Capital project value improvement in the 21st century: Trillions of dollars in the offing

A holistic and practical approach can increase project value by making capital spending more efficient.

Jeff Billows, Kevin Kroll, Piotr Pikul, and Charlene Pretorius

It's well-known in the industry that large, complex capital projects routinely run over budget and behind schedule. One study of 800 major projects (those of value over $1 billion) found that, on average, projects were one year behind schedule and 30 percent over budget.[1] But what's true for major projects is similarly true for projects of various sizes, even projects as small as $10-$20 million.

There is an art to project delivery—one that is shaped by critical factors like good leadership, technologies, and even financing models. But another component can also provide greater efficiency and effectiveness to all projects. *Project value improvement* (PVI) rigorously identifies tools, management practices, and capabilities that optimize a project's financial value from early concept to front-end engineering design (FEED).

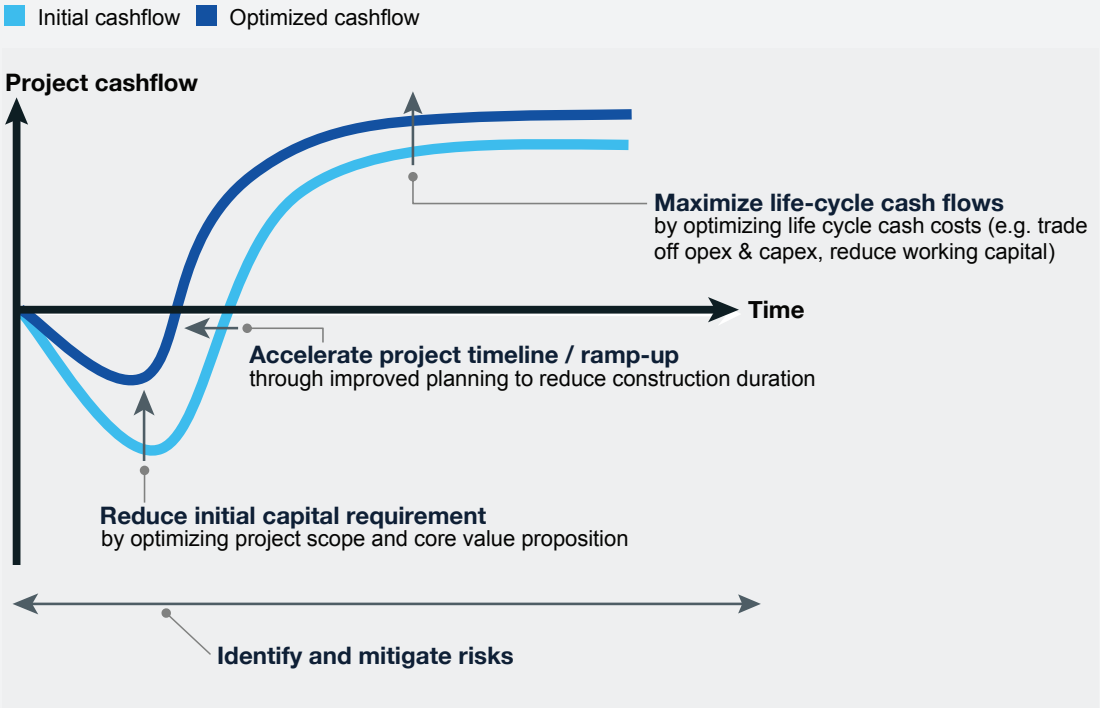
PVI integration could recover trillions over time

McKinsey analysis estimates that global capital spending will total $77 trillion between 2018 and 2023, which places the annual value of that spending at more than $10 trillion. Historically, owners that rigorously integrate PVI have realized in excess of 10 percent of project value in savings. That means if PVI best practices were implemented at scale, an annual benefit on the order of $1 trillion is possible.

PVI is a systematic method used to improve a project's financial value or cashflow. This process most often involves reducing its capital or operating expenditure; increasing its output; or accelerating its completion date so it becomes profitable more quickly. The crux of PVI lies in a comprehensive, "no stone left unturned" approach to identifying and evaluating creative alternatives to a project's economics, with the goal of achieving a higher project return (Exhibit 1).

Exhibit 1

PVI optimizes across all stages of a project lifecycle and increases robustness of the business case



Currently, PVI practices are only being applied intermittently. But the few project owners that do regularly practice PVI achieve significant monetary and temporal benefits, gaining considerable advantage over their competition.

Consider this example: A global mining house planned to build a $7 billion greenfield project in a new geography, with the goal of market expansion. However, cash constraints created challenges in scoping the project. The management team embarked on a rapid six-week process of pressure testing each element of the project, maturing the best ideas and developing a plan to embed them into the base project design. They also revisited multiple elements of the project to look for additional opportunities to reduce costs.

In full, the effort generated more than 100 new ideas and actions to optimize the project. Implementing these ideas resulted in a new processing plant configuration that improved operability, maintainability, and constructability; realized more than $1 billion in capex reductions through reductions in quantities and specifications as well as the use of preassembly and prefabrication; and improved net present value (NPV) by 60 percent.

PVI's origins and evolution

PVI began in the 1950s as "value engineering," where an engineering department's technical solution aligned seamlessly with the economic realities of the business case. With both working in concert, efficiencies were achieved.

Value engineering next evolved into the Stage Gate Process (SGP), a systematic implementation of rigor into the extraction, processing, and other capital-intensive industries between the 1990s and early 2000s. The SGP improved the predictability of project performance in terms of both capital expenditure and delivery timeliness.

In the 2000s, this changed. With that era's capital project boom, best practices took a back seat to schedule acceleration. Project owners rushed to bring projects online. Not surprisingly, this lapse in project-development fundamentals led to the rise of overbudget and behind-schedule project delivery performance.

A mining executive observed: "During the last commodity boom, many mining projects were rushed. They struggled to get talent and resources. Because of that they abandoned many of the typical good practices including a robust stage-gate process with independent and objective analysis and vetting. A lot of bad practices went unchallenged." Today, two entrenched cultural mindsets continue to frustrate attempts to improve performance.

First, PVI is commonly viewed or performed as a one-time exercise applied only at the final investment decision of a project. Most owners do not, however, view it as a rigorous, ongoing process that must be applied throughout a project's lifecycle. When PVI is relegated to later project stages, it is often left undone or only partially complete, abandoned in lieu of scheduling considerations.

Second, after two decades of industry history where PVI practices have been scarcely applied, there now exists limited organizational talent and a lack of institutional knowledge about the implementation and rewards of PVI.

A large defense capital project executive explained: "Little institutional knowledge of capital project value improvement is to be found in my organization. Value improvement is a one-off effort when there is push from the top, but not something people do and think about daily."

Reimplementing the wheel: PVI for the next generation

There are no silver bullets to delivering projects with poor returns. But there are solutions. And the greatest outcomes can only be achieved through a holistic application of PVI. While any one aspect of PVI can improve a project, only a comprehensive PVI implementation can optimize an entire project.

We generally group the elements of project delivery into three categories: mindsets and behaviors, management systems, and technical systems (Exhibit 2).

Mindsets and behaviors

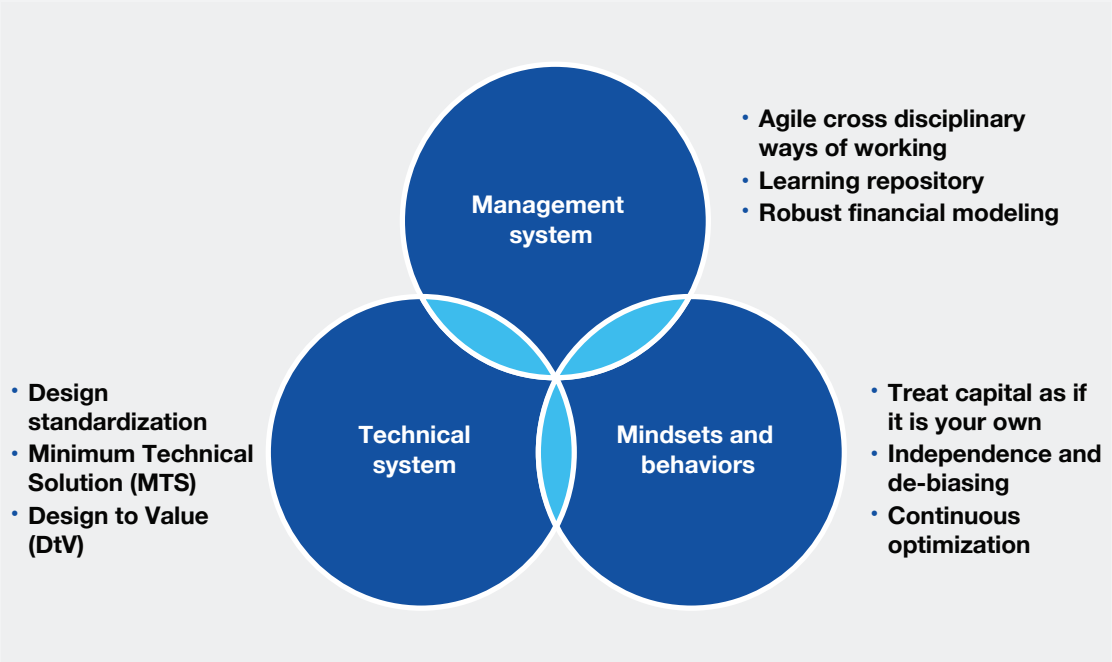
Treat capital as if it is your own

First and most essentially, employee mindsets and behaviors must align with strategic business objectives. Without that fundamental principle, real, sustainable, organizational change will not occur.

Each discipline within the organization must understand its role within the context of the broader objective. To accomplish this, leadership and/or a leadership-appointed PVI manager/team must drive the PVI process, communicating and reinforcing expected behavior for each group through formal processes embedded throughout the culture. The value of this cannot be understated.

To ensure lasting PVI cultural integration, owners and project teams must require every project to undergo PVI review. In addition to project savings, this trains staff and reshapes culture to incorporate the PVI philosophy in all future projects and take ownership of the capital deployed in each one.

Exhibit 2 **The elements of project delivery fall into three categories**



An agrichemicals company in Europe had placed a critical project on hold for three months due to escalating cost estimates. After reviewing the project rationale, the project team—including discipline engineers and plant representatives—held a two-day workshop in which they interrogated the existing project design and developed potential alternatives. They generated more than 60 ideas to improve the project. 25 of those ideas were prioritized and implemented into the revised plan, resulting in a 15 percent improvement in NPV. In addition to the quantifiable savings, the exercise instilled a cultural expectation of true ownership for project team members to challenge each other's assumptions in a drive to improve design.

Independence and de-biasing

Unconscious bias is well-documented in many forms: from confirmation bias, where one tends to interpret evidence as affirming one's existing theories, to anchoring, where one disproportionately relies on an initial piece of information. It is no surprise that such biases complicate capital allocation, which involves making choices amid significant uncertainty.

No amount of analysis can counter biased decision-making, but world-class organizations formalize dedicated systems and processes to reduce it. For example, designating a PVI leader who is not closely associated with the project team or owner can inject more objectivity into the PVI process. Independence can also be achieved through approaches such as:

- *Simulating red team-blue team exercises* in which an independent group plays a deliberately adversarial role in challenging a point of view
- *Conducting premortems* in which teams imagine a project has failed and work backwards to determine root causes
- *Deploying central project decision support and scrubbing teams* who are responsible for identifying and interrogating bias

The most successful de-biasing systems maintain the appropriate level of tension between the independent challenger and the project owner's institutional knowledge.

Continuous optimization

Many people perform project-value analyses only at the investment-decision stage of a project. Seasoned PVI practitioners, though, know that the PVI process must be engaged in continuously, throughout the project lifecycle. In fact, significant benefits can be accomplished early in the project lifecycle, when key trade-offs are often evaluated and technical design can be changed relatively easily without adversely impacting schedule.

A continuous, rigorous PVI implementation even at later stages of the project lifecycle can unlock project savings well after traditional approaches would have ceased to look—even benefiting future projects.

For example, projects in remote, labor-constrained areas often face fabrication and logistics challenges that were not well understood or anticipated during design. One operator gained a 15 percent improvement on fabrication costs by implementing modularization and logistical optimization improvements into the design just prior to fabrication. By modularizing pipe racks, process modules and stair towers, and taking advantage of lowest cost package sizing and routing to minimize transport costs, the team was able to reduce costs while mitigating the risks of working in a remote location.

In the above example, the fabrication and transport ideas generated by the project team were communicated to the design team for incorporation into future designs and specifications.

But wholesale implementation can prove difficult. Project owners must take an active role in this effort, as they are best positioned to maintain continuity between solutions and the core issues at hand. Leadership can begin with small projects to acclimate staff to PVI principles and practices. Once a project team experiences actual value on smaller projects, increase project size until all projects in that business unit fall under PVI requirements. After leadership establishes PVI for a portfolio of projects in one business unit, they can then apply it to all business units within the company.

Management systems

Agile cross-disciplinary ways of working

PVI practices are most effective when the innovative *agile* approach underpins its cross-disciplinary collaboration. "Agile" has made its way through the industry and is a familiar buzzword—however, while many people know the term, it is not well understood. The agile approach posits that requirements and solutions evolve through the collaborative effort of dynamic, self-organizing, cross-functional teams and their customers. It stresses adaptive, iterative, and evolutionary development along with continuous improvement that encourages rapid and flexible response to change. This provides a perfect platform for PVI to break existing silos and harness the best thinking across the board.

For example, one North American unconventional oil operator faced an unexpected drop in commodity prices that challenged the economic viability of several projects. Applying an agile approach, the operator hosted cross-functional ideation workshops and solicited input throughout the value chain. This was significant in the organization because, for the first time, key suppliers and stakeholders from outside the organization were included in the design process. The effort reduced installed costs for equipment by 40 percent and for facilities by 60 percent. The operator achieved these reductions largely by eliminating overly robust requirements that had been specified by designers working in silos without a clear understanding of the broader requirements.

Learning repository

As an organization adopts a PVI culture, it should immediately begin to document and catalogue proven ideas, as well as those that failed. This process formalizes institutional knowledge so that it will endure beyond current circumstances and staff. A major infrastructure firm embraced this concept and leveraged their database of ideas to obtain a 12 percent cost savings on a 500-kilometer road project through simple enhancements in pavement design. The creation of this database was a concerted effort to leverage internal and external experts in the industry to generate ideas, evaluating impact potential and focusing on the highest rated ideas to implement rigorously.

Codifying the knowledge-gathering process and assigning ownership to an individual can also provide functional and effective returns across business lines. We routinely utilize PVI examples collected from hundreds of projects in dozens of industries to improve and streamline processes from the study/funding stage to final delivery.

Robust financial modeling

Last but not least, all ideas uncovered in the PVI process must go through robust financial modeling. Capital project leaders too often make trade-off decisions based on simplistic calculations that lack rigor and result in crude assumptions. World-class capital organizations consistently test various optimization options including Monte Carlo modeling, a technique used across sectors to measure and forecast risk or uncertainty. By modeling a range of potential project outcomes, such as changes in delivery timelines or commodity prices, Monte Carlo modeling can provide a superior

understanding of real world outcome distributions and enable more educated decisions.

Technical systems

Design standardization

Design standardization provides one of the greatest savings opportunities in capital projects. McKinsey research finds that a five-to-tenfold increase in construction productivity would be possible if construction were to move to a manufacturing-like system of mass production, with a greater degree of standardization and modularization. Such approaches are becoming more common, but are not yet the norm.[2]

Capital project designs are often bespoke, which may seemingly preclude the potential productivity gains of repeated manufacture and construction. But projects, particularly major projects, consist of many separate elements and packages—each of which can provide great opportunity for design standardization. Applying PVI, particularly in the planning and delivery phases, can prove most useful in identifying these opportunities.

In addition to savings, project owners who incorporate standard designs often benefit from reduced contractor pricing, as contractors can establish facilities tailored to providing standard products. One upstream petroleum major realized a seven-month improvement in time-to-market by abandoning its legacy of tendering projects that required unique execution approaches (bidding, fabrication, and construction) for each project in favor of a standardized and modularized design. This move to standardization was made possible through detailed interviews and problem solving with contractors, partners, suppliers and owners to identify optimal solutions.

Ultimately, every facet of a project should be examined through the PVI lens to see if it must be bespoke or if it can be standardized.

The Minimal Technical Solution

The Minimal Technical Solution (MTS) methodology serves as a framework to illustrate a project's baseline needs, a starting point for design optimization. Once those needs are defined, the MTS helps users determine necessary add-ons to optimize design, eliminate any content that does not increase a project's cash flow, and improve understanding of the relevant tradeoffs. Analyzed from the macro-level (production system) to the micro-level (single piece of equipment), this framework examines the project's design requirements at the functional design stage before detailed engineering and procurement has begun.

MTS is not simply a cost-cutting exercise that slashes budgets to infeasible levels. Rather, by identifying an intermediate solution that meets mandatory requirements, it sets a starting point for subsequent iteration toward an optimal solution. MTS ensures that capex will not exceed expectations, that design is not over-engineered, and that potential options offer the best NPV. For example, a major downstream petroleum company saw a capex reduction of five to seven percent and an NPV improvement of 30-40 percent through the implementation of MTS in their plant expansion program. The organization defined functional requirements throughout the process flow, identifying the difference between the baseline concept for each dimension and its MTS in order to isolate the largest opportunities.

Design to Value

Each technical solution proposed in the PVI process—from minimizing technical requirements to standardizing components—must be validated with the project business case on an ongoing basis, through a process known as Design to Value (DtV). Each iteration of the design is modeled on an NPV basis to assure that all decisions maximize the project's financial return. In this way, design decisions are tested, improved, and finally validated

with respect to the financial value generated for the project. This continuous interaction between technical and financial considerations throughout the process assures that the project business case is clearly understood throughout the organization.

Capitalizing on the opportunity

A monumental opportunity exists for project owners who embrace PVI. This is particularly important when weighed against the vagaries of unpredictable commodity prices, a fluctuating labor pool, and a shortage of design-and-construction professionals. Going forward, project owners must ensure project success by adopting PVI, rather than chasing more projects. But they shouldn't stop there.

For various reasons, industry leaders failed to sustain or institutionalize PVI best practices in the past. That should not happen again. Meaningful steps must be taken to integrate and systematize PVI into the culture of the industry. In addition, leaders must also take great care to ensure that these practices remain flexible and adaptive, and are periodically tested and reexamined to avoid calcification and rigidity. Done right, PVI implementation can mean trillions of dollars captured that would have been lost to inefficiency and profligate practices. ■

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[1] "The art of project leadership: Delivering the world's largest projects," McKinsey, September 2017

[2] "Reinventing construction through a productivity revolution," McKinsey, February 2017

Jeff Billows is an expert with McKinsey's Dallas office. **Kevin Kroll** is a consultant with the Chicago office, **Piotr Pikul** is a partner with the Toronto office, and **Charlene Pretorius** is a senior expert with the Johannesburg office.