Successful Program Delivery Starts Long Before the Program Does – Part 1

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Abstract

Multiple independent research efforts are beginning to show a more consistent approach to developing successful mega-projects in the areas of oil/gas, mining, major infrastructure, and construction projects than has been used in the past. These mega-projects are characterized by high value (often defined as greater than US 1$ billion), comparably high benefits, years-long time-lines, and correspondingly high risk. While there have been great advances in both project management methodologies and in the tools the project managers have available (such as CAD/CAM, BIM, and advanced project scheduling and budgeting tools), the complexity of these multi-year programs has advanced even more quickly than the tools have. Construction and large engineering projects (called LEPs by Miller and Lessard) have become more complex and ambitious faster than our ability to manage them. These "mega-projects" now are much longer in duration and far more complex than even ten years ago, with concomitant increased risks and failures. Projects costing tens of billions of dollars are no longer rare. The International Energy Agency estimates that meeting global energy needs will require investing more than $17 trillion by 2030 (van der Veer).

> *"Costs are becoming too high," Christophe de Margerie, CEO of Paris-based Total, said Friday in an interview from Switzerland. "Projects of $50 billion leave one thinking 'Isn't it crazy?' "* (Margerie)

This paper examines the common approaches identified by both academics and real life approaches by private industry. It then expands on both the theory and practice to develop a more effective way to approach the early management of these projects. It suggests starting each new megaproject the way you would start up a new business, and developing a strategic planning document to guide the stages of the project, from the early study/feasibility stages through engineering/ architecting and through construction/commissioning.

The emphasis of the approach is on effectiveness, not on efficiency. We can be truly efficient only if we can perfectly predict the future. Since we cannot do that, we must build adaptability into the process, flexibility, to respond to changes and to unexpected events. To effectively produce these projects we need a different approach than the traditional project management approach than has been promulgated by professional organizations for smaller, less complex projects. This approach begins long before the traditional project management approaches and extends into the early operations stages.

In Part 1 of this series of three articles we will look at some of the problems faced by large complex projects. We will discuss the critical emphasis on the external environment on making these projects successful or not, and we will look at the normal approach commonly used more successfully on simpler projects.

In part 2 of this series we follow up on the discussion of part 1 by examining the current approaches to these mega-projects being used by both private industry and by the academic community. We then review two common assessment approaches to determining the thoroughness of the planning and execution stages of the projects.

The final paper in this series follows parts 1 and 2 by proposing new approaches to developing these complex projects. The emphasis is on treating these projects not as projects, but as starting a new business. We will also examine changes in the risk management, stakeholder management, and the procurement process to make these projects more successful.

1. Introduction, Terminology, and Complexity

The seeds of project success are sown in the very earliest set-up stages of a project, before the engineers ever get involved.

These are not new problems. Research going back into the 1970s and 1980s shows the increasing problems of managing these complex projects. See Merrow (Merrow, McDonwell, and Arguden) for the results of earlier research.

We will begin by looking at the business environment that such large projects exist in. We will then review classical project management approaches that focus on delivering the final product within cost and schedule constraints once we begin the execution phase of the project. We will continue by examining multiple lines of research that shows that the ultimate success of a program has very little dependency on how the program is managed once the construction phase begins, and far greater dependency on what happens before that phase begins. If a $10 billion dollar LNG refinery runs late and over budget, the failure has started long before the project schedule was created or the procurement (EPC) process begun. Efficient construction does not compensate for poor business decisions.

Serious research in this area such as that done by the IMEC Research Program (Miller & Lessard) starting in 1995 and by Bent Flyvbjerg (Flyvbjerg, Bruzelius, et al.) shows that the only part of the effort where traditional project management approaches makes sense in the later stages, the engineering and EPC stages. The earlier stages require a different approach to ensure success. For infrastructure projects the most serious discussions are held with the politicians, not with the engineers or project managers.

We will look at four areas:

1. The business environment

2. Overview current project management practices
3. Current research
4. Development stages for programs

And then provide recommendations based on the findings.

While much of the research in this area has concentrated on high-dollar projects in the oil, gas, and mining industries, with some research on infrastructure projects, the approach developed here is for such projects at this scale in any industry. The government of Qatar has planned US 146 billion dollars of infrastructure improvements. This scale of development is occurring in other places in the Middle East and in other places around the world.

Because of the particular challenges in managing public works infrastructure projects, it is particularly beneficial for large projects involving government interfaces such as major transportation or other infrastructure projects. As an example of an infrastructure projects, the Saline Water Conversion Corporation (SWCC) in Saudi Arabia develops some of the largest desalination plants in the world and distributes fresh water over 5000 kilometers of piping. They are presently converting from managing multiple individual projects to a PMO-based program management approach and improving their processes prior to the EPC phase due to the growth in cost of the Ras Al Khair project from $1.6B to $6.4B with no end in sight.

A Word on Terminology

The terminology used not only varies depending on who you are talking to, but different words sometimes mean the same thing.

PMI's Standard for Program Management (2nd Edition) defines a program as a collection of projects managed in a coordinated way to obtain benefits not available by managing them individually. (Disclaimer: The author was the project lead on this standard for PMI.) Unfortunately the word program is also used in many endeavors where program and project management techniques are not useful, such as government programs to improve schools or to provide food stamps to low income residents. While this is a reasonable definition, it does not begin to address the difficult challenges in managing these efforts.

For terminology, current practice uses the word project to cover both projects and programs (in German the word projekt is used for both) with the specific meaning provided by context. We will follow common practice and use the word project for both projects and programs with the understanding that we are for the most part technically talking about programs.

There is often a confusion in the literature about the proper terminology regarding projects. Should projects be divided into phases or stages? For this discussion, we will utilize the term phases for the phases of a specific project and stages for the divisions of a program.

Definition of Success

Let us begin by defining what we mean by success. Why define success? Isn't it obvious that a project is successful when it delivers on time, within budget, meeting all the specified requirements? But how about an 8 year long oil refinery that is a month late? That should still be considered successful from a project management standpoint. What about a US $2 billion desalination plant that costs $2.1 billion? That should still be considered successful.

We will define a successful project as one that satisfies the business benefits it was designed for. If a six month long IT project is a little late and a little over budget, that's probably acceptable. In six months the business needs don't change very much (usually). But in a years-long engineering project the external environment can change dramatically, completely changing the initial business parameters the project was designed to satisfy. It's these decisions made at the very beginning, before engineers and project managers ever got involved, that can have a dramatic effect on success. Now we are outside the realm of project management and we're getting the business involved in the success of a project.

Complexity

One major driving factor into understanding the decision environment is that these projects are highly complex. Complexity is more than just being complicated. Complexity includes multiple and changing relationships among themselves complicated theatres. Complexity is driving by the following factors:

- Technical complexity – How difficult and challenging the technology is as well as how rapidly the technology is changing.
- Time scale – very long projects are subject to larger swings in the overall economic environment.
- Financial complexity – projects of these size are rarely financed by a single entity (exceptions are some government-funded infrastructure projects). In the vast majority they create a financial consortium to share the risk and financers have different motivations and timescales than the owners or contractors do.
- Project team – number of contractors working on the project from multiple countries and cultures.
- Client/Customer – significant complexity can be added by the owners by changing scope after the work has started.
- Regulatory complexity – particularly when governments manipulate regulatory approvals in order to gain more concessions or money from the owners.
- Dynamic complexity – changes in multiple areas during the lifetime of the project including changes in the economic environment, political environment, regulatory environment, and technology.

All of these factors contribute to the complexity of planning and managing megaprojects. The most uncertain decisions, those made long before, often years before, any design or technical work is done face the greatest amount of complexity. A graphic by FIATECH (FIATECH) shows the complex relationships among many of the entities involved:

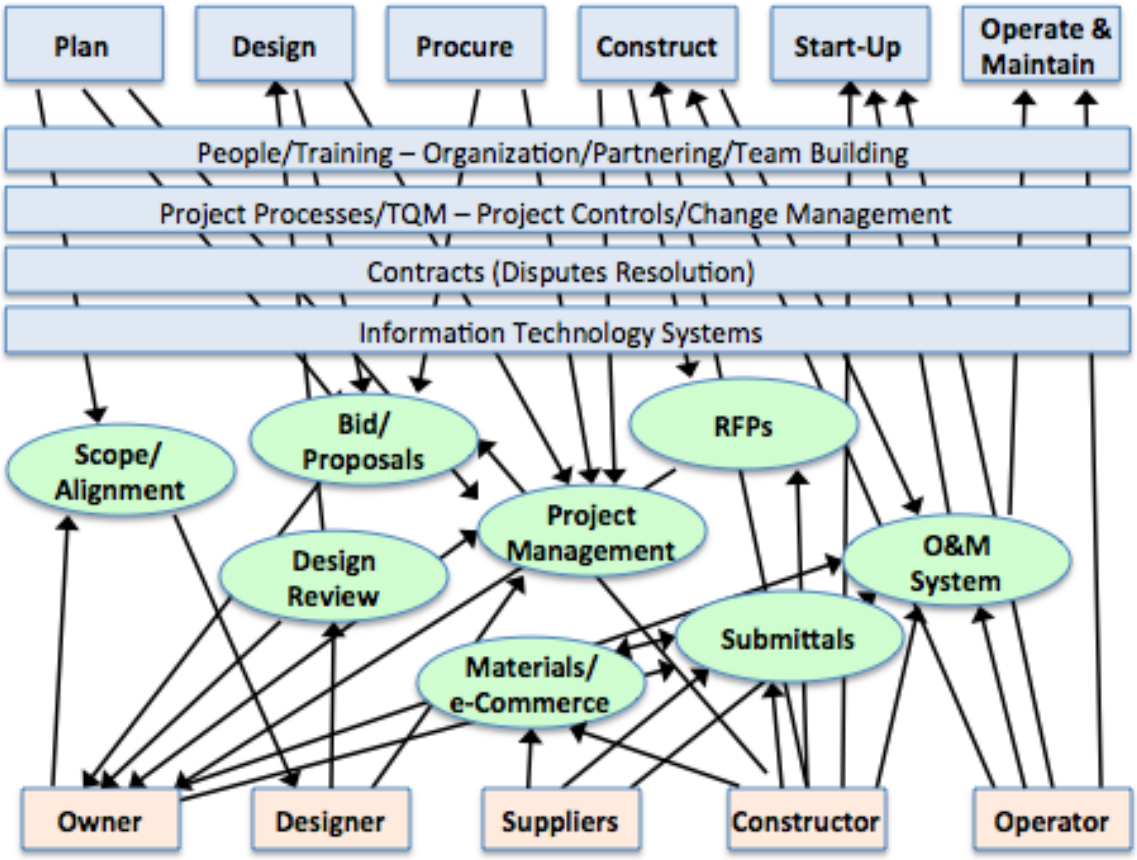


Figure 1: Complexity of Decision Process

Even seemingly unimportant decisions or over-looked external influences can have an impact on successful completion. For an extreme example, look to the newest city in South Korea, Songdo. The Los Angeles Times reported (Los Angeles Times) that

> "*This city on the Yellow Sea seems to have it all: Gleaming skyscrapers, broad avenues, serene parks and new apartment buildings a short walk from restaurants, shopping, schools and public transportation just 20 minutes from the country's main airport,* Incheon International.
>
> *Songdo though is short on at least one thing: people. A work in progress, the city isn't scheduled to be completed until at least 2020. But it now has about 100,000 residents, or about half of what it is designed to hold. More significantly, developers say there are just 70,000 daily commuters, well short of the 300,000 they envision.*

> *But Songdo's biggest problem may be that it is too far from the capital, the country's undisputed economic, political and cultural center. It takes well over an hour by bus or subway to reach most neighborhoods there — too far to commute, but too close to compete. "*

The World Bank and others have a term that describes these much greater uncertainties faced by the business: VUCA – Volatility, Uncertainty, Complexity and Ambiguity. Project manager's careers have been made and broken over poor decisions made long before the actual start of the project.

To a systems engineer, the types of endeavors we are discussing here are not only systems, they are systems of systems (SoS). Large and complex entities with multiple parts, each of which itself is complex. The complexity makes them inherently impossible to fully understand or to manage effectively. Systems engineers take a holistic view to the entities they work with, analyzing and managing the entire entity rather than an individual piece of it. A systems engineer would look at the entire oil processing plant and try to integrate each piece and to optimize the operations rather than concentrating on a single part of it as the design engineers and construction contractors do.

To some extent this broad viewpoint is taken when developing the Front End Engineering Design (FEED) for complex engineering projects. Unfortunately the systems engineering approach works extremely well for the technological part of these efforts, but not for the political, financial, and other non-technology-related areas.

2. The Business and Political Environment

If I'm building a small office complex that is 6-12 months in development, I have some assurance that the economic environment will stay reasonably stable. There are notable exceptions to this, but in the long run I can make reasonable business decisions assuming this to be the case. But in a project that is 3, 5, or 8 years long how big an impact does the external environment have? As you might guess, the impact is significant. Even more important is that changes to the economic environment are relatively unpredictable. Even ignoring Black Swan events, long-term business cycles are challenging to predict.

A strong strategic planning process will not attempt to predict a single future environment. It will predict several possible future environments assigning a probability to each. Decisions are then made based on the decision-maker's "most likely" prediction.

As an example, we can look at the historical data for crude oil prices. In 2013 the Economist (Economist) showed the following graphic on the history of oil prices stretching back to 1861, normalized to 2011 prices (original data obtained from BP):

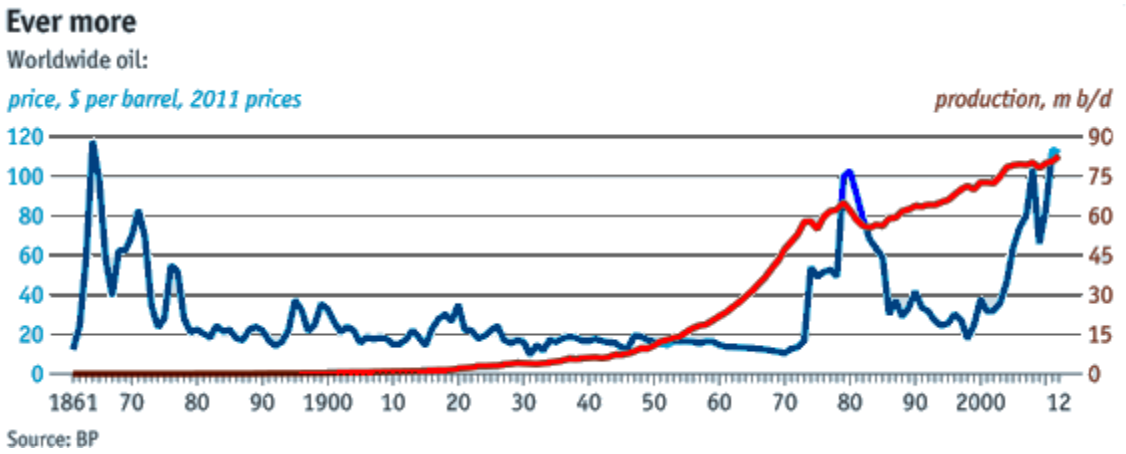


Figure 2: Historical Data on Crude Oil Prices

While for most years prices have been relatively stable, there are a few periods where large swings in prices have significantly impacted projects that were in work at the time the changes occurred.

Let's assume it takes 8 years from the initial decision to develop a new oil or gas refinery to actual start of production (not an unusual amount of time from the first go decision). If the refinery was first approved any year between 1880 and the mid-1960's, classical project management approaches in scheduling and control would have worked fine. But what happens if the initial decision was made at the wrong time?

In 1993 the Indian company Essar decided to build an oil refinery in the Vadinar area of western India despite having no experience building or operating refineries. Due to poor decision-making and lack of experience (the project manager was the son of Essar's chairman and had no experience in oil/gas or in project management) the project took 13 years and cost significantly more than industry benchmarks. However, because the project was started at a low point in the economic cycle and finished at a high point, the refinery was commercially successful despite the management problems.

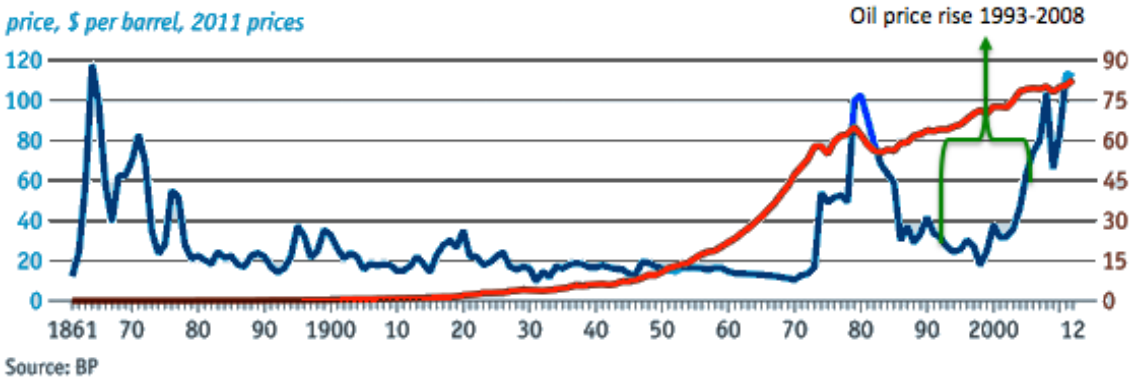
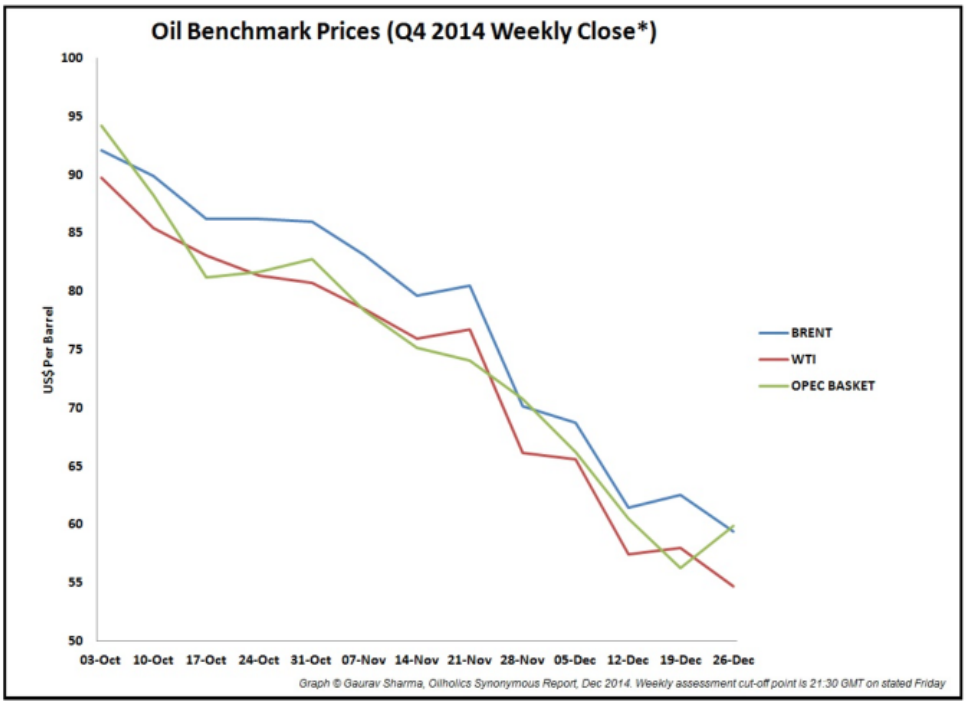


Figure 3: Impact of Starting A Project During An Economic Downturn

While commercially profitable, the project should in no way be considered successful from a project management viewpoint.

More recently, the economic environment has become even more challenging as the price of crude oil drops even further as shown by this figure from the Oilholics Synonymous Report for Q4 2014 (Oilholics Synonymous).



Oil benchmark Friday weekly close prices for Q4 2014 © Oilholics Synonymous Report

Figure 4: 2014 Q4 Oil Prices

Compounding the difficult of predicting the future price of feedstock is predicting the future demand for our final product. The same issue of the Economist show a large variation in the possible future demand depending on our planning assumptions are.

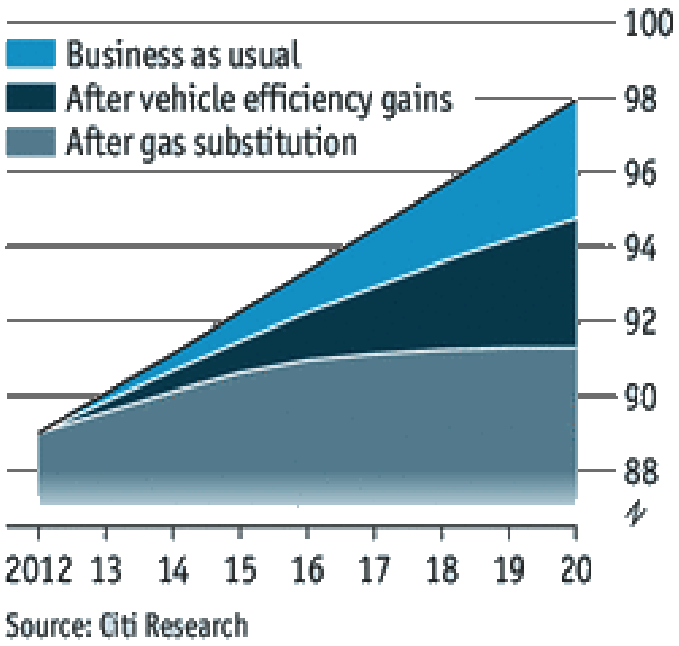


Figure 5: Predicted Global Oil Consumption

Indeed, *"In the USA, gasoline (petrol) needs are forecast to fall to 5 million barrels per day in 2025, down by nearly 40% - 50% from 2012 levels. Various studies forecast that by 2025, the worldwide average miles per gallon (MPG) of new passenger cars / small trucks will have improved by as much as 40% - 50%. The average of 2011 is 28 MPG; in 2025 this is expected to rise to 45 MPG."* (Oilholics Synonymous)

One of the first organizations to emphasize an early Front End Development approach seriously was Royal Dutch Shell around the year 2000. In 2001, they revised their Project Management Guide to take into account the change in emphasis from a pure execution oriented approach to a heavier emphasis on decision-making in the early stages of the project.

Separate from the changing business environment, the political environment changes also. Sometimes these changes are caused by the economic and/or social environment, sometimes by the numerous anti-development NGOs, sometimes by companies pushing politicians to change legislation to support them, and sometimes by unethical politicians.

In early 2014 the government of Indonesia (Market Intelligence of India) became convinced they could produce much more revenue by refining ores such as nickel and exporting the finished product rather than exporting raw ore so they shut down all exports of ore. This caused a huge disruption in every mining-related project and creates an environment where our traditional approaches to these projects no longer work. They were apparently being convinced by Chinese construction companies that the government could generate more revenue by refining the ore itself and exporting the finished metals instead of the raw ore (which the Chinese companies were happy to provide for a price). This effectively closed down all mining projects in the

country. *"January 12, sending prices up as much as 56 per cent and prompting Morgan Stanley to forecast a global output deficit over the next five years."* (The National)

3. Overview of current project management practices

The most common way to manage projects is by cropping the project into distinct phases, each phase having its own inputs, activities, deliverables, closing activities, and milestones. At a very high level, the phases might look something like this:

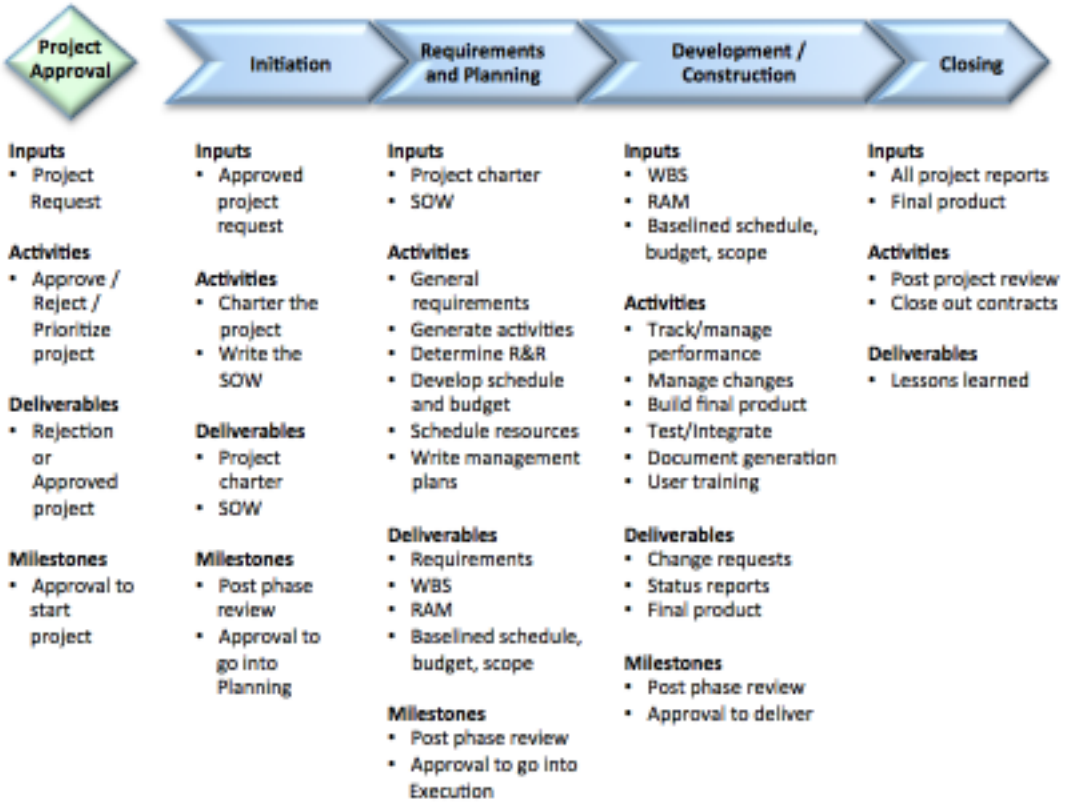


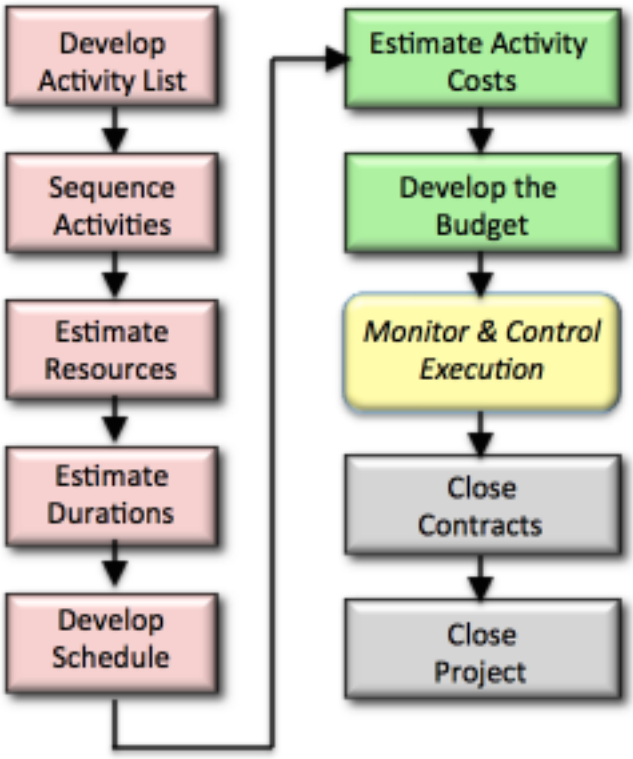
Figure 6: Typical Small – Medium Project Phases

In other words, we plan out each project according to the unique nature of the project itself. This approach has led to the high failure rate of projects both small and large. Research done by the Standish Group (Johnson, J.) shows that 70-85% of IT projects are either failures or are challenged. Ed Merrow (Merrow, E.W.) summarizes the work done by the consulting firm IPA and reports that 78% of industrial megaprojects in oil/gas are failures with specific definitions of failures, including reduced planned operational capacity due to compromises made during execution.

For simpler projects there is a reasonably sequential approach to planning them out. We begin with a piece of paper that justifies and approves the project – a business case, a project charter

(in PMI's terminology), a project mandate (in PRINCE2 terminology) and proceed to doing the initial work involved in development the management documents, identifying stakeholders, determining the communications requirements, early risk development, and so on, all in parallel during the early planning effort.

Figures 7 and 8: Sequences of Activities in Planning Phase



From the WBS we develop the detailed activities, sequence them, add resources, determine the durations, and develop the detailed schedule.

The entire project is planned out in detail and the resulting "waterfall" Gantt chart guides the management of the execution phase of the project. This traditional, approach to project management puts a premium on gathering a complete set of planning data which is used to accurately forecast the future behavior of the project assumes a perfect understanding of the future environment. For a project that is six months long accurate predictions are difficult enough. For a mega-project that spans years it can be impossible.

As the IT and software industries have slowly developed an appreciation for effective management over the past 10-15 years they have evolved a different approach to managing their projects. There are a number of "quick hit" development methods that come under the umbrella of agile methodologies. These approaches don't even try to plan out the entire project at once, but only a small subset of it while keeping the client/customer/sponsor closely in the loop.

While these approaches are adequate for short-term projects where the requirements are very likely to change and where the buyer can't easily visualize the final product, they are of limited use on mega-projects where the technical details are well-defined and where the development goes on for years.

The current traditional planning approach focuses on the details of the project itself, defining the activities needed to do the work and predicting how long the project "should" take and how much it "should" cost. For a mega-project there are too many external influences over a long period of time that impacts our ability to accurately predict the future.

Because the majority of projects do not continue for years, the decision-making process is relatively straightforward. There is less of a need to think about the impacts of a decision when those impacts are five years away. Decisions for most projects are related either to how the projects will be used, or are related to the technical area of the project.

For mega-projects the decision process is much more complex, requires long-term thinking, and involves people not directly associated with the technical details of the project – business management, international financers, government agencies, et alia.

Albert O. Hirschman's (Hirschman, A.O.) principle of the Hiding Hand states that ignorance is good in planning, because if decision makers knew the real costs and difficulties of projects, few ventures would ever get started. (However, don't take the principle of the Hiding Hand too seriously. Bent Flyvbjerg (Flyvbjerg 2016) points out that Hirschman's sample size was very small and biased)

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Mr. Parth teaches project management courses throughout the world and has taught over 4000 students worldwide in preparing for the PMP certification exam. He is a guest lecturer at USC's Marshall School of Business, the University of California, Irvine, and at the American University of Sharjah (AUS) in the UAE, is an accomplished international speaker, and does pro bono teaching of project management in Vietnam.

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