

IPANewsletter

Driving Success in Innovative Technology Projects

By Apostolos Nikolopoulos, *IPA Senior Project Analyst*

Sustainability is a key focus for industry leading chemical companies today. Improved efficiency in production, greater reliance on renewable resources, lower carbon footprint, and adherence to circular economy tenets are all on the agenda. To achieve these goals, many companies are expanding their R&D pipeline and exploring new sustainable solutions. Examples include making new products from recycled materials, creating dual-use materials, and operating more energy-efficient or renewable-powered production processes. These projects can require significant innovation, or new technology, and scaling up from the lab to commercial production can be a highly complex undertaking.



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Independent Project Analysis, Inc. is the preeminent organization for quantitative analysis of capital project effectiveness worldwide. At IPA, we identify Best Practices to drive successful project outcomes.
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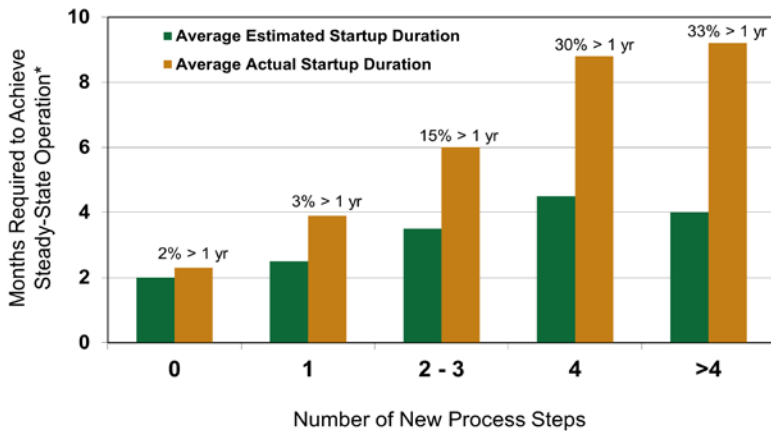
1,500+

Based on IPA data for more than 1,500 **projects using new technology** to any degree...

40% failed to meet their operational and business objectives...

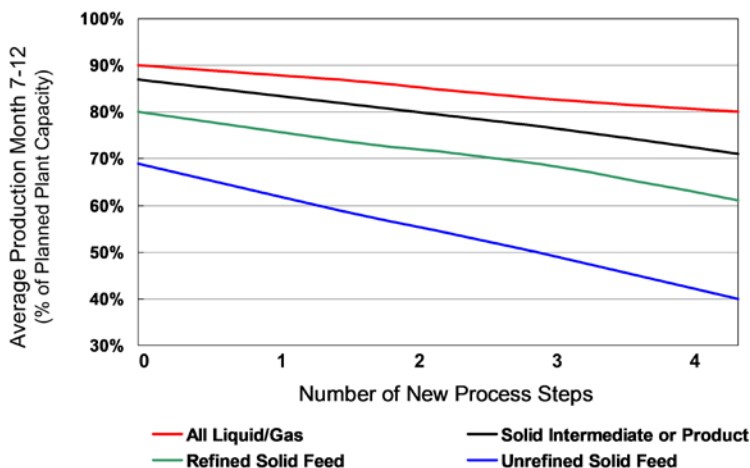
and only **<20%** met the key performance metrics agreed at authorization.

Figure 1: Startup duration is longer and less predictable for innovative projects.



*Measured after mechanical completion

Figure 2: New process operability declines rapidly as particle processing difficulty increases.



IPA possesses more than 30 years of research into the development and execution of new technology projects to help its clients deliver better cost and schedule performing capital projects and meet their sustainable development goals.

IPA's New Technology Projects Database

IPA maintains detailed capital project information from more than 1,500 new technology projects. IPA defines a new technology project as any project that includes at least one physical or chemical process step involving technology that is new in commercial use. Such projects can involve new chemistry or a first-time combination of feed and equipment on a commercial facility.

One method for determining how much innovation a project entails is by looking at the number of new process steps being introduced. IPA has observed that, as more new process steps are introduced, a project's startup duration—measured from mechanical completion to steady state operation—becomes longer and less predictable (Figure 1).

IPA also has observed that new facilities processing unrefined or refined solid feedstock or involving solid intermediates or products are more likely to experience significant operational issues relative to those processing less heterogeneous (such as liquid and/or gas) process streams. The reduction in operational performance is further augmented by the extent of new technology, again measured by the number of new steps, as shown in Figure 2. IPA analyses of solids processing plants reveal that key performance problems may result from physical and mechanical difficulties rather than from issues in process chemistry.



What IPA Can Do To Help

IPA can assist companies by identifying and qualifying risks that threaten new technology project performance. IPA research has shown that owners should develop a robust commercialization strategy for new technology projects.

IPA has identified several key practices for project organizations to integrate into their new technology commercialization strategy.

- Recognize the importance and potential long-term value (in terms of environmental safety and market gains) of the innovation under development
- Develop a complete Basic Technical Data package (fundamental to operational performance and overall project success)
- Develop robust teams with all critical team members established early
- Achieve good project definition, which is key to controlling the risks inherent to innovative projects
- Set an effective change management program, since new technology projects have a higher occurrence of changes than standard technology projects
- Ensure high owner involvement and early contractor participation

Risk-adverse businesses and projects teams may be squandering opportunities to deliver game-changing production advancements that could strengthen shareholder returns and benefit the environment. Recognizing early on how project groups can mitigate risks associated with new commercialization opportunities can improve the effectiveness of capital allocated to these projects.

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IPA improves the competitiveness of our customers through enabling more effective use of capital in their businesses. It is our mission and unique competence to conduct research into the functioning of capital projects and project systems and to apply the results of that research to help our customers create and use capital assets more efficiently.



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IPA Institute Course: Mitigating Risks of Innovation



Incorporate New Technology Into Capital Projects Effectively

Investing in innovative technologies can provide great returns to a business through introducing new products and establishing new markets. Innovations can improve processes for existing operations, thereby reducing the cost to manufacture or materials costs. However, these projects have unique risk profiles and are often difficult to execute and start up.

Few project professionals have experience executing new technology projects. Through extensive research on new technology projects, IPA has identified a set of Best Practices and strategies shown to address the risks associated with commercializing innovation. The **Mitigating Risks of Innovation** seminar shares the learnings from this research to help project professionals minimize

problems when incorporating innovation into their capital projects.

For more information, contact Kelli Ratliff, IPA Deputy Director of Consortia Membership and the IPA Institute, at kratliff@ipaglobal.com.

Cost Engineers Converge in Northern Virginia for CEC 2019



The Cost Engineering Committee (CEC) held its annual meeting September 24 to 25 in McLean, Virginia. The CEC, a working subcommittee under IPA's Industry Benchmarking Consortium (IBC), assists cost engineers by providing metrics and tools that offer an unbiased snapshot of industry cost and schedule estimates and trends.

New and updated capital project research studies were presented at CEC 2019. Cost engineers and other key project team personnel representing CEC member companies were briefed on the latest trends in the engineering, procurement, and construction market and joined in communities of practice discussions.

The following two research studies were featured:

State of Data Integration Maturity in the Capital Projects Industry:

Building on insights gained from IPA's digitalization in capital projects research presented in March at IBC 2019, this updated research study takes a more expansive look at the strategies and tools project organizations with owner companies are using to capture and integrate data to improve project definition. The research takes a cost-benefit approach to demonstrating the value of data integration in project planning and development.

Capital Project Schedule Forensic Study:

Previous IPA-led research has provided CEC member companies with high-level insights into drivers of project schedule slip. This new

research study examines how schedules break down at a detailed level. Owner companies benefit from understanding where optimism is buried in project schedules.

CEC meeting attendees also heard a presentation on the keys to good site-based schedule estimates and received instruction on applying the cost and schedule tools IPA prepared. The CEC focuses on all aspects of cost engineering, including cost estimating, scheduling, and project control practices and metrics, with the goal of expanding the owner cost engineer's capabilities.

Contact IPA Cost Analysis Group Deputy Director Aditya Munshi at amunshi@ipaglobal.com for more information.

IPA Identifies the Attributes of Successful Lead Engineers and Builds on Its Capital Projects Leadership Competency Research

By Yashna Shah,
IPA Research Analyst

Following the loss of experienced staff over the last decade-plus, few highly experienced lead engineers remain in the capital projects industry. Yet, the engineering function remains a critical project team function. How can owner companies recognize, recruit, and retain high-caliber engineering leadership talent to support their portfolio of projects?

A bevy of IPA-led research shows how owner companies can identify the right individuals—including experts in engineering—for critical capital project leadership roles. By identifying behaviors associated with successful projects and the attributes correlated with those behaviors, companies can increase the likelihood of project success by selecting individuals with key leadership competencies and training people to compensate for their lack of experience.

In a study presented at IPA's Industry Benchmarking Consortium (IBC), Competency Series: The Engineering Leader, IPA's Jon Walker, Lucas Milrod, and Yashna Shah endeavored to identify personal attributes correlated with success in the lead engineer role. The study is IPA's fourth in a series of studies on understanding capital project leadership competencies. For this work, IPA surveyed more than 70 lead engineers across a variety of industries and project types. Surveys assessed personality, background, leadership style, and perceived



important and frequent behaviors specific to the lead engineering role. Survey responses were linked to data from completed and ongoing capital projects in IPA's database, allowing researchers to investigate correlations between competencies and project practices and outcomes. Below we highlight some of the study's findings.

Is There a Particular Leadership Style Best Suited to Success in the Lead Engineer Role?

The study investigated four different leadership styles and the links between these styles and behaviors associated with project outcomes. Of the four leadership styles studied, three were linked to some behaviors that improved outcomes. For instance, the supportive

leadership style was linked to performing tasks associated with better project outcomes. Engineers exhibiting a supportive leadership style tend to place importance on people management skills and spend more time communicating. Such leadership styles are linked to better integrated teams and better engineering definition.

What Types of Experiences Are Important to Success in the Lead Engineer Role?

As expected, the study found that prior experience in the lead engineer role was linked to critical behaviors associated with improved Key Performance Indicators (KPIs). However, the study went a bit further and highlighted what experienced lead engineers actually do differently.

As such, lead engineers with more experience spent less time on detail-oriented tasks and attending review meetings. It is likely that, in the course of their time in the lead engineer role, these individuals gain an understating of behaviors and tasks essential to a successful project and recognize that their time is best spent leading and managing the engineering function, not doing the actual engineering.

What Personality Traits Are Important to Lead Engineer Success?

Openness, conscientiousness, extraversion, agreeableness, and neuroticism—commonly referred to as the Big 5 personality traits—are thought to guide our actions and behaviors. While IPA’s researchers were unable to statistically test the effect of openness and conscientiousness due to the lack of adequate variance in the study sample, the three other traits were found to be linked to behaviors associated with KPIs. Personality traits work in tandem with each other, and other personal attributes, to influence our behavior. Neuroticism, extraversion, and site-based experience all influence the lead engineer’s approach to contractor management. The researchers observed that when lead engineers spent sufficient time on contractor management, their projects had fewer project late changes, less materials cost growth, and a higher likelihood of meeting the engineering schedule, all of which are critical to a project’s success.

Should Lead Engineers Focus on Engineering Tasks or Managing Their Team?

All in all, engineering leaders who did not think it was important for them to engage in the engineering team’s tasks and instead let the engineering team do their work were associated with projects with better Front-End Loading ratings. This supports IPA’s belief that the lead

engineer role is fundamentally different from that of an engineer. The lead engineer needs to focus on managing their team and communicating and interfacing with others, rather than spend time creating or working on the engineering deliverables.

The above takeaways are just some findings from IPA’s latest leadership competency study. Previous studies have examined the individual attributes that support success as a project manager, construction manager, and a leader of complex projects. Findings from the series demonstrate the need for talent management processes to account for other attributes that can complement an individual’s performance on capital projects. Assessing leadership styles and personality allows us to understand the behaviors these individuals are likely to engage in and target behaviors associated with negative outcomes through robust training programs. Accounting for these competencies in staffing can aid in selecting engineering leaders likely to succeed in their role and may buffer the effects of a loss of experience and expertise in the workforce.

IPA would like to thank all companies and lead engineers who participated in the study. Their willingness to provide IPA with detailed information about themselves made it possible to quantitatively link individual characteristics with performance.

For more information, please contact Sarah Sparks (ssparks@ipaglobal.com), IPA Organizations & Teams Product Development Leader.

** IPA Organizations & Teams Product Development Leader Sarah Sparks, Deputy Director of Research Lucas Milrod, and Senior Research Analyst Jon Walker contributed to this report.*



IPA’s Ed Merrow Headlines New Innovate iPM Podcast

IPA Founder and President Edward Merrow is the featured guest on a recent Innovate iPM Podcast with host Rob Williams. The two discuss a variety of topics, including FEL, fast-tracking projects, corporate governance, and project leadership. Listen to the podcast at: <https://www.innovateipm.com/podcast>.

The Role of the Project Sponsor

By Pam Wertz, *IPA Chief Development Officer*, and Allison J. Aschman, Ph.D., *Director, IPA Capital Solutions*

The project sponsor's engagement in a capital project is critical to its success. As IPA's Paul Barshop writes about the role in the book *Capital Projects: What Every Executive Needs to Know*, "Weak project sponsorship leads to projects that do not produce as much value as they could have and projects that regularly fall short of delivering that value promised at authorization."

IPA has been examining the sponsor's role in the delivery of capital projects for many years; much of our point of view has come from project teams and project systems personnel to gain an understanding of what they need and the value from sponsors.

For its latest look at the topic, IPA's Director of Capital Solutions, Allison Aschman, and IPA Analysts David Kiomijian and Lynn Dickey analyzed hundreds of IPA interviews performed directly with owner company project sponsors to glean their first-person perspectives about what their role should be. At the 2019 annual meeting of the Industry Benchmarking Consortium (IBC 2019), Aschman presented an overview of the project sponsor's role based on those interviews combined with IPA's body of work on the topic.

The following are important points and takeaways from the IBC 2019 presentation, which are intended to help owners consider ways to more effectively deploy this role at their companies.

Who Is the Project Sponsor? Across Industry, the sponsor is broadly defined as the "person accountable for the value delivered by a project." This person may be the individual who identifies the business opportunity and leads the effort to develop the full venture (i.e., the person that "wants" the project). Or the sponsor may be an individual assigned to the project to be responsible for the value after the opportunity has been identified and approved to pursue.

How Are Sponsors Assigned to Projects? The process of assigning someone to serve as the sponsor is dependent on the organization. Some companies retain dedicated staff to perform the sponsor role in either the business function or projects organization. For most companies, however, the "appropriate" person is assigned (from the business, operations, etc.) and the mechanisms to make that assignment range from structured and official to ad hoc.



In a sample of more than 250 projects evaluated by IPA, only half of the project sponsors were officially appointed to their role. The remaining 50 percent were assigned by "default", i.e., by virtue of their position in the company, they were the "automatic" sponsor. Project performance data for this sample of projects show that one approach is not better than the other, but the default assignment carries its own potential issues (e.g., alignment on the value drivers, business objectives, and project strategy) if the project sponsor is not ready or willing to take on the job.

Three Elements of Accountability: As previously mentioned, the sponsor has responsibility to deliver the project's business value, and this accountability can be broken down across three main elements.

Value Is There to Begin With—The sponsor is accountable for the business planning phase of the Front-End Loading (FEL) process (FEL 1). It is accountable for the initial business case presented at the FEL 1 decision gate, but the role does not complete all FEL 1 work alone. The sponsor provides guidance on the opportunity's objectives, constraints, and trade-offs. Documented sponsor roles and responsibilities support better FEL 1 decision quality, making it much more likely that the right project will ultimately be selected.

Unfortunately, IPA research shows that only 63 percent of companies have officially documented FEL 1 roles to facilitate this work (Figure 1).

Maximum Value Is Extracted—Given even a robust business case coming out of FEL 1, further decisions are still necessary to maximize the project’s value. The sponsor establishes the basis for the project frame, ensuring the project scope matches the required functionality. The sponsor also should find the right balance between cost and quality and between reward and risk. Like the initial business case brought before the FEL 1 decision gate, the sponsor is accountable for the final business case delivered at the end of FEL 2.

Value Is Not Lost—Once the opportunity is defined as a project, primary accountability for the project delivery shifts to the project manager or director. Now it is up to the project team to plan and execute the scope within the project frame. But the project sponsor remains involved, overseeing and integrating work outside the project manager’s responsibility to ensure value is obtained from that asset.

Integration Leadership: Another key aspect of the sponsor’s role is serving as the integrator, both on the business and projects organization sides of the house. On the business side, for instance, the boundary between the business unit leader and sponsor is often blurred. The sponsor and business unit leader must decide and agree on the objectives asset functionality, project scope, schedule targets, and acceptable cost budget. The boundary between project sponsor and project manager also must be clear. The project sponsor and project manager need to be on the same page concerning the project scope, technical design,

project team structure and members, project strategy, and contracting and suppliers.

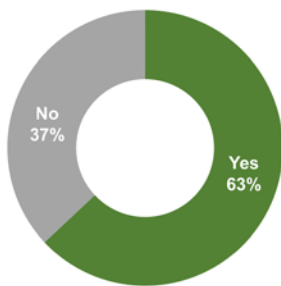
Integration does not happen naturally. It requires strong leadership, consistent engagement, and organizational knowledge. Unfortunately, our research shows that companies, and sponsors, struggle with these elements.

Based on IPA’s project sponsor interviews, sponsor engagement with teams ranges from daily to very infrequent, with most sponsors meeting with their teams once or twice a week, or at least once per month. Both project teams and project sponsors agree that bigger, more complex projects get more sponsor time. Project sponsors report spending about 40 percent of their time on projects when they are greater than \$500 million; this drops to about 10 percent when projects fall below this threshold. However, project teams perceive that the project sponsor’s involvement as being much lower than it is actually. For projects greater than \$100 million, teams believe the sponsor is spending about 15 percent of their time on the project. But the sponsors surveyed in the study report, on average, they actually spend 30 percent of their time on larger projects (Graph 2).

Project sponsor turnover is frequent, with about one-quarter of sponsors turning over during the critical FEL phases, according to IPA research. This increases to almost 40 percent when execution is included.

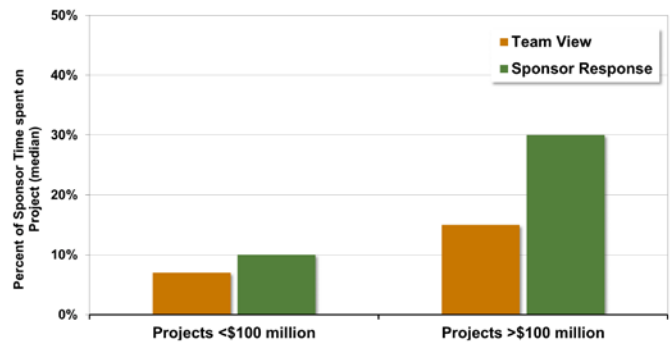
IPA project data also show that most sponsors are relatively new to their role, having been in “regular” (non-project) roles for 2 years or less. Further, 38 percent of those interviewed by IPA indicated that this was their first time as a project sponsor. There is also no trend toward smaller projects for

Figure 1: Are project sponsor FEL 1 roles and responsibilities fully documented?



Reference: Paul Barshop, *FEL 1: Setting the Foundation for Doing the Right Project*, IBC 2014, IPA, March 2014. 50 company systems surveyed.

Figure 2: For larger projects, the team view of sponsor’s time is quite different from the sponsor’s own view.



Data only for projects in which we had both team and sponsor responses

first time sponsors, with new sponsors just as likely to be assigned to large projects as experienced sponsors. In fact, two of the biggest projects in the research dataset had first-time sponsors in the role.

An Enduring Problem: Framing and defining an economically viable project is not easy. Often, the sponsor has other day-to-day assignments to deal with in addition to their project sponsorship role. Another common frustration is that sponsors are expected to make decisions in areas where they may have limited experience. As a consequence, they can end up providing insufficient direction on the goals, priorities, and constraints to guide business case development.

Alignment between the business organization sponsoring a project and the projects organization developing the project is a critical driver of success. The project sponsor can be the lead driver of project success. Despite its importance, the lack of alignment between the business and project team is an enduring problem for many companies, and the onus should be on the sponsor to ensure this integration is achieved.

Developing and Implementing Solutions for Capital Project Systems



Capital project systems are different from normal business operations. Effective capital project solutions require a deep understanding of how projects work. IPA Capital Solutions' knowledge is based on 30 years of research, benchmarking, and consulting for industrial projects. Our sole focus is on project systems and helping our clients to define and implement the changes needed to make their project systems successful.

We apply the principles of change management to our work to ensure our clients realize the full benefit to achieve maximum value from capital project investment. The results of the IPA Capital Solutions-client partnership are practical and tailored project system solutions, driven by IPA's data-based knowledge, measurement, and diagnosis of work processes, organizations, and governance and gatekeeping approaches.

Contact IPA Capital Solutions Directors Allison J. Aschman, Ph.D. (aaschman@ipaglobal.com) and Carlos Tapia (ctapia@ipaglobal.com) for more information.

THE IPA INSTITUTE

Advancing Project Knowledge

Visit www.ipaglobal.com/events to view details and register

PUBLIC COURSES

SEPTEMBER

24-25 Best Practices for Site-Based Projects
The Hague, Netherlands

25-26 Project Management, Cost Estimating, Planning, and Controls Best Practices
Curitiba, Brazil

OCTOBER

1-2 Project Leader Workshop
Houston, Texas

8-9 Best Practices for Site-Based Projects
New Orleans, Louisiana

8-10 Megaprojects: Concepts, Strategies, and Practices for Success
Perth, Australia
Instructed by IPA Founder and President Edward Merrow

NOVEMBER

12-13 Practices for Site-Based Projects
Santiago, Chile

Improving the Capital Competitiveness of Site-Based Projects—IPA’s Site Portfolio Tool

The capital projects industry has witnessed significant erosion in capital effectiveness in site and sustaining capital (SSC) projects during the past decade. Cost overestimating is a key contributor to this weakening performance. Owner companies’ SSC project organizations frequently lack sufficient owner cost engineering and estimating resources—estimating databases among them—plus other critical infrastructure to effectively support project portfolios.

A prevalent Key Performance Indicator (KPI) Industry uses to track cost performance is cost deviation, the change from estimated to actual costs. Not long ago, IPA examined this KPI for SSC projects. Based on data from its proprietary capital projects databases, IPA found that 75 percent of industry SSC projects authorized in 2015-2016 underran their final investment decision estimates. Projects that set less competitive (overestimated) targets at authorization are responsible for driving this trend towards underruns.

For project organizations to improve the competitiveness of SSC projects, they must have access to reliable predictability measures of project cost and schedule performance. IPA has developed a web-based tool

that strengthens the statistical quality control of their SSC project portfolios. The Site Portfolio Tool (SPT) provides companies with a comprehensive view of SSC portfolio projects cost and schedule performance that provides owner leadership with the necessary and timely information to make data-backed decisions and drive continuous improvement.

The SPT incorporates data from IPA’s database of more than 8,000 site-based and sustaining capital projects. It is designed for ease of use and features dashboards that report a suite of cost and schedule KPIs at the project and portfolio levels. Basic scope information, summary costs, and schedule data are required as inputs for each project phase. The SPT provides indicative project-specific cost and schedule KPIs based on IPA’s databases and proprietary models. Key project information can be displayed on a portfolio-level dashboard to allow the users to break down the performance metrics by various project characteristics, and then identify patterns and trends in the overall portfolio performance.

For more information about IPA’s Site Portfolio Tool, contact Aditya Munshi, IPA Cost Analysis Group Deputy Director (amunshi@ipaglobal.com).



TRACK REAL-TIME PERFORMANCE

Assess the overall performance of your SSC portfolios with aggregated cost and schedule KPIs for all projects, as well as individual project competitiveness and predictability measures.



ANALYZE TRENDS

Identify patterns in project performance by breaking down portfolio KPIs by project characteristics of interest, such as size, project strategy, turnaround construction, etc.



MAKE INFORMED DECISIONS

Easily generate and share portfolio summary and individual project reports to facilitate data-based decision making.



IPA Participates in Habitat for Humanity Build

Several IPA employees and summer interns volunteered their time this summer supporting the Loudoun County Habitat for Humanity by helping tear down and rebuild a utility shed for a neighbor in Chantilly, Virginia. IPA supports volunteer and charitable groups worldwide that are committed to improving local communities and helping individuals and families in need of assistance.



IPA Events and Presentations

SPE Annual Technical Conference & Exhibition

September 30-October 2, 2019
Calgary, Canada

IPA Energy Practice Director Neeraj Nandurdikar will participate in a panel discussion on socially responsible engineering on Wednesday, October 2 at the Society of Petroleum Engineering (SPE) Annual Technical Conference & Exhibition (ATCE) Conference in Calgary. The 2019 ATCE will focus on using data to improve productivity and safety in the exploration and production (E&P) industry. View the event's technical program at www.atce.org.

PMI Western Australia Chapter Meeting

October 9, 2019
Perth, Australia

IPA President and CEO Ed Merrow will speak on the topic of leading complex projects. Merrow and IPA Energy Practice Director Neeraj Nandurdikar are the co-author of a book on the topic that explains why complex projects require leadership, not just management, and highlight the characteristics successful complex project leaders share with other highly successful leaders in other walks of life.

7th Congress AACE International, Peru Section

October 18-19, 2019
Lima, Peru

IPA Latin America Regional Director Astor Luft will speak on October 19 AACE International, Peru Section conference on the application of new technologies. He will present the findings of a recent IPA study about the use of digitalization in the development of capital projects.

Scaling Up 2019

November 4-6, 2019
Ottawa, Canada

IPA Energy Practice Director Neeraj Nandurdikar will deliver a presentation titled "Mastering the Human Side of Project Management" on November 5 at Scaling Up 2019, Canada's annual industrial bioeconomy international business conference.

Upstream Industry Benchmarking Consortium (UIBC)

November 18-20, 2019
Lansdowne, Virginia

The UIBC is solely dedicated to the exploration and production (E&P) industry. It provides an independent forum for each participating company to view key metrics of its project system performance such as cost and schedule, Front-End Loading (FEL), and many others against the performance of other companies and share pointed and detailed information about their practices. The consortium highlights Best Practices, reinforcing their importance in driving improvements in asset development and capital effectiveness. Contact Kelli Ratliff, IPA Deputy Director of Consortia Membership and the IPA Institute, at kratliff@ipaglobal.com for more information.

Procurement & Contracting Committee (PCOM)

December 3-4, 2019
The Woodlands, Texas

The Procurement & Contracting Committee is an IBC sub-committee that focuses on quantifying relationships between industry procurement and contracting practices to improve capital project performance. Like members of the IBC and UIBC's cost engineering committees, PCOM member companies benefit from metrics and research developed from IPA's proprietary database of more than 20,000 capital projects. For more information, contact IPA Director, Project Research Division, Mike McFadden at mmcfadden@ipaglobal.com.
