Program Management Lessons Learned: Alaskan Way Viaduct Replacement Program

Education Board Seeks Volunteer Subject Matter Experts

AACE Election Results Announced
SAVE THE DATE!

June 28 - July 1, 2020
Hilton Chicago
Chicago, Illinois, USA
Epic Engineering: Building the Brooklyn Bridge

In the mid-19th century, suspension bridges were collapsing all across Europe. Their industrial cables frayed and snapped under the weight of their decks. So when German American engineer John Roebling proposed building the largest and most expensive suspension bridge ever conceived, New York City officials were understandably skeptical. Alex Gendler details the building of the iconic Brooklyn Bridge.

Source: www.ted.com. Ted-Ed Original lessons feature the words and ideas of educators brought to life by professional animators.
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The Top 10 Reasons
To Join AACE International

Ready to advance your career and begin enjoying the advantages that our members enjoy? Whether you are an experienced cost engineer or a student, we have a membership ready for you.

1. Time
Gain access to a wealth of resources that will save you time and money! You’ll stay informed about the complexities of the cost and management profession - plus you’ll have access to discounts on educational programs, publications, and more!

2. Information
Locate thousands of technical papers and publications in the Virtual Library. AACE’s database is keyword searchable for quickly locating appropriate reference articles.

3. Career
Members can post resumes at no additional cost in our Career Center and keep your career on track through information sources such as our annual Salary and Demographic Survey of Project and Cost Professionals.

4. Learning
We offer numerous online learning courses on estimating and project management. The Approved Educational Provider program helps maintain high quality development courses and providers. AACE also holds many seminars throughout the year.

5. Resources
Starting with the TCM Framework and Recommended Practices that are available for free only to members to our bi-monthly publication Cost Engineering featuring articles for cost professionals around the world. Through the AACE International website, the Cost Engineering journal is a great current resource for members and as a member, you gain access to an archive of past issues.

6. Technical Development
Increase your knowledge and expertise by joining one of AACE International’s many technical subcommittees, committees, and Special Interest Groups (SIGs) at no additional cost to members. Discuss industry problems with your peers or help experts develop new and improved techniques and practices for the profession.

7. Networking
By attending a local section or our Annual Conference & Expo for interesting speakers, informational tours, social dinners and much more. The online Membership Directory is an excellent source for a list of contact information on thousands of members. Join one of our many technical subcommittees and participate in the AACE Forums - a great way to tap into the collective wisdom and experience of our world-wide membership.

8. Excellence
Our certification programs are independently accredited by the Council of Engineering & Scientific Specialty Boards. AACE certifications are a recognized credible standard in the cost management field. A recent study shows that individuals with an AACE Certification earn 17.4% more than their counterpart without a certificate.

9. Discounts
On products and services ranging from AACE International Conference & Expo registration fees, archived webinars and presentations, certification examination registrations, and more!

10. You!
We are your professional partner bringing you information and support you can trust. Join and become part of a unique network of individuals who are dedicated to improving the cost and management profession.

JOIN TODAY! web.aacei.org
Managing Risk

BY DOUGLAS W. LEO, CCP CEP FAACE Hon. Life, President, AACE International

Most important, as I write this message to you as AACE International President, is my wish for each of you, your families, your friends and coworkers to remain in good health as the world deals with the Covid-19 Coronavirus Pandemic. This is a time for all of us worldwide to come together, to cooperate, and to assist one another.

In our professional lives, AACE International members are very familiar in dealing with uncertainties, ever changing risks, and stressful workdays. As managers, estimators, project control professionals, schedulers, risk managers, and cost engineers, we often deal with work and project related risks. The skills that we employ at work, as AACE members, are now needed more than ever as we deal with the risks, uncertainties, and the stress of health concerns and other personal issues resulting from the Coronavirus. We need to recognize that the preparedness that we seamlessly employ at work, is now required in our personal lives. Risks ignored often put project outcomes in jeopardy. We are now called to manage risks in order to safeguard ourselves, our family, friends and co-workers. Wherever possible, AACE International is striving to assist our membership during this difficult time.

AACE International is closely monitoring the situation, adhering to warnings and official recommendations with regards to the safeguarding of our members and preparations for the Conference and Expo. While we are still well over three months out from the Conference and Expo, the safety of our members and attendees is paramount. We plan over this time to frequently communicate with our Sections and will offer updates on the AACE website. We have proactively confirmed that Certification testing may be possible with online proctoring; or, if necessary, by the rescheduling of exams if testing sites are not available. Members can refer to our website or contact headquarters for further details. As always, our technical Body of Knowledge is one of our greatest member benefits. Our Associate Boards will continue to remotely produce the highest quality TCM Frameworks, Recommended Practices, study materials and Certifications. All our technical products are always available to our membership through the AACE International website.

Following is a copy of the message that AACE International sent to our leadership across the globe. This message expands on what I have said and is important for all our membership to hear.

SECTION LEADERS
AACE International is taking all developments concerning coronavirus disease (COVID-19) very seriously. Information and responses are rapidly changing and AACE is continually monitoring the situation.

As AACE Section Leaders you should always put the health and safety of our members first, as we here at headquarters are doing. We have been corresponding with our volunteers and are taking some actions to ensure that we support our members through this unprecedented situation. The organizers of the Region 2 Symposium and Kuwait Conference have taken the proactive step of rescheduling their events to the fall. While the decisions were difficult, it certainly demonstrates that our sections and regions are putting the health of our members in the forefront.

As this relates to the Section Minimum Standards, the Board of Directors has decided that the requirement for at least three meetings this year is waived. We do not encourage large group meetings during the outbreak. If you have the capability to meet with your section virtually that is beneficial. However, it is not a requirement.

At this time, there are no plans to postpone or cancel the Conference & Expo 2020. We have received no cancellations from exhibitors or sponsors at the event, and registrations are on pace with previous years. We will continue to monitor the situation and will be in discussion with health authorities and our AACE leadership. We will work to ensure the highest possible degree of hygiene, safety, and medical care at the conference as the health and safety of all attendees is our highest priority. We will reevaluate our decision on a continuous basis. In the event we have to cancel the conference in Chicago, we have a plan to have a fully virtual Conference & Expo.

With continued aggressive good hygiene, we can all do our part to help keep everyone healthy. We will continue to provide updates as the situation develops and new information becomes available.

AACE’s Board of Directors, Regional Directors, and staff, are here to support you. If you have any questions or concerns, please don’t hesitate to contact any of us. Our goal is to successfully navigate through this crisis. Our thoughts are with you and your families.

If you would like to contact our current president with questions or comments about The President’s Message please address your e-mail to president@aacei.org. To engage in other discussions, check out AACE International’s online Communities at communities.aacei.org.
The AACE Education Board Seeks Volunteer Subject Matter Experts to Assist On-Line Learning Subcommittee Work

The Online Learning Sub-Committee is actively recruiting volunteer Subject Matter Experts to support an ongoing initiative to develop an online training program for the Certified Cost Professional (CCP) certification by 2022. Online training programs for the remaining three professional level certifications – Certified Estimating Professional (CEP), Planning & Scheduling Professional (PSP) and Earned Value Professional (EVP) will follow.

If you are interested in becoming a volunteer for the development of online learning modules, please contact any of the following Education Board representatives:

1. Teri Jefferson – Headquarters Staff Liaison, Education Board (tjefferson@aacei.org)
2. Marina Sominsky – Chair, Education Board (EdChair@aacei.org)
3. Shoshanna Fraizinger, VP Education, AACE Board of Directors (VPEdBoard@aacei.org)

Did you know that 57% of members who responded to the 2019 AACE member value survey indicated a need for virtual, on-demand professional training and 52% indicated positive feedback for virtual, on-demand certification training?

To meet this demand, the Education Board set the goal to develop, as noted above, this online training program for Certified Cost Professional (CCP) certification by 2022, with CEP, EVP and PSP to follow. This is an aggressive objective given volunteer resources. Over the past year, the Online Learning Subcommittee of the Education Board has been working on development and implementation of a few training modules designed to support and guide candidates seeking the CCP certification.

Each online learning module is aligned with the CCP competencies listed in Recommended Practice (RP) 11R-88: Required Skills and Knowledge of Cost Engineering, upon which the competencies and questions in the certification exam are predicated.

The steps of the module development process are as follows:


2. Course mapping – Competencies are divided up into reasonable groups, since each training module should only cover a minimum number of learning objectives. As an example, competencies defined in section 2.2.4 - Cost Estimating and Budgeting – have been divided into seven (7) online learning modules. The first three modules have eight, eight, and three learning objectives respectively.

3. Outline development – This step defines slides, potential graphics, and narration for each module.

4. Storyboard development – The storyboard translates the outline information into a graphic format and assists in the development of slides for each training module.

5. Online modules development – This step of the process involves using the online training authoring software to show the technical content from the source matrix, as well as to be able to add graphics, references, audio, and knowledge check questions.

Candidates seeking AACE International CCP certification can already take advantage of the two online modules listed below. Stay tuned to the AACE website as more modules are created and released.

Schedule Planning – Module 1 https://www.pathlms.com/aace/courses/3446/external_presentations/150658

Schedule Planning – Module 2 https://www.pathlms.com/aace/courses/3446/external_presentations/151021

Remember, the Online Learning Sub-Committee is actively recruiting volunteers to support the online training module creation initiative. If you are interested in becoming a volunteer for the development of online learning modules, please contact Teri Jefferson at tjefferson@aacei.org; Marina Sominsky at EdChair@aacei.org; or Shoshanna Fraizinger at VPEdBoard@aacei.org.
In the October 2018 Source magazine, Valerie Smith, Senior Credentialing Analyst, AACE International Certification Department, authored an article, “Behind the Scenes: Certification Questions Answered.” The article explained how new certification exam questions were vetted, approved, and ultimately became part of the exam question bank. At the time of the article, the Certification Exam Advisory Group (CEAG), comprised of a member from the Technical, Education, and Certification Boards, vetted all new questions prior to approval/inclusion into the exams.

To reduce inefficiencies of the question review/vetting process with CEAG, the Certification Board adopted a more streamlined and time-efficient process for future new exam question submittals. The new process moved the CEAG in an as-needed “consultant” role, placing the responsibility of new question review and vetting on the coordinating Certification Team for each exam.

When a new question is submitted, it must have a source technical/educational document identified from the AACE International Body of Knowledge, (i.e. Recommended Practices (RPs), Skills & Knowledge (S&K), Total Cost Management (TCM) Framework, or Study Guides).

The appropriate certification exam team verifies the tagged source, reviews the question for clarity, assigns the competency, and approves the question for entry into the exam question bank. If the new question does not identify the source document or is confusing/unclear or misleading, the certification exam team returns the question to the Certification Department staff for communication back to the question author. The author has the opportunity to make suggested corrections and resubmit.

Since all new questions are sourced from the approved AACE International Body of Knowledge, they are aligned with the RPs, S&K, TCM, or the various Certification Study Guides. The Technical, Education, and Certification Boards are still aligned to collaborate when needed and consulted to ensure intent of the documents comprising the AACE International Body of Knowledge.

The process of reviewing/vetting new certification questions may be different, but this process improvement results in perfect alignment between the exam questions, required competencies tested, and the AACE International Body of Knowledge. As the Certification Program moves forward, the Certification Board will continually review its processes and procedures for efficiency, clarity, alignment with industry best practices and accreditation, all being done to ensure certificants and future exam candidates have a positive experience.

Writing/submitting new certification questions is one way to accumulate Continuing Education Units (CEUs) for recertification. Visit the AACE International website for more information on writing and submitting new exam questions.

BY VALERIE G. VENTERS, CCP, Certification Board Member
Sree Buravalli was born and raised in India. As a child, Sree always enjoyed spending quality time with family. She especially enjoyed time with her paternal grandmother, who would tell hundreds of stories filled with morals and values she instilled in every child who listened to her. Her lessons will be carried onto the next generations to come.

Sree attended SV University in India, where she earned her bachelor’s degree in civil engineering. She went on to earn her master’s degree in construction management at Vanderbilt University.

Sree started her professional career working as a project engineer at a boutique construction company, NC Sturgeon, which enabled her to learn the nuances of the construction industry and to apply the skills that were taught in grad school. It was a great company with a family-oriented structure, and she could dabble in several tasks including designing structures, estimating, performing takeoffs, scheduling and interacting with subcontractors. Sree cherished every bit of this experience as it laid a good foundation for her current career. She is grateful to her former boss Charles (Chuck) Sturgeon, who was always patient and took time in explaining things to a new graduate. She learned invaluable life lessons from him. Sree is currently working as a senior project controls specialist at Burns & McDonnell’s Houston office. She supports EPC projects in the transmission and distribution industry.

From the very beginning, Sree was interested in being a part of cost management and in analyzing schedules. She believes without an efficient project controls organization, no engineering and construction company can scale up to take on mega infrastructure projects. Project controls enables participation from the time of inception to project finish, wherein you become an integral part of the team. She gets to see all phases of the project and be part of a unique journey as each project is very different and complex in nature. As a project controls professional, she gets to see how we performed within a set budget and on track with the schedule.

Sree has had mentors at each point of her career. Her advisor at graduate school, Dr. Gokhale, encouraged her to pursue a career in construction industry. This has given her true satisfaction with the role she is currently in. She also considers her peers as her mentors, where she learns something new from their experiences every day.

As an AACE International member, Sree values the meetings and conferences offered. They offer a wide variety of experiences to construction professionals she can learn from. It gives her an opportunity to educate herself on the emerging advancements in the industry. She believes learning is an ongoing process and AACE International is a great platform that can be used to become a better professional. Membership has also given her the opportunities to attend training and seminars, which are considered as value adders to her career advancement. It motivates her to set new goals (pursue other certifications) and define her own career path.

Sree encourages other to become AACE International members, so they will have the opportunity to network with some of the best industry professionals whom they can count as their potential clients or mentors. Networking presents you with an avenue of possibilities, which will make you become a good leader within your team.

Her words of inspiration are two quotes she has used in her career.

“An investment in knowledge pays the best interest”
—Benjamin Franklin

‘Arise! Awake! and stop not until the goal is reached”
—Swami Vivekananda
Matthew Pringle, PSP, is a project controls professional with close to 14 years of experience in the construction industry. His experience includes cost, scheduling, and data analysis roles across a wide range of project types from telecommunications, education, data centers, sports and entertainment, commercial building, and medical office buildings. Matt has worked as a cost engineer or project scheduler on projects totaling over 750 million dollars in contract value. He holds an AACE International certification as a Planning and Scheduling Professional (PSP).

Matt grew up in Alpharetta, GA, in a military family that instilled the ideal that anything is possible with dedication and hard work. His family background also gave him a heightened awareness and attention to detail in every aspect of his life. An avid baseball player, baseball taught him how to work hard on and off the diamond. He completed his baseball career as a travel-team all-star and captain of his college club team. Throughout his baseball career, he remained dedicatedly focused on his academic studies and discovered a passion for logistics and supply-chain management. He earned a Bachelor of Science degree in industrial and systems engineering from the Georgia Institute of Technology at Atlanta, GA.

Upon graduation from Georgia Tech, Matt joined Bechtel Corporation’s Southeast Telecommunications Division in Bessemer, AL, as a junior project controls engineer. He was fortunate to learn project scheduling principles under the mentorship of Jeff Renfro, the company’s divisional project lead cost engineer and scheduler for the AT&T Wireless Infrastructure project at Atlanta, GA. Through Jeff’s mentorship, Matt got the opportunity to travel across the country scheduling AT&T wireless buildouts using the techniques that made his mentor successful. Using what he learned through his travels and his systems engineering background, he teamed up with some of colleagues to develop an in-house scheduling system that became beneficial at tracking detailed tasks and engaging project teams to communicate more effectively when planning and scheduling various scopes of work.

Matt is currently employed as senior planner/scheduler by Brasfield & Gorrie at Atlanta, GA, where he lives with his wife and their five sons. At Brasfield & Gorrie, he found several tremendous mentors who pushed him to step outside his boundaries and strive for more in his career, including obtaining his PSP certification from AACE International. At Brasfield & Gorrie, Matt has served as the principal scheduler for the construction of QTS DC-2, the largest data center under construction in the Southeast United States. The two-story, approximately 150,000 square foot data center features its own on-site power substation and direct fiber access to a wide variety of carrier alternatives. In addition to his role on this project, Matt is currently overseeing project schedules totaling over 250 million dollars of contract value including additional data center fit-outs, a four-story library renovation at his alma mater Georgia Tech, the Kennesaw State University Academic Learning Center, and a four-story commercial office building in his hometown of Alpharetta, GA. Additional projects that Matt has scheduled to completion while at Brasfield & Gorrie include the Georgia Proton Therapy Center and several medical office buildings. He has also begun working through the planning and schedule development phase for a new mixed-use and entertainment district, High Street, in Atlanta’s central perimeter.

Matt has been an AACE member and involved with the Atlanta Area Section since joining Brasfield & Gorrie Atlanta in 2018. In 2019, he joined AACE’s Rising Professionals Committee (RPC) and has contributed to the committee’s university outreach initiatives. For Matt, membership in AACE has provided an opportunity to gain more knowledge and perspective on planning and scheduling techniques as they pertain to the construction industry. His favorite experience with AACE was in 2019, when he co-authored a technical paper and presented for the first time at his first AACE Annual Conference & Expo. While there, he also enjoyed the opportunity for continued learning from various presentations and the opportunity to interact and network with other industry professionals. His advice for young professionals in the project controls profession goes back to the ideals that were engrained in him while growing up, have a heighten awareness and attention to detail on any task or project you are working on. Matt adds, “as a project controls professional, we need to have a holistic view of a project’s plan and performance, while also providing influence on a project by knowing the granular details. Keep in mind that even though we live in a technology-based and data-driven industry, project controls professionals should not be afraid to speak up when their intuition is telling them something is not right, because most of the time, that intuition is correct.”
Word has been received of the death of Robert B. McCullough, PE CCP CFCC, on March 16, 2020, in Texas after battling cancer for many years. McCullough, a longtime AACE International member and President of McCullough & Associates, joined AACE International in 1983, the same year he became President of McCullough & Associates.

He had served on the AACE International Board of Directors as Vice President Regions from 1994 to 1996 and as Director-Region 5 from 1992 to 1994. He was a member of AACE’s Certified Forensic Cost Consultant (CFCC) Task Force that created the CFCC certification, serving from 2005 to 2007. He also served as the Annual Meeting Local Arrangements Committee Co-Chair in 1997.

He used his professional experience to serve as a Recommended Practice Contributor toward AACE International’s Recommended Practice 29R-03: Forensic Schedule Analysis in 2011 and Recommended Practice 70R-12: Principles of Schedule Contingency Management – As Applied in Engineering, Procurement, and Construction in 2013. He had served as President of the Dallas-Ft. Worth Section. He authored and presented several papers at the annual AACE International Conference & Expo. (Readers can see the complete list by doing an advanced search at the AACE International Virtual Library).

He also served as a room host for many years at the Conference & Expo during the technical paper presentations. Since 2010, he had his company sponsor the CyberCafe at the annual Conference & Expo.

Prior to becoming President of McCullough & Associates, he had been a Mocon Building Corporation Superintendent/Project Engineer from 1981 to 1983; and with the Hawaiian Dredging & Construction Company as a Senior Engineer from 1977 to 1981. He has a Bachelor’s degree in Civil Engineering – University of California, Berkley (1977). He had 40 plus years of professional experience with expertise in project management, CPM scheduling, productivity tracking, expert witness testimony and impact and delay analysis. He testified in over 300 project cases. He was a Registered Professional Engineer in Texas.

In addition to his AACE certifications of CCP and CFCC, McCullough also was a Certified Document Technologist (CDT) through the Construction Specification Institute. In addition to being an AACE member, McCullough also held membership in the American Arbitration Association (AAA) where he served as an arbitrator; in the Associated General Contractors (AGC), where he was a sub-committee and task force chair with the Dallas Chapter; the American Society of Civil Engineers (ASCE); National Society of Professional Engineers (NSPE); the Project Management Institute (PMI) and with the Construction Law Section of the State Bar of Texas.

McCullough also taught courses on construction related topics to contractors through Dallas universities and colleges. He presented and participated in numerous seminars geared toward claims avoidance and resolution. He obtained his practical experience by working for large private contractors who provided all phases of commercial construction for private owners, as well as the federal government and state agencies.

After becoming a construction consultant, McCullough managed multi-million-dollar disputes for some of the nation’s largest general contractors, specialty contractors, project owners and architects. These projects included high-rise hotels, hospitals, office buildings, airports, power plants, chemical plants, highways, major utility projects, pipelines and related facilities.

McCullough possessed specialized expertise in project management, CPM scheduling, damages, cost analysis and the measurement and tracking of productivity. He was deposed and presented expert testimony in court on all areas of construction, including CPM scheduling analysis and the measurement and pricing of damages and productivity losses associated with delays and impact. ⋆
Longtime AACE member Donald F. McDonald Jr., PE CCP PSP, worked with and was mentored by Rob McCullough. He shares the following memories of this professional association and friendship:

“In 1984 I was a newly minted graduate with a Master’s of Engineering with a poorly written thesis entitled, “Complex Claims Analysis” - only known as being such after the fact when the real world of claims consulting hit me smack in the face. As part of my thesis research I interviewed claims consultants and construction lawyers and is when I first met Rob McCullough, who was working for a construction lawyer in Tyler, TX. After graduation I had the option of working for a highway contractor in a management role that I was well experienced and qualified to take on, or to go to work for the Tyler construction attorney and work with Rob McCullough as a claims consultant – something I had no experience or real qualifications for.

Of course, I went the crazy route and stated working with and being mentored by Rob McCullough on all things cost and schedule damages related in contract claims. When you work with Rob, you work with his very talented wife Ann – a whirlwind if there ever was one. An intense period of several years working with Rob ensued while I learned the ropes and was able to gain my Texas Professional Engineer license under his tutelage.

Rob was a proud Berkley graduate who worked for Hawaiian Dredging/Dillingham Corp in Hawaii and Pacific Islands before returning to his West Coast roots and eventually migrating to Tyler, TX. Ann may recount it a bit differently, but I think the reason Rob got involved in construction contract claims, dispute resolution and eventually became a well-regarded damages expert witness was that the majority of the projects he was working on had fallen into the claims and dispute ditch (I don’t think he was in ‘management’ at the time) and he was tapped to help the legal team develop claims and push them to resolution.

Rob and I worked well together as a team complimenting each other’s strengths and weaknesses. At the urging of my Graduate advisor and strong AACE supporter, Dr. George Stukhart, we both joined AACE and started down the path of studying to take the CCE (now CCP) certification exam. Beginning with the 1985 Annual Meeting in Denver, Rob, Ann and I with my spouse Dolores, began attending almost every AACE Annual Meeting for a 35+ year run.

Even though in 1988 we went our separate ways and had our individual claims consulting firms, we would support each other’s Annual Meeting papers and Cost Engineering Journal publications. Even though we were professional rivals and would occasionally find ourselves on opposite sides of a matter, we continued to support AACE endeavors by supporting technical document development. This even lead to the 2000 AACE Annual Meeting Mock Arbitration — Catfish Contractors vs. NYET County Airport Board. Catfish was a tongue in cheek look at the issues that Rob and I were on opposite sides of in a Texas airport construction project dispute.

Rob and Ann were great supporters of AACE over the past 40+ years. He was a founding member of the Contract Claims & Disputes Special Interest Group that evolved into the Claims & Dispute Resolution Subcommittee. Rob also supported the development of AACE’s 2007 Expertise Level Certification - Certified Forensic Claims Consultant (CFCC).

Often Rob and Ann would provide a kiosk with computers where Annual Meeting attendees could check email and browse the web – all well before everyone had their own iPhone. You would often see Rob, very comfortable in his own skin, wearing a snappy Scottish kilt at one of the evening events. When Rob was busy finalizing an expert report or testifying in a hearing, and could not attend an Annual Meeting, he would send Ann to make sure that AACE was being well supported.

Even though we went our separate ways professionally and time has made our frequent interactions to be more and more distant, Dolores and I always counted Rob and Ann as good friends personally and good friends of AACE. Rob is a good friend whom I will miss.”
AACE Election Results Announced

BY AACE INTERNATIONAL

Winners are being announced in the 2019 AACE International election for seats on the Board of Directors and the Membership Board. Members elected a President-Elect; Vice President-Finance; and five seats on the Membership Board for Director-Region in Regions 1, 2, 4, 7, and 9.

PRESIDENT-ELECT

James E. Krebs, PE CCP FAACE, will be returning to the board as President-Elect. This is a three-year commitment, serving in 2020-2021 as President-Elect, then as President for 2021-2022, and a year as Past President for 2022-2023.

Jim has been an active member of AACE International since 1986, all as a member of the Great Lakes Section having served as President, along with various other board positions. For his dedication to the Great Lakes Section, Jim earned the Charles V. Keane Distinguished Service Award. Jim achieved the rank of Fellow in 2012 and was awarded the O.T. Zimmerman Founder’s Award in 2019. Jim served on the Association Board of Directors as the Director of Region 4 in 2008 and 2009, and the Vice President of Administration in 2015 and 2016. Jim has presented papers and training sessions at AACE Conference & Expos and quarterly board meetings. Jim is the Senior Vice President of Administrative Controls Management, Inc. He has over 33 years of project management, project controls, and construction experience including planning, scheduling, estimating, cost controls, claims analysis and testimony, field supervision, and administrative services.

All remaining Board seats serve two-year terms.

FIVE ELECTED AS DIRECTOR-REGIONS

Each Director-Region provides liaison between the AACE Sections, within their respective Region, and AACE’s Board of Directors and the Membership Associate Board. Beginning terms as Director-Region will be:

Region 1: Sandra Mejia Villegas
Region 2: Michael J. Bennick
Region 4: Dayna Anderson
Region 7: Haya S. Saleh
Region 9: Johnson Awoyomi

Sandra Mejia Villegas, P.Eng., is currently serving as the chair of the mentorship committee and was previously the co-chair for Women in Project Controls Committee. Sandra is also a contributing member of the Latin America Task Force, the Raising Professionals Committee and was part of the Vision 2020 committee. Sandra works for Parkland Refining BC as Project Cost Control Analyst.

Michael J. Bennick, PE CCP PSP PMP, joined AACE International in 2002 and is currently the President of the New Jersey Section. He holds the CCP and Planning and Scheduling certifications, is a licensed professional engineer and is currently a Vice President at JS Held.

Dayna Anderson has worked in project controls for over 16 years and is a former president of the AACE Chicago-Midwest Section and a Board member for many years. She is co-founder and Senior Partner of Breakwater Forensics LLC, headquartered in Chicago.

Haya S. Saleh, PSP, joined AACE in 2007 is currently the President of AACE Jordan Section, a position she has held since 2017. Haya is currently the General Manager and Founder of MESC, a construction management entity in Jordan.

Johnson Awoyomi, CCP CEP, is President of the AACE Nigeria Section. Johnson is currently the Group General Manager Engineering and Technical Division, in Nigerian National Petroleum Corporation (NNPC).

All elected Board of Directors and Membership Board members will officially begin their terms of office at the 2020 AACE International Conference & Expo, June 28 - July 1, at the Hilton Chicago hotel.

VICE PRESIDENT - FINANCE

Patrick M. Kelly, PE PSP, was elected to serve as Vice President-Finance. Patrick is a construction claims analyst and testifying expert with more than twenty years’ experience. Patrick joined AACE in 2007, and earned his certification as a Planning and Scheduling Professional in 2008. Since then, he has been actively involved in AACE, by submitting papers for publication in Cost Engineering journal and presentation at the Annual Conference & Expo. Additionally, Mr. Kelly held the Chair of the Claims and Disputes Resolution Technical Subcommittee for three years, served on the Board of Directors as Director, Region 2 for two years, and is currently finishing a term as Vice President Finance.
Program Management Lessons Learned: Alaskan Way Viaduct Replacement Program

BY DAVID SOWERS, PE; HARRY JARNAGAN, PE CCP; AND BRIAN SMITH, CCP

ABSTRACT
This article provides an overview of program management lessons learned from the Alaskan Way Viaduct Replacement Program (AWVRP), being delivered by the Washington State Department of Transportation (WSDOT) in Seattle, Washington. This landmark program is changing the City of Seattle by replacing an aging, elevated section of State Route 99 with a two-mile-long, large-diameter, machine-driven single bore tunnel, one of the largest of its kind ever completed. This complex engineering and construction effort, with a current budget of $3.3 billion and a delivery schedule spanning more than a decade, is nearly complete. The many lessons learned addressed in this article cover topics such as earned value management; risk management and the use of contingency and reserves; right-of-way acquisition; change control; relations with oversight entities; and the use of alternative delivery contract methods. This article was first presented as PM.3105 at the 2019 AACE International Conference & Expo.

INTRODUCTION
This article provides an overview of program management lessons learned from the Alaskan Way Viaduct Replacement Program (AWVRP), being delivered by the Washington State Department of Transportation (WSDOT) in Seattle, Washington. This landmark program is changing the City of Seattle waterfront. It replaces an aging, elevated section of State Route 99 (SR 99) with a two-mile-long, large-diameter, machine-driven single bore tunnel. This complex engineering and construction feat now threads the city’s hourglass geography over 200 feet below the surface streets, from near the Seattle Center in the north to the professional sport stadiums in the south.

The ability to deliver a mega program like AWVRP is a significant achievement from many perspectives. It improves public safety by removing a structurally deficient, elevated freeway. It provides the opportunity to transform the city’s waterfront. And it increases the efficiency of freight transport in a dense, urban environment. From the owner’s perspective, delivery of this program
The AWVRP is a $3.3 billion program to replace a 65-year old, structurally deficient concrete viaduct that carried approximately 110,000 cars per day and was considered a critical north-south conduit. It also posed a seismic risk for the traveling public.

Schedule was a key planning consideration. In the late 2000s, WSDOT secured additional funding from the Port of Seattle and the US Federal Highway Administration (FHWA) and pressed forward with a series of EIS alternative-neutral projects. These included utility relocations and replacing the southern mile of the concrete viaduct between Holgate and King Streets. In 2010, the state released a request for proposals seeking design-build teams for the central portion of the corridor, a deep bore tunnel. WSDOT had succeeded with design-build projects in the past, most recently the $650 million Tacoma Narrows bridge, which links the Olympic Peninsula with Tacoma, Washington. The state legislature looks favorably upon design build, because WSDOT’s lump sum bid approach gives greater price certainty (fewer change orders and cost growth), risk allocation between WSDOT and the contractor, and, most importantly, reducing the duration of the project schedule over design-bid-build.

Throughout 2010, two bidders competed for the deep bore tunnel project. They met regularly with WSDOT’s team to discuss Alternate Technical Concepts (ATC), risk allocation, insurance, and stakeholder issues. On December 9, 2010, WSDOT opened the technical and price proposals and identified Seattle Tunnel Partners as the best value proposer. Seattle Tunnel Partners is a joint venture between Tutor Perini and Dragados USA.

Meanwhile, WSDOT assembled teams of consultants who were expert in tunneling, program management, and project delivery. Through heavy internal recruitment, WSDOT was also lining up its staff to deliver this challenging project: in construction administration, design review, and myriad other disciplines. All competitive candidates had extensive design-build experience.

**BUDGET AND FUNDING**

Washington State provides major appropriations to agencies on a biennium (2-year) basis. Based upon AWVRP’s master schedule, the program management team developed cash flow needs for each phase (engineering, right of way, and construction) of each proposed contract (34 total), aligned with the proposed funding source. The FHWA defined AWVRP as a mega project and required a formal financial plan. [4] The nomenclature “mega project” has since been replaced by “major project.” The program also received pledges from the Port of Seattle toward capital expenditures and reimbursable funds and from the City of Seattle and other entities for utility relocations and betterments.

During its 2009 session, the Washington State Legislature approved Engrossed Substitute Senate Bill (ESSB) 5768. The legislation identified a deep bore tunnel as its preferred option and directed that the program must include existing state and federal funding of $2.4 billion and no more

![FIGURE 1 Example: Expenditures and Funding by Source, 2010](image)
than $400 million in toll revenue. Combined with up to $300 million from the Port of Seattle, the source of funds totaled $3.1 billion, which was the original 2010 budget.

Figure 1 shows a 2010 cash flow curve that indicates the program would suffer a cash flow gap beginning in 2013 because program expenditures exceeded funding sources. The deficit was due to a lack of toll collection for a program not planned for completion before 2015. Moreover, the $400 million toll revenue was revised down to $200 million in the 2012 legislative session. Revenue studies had indicated $200 million was a more realistic target and would reduce diversion onto city streets. The remaining $200 million was filled with previously unprogrammed federal funding. Figures 2 and 3 show the current program funding sources and uses and the revision to the federal contribution.

US Federal funding was disbursed at the agency level, to be used across all WSDOT eligible projects. Non-federal funds were received according to interagency agreements negotiated between WSDOT and the funding source. WSDOT placed the priority on using federal funds ahead of state funds, to better time state bond sales for all WSDOT projects. Often, AWVRP experienced a swap of funding sources, when federal funds were substituted for state funds that could be used elsewhere in the state. However, these swaps were not obvious to program staff until after they had occurred, complicating efforts to balance sources and uses.

WSDOT had an 80% cash flow accuracy target. Highway projects often fell woefully short of this target, which resulted in inefficiencies in the use of funds, increases in the cost of money, and additional costs associated with the sale of bonds. The AWVRP was projected to be as much as 33% of WSDOT’s cash flow at the peak of construction, and the program strives to increase the accuracy of its cash flow forecasts and meet those numbers, helping the state minimize cash flow inefficiencies and frequently hit 90% or better accuracy on a monthly basis.

**Lessons Learned:**
- Be flexible when balancing project funding sources and needs. Owners must also be prepared to revise funding assumptions or scope to match proposed funding.
- Gain a keen understanding of the rules by which funding is disbursed and used for both federal and non-federal funds. Incorrect assumptions can result in the mistiming of major funding sources.
- Increase cash flow projection accuracy to avoid additional costs for financing projects or to avoid additional costs that might reduce the ability to execute projects, either the particular program or other agency-sponsored projects.

**COST ESTIMATING, THE COST ESTIMATE VALIDATION PROCESS (CEVP), AND VALUE ENGINEERING**

During the initial viaduct replacement Environmental Impact Statement (EIS), which ran 2004-2006, the state evaluated construction and cut cover replacements of the seismically-vulnerable viaduct. In January 2009, the Governor, King County Executive, and Seattle Mayor recommended replacing the central waterfront portion of the viaduct with a deep bore tunnel. The decision created the need for a supplemental EIS. Through ESSB 5768, the state committed to providing $2.8 billion for the SR 99 scope elements and directed the state to provide updated cost estimates for the viaduct replacement alternatives, including the proposed bored tunnel. Following this recommendation, preliminary engineering and cost estimate development began in earnest, building upon earlier parametric cost estimates created for the first EIS alternatives analysis. The cost estimate was a joint effort between the design engineer and owner. The design engineer provided costs based on physical take-offs. The owner and owner’s representative provided owner costs that included engineering, right-of-way, and program management. They also provided specific input from independent experts and overall coordination. A record of decision (ROD) was reached in August 2011.

WSDOT used the Cost Estimate Validation Process (CEVP) to solicit expertise from both the project team and a Strategic Technical Advisory Team (STAT) comprised of industry experts. The risk consultant combined cost and schedule estimates into a critical path network that was subjected to a probabilistic analysis. This process references AACE International’s Recommended Practice 41R-08, Risk Analysis and Contingency Determination Using Range Estimating. The initial model run in 2009 provided results that exceeded the target budget.

A Value Engineering (VE) exercise was undertaken, consisting of three teams of state, city and consultant staff. Each team had a primary geographic focus: south, north and the tunnel itself. The teams evaluated more than 44 ideas that resulted in nine recommendations. The two most significant suggestions were to change the profile of the adjacent Holgate to King project from a subsurface structure to an elevated one, and to realign both the north and south tunnel portals to reduce property impacts. The recommendations implemented for the final CEVP workshop in 2010 totaled $310 million of avoided base cost.

The results of both rounds of CEVP modeling were communicated by AWVRP leadership to transportation committees of the Washington State House and Senate, as well as the Joint Transportation Committee (JTC). The risk-based estimate results were shown with 10%, 60%, and 80% estimate probabilities. WSDOT provided an overview of some of the risks included in the analysis. For budget setting purposes, the 60% probability was established.

CEVP is used primarily during the engineering phase of a project, prior to construction; however, the process was also adopted for AWVRP to latter stages of construction to reassess risks and Estimates at Completion (EAC) and better inform stakeholders, including the state legislature and the governor. This modified process is known as Cost Risk Evaluation (CRE).
Regular monitoring of risks is essential to maintaining discipline throughout the life of a program. Figure 4 is an example of tracking pre- and post-mitigation response. Risks established during the risk elicitation workshop are shown in the Pre-Response Quantification block and plotted on the heat map according the probability and impact of the risk. Input from the teams responsible for managing the risk assess potential mitigation actions which provide input into the Post-Response Quantification block. Reviews are documented in the Monitoring and Control block on the form.

Lessons Learned:
• Develop a project risk register and update it regularly (see Figure 4).
• Account for risks and inflation in estimates.
• Identify and develop risk management plans.
• Engage experts with national and international tunneling experience in urban environments.
• Get input from subject matter experts to identify a wide range of risks, even “black swans.” [8] For example, after weighing risk trade-offs, WSDOT paid for a second bearing for the tunnel boring machine (TBM), to mitigate the low probability but high impact risk of the first TBM bearing failing and causing severe schedule delays.
• Use value engineering techniques to critically examine project assumptions in order to meet project goals while maintaining safety and functionality.
• Make sure the risk and value engineering exercises include not only program implementers but stakeholders from where the project will be constructed.
• Continue risk management beyond design. Regular, monthly risk register reviews should be supplemented with a periodic, comprehensive probabilistic risk review that encompasses all phases of work.

RESERVE AND CONTINGENCY MANAGEMENT
WSDOT makes a distinction between risk reserves and contingency. Risk reserves are held at the program level for addressing quantified risks, whereas contingency is provided to construction projects to address common change order issues.

WSDOT Instructional Letter IL 4071.01, “Risk-Based Project Estimate for Inflation Rates, Market Conditions, and...
Percentile Selection” provides guidance to WSDOT regions for the development and management of risk reserves for capital projects. IL 4071.01 directs that one risk reserve will be established per project or collection of projects, identified by a project item number (PIN), and will consist of the risk dollars identified at the selected probability percentile from either a Cost Risk Assessment (CRA) or CEVP analysis.

During design, as risks are addressed and retired, the values associated with the retired risks are drawn down (see Figure 5). When risks are realized, the amount to which they occur is moved into the base budget. Conversely, as new risks are quantified, they are added to the risk register. Risks that are configuration issues or that meet the trend thresholds are documented and managed through the change control board. Modifications in scope, when they might occur within each project, are estimated and become part of the budget basis. When the project is awarded and goes to construction, change order contingency is allocated to that project.

Lessons Learned:
• WSDOT instruction letter(s) provide clear direction to capital projects for the development and management of risk reserves. In turn, this provides transparency at a statewide level about the amount of funds identified for risk.
• Clear division of responsibility and accountability is documented between program management and projects. Allocation of contingency is within the control of project managers; risk reserves are controlled at the program level.

Design-Build Contracting
For WSDOT, design-build was an easy choice. Design-build had already led to the highly successful delivery of previous WSDOT projects, including the new Tacoma Narrows Bridge. WSDOT management knew that a lump sum approach could be successful, by allocating design risk and machine operations to the design-builder, while keeping responsibility for the subsurface conditions with WSDOT. Most important for AWVRP was the ability to quickly advance the work. For example, in the case of the SR 99 bored tunnel, WSDOT executed the contract and was able to start design before the FHWA issued the final record of decision in August 2011.

WSDOT’s experience with design-build began in the late 1990s, with a pilot project in Vancouver, Washington. In 2001, based on the success of the pilot and other positive experiences among departments of transportation (DOT) nationally, the Washington State Legislature authorized WSDOT’s use of design-build. Not long after, with several more of WSDOT’s projects successfully completed, the legislature required the department to consider design-build as the project delivery method for any project budgeted at $10 million or greater. The legislature lowered this threshold in 2015 to $2 million. Currently, WSDOT awarded 21 active design-build contracts since 2017. They account for over 25% of all WSDOT projects, by dollar-award value.

WSDOT’s design-build delivery approach begins with a Request for Qualifications (RFQ) phase. During the RFQ phase, prospective teams of constructors and designers submit and are then scored on their team’s previous working relationships, key individual managers, and firm experience. This phase does not include scoring a team’s approach to executing the proposed scope or the team’s innovative concepts; that happens later in the Request for Proposal (RFP) phase. Because of the technically challenging nature of the deep bore tunnel and the size of the contract, only three bidders had the technical ability, experience, and bonding capability to submit qualifications.

In February 2010, WSDOT released a draft of the bored tunnel RFP, which was finalized in May. The RFP contained the general conditions and technical specifications required of the designer and contractor. It specified the minimum roadway dimensions, tunnel liner thickness, and permissible ground settlement, among other requirements. The general conditions detailed financial incentives; allowances for various issues, such as insurance, Port of Seattle property access, and cost sharing, in case ground settlement along the TBM’s path exceeded predictions. In short, these general conditions provided the framework for best practices for tunnel mining.

Besides schedule, the other principal reason design-build benefitted a project like the SR 99 bored tunnel was the necessary interface between design and construction that could not have been achieved with traditional design-bid-build delivery. For example, Seattle Tunnel Partners modified the south portal locations significantly, within available state right-of-way, to launch the TBM south of WSDOT’s intended location. This minimized impacts on neighboring properties and the immediately adjacent existing viaduct foundations and, in turn, reduced the number of utilities that had to be relocated at the south portal.

In another example, the design-build contractor, in cooperation with WSDOT, managed risk for controlling ground settlement, induced by mining activity, by way of a $20 million “deformation allowance.” If ground settlements were minor and caused little to no cosmetic damage, let alone structural damage, the design-build contractor benefitted by receiving 75% of the allowance, minus repairs. Thus, the allowance worked as an incentive to encourage careful mining and excavating and other best practices.

By 2016, WSDOT had successfully delivered 29 design-build projects statewide and had others in the pipeline. So, in 2017, WSDOT again chose design-build to deliver the final set of projects for AWVRP. After much deliberation, WSDOT packaged three scope elements together in one design-build contract:

• Demolishing the viaduct
• Backfilling and decommissioning of the Battery Street Tunnel
• Reconnecting the north portal surface streets, which for 65 years had been bisected by the Battery Street Tunnel portal

Again, project duration was paramount. WSDOT estimated that delivering these final projects as three separate design-bid-build projects would have extended AWVRP at least another fifteen months.

Lesson Learned:
While design-build has proven to be an effective delivery method, the many and diverse program stakeholders and their lack of knowledge about design-build proved to be one of WSDOT’s hurdles. The tunnel contract provided an opportunity for education in the design-build process to colleagues at the city and county. The WSDOT staff administering, reviewing design, and overseeing AWVRP construction were all seasoned, having worked on multiple design-build projects. Unfortunately, other agencies needed time to understand the many nuances of design-build—such as Quality Assurance/Quality Control (QA/
QC) responsibility—and this led to minor delays in design development and reviews. In the end, design-build delivery charted the best course for a successful project, while protecting all parties.

RIGHT-OF-WAY ACQUISITION AND CONSTRUCTION IMPACTS

There will always be third parties affected by mega projects in urban environments. Owners of properties along or adjacent to the proposed work site may be the most affected and, thereby, the most difficult to manage. In the case of the SR 99 bored tunnel, the corridor alignment, horizontally and vertically, shown in Figure 6, was selected in large part to minimize the impact on private properties. A deep tunnel can generally pass beneath private property with little impact, depending on the subsurface features of a given legally defined tract of real estate (a parcel). At the tunnel portals, though, property acquisitions get much more involved.

For the SR 99 project, garnering needed property rights factored into a nearly $190 million real estate budget. The project required the rights to cross private property, albeit usually at great depth, and the rights to add instrumentation and to access those instruments during tunneling. WSDOT’s acquisition of property is governed by the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970. The process is highly prescriptive in order to equitably balance the rights and obligations of affected property owners and tenants. As the project is partially funded by FHWA, federal approvals must be obtained before WSDOT certifies right-of-way acquisitions. For design-bid-build projects, this traditionally occurs before contracts are awarded but this requirement creates significant time pressure on the teams. The nature of this design-build required some of the certification to happen post-award due to the identification of real estate acquisitions during the final design process. This was another advantage to design-build.

Technically speaking, the real estate effort required either a three-dimensional subsurface property acquisition (the state cannot obtain permanent easements across private property), a temporary construction easement, or both. In the case of parcel acquisitions, the 56-foot diameter tunnel (mined with a 57.5-foot TBM) required a “box” 150 feet tall and 84 feet wide. The 84 feet was consistent with the city street right-of-way, where the tunnel was directly beneath 1st Avenue. The 150 feet vertically (approximately 50 feet above and 50 feet below the TBM) and 84 feet horizontally provided a “buffer” around the concrete tunnel. This additional space provided some room for error should a property owner extend tie-backs or other foundation elements into the “box” accidentally. Above the tunnel, the 50-foot buffer provided additional stress distribution from footing loads above the tunnel. This was particularly important in the shallower portions of the tunnel alignment. Where the tunnel was approximately 50–100 feet deep below a parcel, WSDOT placed load limit restrictions on future development and on the loading of buildings and foundations. These development restrictions were limited in number, but costly.

Temporary construction easements were required where property access was needed by the state and the design-build contractor to install building and ground instrumentation for the purpose of monitoring subsurface movement as the TBM passed directly beneath or adjacent to a subject property. This was done to inform engineers, in real-time, of any ground deformation, as well as to protect building owners’ interests and limit frivolous claims by property owners over alleged damage. This effort was time consuming; over 100 properties were instrumented. However, this step was critical to WSDOT’s success and to reducing tort claims.

Hiring skilled appraisers and agents to negotiate land acquisitions and temporary easements was one of the biggest challenges. This is an area of technical and legal savvy that required many consultants. Hiring was done from across the Pacific Northwest and the U.S, because state resources were insufficient. However, the outside experts were less knowledgeable about Washington State real estate law and processes, which presented some challenges. The state’s use of threat of condemnation also required skilled attorneys and administrators. In summary, available, skilled workforce were and will continue to be a challenge for real estate acquisitions.

Another challenge was the many out-of-state, and even out-of-country, property owners, a circumstance not fully grasped at the outset of the acquisition process. This condition repeatedly lengthened the overall process, that is, getting appraisals reviewed, offers exchanged, and final negotiations handled, even getting final papers filed.
Lessons Learned:
• Resource planning for the number of real estate professionals needed to handle a large number of transactions over a dense and geographically wide area is vital.
• Adequate time must be allowed for processing real estate transactions where property owners do not live locally and are often corporate entities.

INDUSTRY RESOURCES AND WORKFORCE
AWVRP was a major capital delivery program set in a region with other such programs under way and in a metropolitan area with an already substantial capital project workload. In the transportation sector alone in the Western United States, programs competing for scarce professional staff resources included:

• Sound Transit’s “ST3” program, a $53.8 billion program in the Seattle Metropolitan Area that plans to add 62 new miles of light rail to stations serving 37 additional areas of a regional system reaching 116 miles. [7]  
• WSDOT’s “Connecting Washington” program of transportation improvements in Washington State, with an estimated cost over $16 billion.  
• WSDOT’s State Route 520 Floating Bridge and Landings program another major capital project in the Seattle area.  
• California High Speed Rail, a major rapid transit capital effort, already under construction in California’s Central Valley.  
• Substantial transportation improvements from some of California’s “self-help” counties, including Alameda, Santa Clara, Orange, and Los Angeles. Also, programs from various separate agencies operating in those counties, such as the Santa Clara Valley Transportation Authority, based in San Jose, and the Los Angeles County Metropolitan Transportation Authority.

To successfully deliver AWVRP, the program had to find and attract many professionals in fields where available staff was scarce, for example:

• Estimators and schedulers in the project controls discipline.  
• Appraisers, relocation agents, and acquisition specialists (discussed above).  
• Tunneling and geotechnical experts, given the large-scale tunnel being delivered, with its attendant need to carefully monitor and control settlement along the tunnel alignment.

Workforce planning began early in AWVRP’s capital delivery cycle and would cease only upon program closeout. The following planning measures were important:

• Development of an organization chart and organizational breakdown structure that reflected all owner and consultant staff. Highlighted were those specialty skill sets known to be in high demand.  
• Creation of a convenient contract vehicle with broad scope that could secure various types of professional services. WSDOT met this need by retaining Mott MacDonald under a project management assistance consultant (PMAC) contract.  
• Realizing that securing such hard-to-find staff might require:  
  ◦ Paying higher-than-normal hourly rates to attract desired staff to the program.  
  ◦ Global outreach for program delivery or technical talent. Nations that provided offshore staff included Canada, the United Kingdom, Italy, and Germany. For large-scale tunneling, many experts came from “peer” projects in the industry, such as the Stormwater Management and Road Tunnel (SMART Tunnel) delivered in Kuala Lumpur, Malaysia. Make sure experts in work visas and tax laws applied to non-U.S. labor are available to offshore staff.  
  ◦ Adequate time to find and recruit professional staff. Last-minute requests to secure professional services were doomed in a market where the recruitment timeline was measured in weeks or months, not days.

Workforce planning required a depth of detail and analysis beyond an organization chart. WSDOT and Mott MacDonald developed a spreadsheet-based staffing plan that organized many data for each open position and each member of the program team. Updates to this plan occurred at least quarterly. The benefits of a data-conscious approach were many. Besides giving senior management advanced notice of staffing needs, this staffing plan:

![FIGURE 7 Employee Workforce Report](image)
• Could be “costed,” with labor rates applied to individual positions. Thus, labor costs could be aggregated at various levels of detail. The staffing plan became a QA check on labor estimates derived through the normal estimating process.
• Aided planning for program ramp-up and ramp-down, the most difficult phases for which to provide professional labor. Another difficult phase for which to plan professional staff was the commissioning and start-up phase, because the tunnel included various sophisticated systems and controls.
• Could assist WSDOT and AWVRP consulting firms in planning for an individual’s follow-on assignment, after AWVRP concluded. Within WSDOT, such next assignment planning required discussions among senior staff in WSDOT’s Northwest Region.
• Aided in required labor reporting submitted quarterly to WSDOT’s headquarters. Figure 7 provides an example of this reporting, whereby staffing drawdowns are plotted against calendar quarters.

Lessons Learned:
• Begin staff planning early. The planning and forecasting effort should continue through program completion.
• For consultant labor, create a broad contracting vehicle that provides a convenient means to find and assign a variety of specialists.
• Create a staff planning and forecasting tool that collects and manipulates data to the individual position level. Review output from this tool regularly.
• Identify scarce skill sets regularly. On AWVRP, the management team undertook quarterly reviews of workforce needs and actions. The process to secure scarce expertise typically commenced well in advance of their actual need on the program.
• In the program labor estimate, use somewhat higher labor rates, i.e. 10%-20% higher than the industry average, for specialty skill sets that may be more difficult to attract given the competitive professional labor market. Such rate increases were set based on discussions with members of management most familiar with labor rates for given skills.
• Be prepared to search globally for specific technical talent. Be aware of and be prepared to comply with visa and tax-related requirements associated with offshore recruiting.

THE CONFIGURATION AND CHANGE MANAGEMENT PROGRAM

ESTABLISHING A BASELINE
At the end of the 2009 legislative session, the Washington State Legislature passed the 2009 legislated final budget. This budget included the deep bore tunnel and provided the baseline against which AWVRP progress would be measured. This baseline was the starting point for tracking, reporting, and change control captured by external reports. Internally, the first contract packaging plan served as the configuration against which change was initially tracked and served as the project implementation basis for project scope against which change management was managed. This overall process is outlined in AACE International’s RP 60R-10, Developing the Project Controls Plan. [2]

CONFIGURATION CONTROL AND CHANGE MANAGEMENT
AWVRP’s configuration control program was implemented to manage scope and changes across contract packages, throughout the life of the program. Configuration control, as applied to AWVRP, aligns with definitions provided by AACE International:

“Configuration – A collection of an item’s descriptive and governing characteristics, which can be expressed 1) in functional terms, that is, what performance the item is expected to achieve; and 2) in physical terms, that is, what the item should look like and consist of when it is completed.” [1]

“Configuration Control – A system of procedures that monitors emerging project scope against the scope baseline. Requires documentation and management approval on any change to the baseline.” [1]

AWVRP’s configuration management system documented and obtained the proper approvals for changes to the approved baseline of an AWVRP project’s physical and functional features. The AWVRP’s definition of configuration expanded on the AACE International definition to include, but was not limited to:

• Project termini
• Horizontal and vertical alignments
• Ramp and roadway geometry
• Fire; life, and safety systems
• Electrical systems
• Hydraulic systems
• Other features that defined the look and function of the program

Configuration management provided the mechanism by which project changes were identified; reviewed; evaluated for cost and schedule impacts; evaluated for risks to the project; and controlled and incorporated into the project design. Configuration management was essential to ensuring that all parties working on the
design and, ultimately, the construction of the project, were working to the current project configuration, making sure there were no unintended gaps, overlaps, or discontinuities across AWVRP projects. Deviations from the contract package descriptions and preliminary design drawings were brought forth to a change control board for consideration. Review of proposed configuration changes was a multidisciplinary effort and included an environmental checklist to ensure that potential changes did not impact any commitments in the EIS. Figure 8 shows the form used to ensure that input and review were solicited from all disciplines affected.

The configuration management process, illustrated in Figure 9, worked in concert with the trend/change management process and the WSDOT construction change order process. Configuration management controlled the physical aspects of what was to be built. Trend management controlled the financial and schedule implications resulting from any physical changes. Once a configuration change was approved, if certain schedule or budget thresholds were exceeded, the change was advanced through the change management process via a trend management (change control) document. The trend management program aligned with the AACE International definition of change control:

“(1) Process of accepting or rejecting changes to the project’s baselines”; “(2) process of implementing procedures that ensure that proposed changes are properly assessed and, if approved, incorporated into the project plan”; and “(3) risk abatement process of accepting or rejecting changes to the project’s baselines, based on predetermined criteria or trigger points.” [1]

The trend management process monitored changes to the baseline scopes, budgets, and schedules for the AWVRP projects. The trend management process worked in conjunction with the configuration management process, the construction change order approval process, and the risk management process to bring changes that exceeded budget, schedule, and risk thresholds to executive management’s attention. However, trend notices may also have derived from actions outside the configuration management process, for example, moving money from one control account to another. In many cases, these trends were administrative in nature and could be approved by the trend manager. Figure 10 demonstrates the change management process developed for the AWVRP.

In summary, configuration changes and change control are essential to providing a structured, informed process...
by which project management, senior management, and executives can understand proposed changes and help document them for a program for which they are ultimately held responsible. To date, there have been almost 700 configuration changes and trends processed. These documents provide a roadmap of scope changes throughout the program's life.

**PROGRESS MEASUREMENT AND REPORTING**

Progress measurement methods are supposed to provide management with accurate and timely performance metrics. Developing a methodology appropriate for the level of control and reporting that is cost effective requires experience and professional judgment. Inadequate staffing typically results in low level of control which can lead to oversimplification, while generous staffing can provide greater levels of control and measurement but can be costly in terms of labor. The AWVRP project controls team faced the same challenge. An Earned Value (EV) approach was used that was appropriate to the level of control that was budgeted, but it was supplemented with graphics to communicate program performance trends quickly and effectively to senior management.

**USING EARNED VALUE PROGRESS MEASUREMENT**

Several factors can ensure the success of an earned value management system (EVMS). First, senior management must support the earned value approach. Also, they must communicate the business need for it to the next few levels of management, who must participate in, accept, and apply the results of the EVMS analysis. In a challenging capital delivery environment, when seemingly anything can go wrong at any time, a system to measure performance will detect such problems quantitatively, and those being measured may resist the effective performance of such a system. Senior management must communicate, that EVMS is not to justify punishing staff. Rather, they should clearly communicate that EVMS measures performance and forecasts program issues, leading to proactive corrective actions.

A program must meet the following preconditions for EVMS to be developed and to work properly:

- **Scope must be defined and frozen.**
  The project plan must be in place. For AWVRP, regional headquarters required earned value measurements even before the program’s preferred alternative to replace the elevated viaduct had been chosen. Thus, a key element of program scope was unknown yet earned value metrics were required of the program team. Project scope must not only be defined but frozen, so project controls

![FIGURE 10 Change Management (Trend) Process](image-url)
staff can develop the quantified performance measurement baseline.

- **Project estimate and schedule must be developed.** AACE defines an earned value management system as, "A project progress control system that integrates work scope, schedule, and resources to enable objective comparison of the earned value to the actual cost and the planned schedule of the project.” [1] If such estimates and schedules are not competently developed, even if preliminary, the result is a false baseline against which performance measurements are meaningless.

- **EV plans must cover a project’s full duration.** The performance measurement baseline must cover the entire project delivery cycle, from preliminary engineering through testing and commissioning and eventual completion, as signified by owner acceptance of the project’s improvements.

- **EV metrics should not be applied too early.** Every project is different, and this is especially true of high-value, publicly visible, and risk-intense programs like AWVRP. The delivery staff will have a learning curve early in their assignments, so performance may be erratic. Meaningful EV measurement should commence when a scope of work is about 10% complete. By that point, most delivery teams should have adjusted to the project environment and, hopefully, will be working near full effectiveness.[6]

- **EVMS should be joined by a fully developed change control system.** AWVRP adopted a configuration control system and a trend, or change, control system early in the project delivery cycle as described previously. The approval of any changes to the project represents an associated change to the project performance measurement baseline.

- **EVMS procedures should be ready before EV tracking begins.** EVMS procedures should be developed and ready for use before actual earned value measuring and tracking begins. These procedures will form the basis of team training before EVMS is turned on.

- **Project team must be prepared to support EVMS.** Effective support of EVMS augurs an effective implementation. They should understand the fundamentals of what is being measured, under what circumstances, and that they may be required to explain why their team’s performance may be falling outside a prescribed measurement threshold. The project controls staff:
  - Must include experts in scheduling, estimating, and cost forecasting. The project controls manager must have prior supervisory-level EVMS experience.
  - Must be trained specifically in earned value concepts. No matter what the experience level in earned value methods, refresher training is advised for all project controls staff at the start of the program.

  - Must be expert in the use of their software tools.
  - Must be appropriately sized and motivated. Managing and delivering an EVMS on a mega program is a challenge and represents the synthesis of many skill sets. The work environment can be a grinding, constant quantitative and analytical space that does not relax until program completion.

Project managers, whose work will be subject to EV measuring, should be trained appropriately about EVMS principles and function. They should understand the fundamentals of what is being measured, under what circumstances, and that they may be required to explain why their team’s performance may be falling outside a prescribed measurement threshold. Senior management should reaffirm that the purpose of EVMS is not to negatively reinforce workers but to develop and use metrics that keep project delivery on a track to success.

- **EVMS scope must be supported by contract language covering consultants’ work.** Contract language for consultants must include EVMS-related measurement and reporting requirements. This was especially important on AWVRP, where consultants delivered a significant amount of work scope.

- **Progress metrics should be simple and objective.** Earned value metrics are critical. This data is compared to the planned values and actual costs to reveal variances and determine quantified performance. If the effort to gather this data is cumbersome or complicated, the project team could “burn out” quickly, and EVMS implementation will suffer as a result. [6]

**REPORTING**

Project reporting is important. It should cover not only EVMS metrics but also other performance metrics. It should rely on graphics as much as possible, so senior management can discern intuitively and quickly project status. Reports should include descriptions that identify issues and recommend solutions, as opposed to rote recitations of project status. Details can be provided in an appendix for later reference, as needed.
Lessons Learned:

• Earned Value Management Systems:
  ◦ Senior management must support it and explain the business need.
  ◦ Scope must be defined and frozen and the project plan in place.
  ◦ Project estimate and schedule must first be developed.
  ◦ EV plans must cover a project’s duration.
  ◦ EV metrics should not be applied too early.
  ◦ EVMS should be joined by a fully developed change control system.
  ◦ EVMS procedures should be ready before EV tracking begins.
  ◦ Project team must be prepared to support EVMS through prior experience, training, and qualifications.
  ◦ EVMS scope must be supported by contract language covering consultants’ work.
  ◦ Progress metrics should be simple and objective.

• Reporting:
  ◦ Make maximum use of graphics.
  ◦ Use executive-summary level text that emphasizes issues and recommended solutions.
  ◦ Reports should capture the attention of management, be eye-catching, and require little or no extra explanation.
  ◦ The project controls staff should include an individual who is expert at converting data into effective and expressive graphics.

EXPERT REVIEW PANELS AND OVERSIGHT

AWVRP is a prime example of a high-value, publicly visible, risk-intense program. Because it would forever change the face of a major metropolitan area, it was the subject of focused attention by the taxpayers of Washington State and individuals holding official and elected positions.

For AWVRP, oversight came from various sources:

• Elected officials at all levels, from city council members to the Washington State Legislature and the Governor.
• Funding agencies, including the Port of Seattle and FHWA.
• Expert review panels, which, with AWVRP, were project delivery experts selected by and under contract directly to the Washington State Legislature. These panels delivered reports on AWVRP performance to the legislature on a prescribed time schedule.
• Citizen-based committees, formed, and operating under an official charter.
• Public citizens through the State of Washington public disclosure request (PDR) process.
• Media outlets, such as newspapers, radio and television stations, and blogs, although having no official status, took an intense interest in AWVRP and reported on it continuously.

The program team had to be prepared and ready to answer to such oversight. Approaches taken on AWVRP to create positive engagement included:

• Designating specific project team members to interact with specific oversight groups.
• Creating a communications team. The AWVRP communications team was charged with communicating the project “story” to the public. They were an important resource when strategizing messages about the program and preparing for meetings with oversight entities.
• Adopting an open and transparent communications style. AWVRP staff freely admitted that problems were being faced at different times; but these disclosures were also accompanied by planned solutions. The program risk register became an important document. Problems should be and were, in fact, presented in the AWVRP risk register, along with estimated costs, schedule impacts, and planned mitigation or avoidance or transfer measures.
• Assigning high priority to team response to oversight questions, preparation for meetings with oversight agencies, and the development of reports required by these entities. Oversight interactions involved management and were executed in accordance with pre-planned schedule milestones. The team avoided last minute scrambles, to the extent possible.
• Carefully reviewing after-visit reports prepared by an oversight entity and highlighting content that likely required response by AWVRP senior leadership. Preparing such responses, as appropriate, and reviewing them for later delivery, if requested.

As with other aspects of program delivery, the development of these robust supporting capabilities enhanced interactions with oversight entities:

• The project controls team was ready with performance metrics and cost and schedule forecasts.
• The risk management team maintained completely populated risk registers. The registers’ content reflected periodic risk review meetings or focused multi-day risk workshops.
• The program change control system featured a tracking database and stored digital documentation, which were organized in accordance with AWVRP’s work breakdown structure. This system supported a recitation of the technical and management history of the program at different levels of detail and served as a conveniently available source of information.
• The program document control system relied on a robust, industry-standard software application, Open Text’s Content Server, that featured a hierarchy of folders and used metadata to rapidly retrieve documents. The AWVRP team took advantage of this capability often in communications with oversight entities.

Lessons Learned:

• Project teams should assign specific personnel to act as liaisons to oversight groups. Make these relationships long term, allowing project team staff to develop a professional rapport with the members of the oversight agency.
• Maintain a risk register to share with oversight groups that documents project issues as they are encountered, as well as the estimated costs, schedule impacts, and planned mitigation efforts.
• Give high priority to involvement with oversight entities. Take their involvement in the project seriously and proactively watch for opportunities to educate and keep oversight members abreast of problems and solutions, performance metrics and cost and schedule forecasts.

CONCLUSION
The $3.3-billion Alaskan Way Viaduct Replacement Program is a mega program delivered successfully. AWVRP was an intensive effort lasting more than a decade in a challenging operating environment. The program involved hundreds of owner and consultant staff, representing a variety of technical and management disciplines. This program team turned the many lessons learned into its “way of doing business.” The result is a completed landmark project that forever changed the face of one of the United States’ largest cities and is already considered exemplary by other metropolitan areas.

The capital program delivery profession must make use of these lessons learned, as the future holds the challenges presented by many more mega projects. This profession needs to meet society’s demand for high-quality infrastructure and break the so-called “Iron Law of Mega Projects.” Mega programs are not fated to become management failures, always grossly overrunning their budgets. As AWVRP demonstrates, they can be delivered successfully and meet their quality, schedule, and cost objectives.

REFERENCES
2. AACE International Recommended Practice 60R-10, Developing the Project Controls Plan, AACE International, Morgantown, WV, latest version.

RECOMMENDED READING
1. AACE International Recommended Practice 31R-03, Reviewing, Validating and Documenting the Estimate, AACE International, Morgantown, WV, latest version.

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GREATER CAIRO SECTION

The Greater Cairo section held its first collaborative event with the Dispute Resolution Board Foundation (DRBF) on February 16. The Greater Cairo Section introduced AACE International and the DRBF to the audience which consisted predominantly of engineers. AACE International was represented in this event by the section’s president, Waleed El Nemr. The event discussed the types of dispute boards, their effectiveness and the role of engineers (especially ones with AACE project controls certifications) as DB members, with their miscellaneous expertise and potential in resolving disputes. The event was attended by more than 120 people.

Some 120 attended the Greater Cairo Section’s February collaborative event with the Dispute Resolution Board Foundation (DRBF). The event discussed the types of dispute boards, the effectiveness of these boards, the roles of engineers having different expertise serving on these boards, especially if they hold PCP certification from AACE, and the potential for resolving disputes considering these factors.
The Nigeria Section continues to experience growth. Section members represent various agencies of the government. This shows the Nigerian government is supporting and adopting Total Cost Management in the oil and gas industry. This is not limited to cost reduction of its crude oil production, but also reducing the long contracting cycle and the entire value chain.

For three consecutive years, the Nigerian Section has been holding annual meetings. And this year we have set up a planning committee for the 2020 Annual meeting that will take place in Lagos, Nigeria. The 2017 conference was also in Lagos. The 2018 conference was at Abuja and the 2019 conference was at Garden City, Port Harcourt, in the River State.

(continued on next page)

HAWAII SECTION

On Friday, January 10, nineteen AACE Hawaii Section members and guests participated in a construction site visit of the HNL Consolidated Car Rental Facility Phase 2B Project. The project involves the construction of a five-story structure, intended to meet the operational and spatial needs for all the rental car companies conducting business at the Daniel K. Inouye International Airport (HNL). The facility is situated on nearly seven acres of land, bordered by Aolele Street to the north, the Overseas Terminal Parking Structure to the west, the “Arrivals” roadway to the south, and Paiea Street to the east. The facility is situated over the current operational site for five (5) rental car companies (Advantage Rental Car, Avis Rental Car, Budget Rental Car, Hertz Rental Car, and National Rental Car). The whole project is expected to be completed in the fourth quarter of 2021.

The Hawaii Section members conducted a site visit at the HNL Consolidated Car Rental Facility Phase 2B Project. Shown above from left to right are: Jim Ogata, William “Bill” Fernandez, Ging Ging Fernandez, Rod Nagao, Jian Zhou, Brooks Ford, Maelyn Uehara, Chris Kanae, Yashaira Fletcher, Nicki Dockery, Rollin Wakely, Juhee Han, Jeremiah Laguesta, Brandon Leong, Tommy Uno, Alan Davidson, Kevin Bunting, Evan Yamamoto, Marco Cabrera, Michael Saupan, Robert McAlman, and Jorge Aguirre.

The third annual Nigerian Section Conference at Garden City, Port Harcourt, Nigeria, included a CCP and CEP pre-certification class and attendees are shown above as they prepare to participate in training to better prepare them to take these two AACE International certification exams.
Each conference also featured continuing educational seminars. The Section organized the 2019 conference and workshop in December at Port Harcourt, the Garden City. The theme was, “Project Controls in Nigeria’s Oil and Gas Industry Projects: A Development Roadmap for Nigerian Professionals.” Present at the conference were key industry players, representatives from The Ministry of Petroleum Resources (MPR), Nigerian National Petroleum Corporation (NNPC), Nigerian Petroleum Investment Management Services (NAPIMS), Nigerian Engineering and Technical Company (NETCO), Shell Petroleum Development Company (SPDC), Nigerian Liquefied Natural Gas (NLNG), media outfits and other private engineering and consulting companies.

The Ministry’s team was led by Nkem Agolor, Director, who delivered a speech on behalf of the Minister of State for Petroleum Resources. Thirteen other technical staff accompanied the director in attending the conference. Their goals were to develop technical capacity in the field of cost. Nigerian Section President Johnson Awoyomi delivered an opening speech and welcomed all participants. He highlighted the conference objectives as being an emphasis on the increasing and critical need of project controls in nation building; that the section is the right platform for industry professionals and students to effective exchange ideas and provide excellent networking opportunities that will foster friendship among Section members in Nigeria. He also elaborated on the current industry challenges of the high cost of crude oil production and a long contracting cycle that disregards project controls.

Continuing education classes included one for the AACE Certified Cost Professional (CCP) exam preparation was presented by Antony Emaviwe, Head of Cost Estimating for Shell Petroleum Development Company, Nigeria, and Gregory Akhibi, Head Project Controls, Shell Petroleum Development Company, Nigeria. The other class was the Certified Estimating Professional (CEP) exam preparation and was presented by Jones Basuo, CEP. Since 2018, this is the third time that the Nigerian Section has successfully organized its own local annual international conference under the leadership of Johnson Awoyomi. The fourth annual conference is scheduled in Lagos in November 2020.

The Nigerian Section received a Platinum award at the 2019 AACE Conference & Expo. This is a good reflection of section growth over the last three years. “We were not only honored and delighted to qualify for the Platinum section award but also encouraged to do more as a section,” explains Awoyomi.

Because of awareness created by the different activities of the Nigerian Section, this cost expertise is constantly sought after by those in the industry. At the Nigerian International Petroleum Summit 2020, time was set aside for Section President Johnson Awoyomi to speak on the impact of Total Cost Management in the Nigerian oil and gas sector. Awoyomi also conducted a three-day session with a group of Nigerian National Petroleum Corporation (NNPC) and Nigerian Petroleum Investment Management Services (NAPIMS) staff in February 2020 on Cost Estimate Preparation, Reviewing, and Validation of Third-Party Cost Estimates.

(continued on next page)
Nigerian Section President, Johnson Awoyomi recently lead a three-day session with a group of Nigerian National Petroleum Corporation (NNPC) and Nigerian Petroleum Investment Management Services (NAPIMS) staff in February. The training was centered around the theme of Cost Estimate Preparation, Reviewing and Validation of Third-Party Cost Estimates.

DOES YOUR SECTION HAVE NEWS TO SHARE? See below for complete instructions for how to submit news and photos from your Section’s happenings to be included in the AACE® International Bulletin.

SUBMITTING SECTION NEWS  We invite all sections to submit news and updates to be included in the International Bulletin section of each Source issue. Please submit any and all text as a part of the e-mail or as a Microsoft Word file attachment. Please submit any photos as individual attachments in JPG formats. Do not embed photos in Microsoft Word files. For photos to be used, we require either large original files or print size photos at 300 dpi (dots per inch). For photos to be published, they must be in focus, of print quality, and of sufficient resolution.

Please include the names and titles of each person shown in any photos. Please list names from left to right or refer to those shown as being above left or right. For group photos please list names from left to right, beginning with the front row and working to the back. All submissions should be e-mailed to editor@aacei.org. Please use the official name of the Section as approved by the AACE Board when the Section’s charter was approved. Within 2 to 3 business days of submitting a “Section News” item, you should receive a return confirmation e-mail that your submission was received at AACE headquarters.

MISSING SUBMISSIONS Generally, all submissions received in the above scheduled times will be published in the listed issue. Items are not held because of space restrictions. There is no waiting list and no preference is given to one Section over another. Questions about incomplete submissions or failure to follow these submission guidelines could delay publication. Text will be published without submitted photos if the photo does not meet the listed quality requirements. AACE reserves the right to edit all submissions and/or to refuse to publish any submissions determined by the Managing Editor or the Art Director to not meet the standards of the journal. Any appeals of these decisions will have a final decision determined by the Executive Director.

If a submission is not included in the designated issue, please e-mail or call the Managing Editor to ensure that it has not been lost or misplaced. Call or e-mail if you do not receive a confirmation e-mail within 3 business days of submission.

Source has a submission deadline of two months in advance of the issue date.

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scmmaa@cmaasc.org

7 CMAA SOUTHERN CALIFORNIA CHAPTER DINNER
SB 1 Funding and Upcoming Projects
The Westin Bonaventure, 5:30 p.m. to 8 p.m.
404 South Figueroa Street, Los Angeles, CA
scmmaa@cmaasc.org

9 CONSTRUCTION NETWORK
VIP BREAKFAST Hollywood Burbank Airport Capital Program Update
City Club, 555 S. Flower, 51st floor
Los Angeles, CA
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16 SEAIO MIDWEST BRIDGE SYMPOSIUM
Maggiano’s, 111 W. Grand Ave., Chicago, IL
seaio.org

23 CONSTRUCTION NETWORK
VIP BREAKFAST The LA World Airports Capital Programs Updates
Westin Bonaventure, 8 a.m. to 9:30 a.m.
404 South Flower St., Los Angeles, CA
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28 CMAA SOUTHERN CALIFORNIA CHAPTER
Inland Empire Capital Project Updates
Breakfast of Champions
Inland Empire Utilities Agency, 8 a.m. to 10:30 a.m.
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28 THE STRUCTURAL ENGINEERS FDN.
The Hoover Dam Bypass
5 p.m. reception / 6 p.m. lecture
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MAY

5-6 SECOND ANNUAL MODULAR, PREFAB AND CONSTRUCTION TECH SENATE

JUNE

3-5 AEC NEXT AND SPAR 3D CONFERENCE
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www.spar3d.com/event/spar-aec-next

9 CONSTRUCTION NETWORK
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23 CONSTRUCTION NETWORK
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13 AMERICAN SOCIETY PLUMBING ENGINEERS (ASPE) CONVENTION & EXPO
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12 THE 2020 CMAA SOCAL FOUNDATION GOLF CLASSIC
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