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R&D WORLD

Improving ROI of R&D Facilities with a Systems Integration Approach

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Operational readiness is not a luxury. Today's marketplace moves much too fast to afford a delay in ROI. One of the most impactful things a company can do to ensure the operational readiness of a new or upgraded R&D facility is to understand the importance of using a systems integration approach. When a project is viewed through a systems integration lens from the start, operational readiness is in the crosshairs. What's more, this approach typically reduces the amount of time and money required to complete the project — leading to a lower investment and a faster ROI.

Systems integration is vital in complex environments

Systems integration is not the only way to approach development of research facilities; it's just the clearest pathway to success, given the complex nature of the site.

Simple facilities can be developed with a brute force approach: identify the minimum requirements to achieve the building's purpose, design it, bid it, build it by making adjustments on the fly, and declare it open for business.

Research and development labs are not simple facilities.

A shoot-from-the-hip strategy's likelihood of success is directly correlated to the size and complexity of the project. The bigger, broader, more intricate and more operationally demanding a facility is, the longer, more expensive and less successful a brute force approach is likely to be.

Systems integration considers all the variables ahead of time. It looks ahead to how workflows will move through the building, preventing costly operational delays driven by poor layouts. It more precisely anticipates the needs of the equipment that will perform the work and avoids issues like discovering on move-in day that a room doesn't have the power supply capacity or environmental control tolerance the intended testing use cases require.

Delivering operationally ready facilities

Systems integration doesn't start at the groundbreaking. To ensure a facility is operationally ready on time and on budget, **systems integration begins at the drawing board**, before any final design decisions have been made.

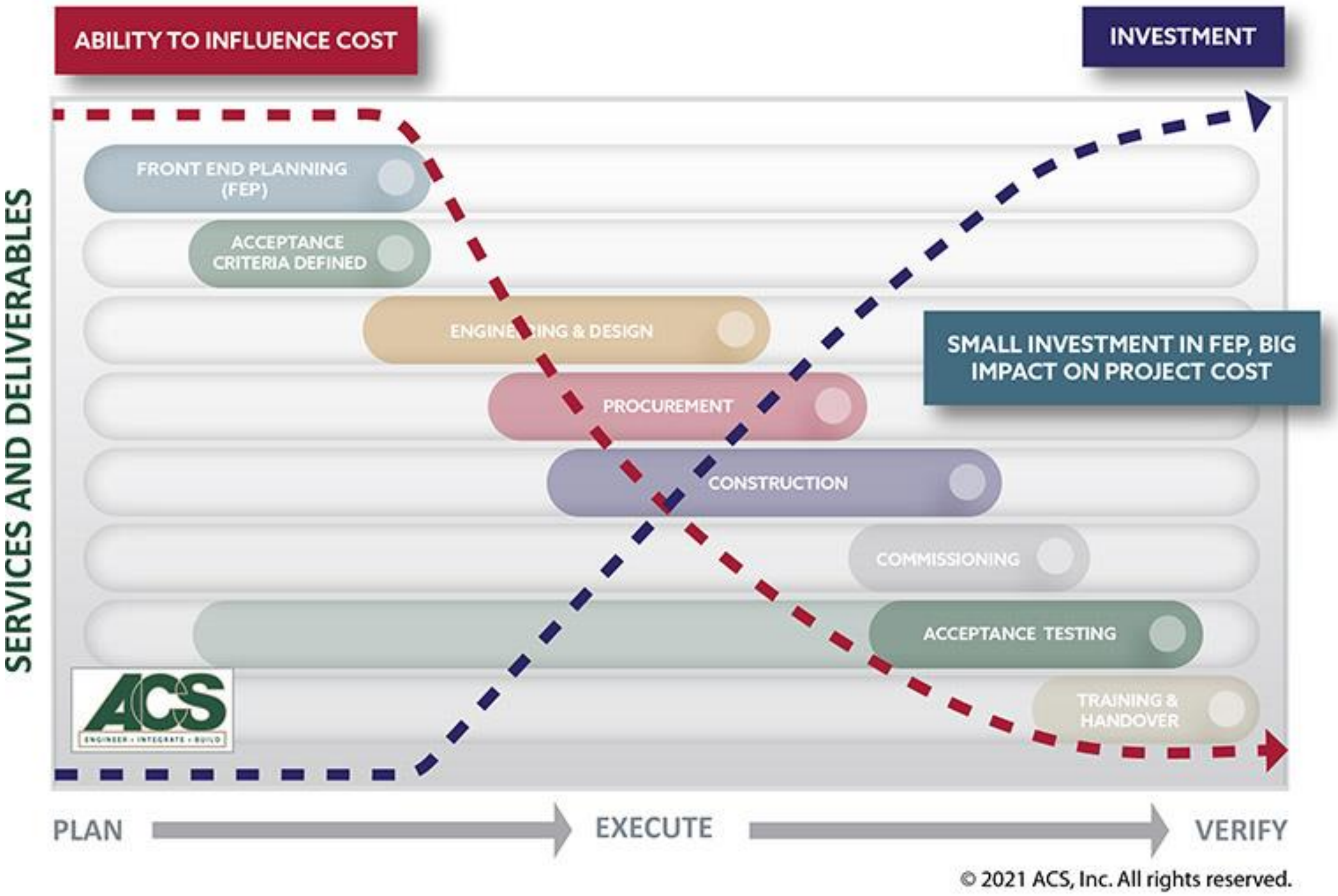
It starts by considering the desired outcomes. What will this facility need to do? In the case of R&D, especially, it's also important to think about what will be required of the facility in the future. By its very nature, research and development will have evolving needs. Accordingly, futureproofing multi-million-dollar investments begins with identifying those needs from the start.

An "inside out" approach to systems integration begins by asking, "what do you want your facility to do?" Requirements of your process, whether that is prototype development, R&D test, or manufacturing & production, drive the facility design.

Systems integration then works backward, considering every element it will take for this structure to get the job done. Research facilities are multilayered and complex. The building, the tools, and the people who work there are all parts of a machine working toward a specific outcome. **Systems integration takes a holistic view** of each discrete element and how it connects to the others to deliver the most efficient result.

Outlining this complex web of connections before shovels break ground is the most efficient way to bring in development projects on time and on budget. A cost-influence curve is a graphic representation of the folly of a shoot-from-the-hip strategy.

The curve shows that early in the project, when changes to layout and functionality are simply about lines on a blueprint or numbers in an equation, it's both inexpensive and easy to influence the final project. Once construction begins, it becomes harder and more costly to change direction or make corrections. The closer a project comes to completion, the more expensive and less influential each change to the original plan becomes.



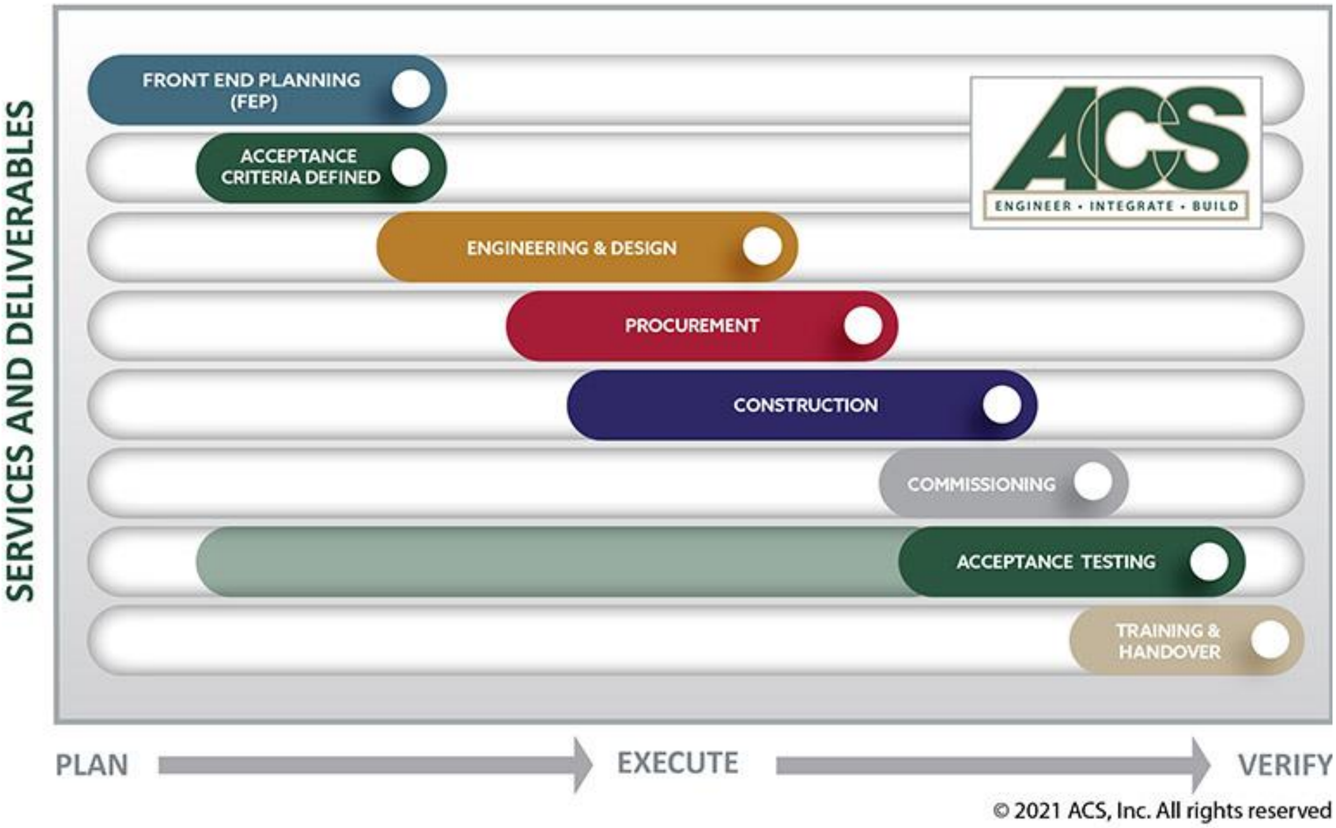
The ability to influence project costs is greatest during planning. Key decisions made early, through an integrated approach, greatly influence the success of the project. Design and construction can be sequenced, and long lead time equipment can be procured early to accelerate project completion.

Consider the case of an agriculture equipment supplier considering lab upgrades to allow for more efficient development of a larger product platform. They understood that their dynamometer needed to be larger and that improved environmental control would allow for more efficient year-round testing. Two potential facility locations were considered: one had some electrical and airflow constraints and the other had more space to right-size the systems. Initially, the answer seemed intuitive. But after considering the details of the required environmental conditions relative to what was currently achievable; looking in depth at the facility power, cooling water and available space; and performing a computational fluid dynamics analysis under various planned testing scenarios, the ROI and business case changed to favor the more physically constrained site.

Plan, execute, verify

Once funding for a new research facility has been released, it’s common and understandable for stakeholders to begin chomping at the bit to get started. When this occurs, the planning phase is often rushed and incomplete, despite its importance to the success of the final project.

A systems integration approach slows down the planning phase, which can be frustrating to stakeholders who want to see progress. But taking time at the beginning of the project pays off in the execution and verification stages, which typically run faster and smoother on a solid foundation achieved through thorough planning.



Ensure your integrated production facility or technical center functions at the highest level possible.

Because systems integration looks at the project from all angles, it considers the vision for the building, its ability to evolve as needs change, and the constraints of environment, equipment, and personnel. Many projects run into snags because certain stakeholders are brought in too late. Imagine waiting until a lab has been built and equipped **before bringing in safety personnel** and learning the equipment poses a risk in its current configuration. Or just consider the implications of constructing the building's shell before consulting environmental engineers and learning the ductwork will need to be rerouted to accommodate a cold room.

The holistic nature of the systems integration approach gathers input from all these stakeholders while the facility exists only as a digital drawing. As the cost-influence curve shows, changing direction at this stage is easier and doesn't result in wasted labor, wasted or missing material and ultimately higher costs.

Once the plan is complete, the next step in the systems integration approach is execution. This is where the work gets done, and it's the favorite step of most engineers. There is a certain satisfaction in seeing the completion of tangible products. But skipping to this step too early is disastrous for ROI. Once time and money have been invested in following a certain design, changing direction creates a conundrum. Either the company tears apart the completed work and starts again — destroying the budget — or it compromises on the efficient pursuit of outcomes. Eagerness to break ground or cut the ribbon is simply never a good enough reason to risk the future outcomes or effectiveness of the new facility.

It is unfortunate when R&D facility projects fail to achieve their goals, especially projects of scale, but they also provide an opportunity to learn. We worked with a large automotive OEM that undertook a substantial project to build a new NVH test center. Despite having a systems integration role specifically to support the design, construction and commissioning of the complex facility, the role was not positioned properly nor with the optimal influence to prevent the core and shell construction from proceeding while the test equipment specification and design were in flux. This situation led to serious budget shortfalls. Due to the approach, the program could not be sufficiently adjusted to rein in the overall cost because investment was already made on both equipment and construction. In the end, substantial cancellation charges were paid and the building was only partially completed with no short-term use. From this we see that even with intention when it comes to systems integration, the execution can be difficult.

Once the masons and mechanics have left the site and execution is complete, a company could be forgiven for thinking the project is coasting into completion. But execution is not the hardest part of building an R&D facility. The final step, validation, is where the rubber meets the road.

The systems integration approach ensured the project was designed and built with specific outcomes in mind. Before it can be declared operationally ready, the facility must be tested to make sure those outcomes are met.

When systems integration is not considered throughout the project, validation can be a nightmare. This is the time when many companies discover problems with how equipment interacts with the environment or how work flows through the space. Correcting issues at this stage delays operational readiness and often compromises the original vision.

The extra time and care systems integration takes in the planning stage usually means validation runs smoothly, and at the very least expectations are appropriate and aligned. Any areas that don't perform as expected can typically be corrected with minor interventions.

Especially in the fast-paced and high-stakes environment of production validation test, we see the fruits of successful systems integration. A large industrial engine OEM undertook an extensive project to design and build an end-of-line validation test cell as part of a complete transformation of a mining truck axle plant to manufacture locomotive and marine engines. A systems integration approach allowed the project to consider several different scenarios, including multiple test cells and the incorporation of newer engines both larger and smaller than originally specified. With the site and configuration selected, the design was executed and built in parallel with the assembly line. As planned early in the process, the validation testing verified the hardware and software system operations through a series of production test procedures. While there were some minor system adjustments made, the test cell went online as planned and continues to support the manufacturing requirements today.

The shortest path to operational readiness

No company that has just spent months and millions developing a new research facility wants to spend the first few weeks making major adjustments and re-working the space for use. As soon as the facility is turned over from the contractor, it should be **ready to begin operations** and start making a return on the organization's investment.

At the same time, it's rare that a completed facility looks just like its original plan. A lot can happen between budgeting for new construction and handing over the keys, and it may have nothing to do with the facility itself. The industry may take a drastic turn, affecting research needs. The business may shift its focus, changing long-term product development goals. Any number of changes can impact the output the company will require its new facility to provide.

These changes are best handled with a systems integration approach. On the whole, systems integration's ability to focus on the big picture without losing sight of the small details goes hand-in-hand with optimal internal communication and allows teams to be nimbler in the face of changing requirements. This model, which works from the inside-out, allows them to deliver an operationally ready facility faster and cheaper than if they had taken a traditional "outside-in" approach.

About the Author

*Matt Thiel is director of Facility Planning and Integration and a Principal at **ACS**. ACS engineers, integrates, and builds technically complex equipment, controls and facilities for companies in markets including automotive, aerospace, energy, chemical, manufacturing and more. ACS specializes in control systems, custom machines, testing solutions, automation and production systems, as well as the design and construction of integrated facilities.*