WHITE PAPER

Using Knowledge Transfer to Get Unique Projects Off on the Right Foot

By Chris Ploetz and Kevin Syphard

As the pace of technological change quickens, more chemical companies are faced with implementing emerging technologies and other first-of-a-kind construction projects. As they move forward, many will discover how experience gaps and insufficient information can add to the complexity of already-challenging projects. To set expectations and keep these projects on track, a structured knowledge transfer process at the onset can help.

When seeking to decarbonize their operations, scale up new processes or implement other consequential changes, chemical companies often enter unfamiliar territory. In some cases, the new operations and design considerations they encounter may be unlike any they have ever experienced. Likewise, technology licensors focused on their core technology may not fully understand how their solution will be integrated into an existing operation.

Information voids and experience gaps are not the only early warning signs that a unique or emerging technology project may be headed off track. A project team that finds itself changing a project's priorities and objectives while its scope is still being defined may also be on an undesirable path, putting the project at risk of scope creep. Unidentified and unmitigated risks can derail a project along the way as well, as can uncertainty regarding a project's economic or technical feasibility.

An engineering and construction partner that understands these and other nuances associated with technology integration can help make projects successful. Using a structured knowledge transfer process can help teams identify and understand the knowns and unknowns at an early stage in a project, which can be instrumental in minimizing change and churn as the project advances through a gated work process.

While a knowledge transfer process can be used before the start of any phase on virtually any project, it is ideally suited for front-end planning on projects that contain elements known to cause indecision. These can include first-time and unique projects, as well as projects that involve scaling up processes or transferring technology to different countries. Knowledge transfer processes also can be beneficial for advanced plastic or battery recycling projects that involve mixed plastics or great metallurgical variety, as well as projects with under-defined heat and material balances, unique flowsheets, solids-handling issues or other factors that add to a project's complexity or uniqueness.

What Is Different About These Projects?

Consider, for example, a petrochemical company that seeks to implement advanced recycling projects to meet its environmental, social and governance (ESG) goals. There are emerging technologies that make it possible to convert plastic and other waste into petrochemical feedstocks, reducing or eliminating a company's need for virgin feedstock. A petrochemical company likely has little experience with these technologies and the special design and construction considerations that impact the cost of integrating them into an existing chemical complex. There are many factors to consider. Among them are: *(See Figure 1)*.

- **Need for controlled environments.** Unlike most refining and petrochemical processes, advanced recycling processes can require controlled, indoor environments. Locating unit operations inside buildings may simplify piping, insulation and heat-tracing requirements, but it can also impact utility requirements and complicate layout, maintenance access and future expansion.
- **Custom material handling systems.** The materials handling systems for plastic feedstocks, intermediates and final products are different from those used to transport gases and liquids through a facility. Each system must be designed to address the unique properties of the materials being managed — issues that may be unfamiliar to hydrocarbon processors.
- **Slow permitting process.** Finding the appropriate regulatory framework for a unique process can take time, especially if the owner wants to avoid permitting under existing rules for established operations.
- **Wastewater characterization and treatment.** In many cases, the wastewater streams from emerging technologies are not well characterized, which can hamper the design and permitting of downstream wastewater treatment systems. Early development of a wastewater strategy and its impact on costs and schedule is needed to determine project feasibility.
- **Special fire protection measures.** Emerging technologies may require upgrades to even the most robust safety and fire protection systems. A contingency analysis that reviews new processes is fundamental to designing systems that identify and address risks.
- **Impacts on utility sourcing.** Capital planning must consider the complexities these projects add to the overall utility infrastructure and the contracts required to deliver needed utility supply, especially if low-carbon energy sources are required.

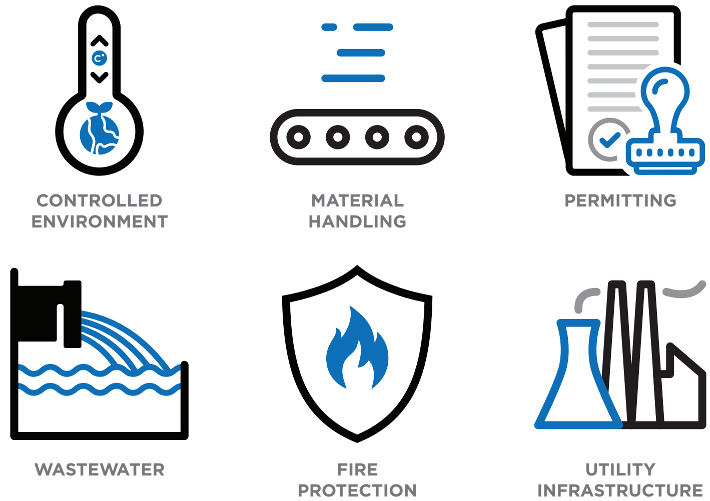

***Figure 1:** Factors Impacting Integration. Special design and construction considerations can influence the cost of integrating new or unique technologies into an operation.*

Using Knowledge Transfer to Support Project Success

Over the course of every project, information is transferred between the owner, operator, licensor, design team and other key stakeholders over time in spurts. By implementing a formal knowledge transfer process, this information exchange is performed systematically using a structured methodology that identifies and ranks areas of technical uncertainty early while aligning all parties on scope. It concludes with a confirmation of the design basis and expected project outcomes, along with concise action plans for any open items.

The knowledge transfer process — a highly disciplined approach to problem-solving — does not extend the project schedule or add to cost. Rather, knowledge transfer is known to benefit both the schedule and budget by focusing resources to the right areas and minimizing rework. Its purpose is simple: to achieve the minimal technical solution — that is, the solution that involves the lowest total cost to solve the problem fully and achieve the project objective.

By driving a team to develop the minimal technical solution, the knowledge transfer process helps prevent side projects from sneaking into the scope. It can also expose opportunities to improve the process, constructability, operability and maintainability of a finished project, all of which contribute to more efficient turnover, startup and commissioning. *(See figure 2)*.

GOAL

Facilitate the application of experience and lessons learned from engineering, procurement, construction and operations to confirm the appropriate design basis that achieves the project premise.

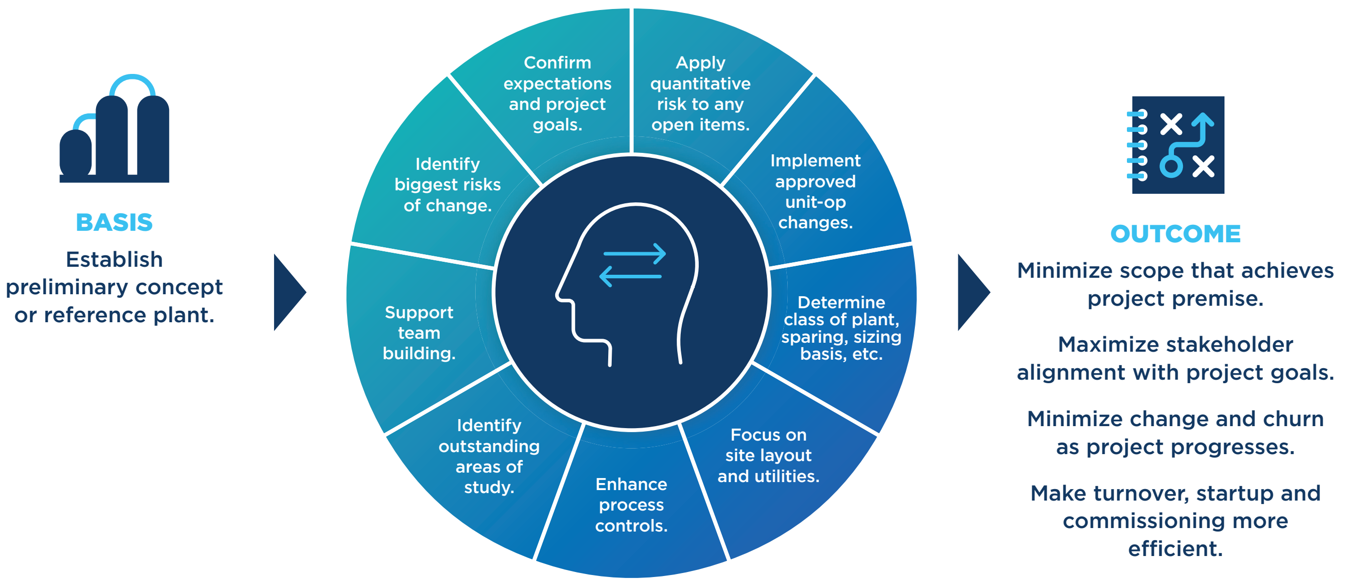

***Figure 2:** Knowledge Transfer Process. Using a structured knowledge transfer process to confirm the design basis and outcomes is imperative to a project's success.*

How the Knowledge Transfer Process Works

Facilitated by a process team leader, a knowledge transfer workshop can last anywhere from a few hours to a few days, depending on project size and scope. During that period, participants evaluate project requirements for everything from the core process technology to the utility systems and material logistics. By doing so, knowledge transfer helps ramp up understanding of the project scope, clarify gray areas to minimize indecision and eliminate nuances that can complicate the estimating and scheduling processes.

A typical knowledge transfer process is conducted in two parts. The first part addresses global decision-making and systems, including general rules, utilities, flare and infrastructure requirements. The second half covers the main process unit operations. To be effective, participants should include process leadership from both the owner and the design team, including the process technology manager, process leads, project manager and any subject matter professionals. Other participants may include operations, maintenance, construction and safety personnel. Depending on the scope, lead engineers for mechanical, electrical, piping, instrumentation and controls, and safety should be on call for participation, as needed.

During a knowledge transfer workshop, the facilitator systematically walks participants through the overall systems and/or unit operations. Depending on the project goals, discussions can range from how to control batch and continuous interfaces to emergency shutdowns. Facilitators will focus on any gaps discovered between the technical leadership team and operations and maintenance staff, reminding both sides that the cost of some requests may not be cost-justified.

Risk-ranking elements can be added for each unit operation or system. Most systems may have low risk. With the implementation and scale up of new or unfamiliar technologies, process risks may arise that require mitigation. The team should agree on the acceptable risk level, what level will require further study and what level requires a different solution than the one scoped.

Consider, for example, a first-of-its-kind reactor, which presents several unknowns to the project team and, therefore, is a higher risk than a traditional reactor. The team may determine that further study is needed on the reactor's construction materials, design safety margins, startup and shutdown requirements, among other issues.

Mindful of the scope that satisfies the project's design, the facilitation team will watch for unnecessary scope additions that may sneak into the design during the knowledge transfer process, including gold-plating, nice-to-haves and other elements that go beyond the project's intent. If consensus cannot be reached, areas needing further study are identified and action plans developed. To minimize potential rework later, the team may choose to not advance deliverables on high-risk units until issues are resolved.

Following the knowledge transfer, any needed actions, studies and changes from the original premise must be agreed upon prior to beginning work. The process group can use the final knowledge transfer output as a basis for moving forward on the project.

Finding the Right Partner

An engineer-procure-construct (EPC) partner that embraces the knowledge transfer process and has the capability to bridge knowledge gaps among parties will add value to many unique or emerging-technology projects. In addition to consolidating the project information and confirming the process design basis and design margins, a strong EPC-led knowledge transfer process can function as proactive value engineering. Rather than waiting until an end phase, which can result in redesign, the knowledge transfer process motivates the team to implement ideas that reduce capital and operating expenses from the start.

A strong EPC partner can improve overall communications as well, helping to strengthen understanding of the owner's expectations, and achieve earlier participation and buy-in among involved parties. All can be key to moving forward confidently toward project success.

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