENCES
1975	DR. JOHN R. KIELY	BECHTEL CORPORATION EXECUTIVE ENGINEERING CONSULTANT
1976	DR. JERRY GREY	U. S. CONGRESS OFFICE OF TECHNOLOGY ASSESSMENT, CHAIRMAN OF SOLAR POWER ADVISORY PANEL, AND A1AA PUBLIC POLICY
1977	DR. LARRY LATTMAN	UNIVERSITY OF UTAH, DEAN COLLEGE OF MINES AND MINERAL INDUSTRIES
1978	JOHN VIEHWIG	NORTHWEST ALASKA PIPELINE CO., CHIEF ENGINEER
1979	COL. BEN POLLARD	USAF, CMDR. USAF ACADEMY PREP SCHOOL
1980	DR. HENRY EYRING	UNIVERSITY OF UTAH, PROFESSOR OF CHEMISTRY AND METALLURGY
1981	HARRY BLUNDELL	UTAH POWER & LIGHT COMPANY, CHAIRMAN OF THE BOARD
1982	DANIEL MILLER	U. S. ASSISTANT SECRETARY FOR ENERGY AND MINERALS
1983	COL. ZANE FINKELSTEIN	U.S. ARMY, DIRECTOR INTERNATIONAL LAW STUDIES, U.S. ARMY WAR COLLEGE
1984	GERALD G. PROBST	SPERRY CORPORATION, CHAIRMAN AND CEO
1985	WILLIAM L. GORE	W. L. GORE & ASSOCIATES, CHAIRMAN OF THE BOARD
1986	KATHY WOOD LOVELESS	KIRCHER MOORE & COMPANY, VICE PRESIDENT
1987	DR. DAVID C. EVANS	EVANS & SUTHERLAND, CHAIRMAN OF THE BOARD
1988	TED WILSON	DIRECTOR OF THE HINCKLEY INSTITUTE, FORMER MAYOR OF SALT LAKE CITY
1989	KATHLEEN F. HARER	NASA KENNEDY SPACE CENTER, CHIEF INDUSTRIAL SAFETY BRANCH
1990	PAT SHEA	SLC OLYMPIC WINTER GAMES-TRUSTEE AND SPEAKER, GENERAL COUNSEL TO KUTV, KALL/KLCY RADIO
1991	DR. STEPHEN C. JACOBSEN	UNIVERSITY OF UTAH, DIRECTOR OF THE CENTER FOR ENGINEERING DESIGN AND PROFESSOR OF MECHANICAL ENGINEERING
1992	R. GILBERT MOORE	UTAH STATE UNIVERSITY, ADJUNCT PROFESSOR OF PHYSICS AND SENIOR RESEARCH ASSOCIATE, SPACE DYNAMICS LABORATORY
1993	DR. WILLIAM E. THORNTON	NASA SCIENTIST-ASTRONAUT
1994	OLENE S. WALKER	LT. GOVERNOR, STATE OF UTAH
1995	DIANNE NIELSON	STATE OF UTAH, EXEC. DIR. DEPT. OF ENVIRONMENTAL QUALITY
1996	BARNEY JURICA	VP LEHI OPERATIONS-MICRON TECHNOLOGIES
1997	DR. STEPHEN C. JACOBSEN	UNIVERSITY OF UTAH, DIRECTOR OF THE CENTER FOR ENGINEERING DESIGN AND CHAIRMAN AND CEO OF SARCOS, INC.
1998	ROBERT A. HUNTER	DIRECTOR OF COMMUNITY AFFAIRS FOR THE SALT LAKE ORGANIZING COMMITTEE FOR THE OLYMPIC WINTER GAMES OF 2002

YEAR	ENGINEERS WEEK SPEAKER	ORGANIZATION
1999	DR. ROBERT HINCHEE	SENIOR TECHNICAL MANAGER FOR BIOREMEDIATION, PARSONS ENGINEERING
2000	ENTERTAINMENT	SWINGNJIVE BAND
2001	DR. SUZANNE WINTERS	UTAH STATE SCIENCE ADVISOR
2001	JAMES JENSEN	CH2MHILL
2002	GUITARIST	GEOF GALBRAITH, HILL AFB
2003	GUITARIST	GEOF GALBRAITH, HILL AFB
2004	GUITARIST	GEOF GALBRAITH, HILL AFB
2004	DAVID P. WIDAUF	UTAH STATE UNIVERSITY ASSOC. PROFESSOR
2005	GUITARIST	GEOF GALBRAITH, HILL AFB
2005	RONALD D. DITTEMORE	PRESIDENT, ATK THIOKOL, INC.
2006	STAN CHECKETTS	S & S WORLDWIDE, INC.
2007	DR. STEPHEN C. JACOSEN	UNIVERSITY OF UTAH, DIRECTOR OF THE CENTER FOR ENGINEERING DESIGN AND CHAIRMAN AND CEO OF SARCOS, INC.
2008	DAVID HART	CAPITOL PRESERVATION BOARD
2009	DR. DAVY BELK	OGDEN AIR LOGISTICS CENTER, HILL AFB
2010	KENT V. ROMINGER	ATK SPACE SYSTEMS GROUP
2011	JOHN NJORD	UTAH DEPARTMENT OF TRANSPORTATION
2012	LANE BEATTIE	SALT LAKE CHAMBER OF COMMERCE
2013	RICHARD B. BROWN, PH.D.	DEAN OF THE COLLEGE OF ENGINEERING, UNIVERSITY OF UTAH
2014	JOHN WARNOCK, PH.D.	ADOBE
2015	MATT BEAUDRY	SECTION MANAGER, DIVISION OF EMERGENCY MANAGEMENT, UTAH DEPARTMENT OF PUBLIC SAFETY
2016	BRYCE GIBBY	DIRECTOR OF BUSINESS DEVELOPMENT AT KEMP DEVELOPMENT, INC.
2017	MARTIN FREY	CISCO, GOED UTAH AND SEVENT SUMMITS, SEVEN SEAS
2018	DR. KERRY KELLY	
2019	NATE WALKINGSHAW	CHIEF EXPERIENCE OFFICER, PLURALSIGHT

YEAR	SCHOLARSHIP AWARDS	ORGANIZATION
1993	DAVID CASSETT	UNIVERSITY OF UTAH
1994	JOHN COATES	UNIVERSITY OF UTAH
1994	CURTIS BLANCHARD	UTAH STATE UNIVERSITY
1994	KORRIE BERGMAN	BRIGHAM YOUNG UNIVERSITY
1995	R. VAUGHN PETERSON	BRIGHAM YOUNG UNIVERSITY
1995	LINDA BOLIN	MESA MATH TEACHER AWARD
1996	JONATHON FRANCOM	UTAH STATE UNIVERSITY
1997	ROBERT WALDRON	UNIVERSITY OF UTAH
1998	JEFF BRIMHALL	BRIGHAM YOUNG UNIVERSITY
1999	JEFFREY D. HODSON	UTAH STATE UNIVERSITY
2000	SARA ANDERSON	UNIVERSITY OF UTAH
2001	ANDREW EBO DADSON	BRIGHAM YOUNG UNIVERSITY
2002	SPENCER FUGAL	UTAH STATE UNIVERSITY
2003	RYAN GRIFFITH	UNIVERSITY OF UTAH
2004	AIMEE WORTHEN	BRIGHAM YOUNG UNIVERSITY
2005	RANDALL S. CHRISTENSEN	UTAH STATE UNIVERSITY
2005	DAVID SCOTT MANSELL	UNIVERSITY OF UTAH
2005	NICOLE CHRISTINA GIULLIAN	BRIGHAM YOUNG UNIVERSITY
2006	HEATHER BURNHAM	BRIGHAM YOUNG UNIVERSITY
2006	WILLIAM SCOTT LEE	UNIVERSITY OF UTAH
2006	JOSHUA HIRSCHI	UTAH STATE UNIVERSITY
2007	ROSE WIELAND	BRIGHAM YOUNG UNIVERSITY

YEAR	SCHOLARSHIP AWARDS	ORGANIZATION
2007	AZADEH POURSAID	UNIVERSITY OF UTAH
2007	ELISABETH LINTON	UTAH STATE UNIVERSITY
2008	SPENCER HARDING	BRIGHAM YOUNG UNIVERSITY
2008	PETER SOMMERKORN	UNIVERSITY OF UTAH
2008	ERIC MONSON	UTAH STATE UNIVERSITY
2009	CORY LARSEN	UTAH STATE UNIVERSITY
2009	MATTHEW SORENSEN	BRIGHAM YOUNG UNIVERSITY
2009	DAVID WILLIAMS	UNIVERSITY OF UTAH
2010	MARINA SAMUELS	BRIGHAM YOUNG UNIVERSITY
2010	JACOB WARNER	UNIVERSITY OF UTAH
2010	ALEX HATCH	UTAH STATE UNIVERSITY
2011	BRITTIN BENNETT	UTAH STATE UNIVERSITY
2011	ROBERT SOWBY	BRIGHAM YOUNG UNIVERSITY
2011	PATRICK LOFTUS	UNIVERSITY OF UTAH
2012	MITCH DABLING	UTAH STATE UNIVERSITY
2012	TEVE LAWSON	UNIVERSITY OF UTAH
2012	JORDAN TANNER	BRIGHAM YOUNG UNIVERSITY
2013	HECTOR PARRA	BRIGHAM YOUNG UNIVERSITY
2013	ANNIKA CARTER	UNIVERSITY OF UTAH
2013	NATHANIEL DECKER	UTAH STATE UNIVERSITY
2013	JOE WESLEY MAHURIN	GERALD PIELE SCHOLARSHIP - WEBER STATE
2014	BRADEN HANCO	BRIGHAM YOUNG UNIVERSITY
2014	REN GIBBONS	UTAH STATE UNIVERSITY
2014	MENA WENG	UNIVERSITY OF UTAH
2014	EVAN CHIEF	GERALD PIELE SCHOLARSHIP - WEBER STATE
2015	CHLOE ROEDEL	BRIGHAM YOUNG UNIVERSITY
2015	PARKER BASSETT	UTAH STATE UNIVERSITY
2015	ANDY GILBERT	UNIVERSITY OF UTAH
2015	ROSE BLOOMQUIST	GERALD PIELE SCHOLARSHIP - WEBER STATE
2016	ERICA GUTHRIE	GERALD PIELE SCHOLARSHIP - WEBER STATE
2016	WILL ANDERL	UNIVERSITY OF UTAH
2016	BRAD SILER	UTAH STATE UNIVERSITY
2016	MATT ANDERSON	BRIGHAM YOUNG UNIVERSITY
2017	SHARON DANSIE	GERALD PIELE SCHOLARSHIP - WEBER STATE
2017	LANDON FOUST	WEBER STATE UNIVERSITY
2017	RAPHAEL CHANUT	UNIVERSITY OF UTAH
2017	SHALANA THOMPSON	UNIVERSITY OF UTAH
2017	MITCH SHEPHERD	UNIVERSITY OF UTAH
2017	JOSHUA PRATT	UNIVERSITY OF UTAH
2017	JEFFREY SMITH	BRIGHAM YOUNG UNIVERSITY
2017	CRAIG MAUGHAN	BRIGHAM YOUNG UNIVERSITY
2017	JOSHUA MCCLELLAN	BRIGHAM YOUNG UNIVERSITY
2017	CHRISTIAN MORRILL	UTAH STATE UNIVERSITY
2017	JAY JACKSON MATSEN	UTAH STATE UNIVERSITY
2017	SETH THOMPSON	UTAH STATE UNIVERSITY
2017	DANIEL ULRICH	SOUTHERN UTAH UNIVERSITY
2018	CORY GOATES	UTAH STATE UNIVERSITY
2018	NATHAN GUYMON	UTAH STATE UNIVERSITY
2018	SYDNEY TAYLOR	UTAH STATE UNIVERSITY
2018	DILLON (DEWEY) POTTS	BRIGHAM YOUNG UNIVERSITY
2018	ALICIA DIBBLE	UNIVERSITY OF UTAH
2018	SHERRY MASUTANI	WEBER STATE UNIVERSITY
2018	JACOB BROWN	UNIVERSITY OF UTAH

YEAR	SCHOLARSHIP AWARDS	ORGANIZATION
2018	LANDON CROWTHER	UNIVERSITY OF UTAH
2018	AMBER BARRON	UNIVERSITY OF UTAH
2018	VICTORIA KRULL	SOUTHERN UTAH UNIVERSITY
2018	HANNAH CRAWFORD	UNIVERSITY OF UTAH
2018	MITCH SHEPHERD	UNIVERSITY OF UTAH
2018	WILLIAM JOHSTON	SOUTHERN UTAH UNIVERSITY
2019	JORDAN DEMANN	UNIVERSITY OF UTAH
2019	DANIEL KADE DERRICK	UTAH STATE UNIVERSITY
2019	BRYSON GOLIGHTLY	BRIGHAM YOUNG UNIVERSITY
2019	KYLER HANSEN	WEBER STATE UNIVERSITY
2019	SETH HUBER	BRIGHAM YOUNG UNIVERSITY
2019	SKYLER IPSEN	SOUTHERN UTAH UNIVERSITY
2019	ANDREW JUE	UNIVERSITY OF UTAH
2019	JOSEPH LYMAN	UNIVERSITY OF UTAH
2019	KATHRYN MARGETTS	UTAH STATE UNIVERSITY
2019	KYLE MAY	BRIGHAM YOUNG UNIVERSITY
2019	GABRIEL MENSINGER	UNIVERSITY OF UTAH
2019	NICOLE MORTENSEN	UNIVERSITY OF UTAH
2019	ROCHELLE PLAZIER	UNIVERSITY OF UTAH
2019	WALLIS SCHOLL	UNIVERSITY OF UTAH
2019	SABRINA SNOW	UTAH STATE UNIVERSITY
2019	GINA YOUNG	BRIGHAM YOUNG UNIVERSITY
2019	SAMANTHA BEATTY	UNIVERSITY OF UTAH
2019	C. GORDON KOU	UNIVERSITY OF UTAH

YEAR	MESA TEACHER OF THE YEAR	ORGANIZATION
1998	WAISEA LESUMA	KEARNS JUNIOR HIGH SCHOOL
1999	LINDA BOLIN	VALLEY JUNIOR HIGH SCHOOL
2000	AMY TREANOR	EAST HIGH SCHOOL
2000	NANCY CLARK	NORTHRIDGE HIGH SCHOOL
2001	VICTORIA FISHER	GLENDALE MIDDLE SCHOOL
2002	ELAINE FUKUSHIMA	HUNTER HIGH SCHOOL
2003	JOHN G. PETERSON	JOHN F. KENNEDY JUNIOR HIGH
2004	JELENA JENSEN	GRANGER HIGH SCHOOL
2005	SHEREE CHRISTENSEN	VALLEY JUNIOR HIGH SCHOOL
2006	MELAMENE WONG	EISENHOWER JUNIOR HIGH
2007	CHERYL DEARING	CLARK N. JOHNSON JR. HIGH SCHOOL, TOOLE DIST.
2008	JENNIFER HOWELL	SOUTH JORDAN MIDDLE SCHOOL
2009	SHAUNA CROPPER	JOHN F. KENNEDY JUNIOR HIGH
2010	CATHERINE MCDONALD	COTTONWOOD HIGH SCHOOL
2011	MATTHEW LUND	COPPER HILLS HIGH SCHOOL
2012	BLAINE PETERSEN	GRANITE PARK JUNIOR HIGH SCHOOL
2014	ANDY MARKS	
2015	JORGE IBANEZ	
2016	BECKY DUNLEAVY	BOUNTIFUL JUNIOR HIGH, DAVIS SCHOOL DISTRICT
2017	TAMI PANDOFF	E. G. KING ELEMENTARY, DAVIS SCHOOL DISTRICT
2018	CARLY STIRLAND	OQUIRRH HILLS MIDDLE SCHOOL
2019	ERIN HARRISON	

YEAR	FRESH FACES OF ENGINEERING	ORGANIZATION	SOCIETY
2003	CAPT. TRACEY SPIELMANN	HILL AIR FORCE BASE	
2004	STEPHANNIE D. MECHAM	DEPARTMENT OF THE U,S. NAVY	
2005	CYNTHIA E. LEE	ATK THIOKOL, INC.	

YEAR	FRESH FACES OF ENGINEERING	ORGANIZATION	SOCIETY
2006	STEVE R. MAUGHAN	FMC TECHNOLOGIES	
2007	ALICESON NICOLE DUSANG	UNITED STATES AIR FORCE	
2008	JUSTIN NADAULD	REAVELEY ENGINEERS AND ASSOCIATES	
2009	MARTIN OLSON	(ASCE)	ASCE
2010	LT. KATHERINE MARRON	HILL AIR FORCE BASE	
2011	JEFFREY CHRISTENSEN	(ASME)	ASME
2012	DALLIN PETERSEN	(SEAU)	SEAU
2013	PHIL JANKOVICH	ASHRAE	ASHRAE
2014	STEVEN LORD	ITE	ITE
2015	PRASAD WEERAKOON	ASME	ASME
2016	RACHEL OBERG	MERIT MEDICAL SYSTEMS	SWE
2017	JAKE MERRELL		SAMPE
2018	IAN KLOSOWIAK	KLOS INNOVATIONS LLC	SAMPE
2019	JORDAN OLDROYD	ISOTRUSS INDUSTRIES LLC	SAMPE

YEAR	UEC LIFETIME ACHIEVEMENT AWARD
2008	KENNETH RANDLE
2010	WAYNE CLARK PETERSON
2013	JIM THACHER

UTAH ENGINEERS COUNCIL

ROSTER

2019-2020

www.utahengineerscouncil.org

UEC'S MISSION

To advance the art and science of engineering
for the general welfare of the people of Utah.

COUNCIL OFFICE

Carla Humes
4049 South Highland Drive
Millcreek, UT 84124
801-676-9722

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Paul White, INCOSE

UTAH ENGINEERS COUNCIL

MEMBER SOCIETIES

2019-2020

www.utahengineerscouncil.org

AAEES
American Academy of Environmental Engineers and Scientists
Status: Active
Members:
Elections:
Meetings:

State Representative/UEC Representative:
Dannie Pollock

ACEC Utah
American Council of Engineering Companies of Utah
Status: Active
Members: 100
Elections: May
Meetings: Second Wednesday of each month
Website: https://www.acecutah.org/
3222 West Bigarade Lane
Taylorsville, Utah 84129

President
Kerry Ruebelman P.G.

VP or Vice Chair
Michael Lasko P.E.

Secretary
Michael Smith

Treasurer
Diego Carroll P.E.

UEC Representative
Michael Smith

AIAA
American Institute of Aeronautics and Astronautics
Status: Active
Members: 300
Elections: July
Meetings: First Thursday of each month at 4 p.m.
Website:
https://info.aiaa.org/Regions/Western/Utah/default.aspx

Chair
John Metcalf

Vice Chair
Dr. Jessica Piness

Secretary
Spence Shupe

Treasurer
Mark Snaufer

UEC Representative
John Metcalf

ASCE Utah Section
Utah Section of the American Society of Civil Engineers
Status: Active
Members: 1661
Elections: Appointment by president
Meetings: First Thursday of each month via web-meeting
Website: asceutah.com
1657 East 410 South
Spanish Fork, Utah 84660

President
Michael Lasko P.E.

VP or Vice Chair
Brent Jensen P.E.

Secretary — Treasurer
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UEC Representative
Daniel Canning

Treasurer
Diego Carroll P.E.

UEC Alternate Representative
Michael Smith

ASHRAE
American Society of Heating, Refrigerating and Air-Conditioning Engineers
Status: Active
Members: 330
Elections: In June
Meetings: First Friday of each month
Website: https://utahashrae.org
3798 south 2700 East
Salt Lake City, Utah 84109

President
Mike Dallon

VP or Vice Chair
Cameron Scott

Secretary
Jarrett Capstick

Treasurer
David W. Griffin II

UEC Representative
Dallen Romriell

ASM
American Society of Metals
Status: Active
Members: 65
Elections:
Meetings: Third Thursday of each month
Website:
https://www.asminternational.org/web/utah-chapter
P.O. Box 150581
Ogden, Utah 84415

President
Amber Dalley

VP or Vice Chair
Dr. Sheila Harper

Secretary
Brett Fuller

Treasurer
Scott Gleed

ASPE
American Society of Plumbing Engineers
Status: Active
Members: 33
Elections: Legislative
Meetings: Third Tuesday of each month, September to May
Website: http://aspeintermountain.org
330 South 300 East
Salt Lake City, Utah 84111

President or Chair
Nick Allred

VP or Vice Chair
Kyle Sorensen

Secretary
Cliff Holmes

Treasurer
Steve Shields

UEC Representative
Jeff Zaugg

UEC Alternate Representative
Brad Welch

GSL-EWB
Great Salt Engineers Without Borders
Status: Active
Members: 6
Elections: January
Meetings: First Tuesday of each month
Website: gslwewb.wordpress.com
3665 S. West Temple
Salt Lake City, Utah 84115

President
Melissa Nichols

VP or Vice Chair
Chris Zawislak

Secretary
Conor Dunkle

Treasurer
David Cline

UEC Representative
David Cline

IEEE
Institute of Electrical and Electronics Engineers
Status: Active
Members: 1000
Elections: November
Meetings: Generally held the fourth Tuesday each month
Website: http://sites.ieee.org/utah
1129 West 250 North
Springville, UT 84663

President
Chad Kidder

VP or Vice Chair
Rio Christenen

Treasurer
Dr. Shanker Man Shrestha

UEC Representative
Chirs Perry

INCOSE
International Council on Systems Engineering
Status: Active
Members: 31
Elections: October
Meetings: Second Thursday of each month
Website: https://www.incose.org/wasatch
1118 West 100 South
Layton, Utah 84041

President
Paul White

VP or Vice Chair
Angie Harbert

Secretary
Paul Nelson

Treasurer
John Richards

UEC Representative
Paul White

UEC Alternate Representative
Jacob Browning

ITE
Institute Of Transportation Engineers — Utah Chapter
Status: Active
Members: 200
Elections: April
Meetings: Third Tuesday of each month
Website: http://www.iteutahchapter.com
2010 South 2760 West
Salt Lake City, Utah 84104

President
Bryan Chamberlain

VP or Vice Chair
Brent Turley

Secretary
Peter Jager

Treasurer
Vijay Kornala

UEC Representative
Bryan Chamberlain

SAME
Society of American Military Engineers
Status: Active
Members: 221
Elections: April
Meetings: Third Thursday of each month at 11:00 a.m., The Landing, Hill AFB UT
Website:

President
David Willis

VP or Vice Chair
Dave Fritz

Secretary
Scott Stoddard

Treasurer
Mark Holt

UEC Representative
Eric Ellison

UEC Alternate Representative
Roberta Schlicher

SAMPE
Society for the Advancement of Material Process Engineering
Status: Active
Members: 146
Elections: May/June
Meetings: Second Monday of each month
Website: https://www.facebook.com/SAMPEUTAH

President
Dr. Andy George

VP or Vice Chair
Jason Carling

Secretary
LeeAnn Hansen

Treasurer
David Moon

SEAU
Structural Engineer's Association of Utah
Status: Active
Members: 242
Elections: April
Meetings: Second Tuesday of each month
Website: http://www.seau.org
380 West 800 South Ste. #100
Salt Lake City, Utah 84101

President
Michael Buehner

VP or Vice Chair
Tait Ketchum

Secretary
Travis Thurgood

Treasurer
Jeff Ambrose

UEC Representative
Cambria Flowers

UEC Alternate Representative
Luke Balling

SWE

Society of Women Engineers

Status: Active
Members: 80
Elections: April
Meetings:
Website: gslswe.org
2742 East 4510 South
Holladay, Utah 84117

President
Shandra Bates

VP or Vice Chair
Celina Lopez

Secretary:
Paisley Tarboton

Treasurer
Cassandra Olsen

UCEA

Utah City Engineers Association

Status: Active
Members: 180-200
Elections: December
Meetings: Four to five a year. Held on a Tuesday.
Website: UCEA.net
1731 South Convention Center Drive
St. George, UT 84790

President
Zan Murray

VP or Vice Chair
Michael Fazio

Secretary
Lloyd Cheney

Treasurer
Currently Vacant

UEC Representative
Sam Kelly

UCLS

Utah Council of Land Surveyors

Status: Active
Members: 373
Elections: Chosen by board
Meetings: Each chapter holds their own meetings. Refer to website for additional information.
Website: www.ucls.org

President
James Couts

Secretary
Susan Merrill

USPE

Utah Society of Professional Engineers

Status: Active
Members: 81
Elections: July
Meetings: First Monday of each month.
Website: www.nspe-ut.org
874 West Edinburgh Dr.
North Salt Lake, Utah 84054

President
Jason Foulger

VP or Vice Chair
Eric Anderson

Secretary and Treasurer
Brad Allen

UEC Respresentative:
Stephen Sussdorf

Utah Engineers Council
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4049 South Highland Drive
Holladay, OT 84124

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