



FRONT END ENGINEERING DESIGN CAPABILITIES

Align Your Automation Plan to Your Business Objectives

Is your project aligned with your business objectives?

Do you have a well-defined scope for lowering the cost of your project?

Is faster implementation and quicker start-up critical to your company's success?

How will you identify and mitigate project risks?

Whether it's a large, complex greenfield project or just adding a few upgrades, the key to success is proper planning—understanding your current environment, recognizing advantages in the latest technologies, and how best to integrate

them into a plan that meets your business objectives. A trusted advisor can help you build your plan. Emerson strives to earn that role in ensuring a successful turnkey solution that includes front end engineering design (FEED), equipment selection, commissioning services, and implementation and operational capabilities.

The first step to success is pre-project planning through a FEED study. This study is the early design work done after conceptual business planning and prior to detailed design. Critical to successful project execution, it identifies and mitigates project risks, thus lowering cost and reducing time to completion.

In undertaking a FEED study, Emerson will align your project and business objectives

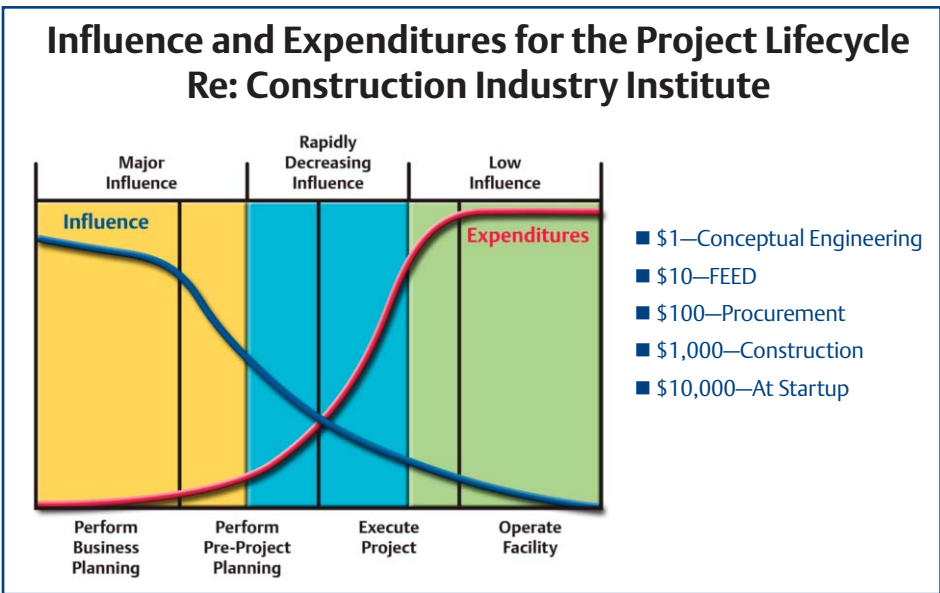
while creating a detailed project foundation. Emerson will combine industry expertise, process engineering and project management with our proven perceptive technology to deliver the return on investment (ROI) you expect from your project.

Containing cost and reducing startup time

Do you know the effect of late changes on your project's cost? Get it right from the beginning, and you can keep your project costs in check. Every dollar spent making a decision is multiplied by an order of magnitude if the decision is delayed until the next phase of the project. Spending a few extra dollars up front will yield significant savings to the cost of your project.

Successful impact of a FEED study

FEED is the process of developing sufficient strategic information with which you can assess risk and calculate resource commitment to maximize the chance for project success¹. The goal of a FEED study is to define the scope of work for a project in order to meet both your expectations and the project requirements in terms of factors such as budget, time, quality, and safety. This phase of project development is so critical; the Construction Industry Institute (CII) identifies FEED as one of its best practices for successful project execution². Regardless of how you define FEED and the goals of the study, few will



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dispute the value this effort will add to the project. By performing a FEED study you will realize benefits throughout the project including:

Faster implementation

The sooner you can start up the project, the sooner you will begin realizing the cost benefits of the improvements. Early identification of potential problem areas and/or necessary changes allows for early resolution, resulting in less impact to the project. Faster implementation and improved project performance are key benefits to performing a FEED study, with cost reductions of up to 30%.³

Identified and minimized project risk

With project staff alignment, business drivers and constraints defined, the project risks are identified and minimized. Business management can proceed with full disclosure of opportunities to mitigate risk and/or project alternatives.

Greater user involvement and management support

Studies show that projects lacking user involvement perform poorly, and that early planning, project definition and goal setting are major factors in gaining user involvement and management support. These

Proven FEED Work Process



factors greatly increase the opportunity for a successful process automation project.⁴

Better project performance

According to a Construction Industry Institute study of 53 large projects⁵, the group of projects that spent the most effort on pre-project planning (another term used for FEED study) averaged:

- 20% lower costs
- 39% schedule reduction
- 15% utilization/capacity increase when compared to the group that spent the least effort on pre-project planning.

Delivering a plan with a proven FEED work process

Emerson's proven FEED work process is built upon the recommended best practices of authorities such as Construction Industry Institute, Project Management Institute (PMI), and Independent Project Analysis (IPA) methodologies.

FEED Planning

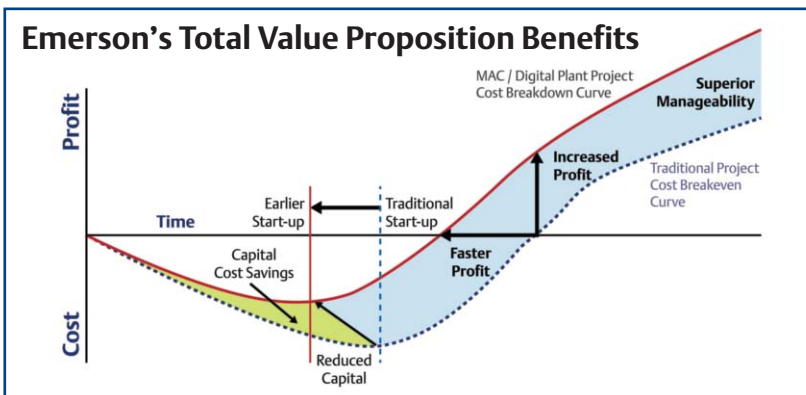
One of the first steps to executing a successful project is to have good communication to identify not only the project objectives, but also the business objectives. Emerson assists with the development of the FEED team to ensure all key stakeholders contribute to and align themselves with the project objectives. Constraints for timing and budget are also reviewed and aligned during identification of the project premise and scope.

Data gathering

For a project in an existing facility, data can be collected in the field using tools compatible with industry-standard project engineering and database software. This compatibility helps to expedite checkout while accurately benchmarking and documenting the existing equipment and installation. The analysis of this data will result in documentation which is verified to minimize risk of unforeseen events related to the project.

Basis for design

From detailed design, construction and commissioning to the completion of each successful startup, our years of experience help you attain the best solution to meet all appropriate standards and codes. Together, we can evaluate project alternatives to meet process and business objectives, while reducing cost and tightening schedules.





Communication and alignment throughout the project are important to ensure the design and deliverables match your project expectations. Emerson can include third parties such as installation contractors to ensure that the design encompasses the complete scope. This minimizes expensive field change orders later in the project.

FEED estimate

The FEED process typically narrows the cost and benefit estimate down to +/- 10% of the overall cost of the project, and identifies the risks and issues that support this estimate.

The estimate includes:

- Detailed functional scope of the engineering and design
- Detailed project execution plan
- Detailed procurement plan

Final document

The final FEED document is the definitive technical and business project summary including all FEED deliverable documents to be used by your organization and your project team. These documents include:

Project Scope Definition

The project scope definition is based on aligning your needs with a plan that includes the engineering and design work. Typical deliverables include:

- Master project schedule
- Project Execution Plan
- Budget plan
- Alternative analysis report
- Functional design specifications
- Engineering drawings approved for design
- Required bill of materials
- Required resource allocation plan

Project Execution Plan

The project execution plan addresses project resources, migration plans, and required purchases. By understanding these factors, contingency funds needed for a project can be significantly reduced due to increased accuracy of the budget estimate.

Economic Justification

The FEED definition often includes the required economic justification in both investment requirements and the expected process and business-related returns. An ROI calculation can be determined as part of a FEED study to ensure that the project clears the required financial hurdles.

Industry and technology expertise ensures project results

Emerson provides a wide range of expertise to meet the demands of your project, including some of the process automation industry's most experienced engineers and designers. Emerson's experts have proven hands-on experience and a track record of solving complex problems across all process industries.

You get a single point of accountability for your instrument and automation system project. Our automation expertise ensures that your project is technically sound, safe, timely, and that it derives the most benefit from today's digital technologies.

Our smart field instrumentation technology leadership means you get skilled and experienced engineers to help you design efficient new facilities as well as analyze and improve your existing operations. In performing the FEED

study, Emerson will ensure the plan has components including:

Project management plan

- Project managers with the training and experience to deliver consistent results
- Global best practices with an organized, structured approach
- Budgeting, schedule control, procurement, quality and requirements management

“One of the major reasons for the success was due to the excellent frontend engineering... The frontend package generated by Emerson and a small team from Solutia allowed us to develop plans and stick to them.”

Greg Kanteres

Project Manager, Solutia

Process automation engineering design

- Automation contractor experience on small to very large projects
- DCS design, configuration, migration and connectivity to legacy systems
- Engineer control buildings, modular process skids and analyzer housings
- Design and implementation of embedded advanced control functionality

Instrumentation and electrical design

- Smart field instrumentation installation, commissioning and start-up
- Supplemental electrical engineering related to automation projects



- Supplemental mechanical and structural engineering related to automation projects
- Supplemental design, construction, and commissioning of piping related to automation projects

Safety instrument system engineering design

- IEC 61511 certified FEED work processes for safety systems
- IEC 61511 certified engineering, installation, and commissioning of safety instrumented systems

Power engineering

- Complete power system engineering from the utility source to the process equipment
- Design of emergency/backup power systems for critical equipment
- Arc flash hazard assessments to complement your facility's safe work practices

Process engineering

- Process knowledge and experience to meet performance and reliability objectives
- Process definition and analysis
- Process descriptions and flow diagrams
- P&ID development

Working together in planning for success

Emerson will work with all of your key stakeholders to ensure your project is aligned with your business objectives, that project risks are identified early in the project and plans are in place to mitigate those challenges. Emerson's capabilities and experience are especially valuable when time is at a premium. By collaborating with a trusted advisor like Emerson, you can be assured a well-defined project scope is prepared that will lower the cost of your project allowing for faster implementation and quicker start-up—thus realizing profitability sooner.

From full main automation contractor (MAC) scope, to main instrument vendor (MIV), to supply of the automation system and configuration services, Emerson can help.

“For the validation project, the front-end work performed by Emerson was quite important as we needed to have accurate cost estimates. It is the ultimate goal of every project.”

John Wilson

Project Manager, Dow AgroSciences

How to get started now

Contact your local Emerson sales office to retain this service. Prior to order acceptance, Emerson will issue a written proposal for your review and approval to ensure that scope, deliverables, timing, and budget meet your needs and expectations.

¹Construction Industry Institute (CII). (1995). "Pre-project planning handbook." Publication No. 39-2, Construction Industry Institute, Austin, Tex.

²Construction Industry Institute (CII). (2007). "CII best practices." (http://www.construction-institute.org/scriptcontent/bp.cfm?section_Order) (February 14, 2007)

³Hwang, Bon-Gang and Ho, Jia Wei (2012). "Front-End Planning Implementation in Singapore: Status, Importance, and Impact" *Journal of Construction Engineering and Management*, 138(4), 567

⁴(2010) CHAOS MANIFESTO: The Laws of CHAOS and the CHAOS 100 Best PM Practices, The Standish Group

⁵Gibson, G. E., and Hamilton, M. H. (1994). "Analysis of pre-project planning effort and success variables for capital facility projects." Rep. SD-105, Construction Industry Institute, Univ. of Texas at Austin, Austin, TX.

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