IPA

Independent Project Analysis Newsletter

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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IPA Turns 30

Independent Project Analysis (IPA), Inc. celebrated its 30th anniversary in November 2017. Since its founding in 1987, IPA has been the organization hundreds of companies have turned to for data-driven insights into how to deliver better returns on capital projects. Recognized by the world's leading industrial processing and upstream companies as the preeminent capital projects industry consultancy, IPA has proven time and again that when capital project systems are organized, staffed, and led properly—and have the right work and governance processes in place—organizations can safely deliver cost and schedule-advantaged projects.

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UIBC 2017 Gathers to Tackle E&P Capital Project System Shortfalls

Representatives of exploration and production (E&P) owner companies who are committed to improving the performance of their capital project systems gathered November 13-15, 2017, in Northern Virginia for the 21st meeting of the Upstream Industry Benchmarking Consortium (UIBC).

A chartered voluntary association facilitated by IPA, UIBC brings together oil and gas companies to review capital project system performance metrics and trends. Companies belonging to the UIBC are able to strengthen their project systems through capital project research and knowledge sharing. During UIBC meetings held annually, member companies find out how their project delivery systems stack up against industry average system performance outcomes for safety, cost, duration, and production performance. Companies are recognized for delivering capital projects with the best safety outcomes and the highest rankings for cost and schedule competitiveness.

New Research

Five new research studies were unveiled at UIBC 2017. A study aimed at helping Industry become more efficient in the front-end of the asset development process garnered particular attention. According to IPA researchers Toba Oyewunmi and Thomas Mead, E&P project teams are taking too long to complete pre-front-end engineering design (FEED) work. Pre-FEED work is, on average, 40 percent or more of a project's total asset delivery cycle time. "The way to go faster is ensuring work along the critical path is actually moving projects forward," said Neeraj Nandurdikar, director, IPA's E&P business. He added that building strong project centric teams allows for quick decision making, which makes the asset development process smoother.

Another study that generated considerable buzz at the meeting focused on the industry's continued difficulties at achieving project plans for production performance. The Industry's perception that long-term production improves in the out years has been proven wrong in this study. In fact, companies are getting about half of the value they expect at the time the full investment decision is made, according to IPA researchers Shubham Galav and David Roberts. The industry's investment decision model is not working because the information being used to justify capital investment decisions is flawed, their research found.

The other new research studies presented at UIBC 2017 examined the neglected state of E&P site and sustaining capital projects, the "lean" scoping of projects to keep project costs low, and the right leadership traits for delivering successful E&P projects. The latter study is the subject of a new IPA book by Nandurdikar and IPA President Ed Merrow that is due out in mid-year 2018.

E&P Site and Sustaining Capital Projects Sessions

For the second year in a row at this UIBC, an entire day was dedicated to E&P site and sustaining capital projects development practices and performance. These smaller E&P projects represent a larger percentage of E&P project portfolios today.

Metrics and performance outcomes for site and sustaining capital projects were discussed.

Systems Not Evolving for Long-Term Success

At the event, Nandurdikar said project performance outcomes and UIBC research conclusions reached in the wake of the latest E&P industry downturn suggest that companies have become adept at "optimizing" systems to achieve short-term gains. However, to deliver capital projects more effectively over the long term, companies should reconsider their asset development work processes, decision-making processes, and project team development approach.

Merrow told UIBC attendees that now is a good time for E&P companies to assess the strength of their asset delivery systems, given that many companies have recently restructured their project organizations to reflect smaller capital project portfolios. "Owners need to assess their situation and make changes now while there is still some give in the human resources market."

For more information about the UIBC, please contact Neeraj Nandurdikar at nnandurdikar@ipaglobal.com.

Establishing a Fit-for-Purpose Project System

By Allison Aschman, Director, IPA Capital Solutions

IPA Capital Solutions is involved in the design and implementation of improvements across many aspects of capital projects and systems used by owner companies in capital-intensive industries. Our work with clients relies on IPA's accumulation of knowledge over three decades about how capital project systems function and focuses on the three essential components of an effective capital project system:

- **Project work processes:** A "roadmap" or "playbook" to guide a project from the initial idea phase through development and planning for sanction and through execution to startup. This includes the phasing, gates, deliverables, templates, and degree of detail/quality in deliverables.

- **Project governance and gatekeeping:** The framework for all project decision making, including decision authority, criteria for each gate, accountability for project results, etc.

- **Project organization:** The competencies that a company has in-house versus those that are outsourced, the reporting structure, the timing of functional input to projects, and more.

We often work with companies that want to drive project improvements by implementing fit-for-purpose systems for capital project development, execution, and governance. There are few downsides to fit-for-purpose systems. When designed and implemented properly, a truly fit-for-purpose system drives project delivery improvements linked to better returns on capital spend. Too often, though, a company will struggle to align a new or revised system, replete with known drivers of capital project effectiveness, with its existing organizational structure and competency framework. A challenge they face is knowing how to and the right order in which they must examine and build their system.

As we develop solutions for a company, we must recognize that a system that is too onerous or does not fit with the company's organizational structure—even if it reflects industry Best Practices—will not be implementable. For the system to be truly "usable," it must avoid being bureaucratic with respect to the work process and gatekeeping approach. Conversely, a system cannot become so simplified that it does not meet its purpose, which is to provide the mechanisms—instructions, assurance, competencies—to drive successful projects. Finally, a system developer must consider the business that the system serves and what outcomes are expected or required to make projects successful. A commodity business may prize low capital cost. By contrast, a consumer products business may require flexibility and ability to handle late changes.

Getting the Foundation Right

A first step in developing a truly fit-for-purpose project system is an adequate (and accurate) assessment of the desired performance. Constraints (or boundary conditions) must be understood. For example, are certain contractual forms mandated? Is the company missing key competencies? If so, can these be trained or hired? All project system development engagements led by IPA Capital Solutions start with a Diagnosis, which addresses these and many other questions and sets the stage for improvement and starts the framing for the practical solution.

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The Diagnosis phase seeks to understand stakeholder concerns and needs as well as the current structure of the project system. The Diagnosis phase also establishes the typical capital project performance achieved under the company or system's current approach. This allows us to quantify the potential value (capital savings, cost consistency, functionality, etc.) of proposed improvement efforts and make a case for change.

The phase should conclude with recommended solutions as to which strengths the company should retain and what changes it should make to establish an optimal capital project system that is fit-for-purpose for the company portfolio, organization, and objectives.

It is important that these recommendations are then discussed and "validated" before any next steps. Critical stakeholders in these discussions are the system gatekeepers. A system, no matter how rigorously it attempts to comply with Best Practices "on paper," will not function effectively if it does not integrate well with the business processes of project initiation, funding, and value measurement. It is rare that a project system can "be everything to everyone." Trade-offs and constraints must always be considerations and should be agreed upon before proceeding to the Solutions Design phase.

Getting the Sequence Right in Solutions Design

It is important to get the sequence right in all areas of project system development, whether you are focusing on governance, organization, or work process (or all three).

Project Organization. A project's organization, for example, cannot be designed without first understanding the portfolio of projects that will be executed by that organization. The project portfolio (number of projects, project sizes and complexities, etc.) dictates, to a great extent, what the organization must include to execute these projects effectively, as shown in **Figure 1**. Consideration must be given to issues such as centralization and decentralization

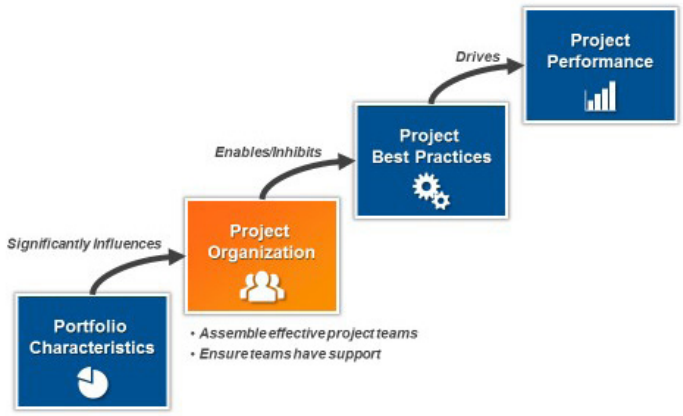


Figure 1

of resources, the right owner-contractor balance with regard to execution approaches, and the need for or availability of specific project competencies. IPA research and knowledge of the most effective organizations provide insight around these considerations and offer solutions.

For instance, an IPA client wanted to restructure its project management office (PMO) because it was too large for the planned future capital spend and was not organized appropriately for the greater volume of smaller projects expected across the system. IPA Capital Solutions collaborated with the client, using IPA research to explore options and then assisted the client in developing the organization design and staffing levels to effectively manage its changing project portfolio. The basis of the design was the anticipated future portfolio.

Project Work Process. As with organizational design, a project work process cannot be designed without first understanding its foundation, or basis, which, in this case, is the project governance structure. Project governance is the framework for all project decision making. An organization's project governance structure establishes the decision authority for stage-gate approval. It must reflect the company delegation of authority for project approvals and funding.

When this is established, we can then develop the work process with considerations for organization and competencies. The work process reflects the requirements that a project must meet and supports the development of required deliverables to receive stage-gate approval. The work process is then documented in a way that provides assurance mechanisms, instructions, tools, etc., to make it fully usable.

Of course, the governance structure and work process requirements for the system are shaped by management expectations for capital project performance. Accountability for specific performance also shapes the design of the new system. For example, if management assigns accountability for cost overruns that are outside the expected range to the project manager, the project governance structure and work processes must reflect that accountability.

Presented on page 5 is a Case Study of how IPA Capital Solutions worked with a company to develop a fit-for-purpose work process to accommodate the delivery of large and smaller site-level projects.

Conclusions

Companies seek to develop fit-for-purpose systems to be as efficient as possible in the initiation, development, and execution of capital projects. Companies want to know: How much is too much? Where can I draw the line? Where can I simplify (processes, organization, assurance, decision-making)? What are the most leveraging practices that drive outcomes (and can I skip the others)? These are not

bad questions to ask! Organizations that do not ask these questions risk developing unwieldy organizations and processes that become bureaucratic and drive "tick-in-the-box" behavior rather than driving the use of best project practices.

What is my portfolio? What is an acceptable risk profile? How is project governance directed by the company's overall operational management excellence system? What are my expectations for system performance? What must projects deliver to be successful? How constrained am I by my organization and competency? Companies seeking to answer these questions without considering the foundational questions risk generating systems that are not truly fit-for-purpose.

For more information on implementing fit-for-purpose project systems, contact the author, Allison Aschman, at aaschman@ipaglobal.com.

A Case Study — Development of a Fit-For-Purpose Work Process

A regional manufacturing company had no common company system (work process, governance, and organization) for capital projects. Sites developed and executed large and small projects relatively independently and the company relied on experience and ad hoc processes with varying results. Generally, though, cost overruns were more common than desired and some very large projects struggled to meet the objectives set at sanction.

The company initiated an effort to make improvements across its capital project system. As a first step, the company centralized the project organization in which key capital project leadership personnel were deployed to the refineries but report to a central organization.

The review also helped to identify the potential value available to the company by making system improvements and establishing a case for change.

IPA then collaborated with the company to develop a project governance structure for large projects. Using the governance structure as the framework, a project process workflow was developed. The creation of guidelines and tools to make the system usable followed. An overview of the major projects governance work process, including expectations for cost estimate accuracy, is shown in **Figure 2**.

To make its approach to initiating, defining, and executing projects truly fit-for-purpose, the company also developed a governance workflow for its smaller, site-based projects.

Governance Workflow for Large Projects

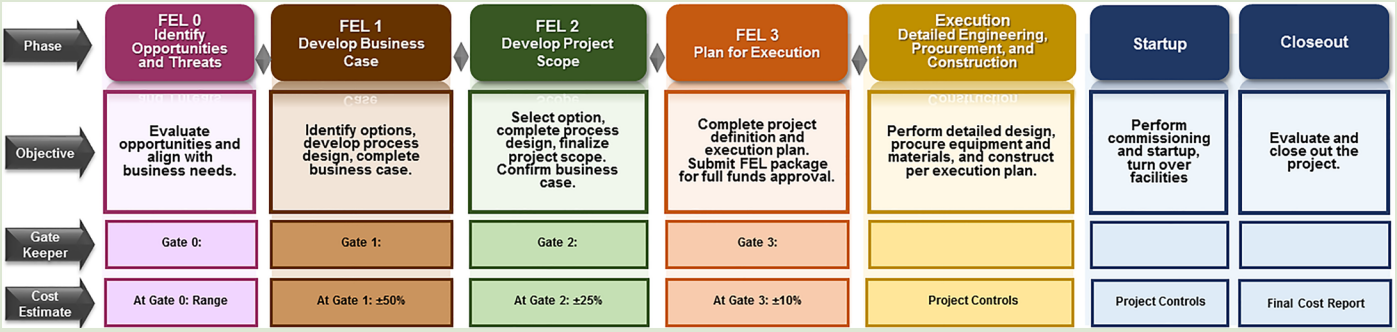


Figure 2

The company then engaged IPA to implement a fit-for-purpose work process for capital project development, execution, and governance. The process had to be aligned with the company's business needs, organizational structure, and competency framework.

The first phase to develop the new project system was a diagnosis of the current system's performance. This was accomplished through a project system review. The review established the strengths and weaknesses of the current approaches to identifying, planning, and executing capital projects at each refinery and defined the stakeholder needs.

The small-project governance workflow includes flexibility to accommodate "micro" projects, which do not require separate distinct phases for project scoping and execution planning, and therefore do not require an FEL 2 gate.

It is important to note that it is the gatekeeping requirements (i.e., desire for a mid-point check on project development or not) that drive the system requirements for a process that can be flexible in this manner. The further development of the work process then provides the "rules" around this flexibility and documents the processes and procedures to accommodate either governance workflow.

Early Estimates of Increasing Importance to Biotech & Pharma Capital Projects

By Jordan Sealock, IPA Manager of Chemicals, Life Sciences, and Nutrition

Buoyed by increases in biopharmaceutical drug approvals, pharmaceutical (pharma) and biotech owner companies are pouring capital into new and current manufacturing facilities, warehouses, and labs. Characteristic of this industry is that many pharma and biotech industry capital projects are schedule driven. But today, business and project managers are also under greater pressure to manage capital project portfolios with a mind not only toward schedule predictability but also cost effectiveness and predictability.

It has and remains imperative for pharma and biotech companies to get product to market on time, but gone are the days when businesses gave project teams plenty of leeway with capital project cost. Like other capital-intensive process industries, project organizations serving pharma and biotech companies are motivated to keep project costs low. However, cost overruns were more or less acceptable in past markets, provided the project team was able to meet the schedule targets, and thus, tight market windows. In recent years, though, businesses have been pushing project teams to commit to cost and schedule targets early in Front-End Loading (FEL). Unfortunately, the pharma and biotech companies have had a difficult time developing dependable early project cost targets.

Rushed to Produce an Early Number

IPA has observed recently that businesses demand firm cost and schedule targets from project teams at the start of a project's Concept development phase (FEL 2), before detailed scope planning. As a consequence, pharma and biotech project teams are hurried into preparing cost and schedule targets with no more data-driven insights than could be hashed out during a golf outing. Not surprisingly, these "golf course numbers" are almost always too low compared to a project's eventual actual cost. And the "golf course" schedule targets are often overshot.

When project teams are required to produce tight cost and schedule estimates (e.g., +5/-15 percent range) early in the capital project development process, the likelihood of project scope reductions increases considerably as the project nears authorization. This means business can expect the project to be of less value before shovels break ground or the first wrenches are turned.

Pharma and biotech project teams are stuck between a rock and a hard place. Project managers must turn in cost and schedule estimates that will satisfy the expectations of the business before they have adequate project designs, supplier quotes, and stakeholder input. But they also know beforehand that business executives may very well be disappointed with the project's cost, schedule, and capacity outcomes—never mind its competitiveness with Industry or capital effectiveness.

Improved Conceptual Estimating With Reliable Data

More reliable cost and schedule estimating early in the project development process is possible, however. To generate the unbiased conceptual estimates necessary for improving the cost and schedule competitiveness of capital projects, project cost engineers benefit from having access to project data from past projects with similar project characteristics. However, even large pharma and biotech companies have found it difficult to maintain the kind of robust project databases that are able to provide users with valuable cost and schedule information on a broad range of project and facility types.

IPA's vast database of 18,000 downstream projects includes over 750 projects from the pharma and biotech industries with detailed cost and schedule data. These pharma projects, executed globally, range from less than $250 thousand to over $2 billion in size. All project types and facilities are represented, as shown in **Figure 3.** Developed from this

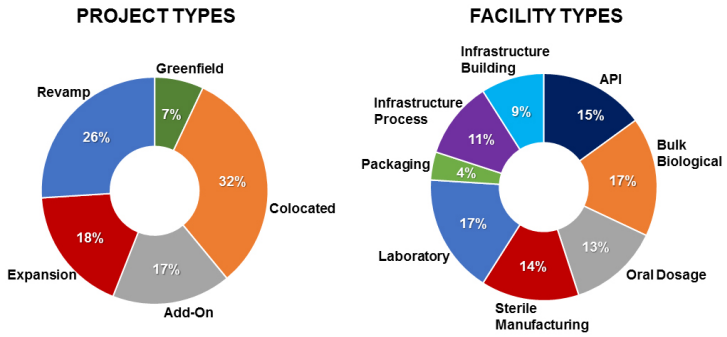


Figure 3

pharma and biotech database, IPA maintains a full suite of cost and schedule metrics that can be used to aid pharma and biotech company project teams in conceptual estimate development and validation, as well as early schedule planning.

Conceptual Cost Metrics

IPA has developed a set of conceptual cost metrics that is customized to support project teams in the pharma and biotech industries. A product of the Cost Engineering Committee (CEC), whose members are owner companies belonging to the IPA-facilitated Industry Benchmarking Consortium (IBC), these high-level metrics are used to support estimate development during the early stages of project definition. The metrics are also useful in supporting internal estimating database and tool development. This includes various summary-level metrics in subsets such as percentages of total project costs, percentages of total office costs (or "soft costs"), and, especially critical for those using unit rates, percentages of total construction costs (construction labor, bulk materials, and lump-sum contracts). A sample metric is shown in **Table 1**.

When used during conceptual estimating, the metrics can help engineering organizations to produce early cost targets that are considerably less likely to be outside the plus/minus cost ranges that might derail projects early in the development. Rather than turning to unreliable and potentially biased sources of cost data, project teams can rest easier knowing that their cost estimates are grounded in actual capital project information derived from comparable projects.

Early Schedule Metrics

IPA has also used its pharma and biotech database to develop early schedule metrics. These metrics are used to support early project schedule development and reviews, assess the company's metrics against industry norms, and support calibration of internal tools and databases. Due to the current market, teams are being pushed to meet extremely demanding schedules; however, this becomes significantly more difficult if they are required to meet those targets while also staying within an extremely tight range around the early FEL 2 estimate. **Figure 4** shows an example of how early schedule metrics can not only identify an aggressive cycle time, but also give a more granular assessment as to which phases (or specific phase overlap) are driving the aggressive schedule. Being able to validate both early cost and schedule targets helps stakeholders to understand if the project's overall objectives are realistic or if it faces considerable risks that may hinder success.

Considering today's pressure-cooker market in which new and existing drugs must be rushed to consumers, it is no surprise that pharma and biotech businesses are pushing their project organizations to deliver earlier estimates. However, project organizations can be armed with the ability to assess portfolio targets and risks, allowing both business and project managers to make informed decisions early on, thereby setting teams up for success rather than failure.

For more information, contact the author, Jordan Sealock, at jsealock@ipaglobal.com.

IPA SUMMARY METRIC SCREENING TOOL

METRIC: RATIO TO TOTAL					Facility Type				Date Run:
Subcategory					Biopharmaceuticals				10/5/2017
Example Metrics #1									
Project Characteristics	Number of Records	Average Value	Standard Deviation	10% Value	25% Value	Median Value	75% Value	90% Value	Relative Factor
Overall	339	0.090	0.071	0.037	0.055	0.085	0.140	0.190	
Size Total	314	0.100	0.055	0.030	0.063	0.090	0.145	0.200	
Biopharmaceuticals	65	0.080	0.047	0.040	0.055	0.070	0.120	0.150	0.889
Example Metrics #2									
Project Characteristics	Number of Records	Average Value	Standard Deviation	10% Value	25% Value	Median Value	75% Value	90% Value	Relative Factor
Overall	306	0.260	0.156	0.070	0.132	0.250	0.340	0.430	
Size Total	303	0.259	0.152	0.060	0.122	0.240	0.336	0.430	
Biopharmaceuticals	65	0.28	0.121	0.080	0.182	0.270	0.320	0.390	1.081

Table 1

Metric statistics

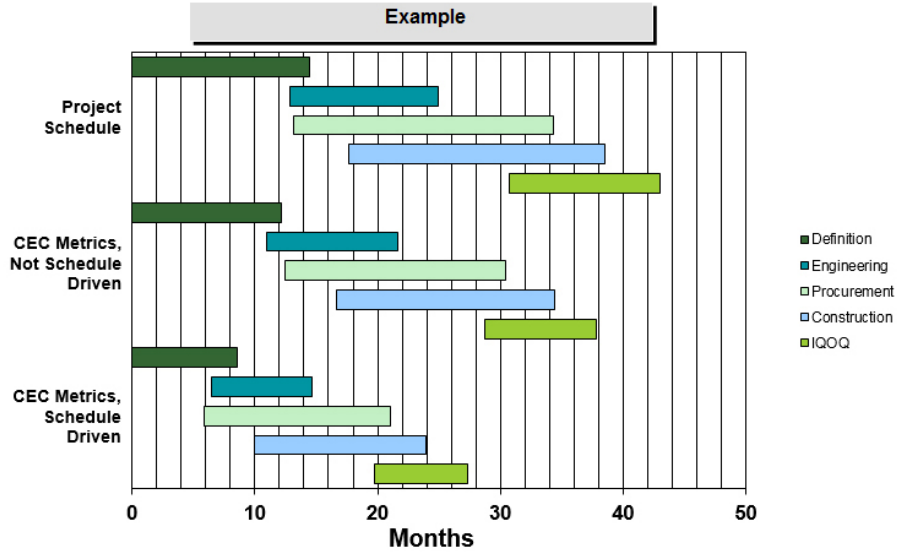
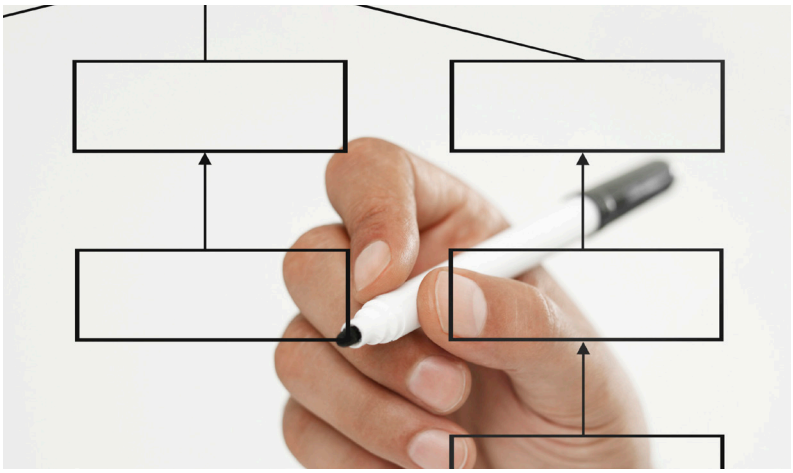


Figure 4

Effective Site-Based Project Portfolio Execution Requires Owner, Contractor Staffing Balance



By Lucas Milrod, Deputy Director of Research, IPA Organizations & Teams; Alex Ogilvie, IPA Deputy Director of Research; and Jay Russo, IPA Associate Research Analyst

There is a natural friction between industrial plant managers and site-based capital project directors. Plant managers are under pressure to drive down capital project costs, and one of their go-to tactics is reducing project system overhead. Core project functions—including project managers, engineers, project services, and construction management—are usually not spared from reductions in force to the site-based project organization. Meanwhile, project directors are still expected to achieve greater return on investment on the projects they are executing, because less money is being authorized for the construction of large projects to bring in revenue.

Plant managers and project directors alike cannot ignore the importance of balancing site-based project portfolio expectations and needs. But determining whether a staffing approach can drive site-based project outcomes is no walk in the park. An IPA research study[1] that evaluated nearly 80 project sites found large variability in full-time equivalent (FTE) project system staffing. So IPA researchers took a closer look at site project system staffing approaches to see whether staffing characteristics affect capital project outcomes. The sites examined are representative of the chemicals, refining, pharmaceuticals, and mining industries, with a median annual portfolio spend of $98 million in delivering an average of 112 projects annually and with representation from much smaller and larger sites.

The researchers evaluated each site's project portfolio characteristics, including industry sector, size, and availability of resources. They defined four site project system staffing approaches—Full Alliance, Owner Engineering, Contractor Engineering, and Core Staffing—based on two factors (**Figure 5**):

1. **Staffing Adaptability**—Determined by continuity of FTEs assigned to the system
2. **Contractor Secondment**—The portion of the engineering function that is outsourced

Each of the four site-based project system staffing approaches was then assessed based on project outcome measurements, including cost, schedule, and internal rate of return (IRR), as well as use of Best Practices for project development, including Front-End Loading (FEL) practices.

Although the research found that all four staffing approaches can deliver successful project outcomes, the most successful projects are delivered at sites that employ the owner engineering approach. Even owner engineering sites with the lowest IRR performance delivered projects that achieved a nearly 15 percent IRR. In contrast, a full alliance staffing strategy in which owners provide limited

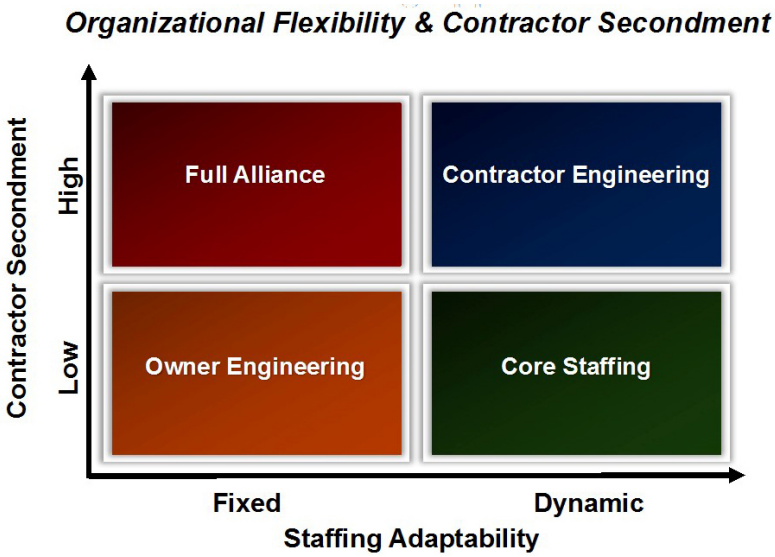


Figure 5 — Four Staffing Approaches

[1]Site Staffing Strategies: What Drives Success? (IBC 2017) by Alex Ogilvie, Deputy Director, IPA Project Research Division, and Jay Russo, Associate Research Analyst, IPA Organizations and Teams Services.

contractor oversight delivered projects with an under 9 percent IRR. Although it may seem that an owner-heavy approach would be expensive, we actually observe the opposite. When costs are considered holistically, projects executed at sites that employ high contractor secondment strategies tend to be more expensive.

It is important to note, however, that this is not an argument against using contractors, who are an important element of most site-based project organizations. In fact, it is possible to be successful with any of the four strategies. Rather, it is a call to understand which strategy is most appropriate given the site circumstances and to find the right balance of owners and contractors given the strategy being employed.

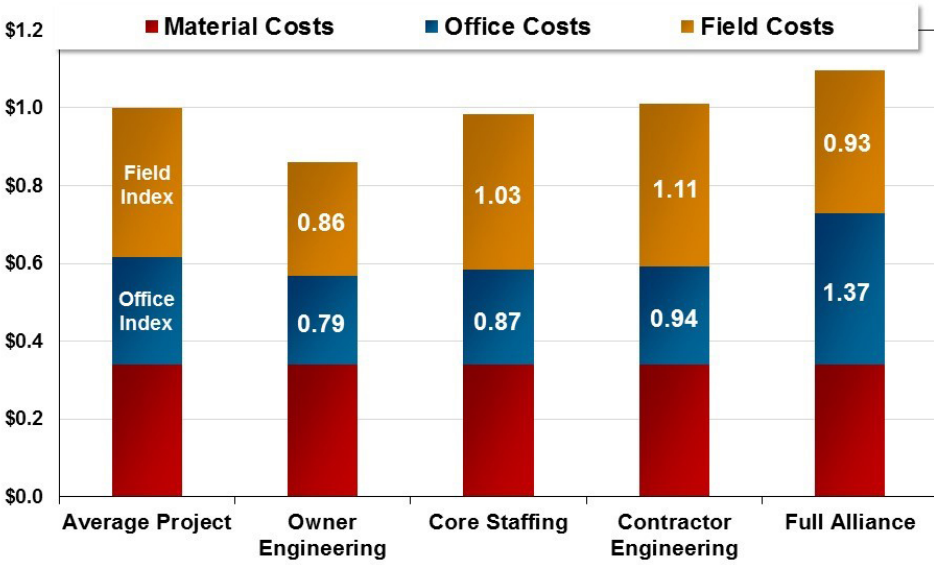


Figure 6: Cost Performance for a Site Project: Owner engineering is the least expensive approach.

Sites with large and stable project portfolios ordinarily capture the benefits of fixed staffing, characteristic of both owner engineering and full alliance staffing approaches. On the other hand, sites with fewer engineering resources available in their local market are apt to have a more flexible staffing approach in place, namely core staffing and the contractor engineering approach. What site management often underestimates is the importance of owner staffing of core project functional competencies, especially project functions previous IPA research has determined are crucial to delivering industry competitive capital projects. Case in point, IPA found that the positive performance of the owner engineering strategy is driven by strong owner staff representation across the entire project system (**Figure 6**).

Although capable of delivering successful projects, sites using more "adaptable" and contractor heavy staffing approaches, by definition, rely more on contractor personnel to deliver projects and they tend to have few owners to manage the contractors. On average, IPA found that wages for contractor FTE project managers and engineers were slightly lower than for owner equivalents. However, the contractor FTE headcount is regularly higher than the number of owner FTEs that otherwise would have been employed to accomplish the same amount of work. In other words, the best performing site-based project portfolios are able to achieve the proper balance between portfolio expectations and resource management. Key to accomplishing this balancing act is finding the right mix of owner and contractor staffing for the site.

Often times, it is up to project leaders to convince business managers why a site cannot afford to understaff owner project competencies. With site projects now having an average design life of 20 years, greater care and consideration should be given to staffing the right people for the right projects. By measuring site project performance and hiring owner personnel with the leadership attributes best suited for core competency functions, site-based capital investments can deliver greater value for business.

This article also recently appeared on SPE's Oil & Gas Facilities website at https://www.spe.org/en/ogf.

IPA Capital Project Organizations and Teams Evaluations and Research

The project organization and project team are the foundations upon which capital value is created. Poor project performance can often be traced back to problems rooted in the staffing or functioning of the project team or even further back to the capabilities and operating (or lack thereof) of the project organization. IPA has identified the key elements of project organizations and teams that drive capital effectiveness. IPA can help its clients find the data-based solutions they need to address their most challenging organizational concerns. Our organizational expertise, industry perspective, and breadth of capital project and organization understanding positions us to provide unparalleled, qualitative insights into what drives competitive organizations and successful teams.

For more information, contact Sarah Sparks, Product Champion, IPA Organizations & Teams, at ssparks@ipaglobal.com, or Lucas Milrod, Research Team Leader, IPA Organizations & Teams, at lmilrod@ipaglobal.com.

Cost Overestimates a Detriment to Airport Construction & Maintenance Projects

By Maria Pinilla, IPA Advanced Associate Project Analyst

The construction and renovation of airport terminals and flight operations facilities worldwide represents a large portion of the capital being spent on infrastructure projects today. IPA's assessment of capital projects at several airports globally shows a significant opportunity to enhance capital effectiveness in this infrastructure sector. Some of these airport projects are large projects involving the construction of new passenger terminals and operations infrastructure, like aircraft hangers. Other projects are smaller in cost but still important, such as baggage claim areas or shopping corridor renovations.

Whether funded by government grants, private funds, or Public Private Partnerships (PPPs), airport projects not only sustain commerce at and near the airport, they can also usher in regional economic growth. But for those involved in the planning and execution of airport projects, there are risks. Airport projects are often subject to public and media scrutiny, especially when they exceed cost and schedule targets and do not perform as planned. IPA's recent work on airport projects shows a lot of room for cost effectiveness improvements with respect to their planning, development, and execution. In particular, like the other types of capital projects IPA has been evaluating in the past few years, project cost overestimation is a major source of inefficiency and economic loss.

Overestimating may sound like a "safe bet" to some, but recent IPA research indicates that capital project systems delivering constant cost underruns are cheating stakeholders who expect maximum value from the capital spent. Project managers have the tendency to approve late changes and extra contractor hours when they know that a cost target is padded to avoid an overrun. Rather than overestimate a project's cost, project managers should aim to deliver projects close to an industry average cost. IPA has taken a closer look at what factors are driving the latest cost overestimation trend. One project characteristic that stands out is that schedule-driven projects are prone to cost overestimation (**Figure 7**). Airport projects are regularly schedule driven, given that other service providers and vendors depend on these projects to be done on time in accordance with commercial agreements. Schedule slip can derail third-party business plans, resulting in losses for retailers and car park management groups, for instance. Late projects can also disrupt airlines' plans for new flight routes and other operations. Airport project managers may also be inclined to overestimate how much a project will cost to complete to avoid angering business and having cost and schedule overruns reported in the press.

Heavy reliance on contractors is another factor driving cost overestimation at airports, notably when the estimate is developed by a contractor. Infrastructure projects are often executed using design-build contracts, meaning that the estimate is based on what the contractor provides. A design-build contract approach may be suitable when a projects group lacks the in-house capabilities to define the scope and develop a cost and schedule. This appears to be true at many airports. The downside for airport project managers, however, is that they have to make a financial commitment to engage a contractor before sufficient definition work has been done.

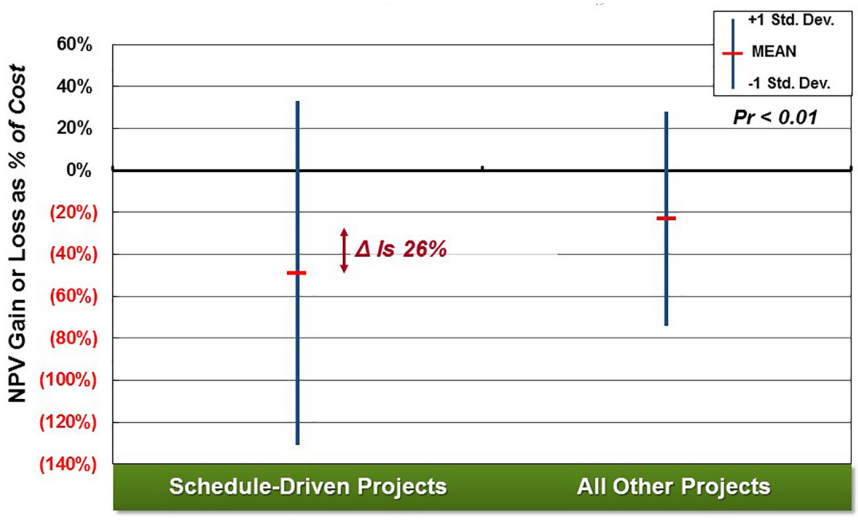


Figure 7: Lower average net present value (NPV) frequently results with schedule-driven capital projects.

This financial commitment is a "de facto" authorization of funds that leads to an overlap of funding for project definition and detailed engineering work. Businesses have grown accustomed to de facto authorizations to secure funding for projects right away, but value is lost frequently from authorizing significantly more money than is required to complete a project.

An increased number of airports located globally have approached IPA to assess their project systems to correct system weaknesses like project cost overestimation. Evaluations of individual airport projects generally show opportunities for increased capital efficiencies. By looking at a set of projects executed by an organization, from a very minor sustaining project to a large growth project, IPA can help an organization understand how practices implemented during the front-end phases of project development affect cost outcomes. IPA research shows that clear objectives and a strong team provide the foundation for delivering successful projects. Solid front-end definition work ensures cost and schedule predictability and effectiveness, and, of course, a project that functions as planned.

Recognizing the constraints of the airport industry, IPA has found that basic definition practices are not applied, and a lot of the risk is passed on to the contractors. For example, ensuring that all functions are represented on the project team (an integrated team) is significantly linked to better outcomes. This is of particular importance for airports because many stakeholders are involved, even for small projects. When key functions, such as the airport's operations

manager, are not engaged until the later phases of a project's design and execution, late changes necessary for operations to run smoothly become very costly.

Airport capital portfolios are substantial, even in smaller airports, so there is plenty of opportunity for cost savings. These savings can be used for additional projects or for boosting resources. IPA can evaluate the project system, identify the gaps, and provide recommendations. This performance baseline provides insight into helping the project organization implement changes that can improve outcomes. By reducing the weaknesses in project practices, the overestimation problem can be resolved and the project system can set more competitive targets. The focus for projects can still be predictable outcomes, but there is opportunity to do so at a lower cost.

Contact one of IPA's regional office directors to learn more about how IPA can work with your organization to improve the capital effectiveness of your infrastructure project. Visit http://www.ipaglobal.com/industries/infrastructure.

Quantitative Insights Into Delivering Infrastructure Projects

IPA has evaluated hundreds of infrastructure projects with diverse scopes, including buildings, transportation assets, and utilities. The owners of these infrastructure projects include governments, developers, and investors in the United States, United Kingdom, Brazil, Chile, Canada, Australia, China, and other countries. IPA evaluates infrastructure projects and systems and also conducts research to identify opportunities for owners to deliver projects that are cost and schedule competitive. IPA infrastructure research has examined topics such as contracting approaches, sustainability practices, and stakeholder alignment. IPA tools and workshops can help establish and document project priorities and trade-offs in ways proven to reduce conflicts among stakeholders. IPA project research has identified Best Practices for project planning and execution that are statistically proven to reduce the likelihood of late changes that inhibit successful performance outcomes.

Continued from cover

IPA turns 30 years old at time when many sectors of the capital projects industry are heating up again. "We're busy everywhere in the world right now," IPA President Edward Merrow told staff gathered to celebrate the company's anniversary in Ashburn, Virginia, home to IPA's corporate headquarters and North America regional office.

Merrow observed that IPA's commitment to its clients, to promote capital project and project system effectiveness, has remained unchanged since the company's beginning. IPA helps companies become better stewards of the capital they spend, so they can build more effective plants, assets, and infrastructure, Merrow said. "We possess a deep expertise in capital project research and evaluation. Our unique competence comes out of our research base." IPA's success as a company is a direct reflection of its commitment to serving its clients' best interests, Merrow added. "Trust is essential to making it work."

A synopsis of IPA's history follows, along with a selection of notable company developments and accomplishments.

Industry Recognition Gained Fast

Encouraged by his earlier research at the RAND Corporation into the performance of pioneer process plants and chemical process facilities, Ed Merrow saw untapped potential for organizations to improve capital project outcomes. IPA was started with the belief that empirical assessments of projects and systems and research-driven products would enable companies to deliver more successful capital projects. Early business success resulted in IPA moving out of Merrow's home, where it began, to an office in Reston, Virginia, in 1990. The 1990s brought expansion with new offices in the Netherlands and Australia and, in the mid-2000s, IPA opened offices in Singapore, the United Kingdom, Brazil, and China.

IPA established its reputation for delivering quality assessments and research early on, and it found success in fostering a shared sense of industry-wide commitment to capital effectiveness and leadership. Since 1992, IPA has directed the Industry Benchmarking Consortium (IBC), a group of companies committed to continued capital project system improvement. A short while later, IPA formed the Upstream IBC (UIBC). Both the IBC and UIBC sanction their own respective cost engineering committees, the CEC and UCEC, with the intent of strengthening cost engineering practices and the project controls functions.

As IPA built on its accomplishments, such as establishing the standard for capital project definition measurement (the Front-End Loading [FEL] Index), it also created specialized internal directorates to spearhead new initiatives. A projects research group, now called the Projects Research Division (PRD), was created in the late 1990s to focus exclusively on capital projects research apart from individual project and system evaluations. The IPA Institute was established in 2002 to share knowledge from IPA's research.

Celebrating 30 Years: Pictured at the top, Ed and Loretta Merrow in front of the Ashburn, Virginia-based corporate headquarters and North America regional office of IPA, the company they started in 1987. IPA staff celebrated IPA's 30th anniversary at its regional offices in the United Kingdom (below), Brazil (opposite page, top), and Singapore (opposite page, bottom). Staff gatherings (not pictured) were also held at IPA's offices in Australia and Northern Virginia.

30 Years of Data-Driven Perspective on Capital Projects

Having conducted thousands of data collections and project team interviews in three decades, IPA has built unparalleled capital project databases to measure the effectiveness of project outcomes, validate cost and schedule estimates, and conduct research. IPA's databases contain detailed information on 20,000 individual capital projects located globally. The projects range in size from several thousand-dollar site-based and sustaining capital projects to multibillion dollar megaprojects. These projects are collectively representative of all capital-intensive industrial sectors, including the chemicals, petro-chemicals, mining, biotech, pharmaceuticals, consumer products, power, infrastructure, and exploration and production (E&P) industries. Notably, and to the envy of many, several thousand descriptive variables are available to assess and understand each capital project in IPA's database.

All of IPA's project evaluations, research services, and products and tools are underpinned by quantitative methods of measuring and assessing project performance. The

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Project Evaluation System (PES®) is IPA's core product suite, encompassing risk evaluation relevant to the various stages of project development. The original PES® analysis included an execution risk and benchmarking assessment typically completed prior to and in support of project sanction. Today the PES® suite encompasses the full project life cycle, starting with an assessment of the robustness of business case and asset optimization through scoping and competitive target setting, execution risk assessment, construction readiness, production readiness, and closeout and lessons learned evaluations of individual projects.

The IPA Project System Evaluation has also evolved from just a baseline measure of project system performance to a deep and comprehensive forensic analysis of a company's project delivery system. A full system evaluation examines project performance, organizational structure and staffing, work processes, and governance as well as the relationship among these key parameters of a capital system. IPA's data-based approach provides quantitative measures of performance and, therefore, measurable key performance indicators. The findings identify opportunities to add value to the capital program and establish a plan for meaningful change.

IPA has completed hundreds of well-received industry research studies in the last decade, including specific studies like Mining Sustaining Capital, Performance of Global LNG Projects, and Contracting for Engineering and Construction. IPA has also completed several regional studies, including an in-depth look at "hot market" periods affecting the supply chain in the U.S. Gulf Coast and several country risk studies for companies seeking to invest in frontier locations. In addition, IPA has released powerful tools that leverage IPA's projects databases, most notably the web-based FEL Toolbox. In the E&P sector, IPA has developed the web-based oil and gas Asset Economics Simulator (AES) and Opportunity Assessment Toolkit (OAT) to help oil and gas companies manage their project portfolios.

IPA's products and services are well known to the process and upstream industrial sectors. The strength and quality of IPA's work has also garnered the business and respect of law and investments firms; government agencies; and industry contractors, suppliers, and observers.

IPA senior leaders have books published by John Wiley and Sons, Inc., that have been well received across the entire industry: *Industrial Megaprojects: Concepts, Strategies, and Practices for Success* (Wiley, 2012), by Ed Merrow, and *Capital Projects: What Every Executive Needs to Know to Avoid Costly Mistakes and Make Major Investments Pay Off* (Wiley, 2016) by IPA Capital Solutions Director Paul Barshop. A third book, *Leading Complex Projects: A Data-Driven Approach to Mastering the Human Side of Project Management* (Wiley), by Merrow and IPA E&P Business Director Neeraj Nandurdikar, is due out in 2018.

IPA President Ed Merrow has received some of the industry's highest honors for his leadership in improving project cost management and engineering, including the Construction Industry Institute Carroll H. Dunn Award of Excellence (1998) and AACEI's Award of Merit (2012). IPA received AACEI's highest corporate honor for cost management services, the Industrial Appreciation Award, in 2016.

The Importance of Organizations and Teams

In the last few years, IPA has endeavored to blaze new trails in areas it recognizes as being vital to developing capital projects more effectively. One of those areas is concentrated on correctly structuring organizations and teams. IPA has developed services to assist companies in strengthening project teams, supporting talent management, and optimizing their entire project organization. Also, in 2016, IPA launched its Capital Solutions directorate. The Capital Solutions service portfolio spans all aspects of capital project performance to deliver uniquely crafted system solutions for individual company needs.

This issue of the *IPA Newsletter* highlights IPA's recent work in these important areas. Staffing approaches for site-based project portfolios is examined (see page 8). On page 3 we review a process for the development of "fit-for-purpose" project systems. In addition, we discuss the importance of early estimating for biotech and pharmaceutical projects beginning on page 6. We also review IPA's work involving airport infrastructure projects (see page 10). Other IPA news, updates, events, and announcements appear too.

Upcoming IPA Events & Presentations

March 19-22, 2018

Industry Benchmarking Consortium (IBC) 2018

Facilitated by IPA, the IBC is a voluntary association of owner firms in the chemical, petroleum, minerals processing, food and consumer products, pharmaceutical and biotech, and forest products industries that have employed IPA's quantitative benchmarking approach. The members have agreed to support the continuous improvement of capital processes through measuring and comparing performance metrics to improve the effectiveness of their project systems. IBC member companies meet annually in Leesburg, Virginia. For more information, contact IBC Director Andrew Griffith at agriffith@ipaglobal.com.

June 2018

Upstream Cost Engineering Committee (UCEC) 2018

The annual UCEC meeting will be held in The Woodlands, Texas. The UCEC strives to improve upstream project and business results by providing metrics for better cost engineering. Member company representatives gather once a year to learn about and review new UCEC metrics packages prepared by IPA. The upstream metrics packages are used by companies to compare their upstream project cost and schedule outcomes with industry cost and schedule norms and, in general, boost business project estimate assurance and evaluation quality.

September 2018

Cost Engineering Committee (CEC) 2018

The CEC is a working subcommittee under the Industry Benchmarking Consortium (IBC) that assists cost engineers by providing metrics and tools that offer an unbiased snapshot of industry cost and schedule estimates and trends. The CEC focuses on all aspects of cost (or investment) engineering, including cost estimating, scheduling, and project control practices and metrics, with the goal of expanding the owner cost engineer's capabilities. The primary vehicles for accomplishing these objectives are validation metrics, Best Practices research, and practice sharing. For more information, contact IBC Director Andrew Griffith at agriffith@ipaglobal.com.

November 2018

Upstream Industry Benchmarking Consortium (IBC) 2018

The Upstream Industry Benchmarking Consortium (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. Consortium attendees learn how to improve specific elements of capital project execution through presentations and other more interactive discussions. For more information, contact IBC Director Andrew Griffith at agriffith@ipaglobal.com.

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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.

IPA In the News

IPA leaders and analysts have been featured or mentioned in industry trade media in the last few months.

IPA President Edward Merrow participated in a panel discussion on the topic of improving project management in the oil and gas industry on October 18 at the Oil & Money 2017 conference in London. The event was cosponsored by *The New York Times* and *Energy Intelligence*. Video of the entire panel discussion moderated by *Energy Intelligence* Executive Editor Jim Washer can by viewed at https://vimeopro.com/user31703857/oil-and-money-conference-2017/video/238774084.

Merrow is also featured in a December 6, 2017, *EI Finance* article, "Q&A: The Path to Better Project Execution," by Jim Washer (online subscription required).

Oil & Gas Facilities, a publication of the The Society of Petroleum Engineers (SPE), International, on December 6, published an article, "Effective Site-Based Project Portfolio Execution Requires Owner, Contractor Staffing Balance," by IPA's Lucas Milrod, Deputy Director of Research; Alex Ogilvie, Deputy Director of Research; and Jay Russo, Associates Research Analyst.

IPA Chief Operating Officer Elizabeth Sanborn is quoted in a November 1 *Engineering News-Record* (ENR) article, "Amid 'Fragile' National Economies, Firms Push Robust Strategies," by ENR staff writers.

IPA Asia-Pacific Regional Director Rolando Gächter's keynote address at Breakbulk Southeast Asia is featured in an article, "Project Industry Seeks Operating Edge," published September 17 by Breakbulk staff.

IPA Community Service 2017

An important principle of operation at IPA is social and ethical responsibility to customers and surrounding communities. Each one of IPA's global offices adheres to this principle by raising money and donating time and goods to local charities serving groups and individuals in need of support. As in years past, IPA employees donated to charities serving the needs of the victims of global disasters, with 2017 having been a particularly difficult year worldwide. IPA's global Community Service Teams supported the following charities, and others, in 2017.

Relay for Life - American Cancer Society
American Red Cross (Hurricane Relief)
American Cancer Society
Northern Virginia Backpack Project
Loudoun County Food Bank
Toys for Tots (US)
Young Minds (UK)
Toys & Teens Appeal (UK)
National Cancer Centre of Singapore
Capa dos Pobres (Brazil)

Helping Santa's Helpers: IPA employees gathered lots of toys in December to turn over to programs, including Toys for Tots and Toys and Teens Appeal.

THE IPA INSTITUTE
ADVANCING PROJECT KNOWLEDGE

2018 Public Course Schedule

The IPA Institute has announced its 2018 public course schedule. Based on participant feedback, the IPA Institute has reduced the durations of most courses from 3 days to just 2 days, resulting in lower registration fees and less time required out of the office.

Visit ***www.ipaglobal.com/public-courses*** to view the schedule online.

Megaprojects — Concepts, Strategies, and Practices for Success (22 PDUs)

April 9-11 (Perth, Australia)

Gatekeeping for Capital Project Governance (16 PDUs)

March 6-7 (Santiago, Chile)

Best Practices for Mining Projects (16 PDUs)

May 8-9 (Lima, Peru)

May 15-16 (Toronto, Canada)

Establishing Effective Capital Cost & Schedule Processes (16 PDUs)

February 27-28 (Houston, Texas)

March 27-28 (Shanghai, China)

April 17-18 (Singapore)

October 23-24 (Landkawi, Malaysia)

Project Management Best Practices (16 PDUs)

July 10-11 (Bangalore, India)

August 7-8 (São Paulo, Brazil)

September 26-26 (Houston, Texas)

October 9-10 (Bangkok, Thailand)

Best Practices for Site-Based Projects (16 PDUs)

April 3-4 (Las Vegas, Nevada)

April 10-11 (Paris, France)

May 15-16 (Frankfurt, Germany)

September 18-19 (The Hague, Netherlands)

October 9-10 (Rio de Janeiro, Brazil)

October 16-17 (Manama, Bahrain)

October 23-24 (Orlando, Florida)

Private IPA Institute Courses Tailored to Client Goals

The IPA Institute offers customized private training courses through its *In-House Learning Program*. The program allows project organization training program coordinators to work side-by-side with experienced IPA analysts and instructors. In-house courses can be led by IPA instructors, co-led by client and IPA instructors, or led by client instructors themselves. Companies benefit from reach-back access to Institute course updates and client-specific project data in order to keep their in-house course instruction fresh and current. For more details, contact IPA Institute Director Andrew Griffith at agriffith@ipaglobal.com.

PMI Registered Education Provider

The IPA Institute is a Registered Education Provider (REP) of the Project Management Institute (PMI). All IPA Institute seminars align with current PMBOK standards, enabling PMI credential holders (PMP, PgMP, PMI-SP, PfMP, etc.) to claim Professional Development Units (PDUs) upon completion of each IPA Institute course.

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