

T H E A A C E[®] I N T E R N A T I O N A L

SOURCE

NO.5 OCTOBER 2020

YOUR SOURCE FOR TOTAL COST MANAGEMENT

Examining Schedule Performance in Phase Transitions on Vertical Construction Projects

The Flexibility
to Evolve

Psychometrics
Made Easy



TECH TALKS

FREE PRESENTATIONS FOR MEMBERS

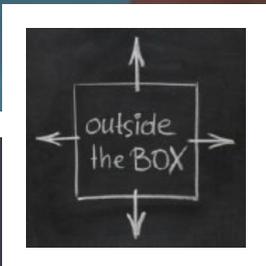
NEW RELEASES AVAILABLE ON WEDNESDAYS

Each week on Wednesday we will be offering a free presentation by some of the top industry leaders for you to watch and learn. Join other members on the AACE Communities in the Tech Talks group for ongoing discussions on the presentations and to share your recommendations or resources during this time that everyone is required to stay at home.

| AIR DATE | TITLE | PRESENTER(S) |
|------------|--|---|
| 10/07/2020 | (Panel Discussion) The Future of Decision and Risk Management in the Post-Digital Era | Dr. Manjula Dissanayake, CCP; John K. Hollmann, PE CCP CEP DRMP FAACE Hon. Life; Christopher P. Caddell, PE CCP DRMP; James E. Arrow, DRMP; Laurie S. Bowman, CCP DRMP EVP PSP; Dev Amratia; Niran Shrestha |
| 10/14/2020 | Avoiding CPM Schedule Mismanagement: Maximize Uses without Compromising Integrity | Jessica Colbert, PSP |
| 10/21/2020 | Estimate Validation and Bias Assessment: Ratio-to-Driver Method | John K. Hollmann, PE CCP CEP DRMP FAACE Hon. Life |
| 10/28/2020 | Progress Earning Rules of Credit and Their Impact on Cash Flow | Estimate Validation and Bias Assessment: Ratio-to-Driver Method |
| 11/04/2020 | Forensic Schedule Analysis Methods: Reconciliation of Different Results | John C. Livengood, CFCC PSP; Patrick M. Kelly, PE PSP |
| 11/11/2020 | Challenges and Strategies for Effective Scope Management Across an Enterprise | Sandeep S. Kurup; Dr. G. Rock Spencer, PE CCP DRMP PSP; Dr. Peerapong Aramvareekul, EVP PSP |
| 11/18/2020 | Applying the Seven Basic Quality Tools to Your Projects | Joseph A. Lukas, PE CCP |
| 11/25/2020 | (Presentation Only) Palms Up - A Servant Leadership approach for Project Management and Support | Richard C. Plumery, EVP |

CLICK TO TUNE IN!

Each presentation will be offered for one week from the date it is aired, then it will expire. However, your CEUs earned will remain on your profile. Note: In order to receive proof of CEU credits, you must watch each presentation in its entirety.



Outside the Box will be a standing column designed to introduce new ideas and concepts from other resources and professions that may help stimulate a new way of thinking about total cost management. The views and opinions expressed are those of the authors and do not necessarily reflect the official policy or position of AACE International.

We invite Source readers to send suggestions on other sources to editor@aacei.org.

CLICK to watch Dr. Brené Brown, research professor at the University of Houston and author of five #1 *New York Times* bestsellers, share insight on courage, vulnerability, shame and empathy.

The Power of Vulnerability

Brené Brown studies human connection — our ability to empathize, belong, love and shares fresh thinking on why caring what others think actually matters, and why critics make us stronger. In a poignant, funny talk, she shares a deep insight from her research, one that sent her on a personal quest to know herself as well as to understand humanity. A talk to share. 🌐

Source: www.ted.com. This talk was presented to a local audience at TEDxHouston, an independent event. TED's editors chose to feature it for you.

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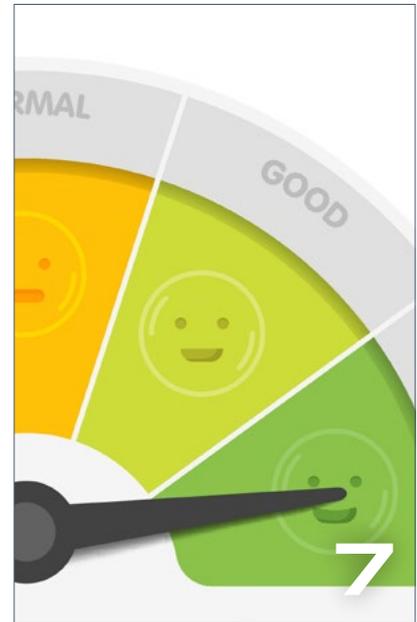
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HEADQUARTERS

1265 Suncrest Towne Centre Dr
Morgantown, WV 26505-1876
+1.304.296.8444 Fax: 304.291.5728
web.aacei.org

MANAGING EDITOR

Marvin Gelhausen
mgelhausen@aacei.org

GRAPHIC DESIGN

Little Fish Design Company
info@littlefishdesigncompany.com

ADVERTISING SALES

Business Development Coordinator
Joanna Boggs
+1.304.296.8444 x1122
jboggs@aacei.org

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For additional industry news and updates, you can always visit us at web.aacei.org.



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The Top 10 Reasons To Join AAACE 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. AAACE'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. AAACE 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 AAACE 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 AAACE International's many technical subcommittees, subcommittees, and Special Interest Groups (SIG's) 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 AAACE 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. AAACE certifications are a recognized credible standard in the cost management field. A recent study shows that individuals with an AAACE Certification earn 17.4% more than their counterpart without a certificate.

9 Discounts

On products and services ranging from AAACE 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

The Flexibility to Evolve

BY CHRISTOPHER P. CADDELL, PE CCP DRMP,
President, AACE International

I hope all our members are staying healthy and taking appropriate measures to keep you and those you care about safe as we continue to deal with the COVID-19 pandemic. This crisis has challenged not only how we work and socialize but shown us how our actions impact those around us and what it means to be part of a community.

In the AACE community, we have been rising to the challenge, working to offer ways for our members to continue to network, discuss issues, learn, and develop. How we work in this industry certainly looks a lot different now than it did 20 years ago when I was first becoming involved with AACE. I have no doubt it will look quite different 20 years in the future from our current state. Whether it will be better or worse may be a matter of perspective, but it will be different. And I don't think any of us have sufficient clarity to understand how it will change. But I feel confident that AACE will be there, providing members with the best technical products, recognition of expertise through certifications, educational support, a forum for exchanging ideas, and networking with our peers.

In my last message I discussed one of the Board's top strategic objectives is to look at updating the organization structure and operating model to better position AACE to meet the future needs of the Association and all its members. We have started the detailed work to draft a new Constitution and Bylaws for the Association. Once complete, it will be presented to the members for a vote.

The goal on one hand is to streamline the documents to provide future leadership greater flexibility to evolve as the world around us changes and the Association needs to adapt. But on the other hand we need

to ensure we protect what makes AACE so valuable to its members. If we look at AACE's Mission and Vision statements, they define what is important to our members and what we need to continue to focus on:

- We arm our members with the technical tools and expertise to support successful projects and programs.
- To be the gathering place and source of thought leadership for professionals who drive successful project and program delivery

The Constitution and Bylaws contain the fundamental rules by which AACE governs itself and the current version supports these ideals. But there are elements that are based on a model that has been in place for decades and does not completely fit with current times. It also contains some detailed, operational elements that could be moved to our Organization Manual, which is another important AACE document containing our policies and procedures. This shift would make it easier to maintain and adjust guidelines, enabling consistent and logical decision-making as we move forward. We could redraft these documents to define exactly how we want to operate today, but that model will become outdated in years to come. The ideal goal is to draft our governing documents so that future leadership is able to make adjustments as we grow and evolve, but provides sufficient structure to ensure we continue to provide what our members value.

This will not be the work of a handful of individuals operating in secrecy. The effort to redraft these documents includes a large and diverse number of volunteers to ensure we are receiving opinions and input from a wide range of members, including the

Constitution and Bylaws Committee. Of course, there will be debate over various details, but the goal is to have a consensus document for members to review and vote on. While we have an ambitious timeline to get this done, our priority is to create a quality set of documents. We will take the time needed to get it right.

The other element of this effort is updating the Organization Manual. These policies and procedures need to be reviewed in tandem with the Constitution and Bylaws update. To increase transparency, the plan is to revise the manual and post it on the AACE website for all members to access. Members should be able to review our policies, procedures, and other operating documents. If we move elements of how we operate from the Constitution and Bylaws to the Organization Manual, it is more important than ever that these documents be accessible.

At the end of this endeavour, we hope to reinforce what makes AACE so valuable, provide flexibility to future leadership to adapt to the times, and provide accountability through transparency to all our members on how we operate. 🌐



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.

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Credibility Capital is Hard to Acquire But So Easy to Lose

BY RICHARD PLUMERY, EVP

We spend a good part of our careers trying to build our credibility.

We try to do the right thing despite difficult circumstances. At some point, things will likely go awry, and we might be caught up in something appearing to be deceptive, which may bring down our credibility capital at a much higher rate than the rate it took us to acquire that capital. In certain cases, this can be job threatening.

From my experiences owning Velocity Sports Performance (VSP) centers, I learned how our VSP coaches built credibility with their athletes. It is a relationship-based profession just like it is for us and our clients in the design and engineering industry. Lose your credibility, lose your client. Results become the ultimate determinate. If the athlete improves, credibility and trust grow, and if they regress or they experience injury, then it is all gone. Same goes for most projects ... results are what counts ...

At VSP, we brought in hundreds of college football players over the years who were trying to take their game to the NFL. The reason we were able to attract so many athletes was because of our strong credibility and reputation gained from our results year over year. These athletes and their agents were trusting us with their future, over all the other options, because they believed in my coaches. That is a lot of responsibility, so we made sure we were honest with them and gave them reasonable expectations that we could help them deliver upon.

When I first started my career in project controls, my mentor made the statement, "All you have in this role is your credibility and if you lose that, you lose your value in this field." This has been imprinted in my mind and I always harken back to it when I am in difficult situations. I learned to be as honest as possible and present facts that could be backed up. This honest and factual portrayal was sometimes challenged by my project manager because it did not tell the story that they wanted to be told. They would often use an optimistic bias to counter. "Well, it could be possible, right?"



You need to find a balance between what is possible and what is probable. Be cognizant of what is fact and what is optimistic bias. Optimism is not automatically a bad thing, but it can destroy a project and everyone's credibility. Also, consider the timing of your argument or contradiction. It is probably not a good idea to withhold your input until your boss is in front of their boss. That can have a really bad ending.

Proposal and/or capture managers need to be careful when bringing forward proposals. How many times have you been in a proposal meeting when benchmarking is employed and there is an excuse for every piece of historical or parametrical evidence because they "need" this project to move forward? Being overly optimistic can give the execution team no chance for project success which is very demoralizing and may result in an erosion of credibility. The issue for me is when this issue repeats itself over and over again, despite any historical evidence. Just like overpromising an athlete great results, if a project team continues to fall short of unreachable, overly optimistic goals, frustration and blame will set in, eventually destroying any built relationship.

Build and hold your credibility capital like a precious commodity and your fan base and career will prosper. ☺

Psychometrics Made Easy: How the Certification Board Applies Psychometrics to Improve the Certification Process

BY F. SAM GRIGGS, CCP FAACE

This article is part one of a two-part series to familiarize the reader with the field of psychometrics, which is used in the AACE certification examination process to achieve enhancements in the exam process. For now, we will cover the basics and highlight the principles, saving the inner workings and mechanics of psychometrics for part two of this article.

Psychometrics is the study, or science, of evaluating certification questions by applying statistics and statistical analysis. Simply put, it is using statistics to develop a road map for enhancing the examination process.

To grasp the importance of psychometrics, it is beneficial to review a brief history of the AACE International Certification program. Many of our veteran certified members and non-member certificants will remember the “old days” when the certification exam was a manual, paper-based examination, lasting for 8 hours - across an entire day, and with in-person proctoring! Needless to say, in those days, the full range of statistics to support effective psychometric analysis was difficult to attain.

After converting to computer-based testing in the fall of 2012, AACE suddenly had a wide range of statistics available to compile, analyze and produce pathways through which we can more readily **enhance the examination process**. The statistical data is used to capture key features of the exam, such as pass rate, question difficulty, correlation, negative correlation, etc., which are analyzed and in combination with post-exam surveys are applied to enhancing the overall examination process.

There are three key

words in the world of psychometrics: distractor, validity, and reliability.

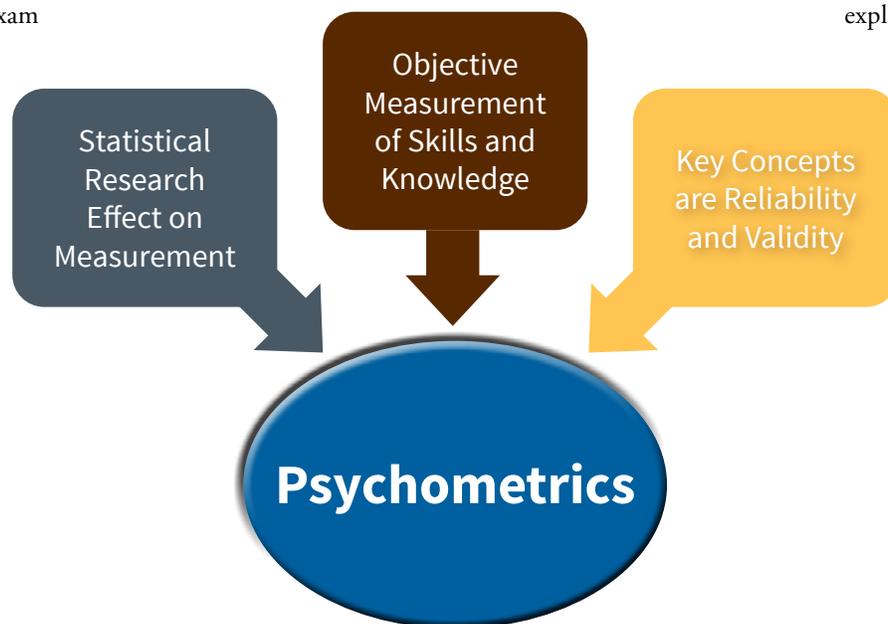
A **distractor** describes the incorrect answer for a multiple-choice answer examination question. It is common practice to make the distractors plausible and seemingly correct, Choosing a poor **distractor** can add unnecessary complication to the examination process and make selection of the correct multiple-choice response much easier or much harder than intended.

The considerations of **reliability** and **validity** are viewed as essential elements for determining the quality of any examination. Most professional associations with certification examinations have embraced the importance of these key concepts when developing examination parameters and assessing the quality of any examination.

Reliability describes a *reliable measure*. In other words, is the examination reliable? It should measure examination content consistently across time, individuals, and situations. For example, one would expect a consistent pass grade over several test periods for a particular exam. The overall test score would not be expected to fluctuate say, from 50% to 90%, but it would be expected to stay in a reasonable range. An important feature, reliability is necessary, but not sufficient for validity.

Validity describes measuring what is *supposed to be measured*. In other words, measuring the *defined competencies* in the body of knowledge relevant to the particular examination (this is explained further in the final paragraphs).

One of the primary duties of the Certification Board is to review



How Did We Get Here?

the examination questions and analyze the psychometric data to ensure the questions have both reliability and validity. This process of analyzing the performance of examination questions is an ongoing task under the individual examination Committees with regular reporting, reviews, and analysis of examination performance.

The Certification Board also strives to ensure a proper mix, or balance, of very challenging questions and less challenging questions. Creating an examination in which all questions had a 90% pass rate would not work, as everyone would pass. Conversely, having an examination wherein all questions were a 20% pass rate would likewise not work, as everyone would fail. There is a delicate balance in creating an appropriate mix of questions for each examination test form.

Occasionally, analysis of examination results in combination with a review of the questions indicates there may be a basis for improving the overall quality of the examination. It may be an overly difficult question and perhaps the pass rate may be too low. In this case, changing the distractor may prove to be a good solution, or perhaps the question requires restructuring.

The following illustrative question may suffice as an example of how distractor answers may be adjusted.

Sample Question A1: In which state is Jacksonville State University located?

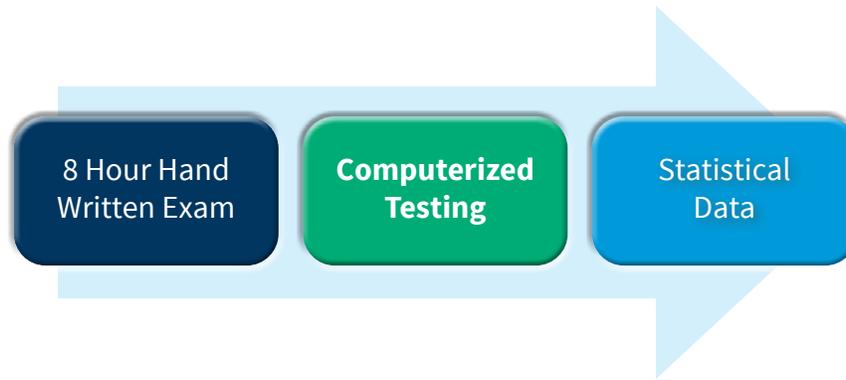
- a. Florida
- b. North Carolina
- c. Alabama
- d. California

Let us say this example is considered a difficult question, because the psychometric analysis shows only 25% of the candidates answered correctly. A random guess would work out to be 25%, but worst case, many people may associate the college with Jacksonville, FL and mark Florida as the correct answer. Others might associate the college with North Carolina since there is a military installation in Jacksonville, NC.

But what if we change the distractors to make it easier?

For instance, what if we change the first distractor “a. Florida” to “a. Hawaii.” In the original question, Jacksonville is the largest city in FL and more people would recognize it and may have marked it as correct.

Secondly, what if we change “b. North Carolina” to “b. Alaska.” A large military installation is located in Jacksonville, NC, and many people would recognize it and may have marked it as correct.



Alas, two semi-obvious or recognizable answers, that were **distractor answers** (incorrect answers), are now out of the picture and that will change the dynamics of the statistics coming from responses chosen across multiple examinations. Changing two of the more obvious distractor answers

would potentially increase chances of a candidate selecting the correct answer.

Sample Question A1 (Revised): In which state is Jacksonville State University located?

- a. Hawaii
- b. Alaska
- c. Alabama
- d. California

The revised question reflects the two distractor changes. If the candidate excluded the two obvious incorrect answers (a and b) and made a random choice from the remaining two (c and d), there would be a 50% chance of getting the answer correct (the correct answer is “c. Alabama”).

The competencies expected to have been developed by candidates through education, training and experience are represented in examinations and are also included in the psychometric data gathered and reported. This is important in assisting the Certification Board to pinpoint concepts in the AACE Body of Knowledge that may need additional attention and further coordination with the Education and Technical Boards. The competency represented in each examination question is tied to its respective section the TCM and Recommended Practice(s) (RP), for example with 11R-88 considered the most essential with respect to cost estimating, as it contains competencies represented in each of AACE’s eight certification examinations.

As presented through AACE’s website: “This Recommended Practice (RP 11R88) has the following purposes: 1.) define what core skills and knowledge of cost engineering a person is required to have in order to be considered a professional practitioner, and in doing so, 2.) establish the emphasis of core subjects for AACE International education and certification programs.”

In part-two of this series, we will focus RP11R-88 more fully, in addition to the inner workings and mechanics of the Psychometrics, possible future aspects of psychometrics, and giving tips to enhance the potential of a better result when taking the certification examination.

Stay tuned for Part 2 in December! 📍

SPOTLIGHT ON

Jessica Colbert

BY CINDY WHITMILL, PSP

Jessica Colbert grew up in Delaware where she was raised with strong values of independence, critical thinking, and a lack of gender lines. “She was able to do anything the boys could do.”

Jessica earned her BS in Building Construction from Virginia Tech. While working full-time, she also completed two graduate degrees: Master of Business Administration from UMUC and Master’s in Management from UMUC.

She started her career working for the construction division of APAC-Atlantic as a project manager for transportation projects. In 2005, she joined Allan Myers, formerly known as American Infrastructure, as a senior project engineer. Allan Myers was growing from only private-sector work in Virginia to the public transportation market in 2006. Jessica was able to contribute to the growth of the business from the start. From 2006 to 2012, she fulfilled the roles of senior project engineer and project manager for projects ranging from \$3M to \$60M. In 2012, her career transitioned from operations management to project controls. She supported the Virginia region as schedule and claims manager for a few years prior to becoming the schedule manager for \$1.4B design build project in southeastern Virginia. In 2015, she returned to supporting the Virginia Region as project controls manager. During the last eight years she has contributed to the development of Myers’ Project Controls programs. She has continued growing with Allan Myers and is now the current director of project risk, since October 2019.

Jessica has always performed project controls functions in her project management roles. However, in 2012, she had the opportunity to focus her contribution to the organization to project controls functions on a more global basis (organization wide rather than project specific) – specifically in the areas of scheduling, contract management, and dispute resolution. Her attention was focused on any project that may be experiencing challenges. Through this assignment, she was able to identify areas that her organization could improve its processes.

When asked; Why did you choose this line of work and what was the attraction for you? Jessica initially pursued a degree in Building Construction because she was drawn to the idea of



“AACE pursues advancement of the industry through volunteer efforts [...] Volunteer for ONE thing. Do that one thing well, and the leadership opportunities will be paved in front of you.”

— JESSICA COLBERT

managing things getting built. Growing up, she did a variety of building projects with her parents and she is naturally drawn to problem solving and planning how to get something done. This has carried over into her adult life – both professionally and personally.

She has had a variety of mentors over the years. She thinks it is important to find a mentor or coach who can provide guidance through your current challenges and challenge you to become better.

AACE has given her learning opportunities to bring industry best practices back to her organization to strengthen their processes. Through annual conferences, she has met many professionals that she has been able to call for advice, recommendations, and partnerships. These connections are invaluable.

The resources available through AACE, such as technical papers and Recommended Practices have provided her a source of industry best practices as she has developed her own skills and experience in project controls, scheduling, and risk management. Earlier in her career, she found herself sitting across the table from many people who held AACE certifications. By pursuing her own PSP certification, she found that her analysis and

recommendations held more weight at those tables. The AACE networking available for experiential learning is what she values the most.

When Jessica was asked; What would you tell others about AACE and the opportunities available? She replied, “AACE, like many organizations, pursues advancement of the industry through volunteer efforts. There are immense opportunities for contribution and leadership in the organization. If you doubt this, volunteer for ONE thing. Do that one thing well, and the leadership opportunities will be paved in front of you.”

If she could rewind twenty years and tell herself one thing it would be this: “Don’t pursue the promotion. Figure out what you are passionate about – know that your passion will change over time. Look for ways that your current passion can contribute to the world around you – whether it be your employer, a professional organization, your church, your family, your community. Where passion and purpose meet, you’ll find true fulfillment ... and often the promotion.” 🌟

SPOTLIGHT ON

Ricky Payne, PSP

Ricky Payne, PSP, is a planning and scheduling professional with 11 years of experience in the construction industry currently working for Brasfield & Gorrie in Raleigh, NC. He has a diverse background in planning and scheduling that spans multiple areas within the construction industry. He has worked in areas ranging from nuclear fuel processing facilities and nuclear reactors, power substations, healthcare, hospital, and commercial construction projects ranging anywhere from \$10 million to \$10 billion. His experience includes planning and scheduling responsibilities on the first nuclear reactors to be constructed in the US in 30 years. He holds an AACE International certification as a Planning and Scheduling Professional (PSP), and he is a Project Management Professional (PMP) through PMI.

Ricky grew up in Jamestown, North Carolina. Growing up in a smaller town allowed his love of sports and the outdoors to blossom. For as long as he can remember, being on a ballfield or in the great outdoors has always been a part of his life. After graduating high school, he pursued a lifelong dream of playing college baseball. That dream was fulfilled at Barton College. His time at Barton College was short-lived, as the mountains and the outdoors were calling and Ricky soon found himself at Western Carolina University in Cullowhee, NC. Upon arrival at WCU, Ricky was still unsure of what direction he wanted college to take him in his professional life, when his dad, a commercial real estate banker, suggested the construction management program.

After graduating with Bachelor of Science degree in Construction Management in 2008, Ricky's soon-to-be wife referred him to a Junior Project Controls position in Aiken, South Carolina, where he would cut his teeth on a \$9 billion nuclear mixed-fuel fabrication facility, nicknamed MOX. He joined the MOX team as a cost/scheduler and worked with the design engineering groups and construction teams. This was Ricky's first real exposure to project controls. While working on MOX, Ricky learned the basics of project scheduling from Mike Mogilefsky, a master scheduler with over 40 years in the nuclear construction industry. Mike instilled in Ricky proper scheduling

principles, baseline maintenance practices, and earned value methodology. Mike not only served as a valuable mentor to Ricky but grew into a lifelong friend.

After two years in South Carolina, Ricky wanted to be back in North Carolina, where he transferred to Charlotte to work on the VC Summer and Plant Vogtle AP1000 New Nuclear Projects. As a project scheduler on these large and complex projects, Ricky was responsible for scheduling civil and structural engineering & procurement tasks, totaling over 40,000 project schedule activities. As Ricky's experience grew, he was looked upon to provide training and guidance to fellow coworkers in the department. He led schedule meetings that coordinated with engineering management, construction managers, South Carolina Electric and Gas, as well as the Nuclear Regulatory Commission.

After four years in the Charlotte, Ricky saw an opportunity with ABB Inc. to continue his career in power generation in Raleigh, NC and seized the opportunity. At ABB, he was given the opportunity to harness his diverse project controls experience to lead a results-driven team, responsible for supporting project management and the construction of substation power projects throughout the United States. Ricky implemented proper project controls processes and procedures that were instilled in him from his time at MOX. These processes helped identified project issues and trends that led to improved monthly and quarterly forecasting to within 3%. At ABB, Ricky also got his first taste of project management while working on a \$100+ million substation in Washington, DC, by developing scopes, schedules, and budgets. Seeking new and exciting challenges, Ricky was hired by Brasfield & Gorrie in 2017 as a part of the growing Raleigh office to develop, support, and manage their healthcare and commercial projects throughout the Carolina's.

Through three years with Brasfield & Gorrie, Ricky has touched a wide array of projects, all ranging in size and complexity. In his current role, Ricky is overseeing project schedules totaling over 400 million dollars of contract value including multiple tenant fit-outs, medical office buildings, a 2-story vertical expansion



to WakeMed Cary Hospital, and a state-of-the-art healthcare/emergency department in Greensboro, NC. Ricky is currently working on one of Brasfield's largest preconstruction efforts for a large, mixed-use commercial and entertainment development in the heart of Raleigh.

Ricky became an AACE member in 2017, and is currently the President of the Catawba Valley Section. He obtained his PSP in January 2019 and later that year, Ricky joined AACE's Rising Professionals Committee as a way to continue his growth, as well as serve as a resource for younger project controls professionals. In 2019, he attended his first AACE Annual Conference & Expo, and while in attendance Ricky enjoyed fostering relationships, as well as connecting with

new AACE members to form lasting career relationships. Ricky has found his peers in AACE to be an extremely valuable resource, not only technically, but professionally as he continues his career growth. His favorite experience with AACE was his attending first annual conference in 2019 in New Orleans and networking with his peers.

Ricky's advice for rising professionals is "succeed or fail, it's about getting outside of your comfort zone. Learn the projects, the finite details, and the teams so you can provide solutions and influence. Even though we are a technology and data driven based profession, don't be afraid to dive into the details and ask questions. You gain more respect from your peers by asking questions and challenging solutions than sitting idly by being a key puncher." 🚀

"You gain more respect from your peers by asking questions and challenging solutions than sitting idly by being a key puncher."

— RICKY PAYNE, PSP

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Examining Schedule Performance in Phase Transitions on Vertical Construction Projects

BY DANIEL P. GILMOUR, PSP AND MATTHEW L. PRINGLE, PSP

ABSTRACT

On many vertical building construction projects, poor schedule performance trends often coincide with periods of phase transition. For example, schedule execution commonly suffers as projects transition from the structural phase of construction to building enclosure and interior buildout. Using eleven recently constructed vertical building projects as case studies, this article will analyze historical schedule data using both deterministic and probabilistic methodologies to identify schedule performance and execution trends. Using these case study models, the authors will examine possible root causes for schedule performance declines in phase transition. These include institutional tunnel vision,

schedule development, project management staff scoping responsibilities, phase pre-planning, and subcontractor coordination. Finally, this article will offer strategies and potential solutions to combat negative schedule performance trends in periods of phase transition for future vertical building construction projects.

INTRODUCTION

Building construction projects of all types and sizes invariably experiences peaks and valleys in project performance and schedule execution throughout the course of the construction timeline. On typical vertical building projects, where the phases of construction are generally easy to define, periods of phase transition

or phase overlap are frequently marked by poor performance trends and diminished schedule execution. Specifically, the phase transition between structural construction and interior buildout is often the intervallic culprit for project performance decline, resulting in increased late-project costs to support project completion milestones or late completion altogether.

Using eleven recently constructed case study projects typical to the vertical building construction model, this article aims to pinpoint and verify performance and execution declines in the phase transition between structural construction and interior buildout. Each case study project's periodic schedule updates were analyzed for performance trends using deterministic

and probabilistic methodologies and those measures were compared to the periods of phase transition. The results are striking: all eleven projects saw significant declines in the execution of their project plans during phase transition and were appreciably less likely to complete on time after proceeding through phase transition.

Initially, this article will discuss the methodologies used for analyzing the case study projects. These methodologies include how the individual case study projects were chosen, how phase transition was defined for the purposes of period comparison, the deterministic measurement of project performance using historic schedule data, and the probabilistic measurement of project performance using simulation and its input parameters. Next, each case study project is introduced, and its phase transition performance is examined. The discussions of each case study project are followed by a summarized narration of the wholistic performance in phase transition of the eleven case study projects. The possible causations of project performance decline during phase transition in the eleven case study projects will then be investigated and several major root causes will be assessed. Finally, this article will conclude by proposing strategies to combat performance decline during phase transition on vertical building construction projects.

METHODOLOGY

CASE STUDIES

Eleven case study projects of various size and scale were chosen to be analyzed for schedule performance trends during periods of phase transition. Each project represents an archetypal representation of vertical construction installation and sequencing for a typical vertical building construction product. The eleven projects range in contract value from \$10 million to \$250 million and range in footprint from 30,000 square feet to 1,000,000 square feet. Each of the case study projects was completed between 2015 and 2019. The case study projects include office buildings, hotels, a laboratory and research facility, hospitals, medical office buildings, and an apartment building. These projects were specifically chosen because their schedules were both updated in regular frequencies throughout the duration of the project and were subjected to recurrent quality control evaluations in line with the specifications and

best practices produced by organizations like the Defense Contract Management Agency (DCMA) or the Government Accountability Office (GAO). A high-quality schedule that is logically linked and adheres to industry recommended practices is essential for any risk analysis or probabilistic simulation as the credibility of any such analysis relies on the quality of the analyzed schedule [3, 3].

DEFINING PHASE TRANSITION

For the purpose of analyzing the chosen case study projects, this article defines phase transition as the overlapping time between the start of a later phase of construction and the completion of an earlier phase of construction. For example, the time period that would define the phase transition between structural construction and interior buildout on a typical vertical building construction project would be the time between the start of the first interior buildout schedule activity (generally wall layout or overhead rough-ins) and the completion of the final structural schedule activity (generally a structural top-out milestone).

DETERMINISTIC MEASURE OF PROJECT PERFORMANCE

The methodology chosen to deterministically measure schedule performance in phase transition in the eleven case study projects was to calculate the Schedule Performance Index (SPI) for each update period (approximately monthly frequencies) on the timeline of the project. SPI is a basic earned value concept defined as the ratio of work performed in a given period to the work planned in a given period [1, 107]. This ratio serves as a measure of schedule efficiency [5, 3]. For clarity, a SPI value of 1 indicates the project is completing the exact amount of work planned for that period, a SPI value over 1 indicates the project is overperforming its plan, and a SPI value under 1 indicates the project is underperforming its plan. For simplicity and given the schedule files available for the case study projects, the work planned value for a given update period was derived from the previous update's projections for that period. This measure is referenced in the remainder of this paper as *SPI*.

PROBABILISTIC MEASURE OF PROJECT PERFORMANCE

In order to probabilistically measure schedule performance in phase transition, Monte Carlo simulations were performed on each schedule update period of the

eleven case study projects to determine the probability of the project finishing on time at each stage of the project timeline. Monte Carlo simulation is a standard practice in analyzing project risk and is the most commonly applied method to analyze the impact of multiple risks on a project schedule [2, 3]. This measure is referenced in the remainder of this article as *completion likelihood or probability of completion*.

In order to properly perform Monte Carlo simulations, several risk analysis input decisions must be made: the type of probability distribution curve, the statistical parameters of the probability curve, the p-value or calculated probability, and the number of iterations performed for each simulation.

Based upon the complexities of the eleven case study projects and the wide range of project scales, it was determined that a three-point risk estimate with pessimistic, most likely, and optimistic bounds was optimal. Further, it was decided that a triangular distribution or a betaPert distribution best fit the data present in the case studies because of the ease in assigning curve parameters and their versatility and standard usage for the type of projects analyzed [10, 2037]. A betaPert distribution was eventually chosen as it aligned more closely with the empirical data by assigning a greater weight to the most likely value whereas a triangular distribution would give each parameter equal weight, exposing a tendency to overweight skewed ranges [4, 4].

Where possible, any determinations regarding probability distribution parameters should reference actual performance data to generate informed statistical modeling. The benefit of using historical data when setting parameters for Monte Carlo simulations is the validation of assigned risks through historical knowledge, thereby resulting in improved estimates of project outcomes [6]. The as-built duration data of the eleven case study projects was evaluated for duration overruns and underruns, and based on the results, an asymmetric betaPert distribution curve slightly weighted towards activity duration overrun was deemed appropriate. The betaPert distribution curve derived from the as-built duration data used for the probabilistic analyses of the case study projects used the following distribution parameters: pessimistic – 0.65, most likely – 1.00, optimistic – 1.45.

Because of the many unknown risks present in the eleven case study project schedules, a p-value or calculated probability of 80th percentile was used to determine the

simulated project completion date. A P-80 value is a generally conservative certainty target for projects where specific risks or uncertainties are unknown [8, 17].

Finally, through testing Monte Carlo simulations on the largest schedule of the eleven case study projects, it was determined that statistical convergence of completion likelihood occurred around 2,500 simulation iterations. This iteration magnitude was thereby used for the Monte Carlo simulations on each of the eleven case study projects.

A NOTE ON CORRELATION

While it is tempting to try to establish correlations between the deterministic and probabilistic measures of project performance illustrated as trend lines below, it is important to note two principal differences that make correlation unfeasible. First, the two metrics operate on separate planes of value range. SPI, being ratio-base, is not bounded by a maximum or minimum value, while completion likelihood values cannot be above 100%. Additionally, while SPI will always show a value of 1 for the first update period because there is no current earned work performed, the completion likelihood percentage will vary depending on the risk level of the project schedule at project commencement. Therefore, the two measures may have trend lines that seem to coincide, run relatively parallel, or widely diverge. Second, the deterministic measure, SPI, strictly evaluates data within a singular period while the probabilistic measure, completion likelihood, is a function of the current performance period, criticality, and the time remaining until completion. The result of this difference is that the SPI trend lines are often more statistically noisy, spiking for periods of over and under performance while the completion likelihood trend lines are more static and as the projects progress, are less reactive to periods of over and under performance. For this reason, when analyzing declines in completion likelihood resulting from phase transition in the case study projects below, the update periods immediately preceding phase transition were included as possible resultant low values.

CASE STUDIES

PROJECT A

Project A was a 16-story, 260-room luxury hotel built in the Southeastern United States with a contract value of approximately \$80



FIGURE A Project A - Schedule Performance in Phase Transition

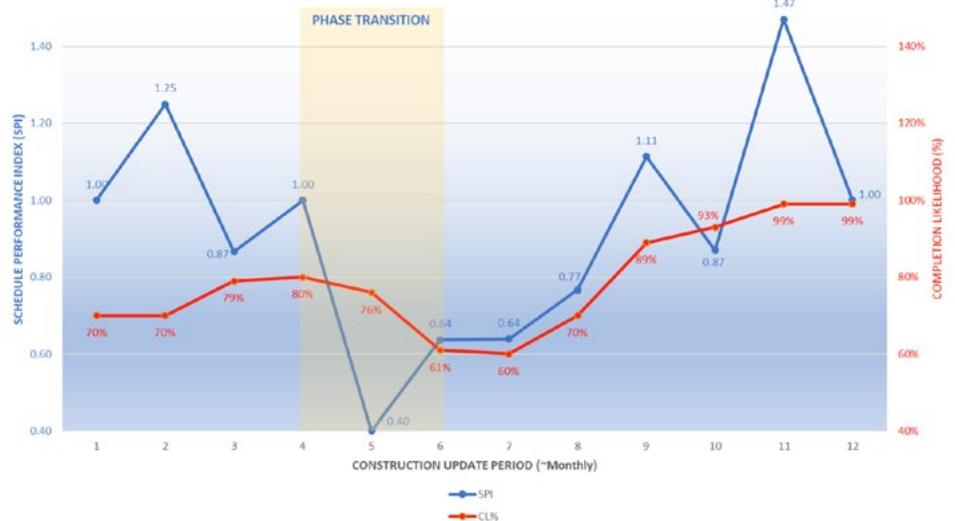


FIGURE B Project B - Schedule Performance in Phase Transition

million. The project included ballrooms, a conference center, a restaurant, rooftop hospitality suites, and an elevated pool and amenity deck. Sitework and deep foundations for this project were performed under a separate contract, so the elevated structural work began immediately. Phase transition between structural construction and interior buildout occurred between the 5th and 9th update periods as indicated in Figure A.

Project A executed its schedule plan to moderate success in early periods of structural construction, experiencing SPI values in the range of 0.81 to 1.00. Prior to phase transition, the project was completing, on average, 90% of its planned activities. Project A suffered a maximum SPI decline of 0.21 during phase transition, indicating that after phase transition began, the project was

completing 21% less work than the project schedule planned. The lowest SPI value in the project's timeline (0.60) occurred amidst phase transition, during update period 8. Though the project's SPI values briefly rebounded in the phase transition, the project's SPI languished in the 0.65 range for much of the remainder of the project and only rebounded sharply at the very end of the project.

Similarly, Project A's completion likelihood remained relatively static until phase transition, starting at a completion likelihood of 80% and entering phase transition at a completion likelihood of 73%. As the project passed through the periods of phase transition, the project's completion likelihood bottomed out at 49%, indicating a loss of project completion likelihood of 24%. Project A continued with generally flat completion likelihood values,

and in the update period directly prior to completion only had a 61% probability of finishing on time.

PROJECT B

Project B was a multi-story, 31,000 square-foot laboratory and research facility built in the Southeastern United States with a contract value of approximately \$10 million. The project included lab space, offices, specialized equipment, and a pedestrian bridge connecting to an adjacent building. Phase transition between structural construction and interior buildout occurred between the 4th and 6th update periods as indicated in Figure B below.

Project B executed its schedule plan successfully in early periods of structural construction, experiencing SPI values in the range of 0.87 to 1.25. Prior to phase transition, the project was completing, on average, over 100% of its planned activities. Project B suffered a maximum SPI decline of 0.60 during phase transition, indicating that after phase transition commenced, the project was completing 60% less work than the project schedule planned. The lowest SPI value in the project's timeline (0.40) occurred amidst phase transition, during update period 5. Project B's SPI values rose after phase transition and averaged above a value of 1.00 over the final four update periods as the project reached completion.

Project B's completion likelihood remained fairly flat through structural construction, starting at a completion likelihood of 70% and entering phase transition at a completion likelihood of 80%. As the project passed through the periods of phase transition, the project's completion likelihood dropped to 60%, indicating a loss of project completion likelihood of 20%. Project B's completion likelihood continued to rise after phase transition and through interior buildout, settling at a probability of completion of 99% in the updates preceding the project's finish.

PROJECT C

Project C was a ten-story, 250,000 square-foot office building built in the Southeastern United States with a contract value of approximately \$60 million. The project included two parking levels, nine levels of office space, and a rooftop amenity deck. The project was delivered as a core and shell product, with interior tenant fit-out completed under a separate contract. Due to site preparation and the construction of the



FIGURE C Project C - Schedule Performance in Phase Transition

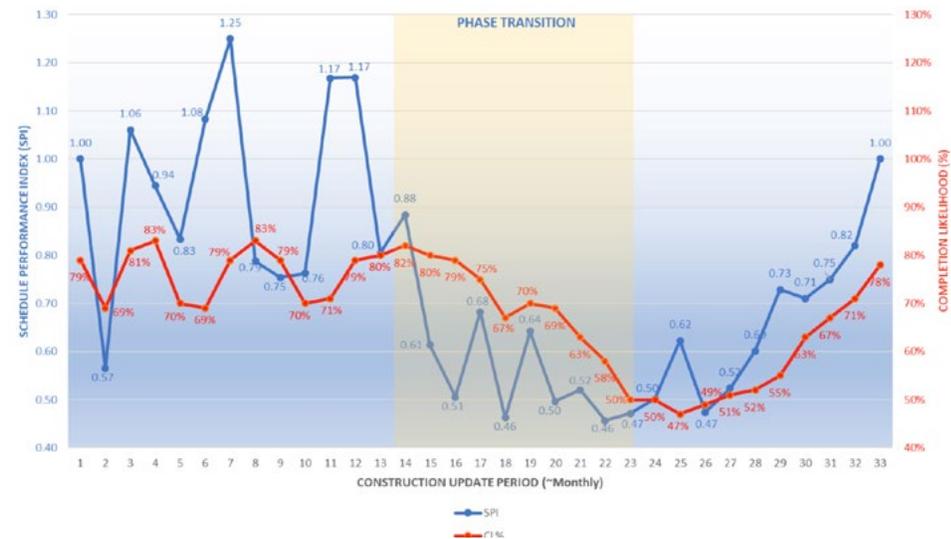


FIGURE D Project D - Schedule Performance in Phase Transition

parking levels below grade, phase transition between structural construction and interior buildout did not occur until between the 10th and 15th update periods as indicated in Figure C.

Project C executed its schedule plan successfully in early periods of structural construction, experiencing SPI values in the range of 0.75 to 1.25. Prior to phase transition, the project was accomplishing, on average, 97% of its planned activities. Project C suffered a maximum SPI decline of 0.45 during phase transition, indicating that after phase transition commenced, the project was completing 45% less work than the project schedule planned. The lowest SPI value in the project's timeline (0.55) occurred amidst phase transition, during update period 12. Project C's SPI values

continued to spike up and down coming out of phase transition and experienced a three-update period of low performance during interior buildout, only to steeply rise in the final three update periods of construction.

Project C's completion likelihood stayed between 88% and 96% through structural construction, starting at a completion likelihood of 95% and entering phase transition at a completion likelihood of 92%. As the project passed through the periods of phase transition, the project's completion likelihood bottomed at 64%, indicating a loss of project completion likelihood of 28%. Project C's completion likelihood continued to rise after phase transition and through interior buildout, settling at a probability of completion of 100% in the update period preceding the project's finish.

PROJECT D

Project D was a 12-story, 615,000 square-foot hospital tower built in the Southeastern United States with a contract value of approximately \$250 million. The project included 220 patient rooms, a 97-bed emergency department, and interventional cardiology and radiology spaces. Phase transition between structural construction and interior buildout occurred between the 14th and 23rd update periods as indicated in Figure D.

Project D executed its schedule plan effectively in early periods of structural construction, experiencing SPI values in the range of 0.75 to 1.25. A low SPI value of 0.57 in the second update period was because of geotechnical issues with the site and deep foundations. Prior to phase transition, the project was completing, on average, 93% of its planned activities. Project D suffered a maximum SPI decline of 0.42 during phase transition, indicating that after phase transition began, the project was completing 42% less work than the project schedule planned. The lowest SPI value in the project's timeline (0.46) occurred amidst phase transition, during update periods 18 and 22. Project D's SPI values recovered slowly coming out of phase transition and experienced a steep three period SPI rise in the final update periods of construction.

Project D's completion likelihood swung between 69% and 83% through structural construction, averaging a probability of completion of 77%. Project D started at a completion likelihood of 79% and entered phase transition at a completion likelihood of 82%. As the project passed through the periods of phase transition, the project's completion likelihood dropped to 47%, indicating a 35% loss of project completion likelihood. Project D's completion likelihood continued to rise after phase transition and through interior buildout, settling at a probability of completion of 78% in the update period preceding the project's finish.

PROJECT E

Project E was an 11-story medical office building built in the Southeastern United States with a contract value of approximately \$30 million. The project included two parking levels, nine levels of office space, and an attached seven-level parking deck. The project was delivered as a core and shell product, with interior tenant fit-out completed under a separate contract. Phase transition between structural construction and interior buildout occurred between the 5th and 9th update periods as indicated in Figure E.

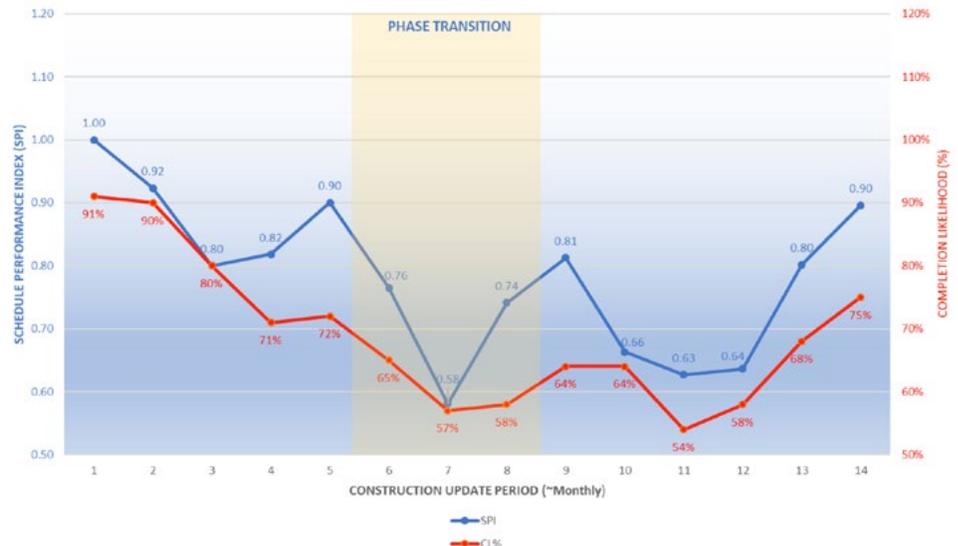


FIGURE E Project E - Schedule Performance in Phase Transition



FIGURE F Project F - Schedule Performance in Phase Transition

Project E executed its schedule plan well in early periods of structural construction, experiencing SPI values in the range of 0.80 to 1.00. Prior to phase transition, the project was completing, on average, 89% of its planned activities. Project E suffered a maximum SPI decline of 0.32 during phase transition, indicating that after phase transition commenced, the project was completing 32% less work than the project schedule planned. The lowest SPI value in the project's timeline (0.58) occurred amidst phase transition, during update period 7. Project E's SPI values stayed stagnant for several update periods coming out of phase transition and experienced a steep two period SPI rise in the final update periods preceding project completion.

Project E averaged a completion likelihood of 81% in the early structural

phase of construction. Project E started at a completion likelihood of 91% and entered phase transition at a completion likelihood of 72%. As the project passed through the periods of phase transition, the project's completion likelihood dropped to 57%, indicating a 15% loss of project completion likelihood. Project E's completion likelihood continued to languish after phase transition and through interior buildout, settling at a probability of completion of 75% in the update period preceding the project's finish.

PROJECT F

Project F was an eight-story medical office building built in the Southeastern United States with a contract value of approximately \$90 million. The project included six levels of medical office space, two levels of traditional

office space and an attached seven-level parking deck. Phase transition between structural construction and interior buildout occurred between the 10th and 13th update periods as indicated in Figure F below.

Project F executed its schedule plan well in the early periods of structural construction, fluctuating between SPI values in the range of 0.82 to 1.10. Prior to phase transition, the project was accomplishing, on average, 95% of its planned activities. Project F suffered a maximum SPI decline of 0.43 during phase transition, indicating that after phase transition commenced, the project was completing 43% less work than the project schedule planned. Project F's SPI values stayed stagnant for several update periods coming out of phase transition and the project completed with four periods of highly effective performance.

Project F's completion likelihood stayed relatively consistent between 72% and 80% through structural construction, averaging a probability of completion of 77%. Project F started at a completion likelihood of 75% and entered phase transition at a completion likelihood of 76%. As the project passed through the periods of phase transition, the project's completion likelihood dropped to 52%, indicating a 24% loss of project completion likelihood. Project F's completion likelihood continued to rise after phase transition and through interior buildout, settling at a probability of completion of 79% in the update period preceding project completion.

PROJECT G

Project G was a 25-story, 190,000 square-foot apartment building built in the Southeastern United States with a contract value of approximately \$40 million. The project included 147 apartment units, street-level retail and restaurant space, and a rooftop terrace and pool. Phase transition between structural construction and interior buildout occurred between the 11th and 14th update periods as indicated in Figure G.

Project G performed its schedule plan moderately well in the early periods of structural construction, fluctuating between SPI values in the range of 0.70 to 1.00. Prior to phase transition, the project was completing, on average, 81% of its planned activities. Project G suffered a maximum SPI decline of 0.40 during phase transition, indicating that after phase transition commenced, the project was completing 40% less work than the project

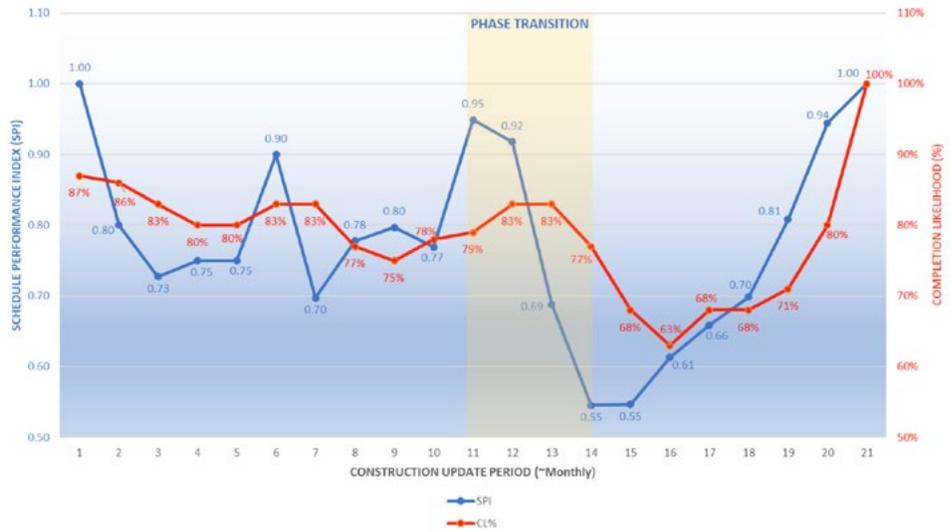


FIGURE G Project G - Schedule Performance in Phase Transition

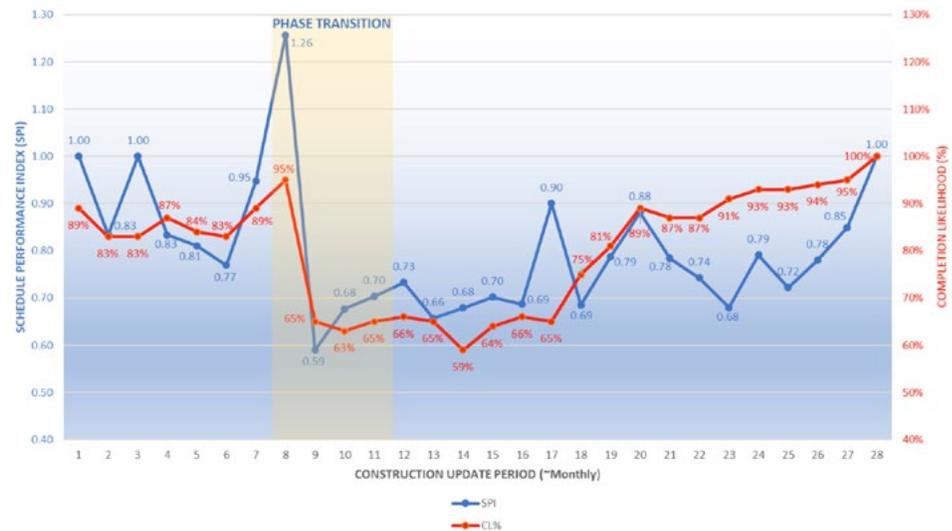


FIGURE H Project H - Schedule Performance in Phase Transition

schedule planned. The lowest SPI value in the project's timeline (0.55) occurred amidst phase transition, during update period 14. Project G's SPI values rose sharply coming out of phase transition through interior buildout and onto project completion.

Project G's completion likelihood stayed relatively consistent between 75% and 87% through structural construction, averaging a probability of completion of 81%. Project G started at a completion likelihood of 79%, rising briefly to 83%. As the project passed through the periods of phase transition, the project's completion likelihood dropped to 63%, indicating a 20% loss of project completion likelihood. Project G's completion likelihood rose rapidly after phase transition and through

interior buildout, settling at a probability of completion of 100% in the update period preceding project completion.

PROJECT H

Project H was a six-story, 350,000 square-foot hospital built in the Southeastern United States with a contract value of approximately \$125 million. The project included 80 patient beds and a new emergency department. Phase transition between structural construction and interior buildout occurred between the 7th and 12th update periods as indicated in Figure H.

Project H performed its schedule plan effectively in the early periods of structural construction, fluctuating between SPI values in the range of 0.77 to 1.26. Prior to phase transition, the project was completing, on

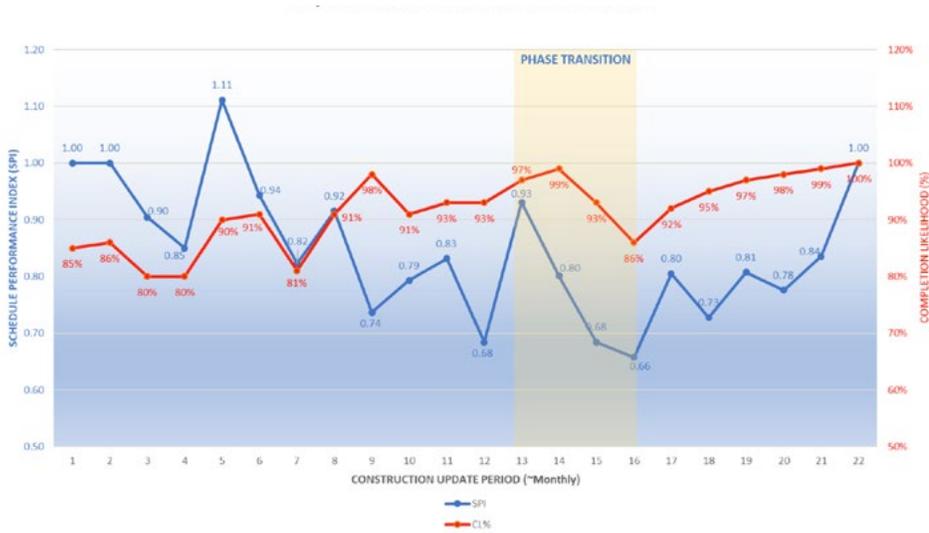


FIGURE I Project I - Schedule Performance in Phase Transition

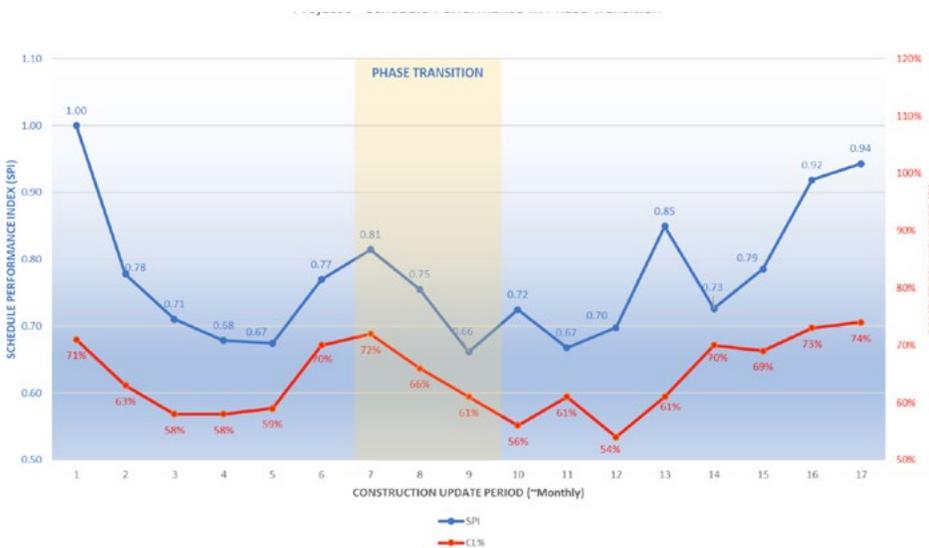


FIGURE J Project J - Schedule Performance in Phase Transition

average, 93% of its planned activities. Project H suffered a maximum SPI decline of 0.67 during phase transition, and the lowest SPI value in the project’s timeline (0.59) occurred amidst phase transition, during update period 9. Project H’s SPI values stayed stagnant for several update periods coming out of phase transition and fluctuated between periods of effective and poor performance until the end of the project.

Project H’s completion likelihood stayed relatively consistent between 83% and 95% through structural construction, averaging a probability of completion of 87%. Project H started at a completion likelihood of 89% and entered phase transition at a completion likelihood of 95%. As the project passed through the periods of phase transition, the project’s completion

likelihood dropped to 59%, indicating a 36% loss of project completion likelihood. Project H’s completion likelihood rose rapidly after phase transition and through interior buildout, settling at a probability of completion of 100% in the update period preceding project completion.

PROJECT I

Project I was a 15-story, 986,000 square-foot office building built in the Southeastern United States with a contract value of approximately \$100 million. The project included three parking levels, 12 levels of office space, several amenity decks, and a retail grocery space. The project was delivered as a core and shell product, with interior tenant fit-out completed under a separate contract. Because of significant site

preparation, shoring, and the construction of the parking levels below grade, phase transition between structural construction and interior buildout did not occur until between the 12th and 16th update periods as indicated in Figure I.

Project I executed its schedule plan moderately well in the early periods of structural construction, fluctuating between SPI values in the range of 0.68 to 1.11. Prior to phase transition, the project was completing, on average, 89% of its planned activities. Project I suffered a maximum SPI decline of 0.27 during phase transition, indicating that after phase transition began, the project was completing 27% less work than the project schedule planned. The lowest SPI value in the project’s timeline (0.66) occurred amidst phase transition, during update period 16. Project I’s SPI values rose with periods of mostly effective performance until the end of the project.

Project I’s completion likelihood stayed relatively consistent between 80% and 98% through structural construction, averaging a probability of completion of 89%. Project I started at a completion likelihood of 85% and entered phase transition at a completion likelihood of 97%. As the project passed through the periods of phase transition, the project’s completion likelihood dropped to 86%, indicating a 13% loss of project completion likelihood. Project I’s completion likelihood rose steadily after phase transition and through interior buildout, settling at a probability of completion of 100% in the update period preceding the project’s finish.

PROJECT J

Project J was a 11-story, 190,000 square-foot luxury hotel built in the Southeastern United States with a contract value of approximately \$65 million. The project included 325 guest rooms, a conference center, retail and restaurant space, an elevated pool and amenity deck, and a four-level parking deck. Phase transition between structural construction and interior buildout occurred between the 6th and 10th update periods as indicated in Figure J.

Project J executed its schedule plan moderately well in the early periods of structural construction, fluctuating between SPI values in the range of 0.67 to 1.00. Prior to phase transition, the project was completing, on average, 77% of its planned activities. Project J suffered a maximum SPI decline of 0.15 during phase transition,

indicating that after phase transition commenced, the project was completing 15% less work than the project schedule planned. The lowest SPI value in the project's timeline (0.66) occurred amidst phase transition, during update period 9. Project J's SPI values rose steadily through interior buildout and onto project completion.

Project J averaged a completion likelihood of 64 % through the early stages of structural construction. Project J started at a completion likelihood of 71% and entered phase transition at a completion likelihood of 72%. As the project passed through the periods of phase transition, the project's completion likelihood dropped to 56%, indicating a 16% loss of project completion likelihood. Project J's completion likelihood rose steadily after phase transition and through interior buildout, settling at a probability of completion of 74% in the update period preceding the project's finish.

PROJECT K

Project K was a 34-story, 1,000,000 square-foot office building built in the Southeastern United States with a contract value of approximately \$225 million. The project included five levels of parking with 29 levels of office space above. Interior tenant fit-out was completed as part of this project. Phase transition between structural construction and interior buildout occurred between the 10th and 15th update periods as indicated in Figure K.

Project K executed its schedule plan effectively in the early periods of structural construction, fluctuating between SPI values in the range of 0.72 to 1.00. Prior to phase transition, the project was completing, on average, 85% of its planned activities. Project K suffered a maximum SPI decline of 0.28 during phase transition, indicating that after phase transition began, the project was completing 28% less work than the project schedule planned. The lowest SPI value in the project's timeline (0.64) occurred amidst phase transition, during update period 13. Project K's SPI values increased quickly coming out of phase transition and continued to rise through interior buildout and onto project completion.

Project K's completion likelihood stayed relatively consistent between 68% and 79% through structural construction, averaging a probability of completion of 72%. Project K started at a completion likelihood of 79% and entered phase transition at a completion likelihood of 75%. As the



FIGURE K Project K - Schedule Performance in Phase Transition

| Table 1 - Case Study Phase Transition Summary | | | | |
|---|-------------------------------|-----------------------|-------------------------------|-----------------------|
| Project | Max SPI Decline in Transition | Low SPI in Transition | Max CL% Decline in Transition | Low CL% in Transition |
| A | 0.21 | 0.60 | 24% | 49% |
| B | 0.60 | 0.40 | 20% | 60% |
| C | 0.45 | 0.55 | 28% | 64% |
| D | 0.42 | 0.46 | 35% | 47% |
| E | 0.32 | 0.58 | 15% | 57% |
| F | 0.43 | 0.64 | 24% | 52% |
| G | 0.40 | 0.55 | 20% | 77% |
| H | 0.67 | 0.59 | 36% | 59% |
| I | 0.27 | 0.66 | 13% | 86% |
| J | 0.15 | 0.66 | 16% | 56% |
| K | 0.28 | 0.64 | 13% | 62% |
| Average | 0.38 | 0.58 | 22% | 61% |

Blue Values indicate project low value

TABLE 1 Case Study Phase Transition Summary

project passed through the periods of phase transition, the project's completion likelihood dropped to 62%, indicating a 13% loss of project completion likelihood. Project K's completion likelihood rose incrementally directly after phase transition and then rapidly in the final update periods of construction, settling at a probability of completion of 100% in the update period preceding the project's finish.

SUMMARY FINDINGS

Table 1 summarizes the deterministic (SPI) and probabilistic (completion likelihood) measures of schedule performance in phase transition found in the eleven case study projects. This data clearly shows a trend of

poor schedule performance in periods of phase transition.

All eleven projects experienced a decline in SPI during phase transition and on average, the case study projects experienced a 38% decline in schedule plan execution during the transitional periods between structural construction and interior buildout. Ten of the eleven case study projects experienced their lowest SPI values amidst phase transition. The lowest execution values that the case study projects experienced in phase transition ranged from 40% to 66% execution of the work planned in the schedule in that specific period, for an average low of 58% execution of the work planned.

All eleven projects also experienced a decline in completion likelihood during phase transition. The case study projects, on

average, were 22% less likely to complete on time after periods of phase transition. Seven of the eleven projects experienced their lowest completion likelihood in the periods of, or directly after, phase transition. Four of the remaining five projects experienced their lowest completion likelihoods in periods well after the probability of completion had declined during phase transition.

ROOT CAUSES

The trend of poor performance during phase transition is clear and evident in the eleven case study projects. The root causes for these performance declines are less clear. The first and most understandable rationale for performance declines during the phase transition between structural construction and interior buildout is the fact that this is the period in which projects usually experience their highest density of work activities. A higher density of work activities necessitates an enhanced volume of coordination with additional subcontractors and vendors. Project execution is inherently harder in this transitional period. While this explanation may seem obvious, the true picture of project performance decline during phase transition in the case study projects is likely complicated by several factors that require varied solutions to set the project on the right course. These factors can be synthesized into the following five topics: institutional biases, schedule development, project management team scoping, tunnel vision, and subcontractor communication.

INSTITUTIONAL BIASES

Each of the eleven case study projects were built by the same contracting organization. This organization has a significant historical legacy of self-performing structural components of construction and the majority of the case study projects included elements that were self-performed. This organizational model potentially introduced substantial blind spots within the eleven case study projects: institutional knowledge and training gaps, as well as apathy toward interior trades.

Because of the historical preponderance of self-perform structural packages in the organization's portfolio, personnel in both project management and field supervision roles were highly experienced and highly trained in effectively executing vertical building construction projects to structural

top-out. Many of the field supervisory personnel had, in fact, begun their careers in the structural trades and were, in a way, specialized to this phase of construction. This solid focus on the structural components of building construction, while an organizational strength, potentially concealed gaps in knowledge and experience with the follow-on trades that are essential to forming a successful project management team.

It is intuitive to observe that project performance is easier to control when construction is being self-performed than when subcontractors are being managed in a more traditional construction manager role. However, this disparity is magnified when the organizational biases described above come into play.

SCHEDULE DEVELOPMENT

The root cause of phase transition performance decline that all planning and scheduling professionals cringe to hear is that the schedule is the problem, but oftentimes the schedule has played a contributing role by projecting work earlier than functionally possible and essentially hastening phase transition. Project schedules might simply be overly optimistic in periods of phase transition and metrics like SPI values are particularly sensitive to the planning mistake of too much, too soon. Drilling specifically into the periods of phase transition between structural construction and interior buildout in vertical building projects, the mistake of planning work too early often originates from three main elements: weather sensitivity, structural falsework, and vertical conveyance.

When project schedules do not adequately account for these three elements, they inadvertently forecast phase transitions too early in the project timeline. For example, a project schedule that does not fully contemplate the various factors that contribute to achieving a water-tight or dry building will show weather-sensitive activities starting before they should actually occur. Likewise, when a schedule does not account for the removal of structural reshoring or falsework properly, it will likely project initial interior layout and rough-ins to start too early. Finally, a schedule that does not sufficiently consider how labor and material will be vertically conveyed through a building is liable to show more work occurring in a period than is realistically possible. While data

indicators of performance decline stemming from poorly planned schedules may seem like false gauges of actual project execution, poor plans lead to poor communication and poor performance.

TEAM SCOPING

Traditionally, project management team scope responsibilities are divided up by project trades. For example, a three-person project management team on a vertical building project may be divided so that one project manager focuses on structure, one project manager focuses on enclosure, and one project manager focuses on interiors. As projects grow in size and scale, field supervisory personnel may also be divided into similar scope responsibilities. While this traditional staffing model is widely deployed on vertical building projects to general success, it does have drawbacks that can affect project performance, particularly in phase transitions. Some of these drawbacks include inequalities in the personnel themselves and the management and supervision the scoped trades receive, communication gaps between staff members and trades, and point of contact issues for subcontractors.

TUNNEL VISION

Tunnel vision is an inherent stumbling block for all project management teams. It is especially hazardous during periods of project phase transition as teams keep an ardent focus on the phase that has been continuing for long periods of time while the introductory phase goes relatively unnoticed and unmanaged. The structural phase of construction has an intrinsic susceptibility to tunnel vision - watching a structure rise vertically gives more of an aesthetic and volumetric impression of accomplishment than any other phase of construction. The institutional biases in the case study projects described above can also come into play here in a big way.

Tunnel vision in phase transition means a lack of pre-planning and coordination for the phase to come. A lack of pre-planning and coordination frequently precedes deficiencies in material procurement and subcontractor manpower. Tunnel vision can also lead to insufficient fielding and flushing out of design flaws, gaps, and changes in future phases in a timely matter such that any associated impacts do not affect installation. Distinctive attention must be

paid to future phases to offset the effects of tunnel vision in periods of phase transition on vertical building projects.

SUBCONTRACTOR COMMUNICATION

As stated previously, the most obvious rationale for performance declines during the phase transition between structural construction and interior buildout is that this is the period in which projects experience their highest density of work activities and that necessitates an enhanced volume of coordination with subcontractors and vendors. This enhanced volume of coordination between all of the project's stakeholders introduces a heavy communication burden on the project team to convey the project plan and manage the day-to-day intricacies of setting a project on the right course to successful completion.

Thus, it is not surprising that periods of phase transition also happen to be the time periods where subcontractors most commonly complain of being made to work inefficiently due to unanticipated constraints from other trades. Poor subcontractor communication is both the eventual culmination of all the root causes discussed above and the most vital factor of performance decline in the phase transitions between structural construction and interior buildout on vertical building projects.

CONCLUSION

Vertical building construction projects experience declines in project performance and execution for many reasons. Frequently, poor performance trends often coincide with periods of phase transition. In fact, the eleven case study projects analyzed in this article demonstrate that periods of phase transition between structural construction and interior buildout are often the lowest performing periods on a given project's timeline to completion.

Each of the eleven case study projects experienced performance declines in both Schedule Performance Index (SPI) and completion likelihoods produced through Monte Carlo simulation during phase transition from structural construction to interior buildout. An analysis of SPI values throughout the eleven project timelines found that project plan execution, on average, dropped 38% during periods of phase transition. Ten of the eleven case study projects experienced their lowest SPI

values amidst phase transition. Monte Carlo simulation revealed that the case study projects were 22% less likely to complete on time after periods of phase transition. While the case study projects were not resource loaded such that an integrated cost-schedule analysis could be performed, it is important to note that any risks that apply to time are also risks that apply to costs [9]. In the analyzed case study projects, the cost impacts of performance decline in phase transition go beyond the potential cost risk of simply overrunning required project completion dates. The costs associated with recovering and accelerating late-project trades to meet said completion dates resulting from performance decline in phase transition must also be considered.

The causation for performance decline in phase transition is not simple; it is multi-faceted and almost certainly the consequence of culminating factors. The dynamics identified in the eleven case study projects as potent triggers of performance decline are institutional biases, schedule development, project management team scoping, tunnel vision, and subcontractor communication. These elements build upon each other and lead to declines in project execution. Poor planning, unthoughtful team scoping, and tunnel vision lead to poor project communication and poor project performance.

Institutional biases need to be addressed through training and the introduction of outside influences to combat potential organizational blind spots. The process of schedule development for phase transitional periods between structural construction and interior buildout needs a dedicated focus in preventing the issue of planning too much, too soon. Specific areas of focus for schedule planning in these transitional periods must be building dry-in, removal of structural falsework, and vertical conveyance of labor and materials. Additionally, traditional team scoping on vertical building construction projects could benefit from being rethought. The implementation of cross-training and cross-scoping for project teams would be advantageous for addressing gaps and improving project performance in transitional periods between team members' respective scopes. Furthermore, project teams approaching periods of phase transition must put an added emphasis on pre-planning to offset the effects of tunnel vision in periods of phase transition on

vertical building projects. This emphasis on pre-planning should include reviews of material procurement, worker projections, and assessments of design feasibility for the upcoming phase. Finally, a larger weight must be given to managing and improving subcontractor communication before, during, and after phase transitions. The incorporation of elements of the Last Planner System such as daily huddles, weekly work plans, and constraint logs can provide project teams with the formal structure to enhance project communication and improve project performance [7, 7-8].

Just as these elements can compound to depress project schedule performance in periods of phase transition, they can also build upon each other to produce positive project outcomes. Thoughtful schedule development steers better pre-planning and better pre-planning can break down the silos of traditional team scoping, leading to better overall project team communication and more effective project performance in periods of phase transition.

REFERENCES

1. AACE International. *Cost Engineering Terminology*. Recommended Practice 10S-90. AACE International, Morgantown, WV, 2018.
2. AACE International. *Integrated Cost and Schedule Risk Analysis Using Monte Carlo Simulation of a CPM Model*. Recommended Practice 57R-09. AACE International, Morgantown, WV, 2011.
3. AACE International. *CPM Schedule Risk Modeling and Analysis: Special Considerations*. Recommended Practice 64R-11. AACE International, Morgantown, WV, 2012.
4. AACE International. *Selecting Probability Distributions Functions for Use in Cost and Schedule Risk Simulation Models*. Recommended Practice 66R-11. AACE International, Morgantown, WV, 2012.
5. AACE International. *Required Skills and Knowledge of Earned Value Management*. Recommended Practice 81R-13. AACE International, Morgantown, WV, 2014.
6. Boudreau, W. Using Historic Data to Improve Monte Carlo Prediction of Project Outcomes. 2016 AACE International Transactions. 1-17.

7. Eilers, H., Morrow, M., Parco, W. Last Planner System and the Construction Project Schedule. 2016 AACE International Transactions. 7-8.
8. Hulett, D. What to Do with Unknowns in Schedule Risk Analysis?. 2016 AACE International Transactions. 1-23.
9. Hulett, D. Integrated Cost-Schedule Risk Analysis Using Monte Carlo Simulation. 2017 AACE International Transactions. 1-17.
10. Visser, J.K. *Suitability of Different Probability Distributions for Performing Schedule Risk Simulations in Project Management*. 2016 Proceedings of PICMET '16: Technology Management for Social Innovation. 2031-2039.

ABOUT THE AUTHORS



Daniel P. Gilmour, PSP, is with Brasfield & Gorrie. He can be contacted by sending email to: dgilmour@brasfieldgorrie.com



Matthew L. Pringle, PSP, is with Brasfield & Gorrie. He can be contacted by sending email to: mpringle@brasfieldgorrie.com

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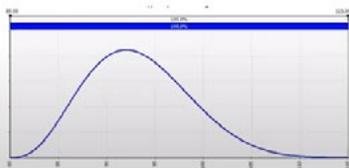
Section News from Around the World

GREATER CAIRO SECTION

The months of July and August witnessed a variety of virtual technical meetings for the Greater Cairo Section. To recap these meetings, the section presents four photos and photo captions. The section is planning an active quarter ahead, including more technical meetings and collaborations with other institutions and associations.

At the Greater Cairo Section, on 4 July, a technical meeting was conducted in which Alaa Khater, CCP, presented a technical program on, "Estimate Accuracy and Contingency: Do's and Don'ts." See the Calculating Contingency Using Pert diagram as shown above.

Calculating Contingency using PERT

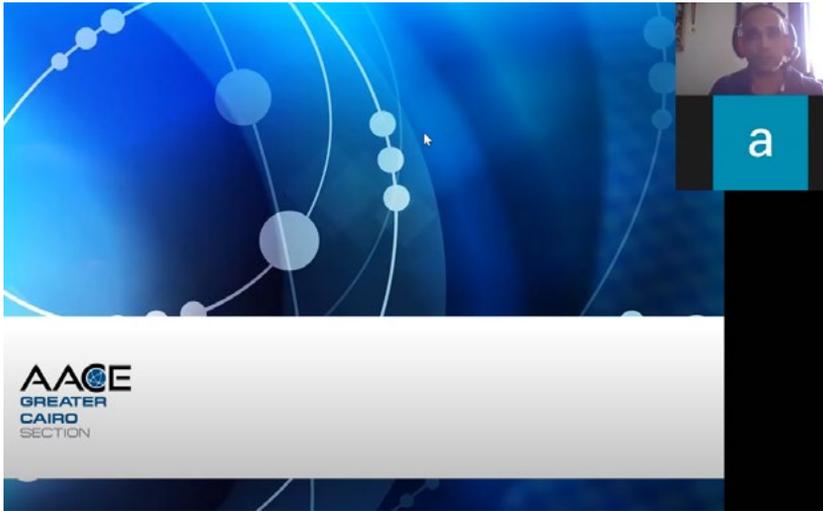


| | OPTIMISTIC COST \$ (A) | MOST LIKELY COST \$ (M) | PESSIMISTIC COST \$ (B) |
|--------------|------------------------|-------------------------|-------------------------|
| Activity 1 | 6000 | 7000 | 12000 |
| Activity 2 | 3000 | 5000 | 9000 |
| Activity 3 | 4000 | 8000 | 8500 |
| Activity 4 | 10000 | 11000 | 19000 |
| Activity 5 | 1500 | 2400 | 4000 |
| Activity 6 | 5000 | 5900 | 7000 |
| Total | 29,500 | 39,300 | 59,900 |





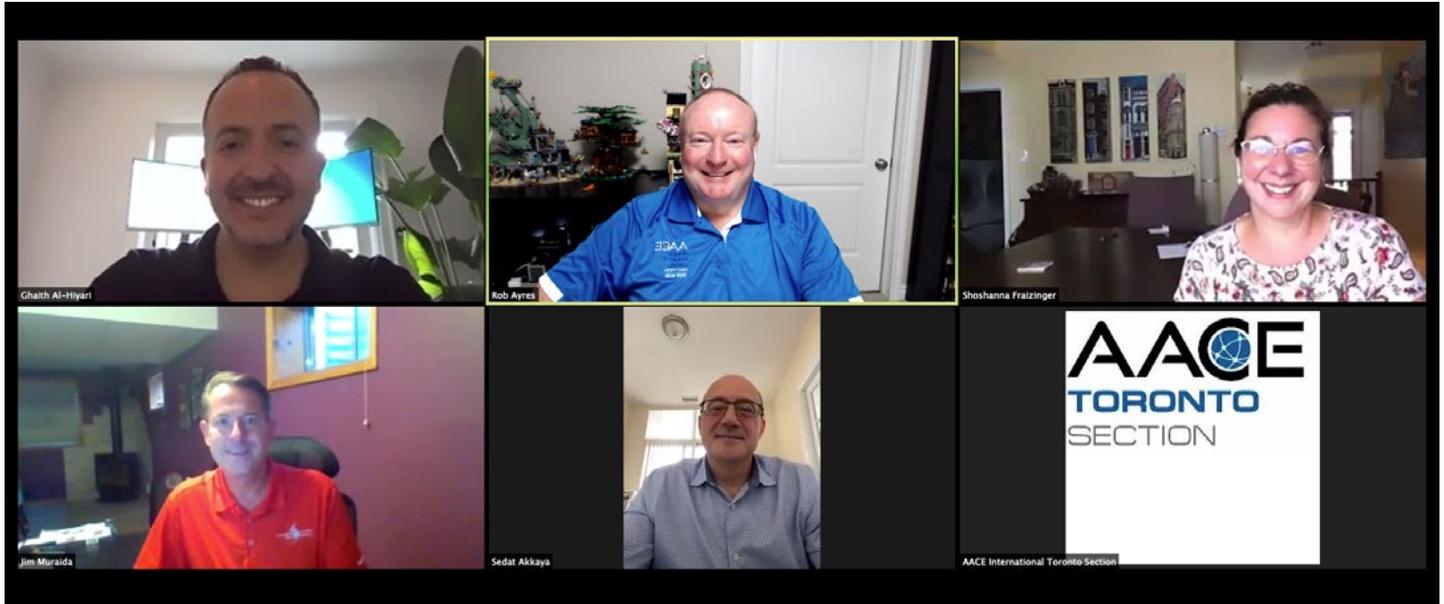
Below: At the Greater Cairo Section, Hossam Kandeel, EVP, the section's president, provided an introduction to AACE International's certifications to members and non-members on 25 July. See the virtual presentation image below. **At right:** At the Greater Cairo Section, on 8 August, there was a technical meeting in which Ahmed Afifi, shown at right, presented to a limited number of in-person attendees, as well as to virtual participants, an open discussion on extensions of time claims, project control techniques, and case studies.



Above: At the Greater Cairo Section, the application of artificial neural networks in construction claims was another interesting topic for the technical meeting on 14 August by Dr. Rania Fayed. See the virtual presentation image above.

TORONTO SECTION

On August 12, the Toronto and Bruce County Sections conducted their first coordinated and combined meeting. The idea behind this effort was first discussed at a section leadership meeting conducted as a part of the AACE 2020 Virtual Conference & Expo. Officers from both sections shared what upcoming events are in the pipeline. They looked ahead and discussed plans for the upcoming months. Ideas were exchanged and ways to collaborate on various projects in the short range, midterm and long range were looked at. Attendees agreed to meet bimonthly and nominated one of their officers to act as the liaison point of contact. See the image above from the first virtual collaboration meeting. Ghaith Al-Hiyari and Shoshanna Frazinger are both CCP certified.



UNITED ARAB EMIRATES SECTION

The UAE Section had a great start for the year 2020-21 with its new members of the board assuming office in June 2020. The members of the board have set aggressive targets for themselves and working toward offering better services to the section members. The UAE Section has conducted its first-ever virtual section members meeting, coping with the new normal situation post COVID-19, on 21 June 2020. In addition, all the technical events are being organized through live webinars. The UAE Section has organized three webinars from June 2020 to August 2020 under various topics and presented by leading experts from the region. All the webinars were encouraging and had active participation of more than 150 attendees from various parts of the world.

AACE – UAE Section



| | | |
|---|--|--|
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Shown above is an image of the new board of the UAE Section for the year 2020-21. Selvaraj Ramasamy, Manoj Kumar Panigrahy, Abu Bakar Asif, and Suhas Sahebrao Jadhal, PEng, are each CCP certified. Mr. Asif also holds EVP and PSP certifications and Sary Mohamed Adel Badawi is PSP certified.

Tendering and Contracting Process
Today's Discussion

- Today's topic is to explain:
 - Pre-qualification Process
 - Tendering Process
 - Tender Evaluation Process
 - Tender Reports and formation of Contract
 - Real-life Experience.



1- As planned Vs. As built

Schedule before adding delays

| Activity ID | Activity Name | Original Duration | Start | Finish | Total Float |
|-------------|----------------------------|-------------------|------------|------------|-------------|
| Total | | 90 | 06-Aug-13A | 10-Oct-13 | 0 |
| ATTC | | 30 | 06-Aug-13A | 31-Aug-13 | 52 |
| BEC | | 30 | 06-Aug-13A | 30-Oct-13 | 0 |
| CLIENT | | 34 | 06-Aug-13A | 12-Aug-13A | 0 |
| STC | | 97 | 06-Aug-13A | 09-Oct-13 | 19 |
| A1270 | Wall dash coat & IM guides | 14 | 06-Aug-13A | 25-Aug-13 | 40 |
| A1270 | Column erection | 6 | 06-Aug-13A | 12-Aug-13A | 0 |
| A1280 | Joinery works | 38 | 10-Aug-13A | 03-Sep-13 | 25 |
| A1280 | Beams & connectors | 15 | 10-Aug-13A | 30-Aug-13A | 0 |
| A1740 | Plaster | 25 | 03-Aug-13A | 29-Aug-13 | 36 |
| A1360 | Floor screed | 11 | 25-Aug-13 | 02-Sep-13 | 36 |
| A1780 | Plant walls | 23 | 25-Aug-13 | 15-Sep-13 | 36 |
| A1370 | Chang. Scaff. Sys | 13 | 27-Sep-13 | 10-Oct-13 | 0 |
| A1270 | Cast-in situ | 13 | 28-Aug-13 | 09-Sep-13 | 36 |




Integrated Risk and Change Management




STRATEGY IDENTIFICATION CHANGE COST RETENTION METHOD CONTEXT PRIORITIZATION RISK MANAGEMENT BUSINESS TREATMENT SCOPE SOLUTION OPPORTUNITY CHANGE MANAGEMENT PROBABILITY RESOURCE KNOWLEDGE IMPACT PLAN STANDARD

Top, left: Mr. Lokesh Karavita is shown above presenting a webinar on, 'Tendering and Contracting Process' for the UAE Section. **Top, right:** Ms. Gagan Preet Kaur is shown above presenting a webinar on, 'Delay (Extension of Time) Analysis Using Primavera P6' for the UAE Section. **Left:** Mr. Ratnesh Varma is shown above presenting a webinar on, 'Integrated Risk and Change Management Overview' for the UAE Section.

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 AAACE® International Bulletin.

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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@aaacei.org. Please use the official name of the Section as approved by the AAACE Board when the Section's charter was approved. Within 2 to 3 business days of submitting a "Section News" items, you should receive a return confirmation e-mail that your submission was received at AAACE headquarters.

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- By Dec. 31
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vpmktboard@aacei.org

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vpreions-na@aacei.org

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vpreions-intl@aacei.org

HEADQUARTERS STAFF

Executive Director/ Chief Executive Officer

Debra L. Lally, CAE
dlally@aacei.org

Manager, Accounting and Administration

Janice L. Johnson, CPA
+1.304.2968444 x1107
jjohnson@aacei.org

Accounting Assistant/Accounts Receivable

Molly Burrow
+1.304.2968444 x1118
mburrow@aacei.org

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Manager, Information Technology

Ryan Schwertfeger
+1.304.2968444 x1119
rschwertfeger@aacei.org

Technical Operations Coordinator

Greg Carte
+1.304.2968444 x1116
gcarte@aacei.org

Manager, Certification and Membership

Penny Whoolery
+1.304.2968444 x1104
pwhoolery@aacei.org

Senior Credentialing Analyst

Valerie Smith
+1.304.2968444 x1112
vsmith@aacei.org

Certification Administrator

Sara Peters
+1.304.2968444 x1115
speters@aacei.org

Coordinator, Member Services

Gina Mazzetti
+1.304.2968444 x1105
gmazzetti@aacei.org

Manager, Education

Teri Jefferson, CMP
+1.304.2968444 x1120
tjefferson@aacei.org

Director, Governance, Marketing, and Meetings

Jennie Amos
+1.304.2968444 x1106
jamos@aacei.org

Business Development Coordinator

Joanna Boggs
+1.304.2968444 x1122
jboggs@aacei.org

Director, Technical Guidance

Christian Heller
+1.304.2968444 x1117
cheller@aacei.org

Managing Editor

Marvin Gelhausen
+1.304.2968444 x1111
mgelhausen@aacei.org



1265 Suncrest Towne Centre Dr
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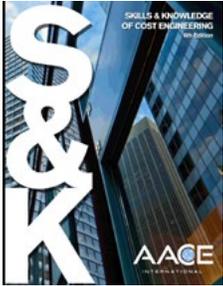


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AACE is working with RICS and CIQS for a quarterly North America Construction Monitor survey. The latest survey is now open until October 5th. Members are encouraged to participate in the survey if interested: survey.sogosurvey.com/r/KlezsY



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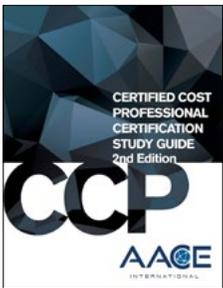
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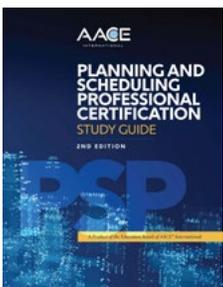
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Dr. Makarand Hastak, PE CCP, Editor, 2016

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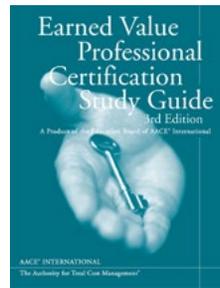
PSP CERTIFICATION STUDY GUIDE, 2ND EDITION

AACE Education Board, 2018-2019

This certification study guide aids professionals wishing to achieve AACE International's specialty certification in Planning and Scheduling. Second, the PSP Certification Study Guide summarizes various topics considered central to the planning and scheduling professional, as

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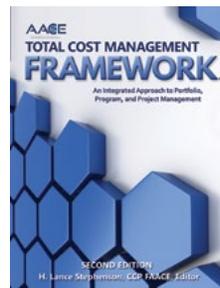


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Sean T. Regan, CCP CEP FAACE - Editor, 2015

This study guide is intended to assist you in your study and review of the overall topics as one step toward successful Earned Value Professional certification. The outline provides a listing of the terms you should know & topics for which you should have a good understanding of how to apply the concepts to solve problems. Each chapter also contains sample exercises, which test your knowledge of that chapter's concepts.

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H. Lance Stephenson, CCP FAACE, Editor, 2015

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