Avoiding Project Failures

Recognize these key project-failures modes, so that corrective action can be taken

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Companies in the chemical process industries (CPI) spend billions of dollars every year on capital projects. Most are successful, yielding the desired results. Some projects are only partially successful (and therefore partial failures), in that they are ultimately completed and work as desired, but only after a budget or a schedule overrun. And some projects fail completely, sometimes spectacularly, never providing the desired results. This article discusses some of the key reasons for project failures. The intent is to assist the reader in recognizing some of the failure modes, so that corrective action can be taken and project failure - even partial failure - can be avoided. The article assumes some basic knowledge of capital projects and is intended for the novice project manager or capital manager. Project professionals will recognize many of these failure modes, and could probably contribute many more.

The three basic components of a project, the so-called "iron triangle" of projects, are scope (what is supposed to be provided by the project; for ex-ample what is to be built), budget (how much it is supposed to cost) and schedule (how long it is supposed to take) [1]. Several of the failure modes, as might be expected, involve these three items. There are, however, also other ways that projects can fail. Some of these involve "softer" issues, such as human factors.

Poorly scoped project

Most project professionals would probably agree that the leading cause of project failure is a poorly scoped project. As mentioned above, the scope of a project is what it is supposed to provide. In the case of a CPI project, in its most simple form, the scope is the equipment that is to be installed. While this sounds pretty simple, one would be surprises how often projects are initiated without a clear idea of what the scope is.

Note that scope is different from objective. The objective may be to produce 100,000 tons/yr of a certain product with a certain specification. Often objectives are easier to define than scope, as scope is much more detailed.

Scope gets down to the "nuts and bolts" - exactly how are we going to produce that 100,000 tons/yr [2]? Every project should have a clearly written scope that defines what the project is providing and sometimes states what it is not providing. Not doing so almost guarantees a partial project failure in term of budget and schedule – as the project team tries to figure out what it is relly trying to do, or has to do in order to meet the overall project objectives – if not a larger failure.

Scope changes

Another failure mode involving project scope is poor scope control. Once the scope of a project in defined and established, scope changes become the enemy. Often, the process engineers on the project will come up with ideas to improve the process. While this may seem like a good thing, it can still be detrimental to the project, as every change has a ripple effect.

For example, say the process change is to change a heat exchanger from a shell-and-tube to an air-cooled fan exchanger. New equipment specifications must be developed, the piping design will have to be modified, the supports and foundations will need to be modified, and now electric power will be required for the motor(s).

If the project is still in the design phase, the only cost is engineering re-work, and there will be an associated schedule delay. But obviously, the later in the project a scope change occurs, the more impact it has in terms of both cost and potential schedule delay. If equipment has been bought, and especially if installation of the equipment has begun, the cost impact increases tremendously. Once the scope of the project is defined, avoid changes like the plague. Improve and optimize the process after the project has been completed.

Poorly budgeted project

Another often-repeated fatal error on projects is artibirarily setting the budget. One might think, “Who would do that? How could that happen?” Well, it usually happens like this: a manager asks a project manager, “How much will this cost?” The project manager goes off and develops a project cost estimate to the best of his or her ability using whatever resources are available and presents it to the manager, who then says, “Well that’s to much. We only have X dollars available, so you'll have to do it for X".

Project costs typically consist of equipment costs (for not only process equipment, but also utility equipment, electrical equipment, instrumentation, control systems and so on), bulk material costs (for example, piping, wiring, concrete and steel), and services costs (such as engineering and construction labor). Within a given market or region, there is only so much variability in those costs. The only way to significantly reduce costs is to reduce scope.

And, if you reduce scope, by definition you are not getting the same project you originally intended. That may be acceptable, but it needs to be well thought through. Every project should have a well-documented budget (based on a well-defined scope) to serve as a basis for cost control. Not doing so almost guarantees a partial failure in terms of a budget overrun.

Poorly planned and scheduled

Another way that projects can fail is to have an inadequately thought-out schedule and plan for execution. Again, sometimes schedules are set arbitrarily: "We must have this by the end of the year," or even better, "We need this ASAP!" ASAP is not a schedule.

Well thought-out project schedule allows time for items such as permitting, safety reviews, detailed design, tie-ins, bidding cycles, equipment de liveries, construction durations and so on. It also needs to be properly sequenced to assure that required tasks are completed before moving on to the next task, and that nothing needs to be "undone" and then "re-done." Every project should have a well-developed, documented schedule. Not doing so almost guarantees a partial project failure in terms of a schedule delay.

New or ill-defined technology

This could also be considered a subset of a poorly scoped project, but the root cause is different. Attempting to implement new technology (such as a new process) is one of the highest-risk types of projects. Due to scaleup issues, these types of projects are even more risky if a typical step in the development of a process (for example from laboratory to pilot plant to semi-works to full-scale production plant) is skipped. Scaleup can be tricky business. Sometimes things don't behave the same in a plant as they did in the laboratory.

À project that implements new technology requires even more diligence a I and attention than some other types of projects. While the rush to market may provide additional schedule pressures, it is advisable to have additional time built into the schedule for commissioning and startup for these types of projects. It is also advisable to have additional budget contingencies for unforeseen issues. New technology and scaleup projects are probably the most likely candidates for a total project failure.

The most spectacular project failure I have ever witnessed (fortunately not as a direct participant) involved a chemical company that wanted to build a production-scale unit of an R&D process to make a new product for one of its major customers. The process was not very well developed, but the project proceeded. An engineering firm was hired, detailed design was performed, equipment was bought, construction contracts were awarded and a plant was built.

The project was budgeted at around \$20 million. When construction was completed and startup began, numerous problems were encountered, such as plugging and corrosion issues that limited operations to short runs before shutdowns were required for cleaning and repairs. After months of delays and another nearly \$20 million of capital investment, the company finally pulled the plug on the project. The process never ran successfully. It was the most complete project failure I have ever witnessed. I think this could have been prevented by taking the typical scaleup steps mentioned above, instead of trying to go from laboratory to production scale in one step. But that could have taken a couple of years and the company was not willing to do that.

Poorly selected manager

The key person on any project is the project manager. Although the project manager does not have to know everything, he or she must "know what they don't know." Even an inexperienced project manager will likely succeed if he or she has a support network of project management and subject matter (such as process engineering) experts that they can call upon. But an inexperienced project manager with no support system will likely fail.

Another consideration for assigning a project manager is compatibility. When you get right down to it, projects are accomplished by people who must work together as a team. That doesn't mean that they all have to be best friends, but if there are compatibility, personality, communications or similar issues between the project manager and the internal or external project-team members, this puts the project at risk. One of my favorite articles about projects is called Keep Attila the Hun off of Your Project [3]. As the title implies, you don't want that type of person on your project team – you nedd the team players.

Inadequate project support

Projects require resources, mostly human, but of other types as well. One of the biggest mistakes companies can make is not committing the necessary resources to a project. Assigning a project manager is only the start. Other resources, such as process engineers, plant liaison people (for example, for electrical and controls interfaces), operations and maintenance people, procurement people and so on, may be required - even if only on a parttime basis - to provide input and assistance for the project to be successful.

While an engineering firm is often engaged to provide project support [4], there are some things that you cannot assign or contract to third parties. If corporate or plant management persons do not make a commitment of these resources, it will put the project in jeopardy. And, providing input late can sometimes be as bad as not getting it at all – see scope change above.

Poor stakeholder consideration

The Project Management Institute (PMI; Newtown Square, Penn.; www.pmi.org) defines a project stakeholder (paraphrasing) as anyone involved with or affected by the project [1]. So obviously, the project team members are stakeholders, as is the "customer, meaning for example, the business unit for whom the project is being built. But there are also other stake-holders, such as the unit operators, the maintenance personnel, and even people outside the fence line, such as neighbors and community members.

In the case of large, grassroots plants, these external stakeholders can be key to even allowing a project to be built (you have probably heard of "NIMBY" - not in my back yard). So careful consideration of all project stakeholders is critical, or the project may fail before it even gets started

Inadequate communication

The PMI says that 90% of a project manager's time is spent on communication [1]. This includes communicating goals, objectives, plans and directions to team members, communicating progress and status to management; communicating with outside entities such as vendors and contractors and more.

Communications can be so complicated that a communications matrix can be set up to establish the required communications channels and assure that nothing is missed. A sure-fire way for a project to fail in by a lack of communication. If the project team is not sure of its goals or direction, if management is not aware of the status of the project, or if outside entities are not aware of their responsibilities, you can be assured that you will have at least a partial failure in terms of scope, schedule or budget.

Inadequate risk management

Every project involves risk. The PMI defines risk as an uncertain event or condition that, if it occurs, has a positive or negative effect on a project's objectives [1]. At the beginning of every project, a risk management exercise should be done to identify potential risks and put together plans on how these risks would be handled.

For example, say your project involves a pressure vessel to be fabricated from an exotic alloy that is experiencing wild price fluctuations and limited availability. It is not known what the price or delivery time will be at the time the order for the vessel will be placed. Your project – risk – management plan should address these risks in terms of budget and schedule contingency, and perhaps include approaches such as alternative suppliers and alternative materials of construction. On larger projects, formal risk-management plans are a good idea (actually a requirement in many companies), but even on smaller projects a risk management plan is a good idea. Failure to consider risks could easily lead to a partial project failure in terms of schedule and/or budget.

Poorly chosen engineering firm

As mentioned earlier, an engineering firm is often engaged to provide the necessary resources for detailed design, including drawings and specifications needed for buying equipment and getting the project build. I suggest engineering firms be evaluated on five Cs: capability, competency, capacity, commitment and compatibility.

Capability involves technical capabilities. Consider if the firm has all of the necessary skill sets that you need for the project (such as process, piping, instrumentation, electrical, civil, structural, architectural and other areas of expertise).

Competency is harder to judge, but can often be assessed by checking references.

Capacity is essentially "do they have enough of the right kinds of people to execute the project?"

Commitment is the firm's willingness to assign the right people, and right numbers of people, to the project and work with you through any obstacles that might be encountered, toward a successful completion.

And compatibility is often the key: is the firm the right size, is it organizationally compatible, does it seem to share the project team's values, does it understand the project objectives, is it a good fit for the project? Obviously the answers to these questions can be pretty subjective, and these issues can begin to be assessed in meetings with the firm.

One of the worst things that can happen is for an adversarial relationship to develop with the engineering firm. While this may not cause the project to fail, it is guaranteed to make the project a miserable experience. And remember, if you must bid engineering services, the low bidder is not always the best choice [5].

Poorly chosen contractor(s)

Likewise, as with engineering firms, the same "C" questions should be asked of potential construction contractors. In my experience, if you have pre-qualified the construction contractors based on the five Cs, and done a good job of developing construction bid packages in detailed design, lumpsum competitive bidding is still an appropriate way to select a construction contractor.

However, the five Cs should still be evaluated and the low bidder may not be the best choice.

The selection of construction contractors can make or break a project. Contractors who do not have adequate resources, are not committing the needed resources, or are more interested in generating change orders than in building the project, almost certainly guarantee partial failure in terms of schedule and budget.

Final thoughts

Large operating companies and engineering and construction (E&C) firms have processes and procedures in place to prevent many of these failures from happening. The front-end loading (FEL) process that many companies employ is designed to prevent many of the scope, budget and schedule problems fronts occurring. They emphasize up-front planning and require approvals at various "stage gates" to confirm that the appropriate scope, budget, and schedule development has occurred. If your organization does not have these processes and procedures for executing projects, hopefully you will be able to recognize some of the warning signs, raise a flag and get some help.

It is often the "softer," people issues that are harder to immediately identify and harder to rectify, but these will cause project failure just as surely as any other issue. Be on the lookout for them, and be prepared to deal with them if you must.

There are many organizations available that provide resources and information on managing and executing projects (see box). There are also many consultants available to assist with projects.

Successful capital projects are a key to the overall success of companies in the CPI. If you and/or your organization are inexperienced in executing projects, hopefully this article will help you recognize some of the potential ways in which projects can go astray, so that corrective action can be taken, and failure - even partial failure - can be avoided.

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