# Management of Assumption Infatuation in Large Complex Projects

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We love assumptions. In fact when it comes to large engineering and construction projects we have come to love them so much that we take them for granted. Subconsciously, or maybe it is unconsciously, we make hundreds if not thousands of assumptions as we plan, budget and schedule these mega and giga scale projects. And because we do so, with rarely a second thought, our baselines might be best described as founded on a compounded uncertainty.

But rather than closely monitoring and tracking assumptions we allow them to propagate and migrate as the project proceeds, acting as "termites" that progressively further weaken our already uncertain foundations. How might our assumptions change and importantly, how might our management of large complex projects change if we simply wrote down all our assumptions and tracked their continuing validity throughout the project.

Assumptions are a fact of project execution but they require challenge by those who do not necessarily share the same reality. These assumptions pervade every aspect of project execution including the foundational theories of project management, developed in simpler times for simpler projects, but which we now treat as dogma. Until we are willing to challenge and revisit these foundational assumptions we will be held back from truly addressing the reality of large project execution – 2 out of 3 fail!

***Assumptions are thoughts we take for granted and believe them to be true. They aren't based on facts; they are based on experiences of the past. They are fiction. Assumptions inform our decision making, and this is precisely where the problem lies. They influence the decisions we make and often cause inertia.***

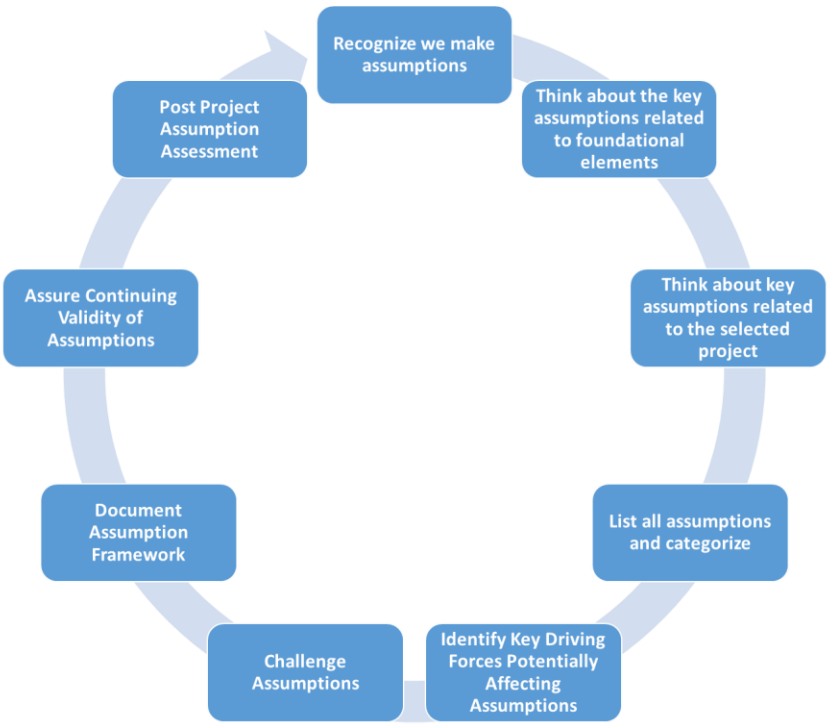
*Be a CHANGEMASTER*

*Karla Reiss*

As we approach the planning, scheduling and budgeting of large, complex projects we need to heed the spirit of Occam's razor and make no more assumptions than are absolutely necessary. And in this parsimonious assumption set, as we write down our

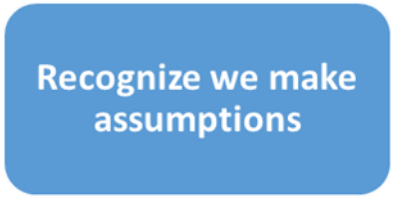
assumptions, made by tens or hundreds of individual actors, as a minimum let's make sure they are internally consistent.

This paper lays out a framework for improving our treatment of assumption that can be summarized by the following figure, "Recommended Assumption Management Cycle"




**Recommended Assumption Management Cycle**

## Recognize we make assumptions




Recognize we make assumptions. We make them every day. Often we make them without recognizing that we are doing so. We take them to be facts or business norms, applicable to the project at hand. Assumptions are made at all levels in the organization and are typically uncoordinated in most regards. Optimistic business model assumptions, founded on fixing scope and eliminating changes may be inconsistent with the project's actual state of knowledge or engineering's efforts on optimization around factors other than overall project schedule.

A "fit for purpose" scope definition may not map to actual factors of safety incorporated in the design. Inflation assumptions appropriate for life cycle analysis may understate actual project costs in an overheated capital construction market. In each case, the assumptions must be recognized as just that and appropriately examined and tested.

The assumption management cycle starts with this recognition that today's large projects involve hundreds if not thousands of assumptions, many of which we don't even recognize. Recognition is truly the first step in assumption management.

**Think about the key assumptions related to foundational elements**


Large complex projects often underperform because they were founded on weak foundations. These weak foundations can encompass the fundamental business model; clarity of strategic business objectives; stakeholder behaviors anticipated; assumptions around risk; and even the project scope. We must get the foundations right and there is probably no more important place where assumptions must be recognized, understood and challenged.

The business models used to define the selected project and its outcomes is based on a chosen underlying scenario with an explicit, and implicit or embedded, set of assumptions. Do we understand what those assumptions are and do the assumptions made in the developing project reflect a consistent set of assumptions? If the business model hinges on having 50% of final capacity in the market by a fixed date, should we be optimizing around a design that has better unit cost but doesn't deliver any output until 6 months after the initial market servicing assumptions in the underlying business model?

This decoupling between business model and project model often arises from failure to recognize and understand the importance of the embedded assumptions in the business model.

We see a similar form of decoupling with respect to achieving the project's strategic business objectives. Project outputs become a focus whereas the emphasis should be on outcomes….meeting market penetration targets for example. The simple act of articulating the project's SBO's requires a deeper consideration of what is to be accomplished. Not only is such an articulation essential for executive and project team alignment, but it also opens up a window into the deeper business model assumptions made and how they affect the project model.

A third foundational area requiring careful examination is that associated with stakeholders. Have we recognized all key stakeholders? Importantly, do we understand the broader context in which they exist, the externalities which act upon them, their needs and their capabilities? Are there natural allegiances across stakeholder sets or

are our assumptions about their needs and how to address them mutually exclusive? Satisfying national level stakeholders may be viewed negatively by the local stakeholder group from which your workforce derives.

A fourth foundational area chockful of assumptions is in our consideration of the risks the project may face and how to deal with them. While we focus on risks and other project issues we often ignore and fail to challenge the assumptions and coupling which exists in the "white spaces" of the project.

| **Risk Areas Subject to Assumption Management** |
|---|
| |
| • Posture and tolerance |
| • Risk framework |
| ○ Economic |
| ○ Social |
| ○ Political |
| ○ Cultural |
| ○ Intellectual/ideas |
| ○ Technological |
| • Risk probability |
| • Risk consequences |
| • Risk model |
| • Risk mitigation |
| |

What is our professed risk posture? Are the assumptions we made consistent with that posture? For example, we say our posture is "conservative" but we assume top decile performance in all project aspects. Have we recognized the compounding of risks that occur with extended project durations?

But it is more than our risk posture where we must examine the assumptions we have made, it is also in our risk tolerance. Have we built a business model that seeks to retain risk and accrue financial benefit by aggressively managing that risk, only to adopt a contracting strategy that seeks to largely transfer risk, and its management, to others?

Similarly, we need to understand the myriad of assumptions we have made in developing our risk framework. The ESPRIT risk framework I have written about previously is one starting point for assuring we understand the assumptions embedded in our risk assessments and analyses. ESPRIT systematically considers risks across economic, social, political, religious, intellectual and technological realms and can be

extended to examine the implicit and explicit assumptions we have made in these regards in our project model.

Examples of potential assumptions to be identified and challenged can be seen in the following table but closer, project specific examination is required.

| **ESPRIT Assumptions** | |
|---|---|
| | |
| **Category** | **Typical Assumptions** |
| | |
| **Economic** | • Market/Demand Growth<br>• Core Input Prices (includes labor)<br>• Employee Healthcare and Benefit Cost<br>• Energy<br>• Major Non-Energy Commodity Prices<br>• Interest Rates<br>• Lending Standards and Access to Capital<br>• f/x Rates<br>• Long Lead Equipment Delivery Timeframes<br>• Tax Regime |
| **Social** | • Supply Chain Performance<br>• Labor Posture<br>• Labor Availability |
| **Political** | • Trade and Non-Tariff Barriers<br>• Tax Regime<br>• Decision and Approval Frameworks and Durations |
| **Religious/Cultural** | • Stability/Conflict<br>• Impacts on Work Rules and Labor Practices<br>• Limitations on Multi-Cultural Workforce |
| **Intellectual/Ideas** | • Emerging concerns (global climate change; terrorism; resilience)<br>• Global NGO Projection into Project |

| | |
|---|---|
| | Setting<br>• New/Emerging Procurement and Contracting Models |
| **Technological/Technology** | • Technology Change Impacting Primary Processes<br>• Disruptive Technology<br>• Technology Upgrade Cycle |
| | |

We also make assumptions in our modeling of risks, their probability and their consequences. One area to highlight is in our assessment of risk probabilities. Our assumption of a normally distributed world can lead us to significantly underestimate probabilities for risks that are more "catastrophically" distributed. When we look at the performance of large complex projects perhaps we should assume more "catastrophic" distributions especially in large complex system elements. That risk we assume to have a 5σ value in a normal risk distribution has just a 1 in 3.5 million chance of occurrence and despite its potentially large impact will likely not make the top risk list. If we change our assumption to reflect the fact that this particular risk might be more "catastrophically" distributed, the probability rises to 1 in 16 and most certainly would make our top risk list.

Risk consequences must also have their underlying assumptions evaluated. The risk consequences of supply chain disruption change dramatically if 60% of your global supply chain (including intermediate value adding steps, pass through a potential logistical chokepoint (Straits of Malacca; Straits of Hormuz; Panama or Suez Canals)

Finally, as it relates to the risks we may encounter, we develop mitigation strategies, each with their own set of assumptions. While in the abstract these assumptions may be reasonable, we must test them against context, especially temporal context. The mitigation measures available to us at the beginning of a project may be very different three quarters of the way through the project. Assumed equipment or skilled labor for mitigation may have already left the job.

One added foundational element that does not get the attention it often deserves is the project's scope. Business case decisions may be made on the basis of a lean, fit-for-purpose scope while project teams seek to optimize performance or other characteristics against a design basis which exceeds these fit for purpose needs. This scope creep has disastrous consequences for meeting project cost and schedule targets and perhaps the weakest assumption may be in our belief set that we can adequately control project scope. The owner's business case assumptions often do not

flow down sufficiently in his project requirements and well intentioned project teams may drive scopes in unintended directions.

One example was seen in a large program I was asked to help get back on track. Cost and schedule were growing on each of the three projects that comprised the program. A meeting was held with the owner's three project managers and his overall program manager. Each project manager made the case for added time and money, demonstrating how more value could be recognized. The program manager appeared stunned and simply said that there was no more money and no more time. The goal was to spend the allocated money in the established time frame. Scope was fungible since the owner's primary requirement was centered on economic development.

Scope creep can also be witnessed in design life that substantially exceeds the project's economic time frame or improvements to increase plant availability which may go well beyond the business case assumptions. It is not to say that these changes in scope should not be considered but rather to highlight that such considerations must happen with full awareness of the underlying assumptions and an appreciation for what changes to these scope defining assumptions truly means.

**Think about key assumptions related to the selected project**


Having carefully considered our foundational assumptions, we must now turn to the more detailed assumptions characteristic of large complex projects. These assumptions are very expansive in nature and it would be impractical to address every likely category never mind the assumption nature and types themselves. In many ways this expansiveness highlights the challenge that assumptions represent on large complex projects.

The following table highlights some assumption areas worth further exploration.

| Project Related Assumptions |
|---|
| |
| • Fit for purpose requirements |
| • Potential scope changes |
| • Required owner's skills, capabilities and resources |
| • Required skills. Capabilities and resources of others |
| • Availability of resources |
| • Project management approach |
| • Project execution strategy and plan |

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|---|
| • Project phasing and packaging |
| • Project level risks |
| • Project decision making approach |
| • Project level authorities |
| • Constraints the project may face and how accounted for |
| • Opportunities that may become available and how accounted for |

### *Fit for purpose requirements*

Fitness for purpose equates quality with the fulfilment of a specification or stated outcomes. At one level, "fit for purpose" might be viewed as the individual's interpretation of what it takes to meet the Owner's Project Requirements (OPR), narrowly defined. I say narrowly defined since the lense for OPR in many instances deals with facility technical requirements, very much from an engineering perspective only. Returning to the "subjectivity" point for a second, we recognize this issue as we look at design margin as a method to reduce the scope of this subjectivity.

For purposes of this paper I will define "fit for purpose" as equivalent to meeting OPR from a technical perspective. But to ensure we are delivering the owner's desired outcomes we must redefine "fit for purpose" so that meeting OPR technical requirements is done in such a way as to meet OPR implied requirements as they relate to capital efficiency. I do not view this as an increased obligation since a level of capital efficiency underpins every investment decision our client's make. I do want to be clear that I am not necessarily implying "optimizing" capital efficiency since the point of optimization is very much in the eyes of the beholder.

As we look at fit-for-purpose assumptions, we must ensure they are fully aligned with those associated with the business model underpinning the project. These assumptions must be confirmed, consistent, captured and recorded. In particular these assumptions must cascade down throughout the larger body of project assumptions. Without clear flow down there emerges a risk of inconsistency.

Fit for purpose assumptions are also subject to change, driven by externalities such as market conditions, available financing, or emergent owner constraints further highlighting the need to cascade these assumptions down with traceability and continuously tracking or reconfirming them.

Examples of fit for purpose assumptions may include:

- Performance levels – output; service levels; availability; reliability; performance under extreme events (resilience)

- Outcomes – job creation; social objectives (small and disadvantaged business development); public acceptance; reduced congestion

### *Potential scope changes*

In developing the project scope we must recognize the scope impacting assumptions that we routinely make. Examples of such assumptions may include:

- Scope adequacy & completeness – consistent with SBOs; SBOs comprehensively addressed; scope is complete (all elements identified)(Example – build a bridge between two man-made islands but islands are in no one's scope; plant to use potable quality water but no pre-treatment plant is in the scope); scope is well bounded or unbounded potentials recognized and provided for; key process technologies specified and not subject to change; integration assumptions complete and reasonable
- Feedstock quality & characteristics – ore concentrations; coal quality; water quality; waste fractions
- Capacity – full capacity level; required partial capacity levels (2x50; 3x33); ramp up time frames

### *Required owner's skills, capabilities and resources*

The development of project strategies inherently assumes that the owner will provide the required management and administrative support of the activities he is responsible for. Owners facing infrequent or even generational scale projects may find they no longer have the requisite skills, capabilities and other resources required to support the project.

Large complex projects give rise to new governance and oversight requirements in owner's organizations and the assumption that these capabilities and resources will be fully met may represent one of the assumptions at most risk of "migrating".

Some particular assumptions worth noting include:

- Owner review and approval times
- Owner procurement cycles and higher level approvals and authorizations of funds
- Invoice processing and payment cycles
- Change order approval cycles
- Resources required by contractor to support owner needs
    - Meeting frequency and durations
    - Man-marking by owner and implicit labor efficiencies

### *Required skills. Capabilities and resources of others*

Assumptions are routinely made with respect to the capabilities and resources of others including:

- Partner's - ability to support their commitments in a timely way (labor, equipment, specialized skills including management and supervision)
- Subcontractor's - timely and efficient performance (financial and human resource capacity; order book and volumes; productivity; capability and condition of equipment to be utilized (bucket of bolts "risk")
- Supply chain – availability; costs; lead times; quality level; documentation completeness, clarity and format

It is important to not only be aware of these assumptions but to also ensure they cascade into appropriate teaming, procurement and contract documents.

### *Availability of resources*

Resource availability can be thought of as encompassing labor, materials, equipment; logistical facilities and supporting infrastructure. Assumptions encompass all elements of the construction process including:

- Labor – volume and skill mix required; productivity; competing demands for resources; timing and competition of skilled resources; work rules; labor union and agent training and induction effectiveness; availability of travelers and ability to work; mod yard labor profile (similar to final site considerations)
- Materials – materials of construction volumes and timing; market conditions and competing projects; concentration of suppliers; capacities of suppliers (concrete batch plants; fabrication shop capacities; mill capabilities and capacities in project time frame); available inventories; specialized material requirements
- Equipment – construction equipment mix and any special requirements; consistency of requirements with selected means and methods; specialized equipment to be fabricated (Example: specialized heavy lift marine crane; TBM; bridge launching system)
- Logistical facilities – construction material wharfs; railroad siding availability; warehouses; mod yard requirements; special access requirements/permitting time frames; limitations on laydown areas
- Temporary works – extent and nature; staging requirement/restriction; access; special requirements
- Supporting infrastructure – available road, water, power; support facilities for labor force; refueling capacities; local shop and maintenance capabilities and capacities

### *Project management approach*

Assumptions around how a project is to be managed need a high level of alignment. Differing management approaches from what was anticipated can be extremely detrimental to project success. Specifically, assumptions around the following warrant special attention:

- Stage Gates – frequency and requirements at each gate
- Organizational structure – co-located or separated; arm's length or integrated; man-marking; micro-management; role of owner's functional organization
- Required meetings – frequency; content and purpose, duration, attendees (contractor's project manager only or also including all of his direct reports)
- Project management system – maturity of management systems of both owner and contractor
- Commitment to dealing with hard issues – timing and frequency of alignment sessions and supporting activities
- Significant philosophies – labor; safety; risk

### *Project execution strategy and plan*

Project plans and execution strategies encompass a wide range of assumptions, some of which have been separately covered. Key assumptions include:

- **Scope related assumptions**- completeness of scope; allowances for estimated quantities; temporary facilities; site characterization (geotechnical; utilities; property rights; approvals); identification of risks; provisions for scope change; scale challenges; complexity
- **Cost basis assumptions** – estimate accuracy; market conditions; labor cost over project duration; temporary equipment and works; restrictive site or owner's conditions; completeness of owner furnished equipment; overhead (including healthcare; social benefits; owner driven costs); productivity factors (skill levels; environmental conditions; work rules; labor posture); contingencies; allowances for event risk (excess bad weather; delayed start; potential partial demobilization); general conditions costs
- **Activity duration assumptions** – productivity rates; quantity estimates; learning curve assumptions; set-up and breakdown durations; precedence identification, timeliness and completeness; sensitivity to event risks and timing; supply chain performance; reviews, approvals, decisions and other owner actions; completeness and accuracy of design (number of RFIs); interface identification, completeness and clarity; impacts of disruptions; interferences within project; interferences and other impacts from outside project
- **Quality assumptions** – effectiveness; rejection and rework rates; standards and specifications to be met; applicable testing standards; acceptance criteria;

common fit-for-purpose definitions; required level of subcontractor and supplier quality assurance; documentation requirements

- **Assumption regarding completeness of the** plan – degree to which project is "bounded"; assumed uncertainty levels/ confidence levels; allowed scenarios covered by plan; assumed "white space" risks; contingent strategies available; reliability of baselines; completeness of stage gate processes; interface definition; reliability of assumed stakeholder requirements
- **Management system assumptions** – clarity and alignment on SBOs; risk model assumptions; adequacy of reference class checks on planning fallacy; complexity assumptions; assumed delegations of authority; reliability of baselines; adequacy of interface definitions; governance system assumptions; PMO capabilities and role; forecasting capabilities; change management; compatibility of various management systems (owner, EPCM, PMC); O&M requirements fully addressed; consistent safety posture; availability of sufficient staff with requisite skills; "flow" assumptions; level of effort and effectiveness of stakeholder engagement programs
- **Stakeholder assumptions** – key direct stakeholders; key indirect stakeholders; core beliefs; degrees of freedom to act; issues and candidate resolutions; stakeholder context (broader environment); stakeholder-stakeholder interaction and influence
- **Supply chain assumptions** – overall market condition; forward pricing, terms & conditions; source countries; adequacy of marine transport; other logistical availability and pricing; supply lead times; quality/defect levels; level of expediting; levels of shop inspection; warehousing requirements
- **Means & methods assumptions** – effectiveness; productivity levels; availability of required equipment and tools; performance of purpose built equipment; contractor capabilities relative to selected means & methods; availability of labor with requisite skills; impacts on general conditions; level of supervision required; changes to permitting requirements; stakeholder impacts (if any); changed risk posture (example: increased exposure to adverse weather)
- **Organizational effectiveness assumptions** – owner's management capabilities; alignment of owner's organization; ability of owner support elements to support project (change order approvals; procurement actions; required legal reviews); joint venture alignment and effectiveness; supply chain management skills and efficiency; sub-contract management skills and efficiency; scope discipline; decision making timeframes; delegations of authority; ability to attract and retain key staff; IT capabilities; document management capabilities

### *Project phasing and packaging*

Assumptions relative to project phasing and packaging are very important. In one project three contracting activities were packaged together to "simplify management"

leading to two extremely impactful outcomes. The first impact on this lump sum contract required the latest available technology to be used for a particular system. At time of bid this technology was priced and included in the lump sum. However, the sequence of construction did not really require a technology buy until three years after the initial bid. At that point the latest available technology was two generations later and 30% higher in cost. The second impact arose from a standard contracting clause that said "no work should proceed until all necessary permits and approvals for work covered under the contract had been received". When originally envisioned as three separate contracts the clause presented no significant problems but when the three originally planned contracts were combined, the long approval process associated with the third piece of work delayed the overall project years. In the original concept work was not required to begin on the last piece of work until about 4 years after start of work on the first piece.

Project plans and budgets were assumed to involve three separate packages but these assumptions were undermined by an attempt to "simplify management" of the project.

Do phasing and packaging assumptions:

- Add complexity through bundling?
- Adequately address the interfaces between multiple projects?
- Drive activities to occur in less than optimal timeframes?
- Rest on unreasonable precedence?

### *Project level risks*

Each project level assumption adds a degree of uncertainty and risk to the project. Many of those assumptions have been highlighted in this paper. Let me turn my attention to assumptions on how we model and think about risk considering risk identification, risk impact, risk uncertainty/modeling and risk mitigation.

- Risk identification – at best a subjective process, represents a collection of assumptions about what can or may go wrong. Risk identification is prone to several assumption related biases including optimism and inductive biases. It may become prematurely bounded, making assumptions that certain risks are too remote to warrant consideration, potentially ignoring the fat tailed distribution of the risk. Risk identification gravitates to the knowns and does not capture well the potential unknowns that live in the white space of the project and in the broader mesh of externalities in which the project exists.
- Risk impact – assessments are often founded on simplistic assumptions for modeling and quantification. Cascading or coupled impacts are not well categorized. A simple example is in encountering a change or risk at mid project. The direct cost may be calculated and used to model the risk provision to be provided but often the cost modeled excludes the cost of disruption to the project which may be as much as three times the direct cost.

- Risk uncertainty/modeling – the risk distributions we choose to model individual as well as collective risks may assume normal, triangular or some other common distribution. Yet we know large complex systems behave catastrophically and demonstrate an optimism bias but fail to utilize more fat tailed distributions as we consider uncertainty.
- Risk mitigation – having identified and assessed a risk, we seek to employ risk mitigation strategies. These strategies themselves are rife with assumptions which should lead us to properly regard them as mitigating rather than eliminating. All too often this is not the case.

***Project decision making approach***

We make assumptions on how decisions will be made on a project, who has authority and how long decisions will take. Decision making approaches are functions of many things:

- Nature of decisions to be made
- Experience and skill levels of decision makers
- Level of project oversight
- Project team dynamics
- Perceived project issues
- Confidence derived from prior project decisions
- Cultural decision making context (authoritative; consensus or group decisions; non-decision)

These assumptions, if not met, may create temporal friction in project execution and significant delays at transition or disruption points.

***Project level authorities***

The ability to make decisions and act is key to efficient project execution. How do our assumptions map to the authorities actually delegated to the owner's project manager or our own? Have we reflected actual approval times likely to be encountered or assumed a more efficient approach based on hope and desire? The extended project durations that are likely still do not reflect the ripple effect of disruption that will propagate through the entire project plan.

***Constraints the project may face and how accounted for***

Optimism bias, at times derived from the framing questions of others, leads us to assume a lower level of constraints than real world results would seem to support. We make think of the assumptions we make with respect to constraints as falling into two broad categories:

- Recognized constraints – that we underestimate the impact of or optimistically minimize in our project assumptions. Even with recognition we often fail to recognize that the realization of one constraint often makes others more susceptible to realization
- Unrecognized or unseen constraints – such as the second or third order coupled constraints described earlier. These create the prospect of sudden catastrophic failure of project execution plans

Constraints impose limits on a project and the validity of its execution approach. Underestimating constraints through the assumptions we make increase the risk of failure of our project execution strategy and plan.

### *Opportunities that may become available and how accounted for*

Not all changed assumptions lead to negative outcomes. We make assumptions on the timing or availability of improved technology, tools, regulations or other changes. Our assumptions may lead us to limit our ability to capitalize on this favorable change. But if we track our assumptions we increase the likelihood of seeing these positive developments earlier allowing us to fully capitalize on these improvements.

Recognizing the extent to which we make assumptions, it is now essential that we capture, manage and capitalize on them.

### List all assumptions and categorize


Having identified the assumptions we make, it becomes important to capture them. In all likelihood you have begun the creation of a listing of these assumptions as part of your identification process. Given the hundreds, if not thousands, of assumptions we make it is important to establish some collection guidelines. It may be possible to do this prior to the identification process but you run the risk of inadvertently screening out what may prove to be an important set of assumptions.

### *Establish assumption collection guidelines*

Assumptions should be collected in a manner that supports their further categorization and mapping to business and project aspects impacted by changes in the assumed values. The categorization system selected will provide guidance on the particular relevant factors to be collected. The following section illustrates some potential categorization systems that may be employed but composite and bespoke systems are also possible.

The collection guidelines must provide adequate information to determine when assumptions in various aspects of the project may act in tandem (synchronously) or are

in direct conflict with other aspects of the assumption framework and reflect a project model with inconsistent or asynchronous assumptions.

An example would be an assumption of a high growth in unit revenue rates driven by projected growth in disposable income while assuming low unit cost growth associated with a tepid economy. The assumptions are in conflict but only if we understand the underlying assumption basis. These bases must be discernable from our categorizations.

### *Categorization systems*

A nearly limitless variety of categorization systems are possible for assumption tracking but five are suggested below. Hybrid systems for categorization of assumptions are possible but impose added information collection requirements as we build the assumption register. These hybrids do offer to point out how we view systemic pressures on assumption sets and should not be dismissed out of hand.

The five categorization systems outlined include:

- Critical assumptions
- Critical success factors
- ESPRIT
- Life cycle
- Milestone

These five systems are outlined in the following table.

| **Candidate Assumption Categorization Systems** | | |
|---|---|---|
| | | |
| **Critical Assumptions** | Macro-setting (economic; social; political; cultural) | |
| | Stakeholders | |
| | Partners | |
| | Organizational Performance (Owner) | |
| | Innovation & Technology | |
| | | |
| **Critical Success Factors** | Key assumptions for each success factor | Uncertainty/ Importance |
| | | |
| **ESPRIT** | Economic | |
| | Social | |
| | Political | |
| | Religious/ cultural | |
| | Intellectual/ ideas | |
| | Technological/ technology | |

| | | |
|---|---|---|
| **Life Cycle** | Planning durations and approvals | |
| | Decision making efficiency and effectiveness | |
| | Design margins; scope control; productivity; RFI minimization | |
| | Supply chain efficiency and effectiveness; market condition | |
| | Construction means & methods; RFI levels; productivity; contingencies and externalities | |
| | Financial factors; exchange rates; interest rates | |
| | Market factors | |
| | Operating factors; labor; energy; consumables; availability; required inventories | |
| | Maintenance factors | |
| | | |
| **Milestone (each may be further decomposed)** | Assumptions related to scope of project | |
| | Assumptions related to timely and efficient initiation of the project | |
| | Assumptions related to control of design scope and estimated cost and schedule | |
| | Assumptions related to timely completion of complete design packages | |
| | Assumptions related to supply chain capabilities, pricing and delivery | |
| | Assumption related to construction inputs – labor, materials, equipment, information | |
| | Assumptions related to construction execution – quality of design, factors impacting construction (weather; logistics; labor posture); change process effectiveness | |
| | Assumptions related to organizational effectiveness | |
| | | |

### *Linked assumptions*

A primary objective of assumption identification and categorization is to identify those assumptions which underpin broad elements of the project. This aids in identification of key assumptions to be tracked during the project. Let's consider a simple case where 1% of project supply was to come from a particular country and for which we had assumed a benign inflation environment. If local conditions changed and inflation became significant we would see a cost growth from this part of the project but its impact would be limited. Knowing our exposure we might try to source from another country.

Now let's consider the case where reimbursable subcontractors had planned to do significant portions of their work in a module yard in that country. Without visibility of those assumptions we might have greater cost exposure than first recognized.

If the assumptions made by the various suppliers were the same as those at the overall project level, we would have coincident assumptions, that is, the assumptions are the same.

Now let's consider the case where each of the suppliers has made their own assumptions on inflation rate with half assuming a benign inflation rate and the others assuming a very aggressive one. What is our business model based on? How do we know we are making optimal decisions when the planning basis is not consistent? This is an example of contradictory assumptions; one's which are opposed or divergent. The assumption categorization process helps us identify these inconsistencies which can be even more significant than in this example.

**Assumption Linkage**

- Coincident (same assumption)
- Contradictory (opposed/divergent assumptions)
- Coupled (deeper coupling such as constraint coupling present)

A final example of linked assumptions can be described as coupled assumptions. In the situation we have just considered, the inflation driver might be the result of higher agricultural prices driven by fertilizer costs or a regional drought. In this case other countries we have chosen to source from may also be impacted to a more or less degree. This would be an example of a driving force which we will discuss in the next section. We can also consider the case of a three activity project where the critical path flows through activities one and two and activity three is viewed in the project plan as

independent, starting after activity one, finishing before activity two and not reliant on any inputs from activities one and two and they not reliant on inputs from activity three. Now let's consider activity three slipping by six months but still shown as finishing before activity two. The project would still be viewed as meeting its overall schedule. But should it be?

Maybe not! In this particular project the skills required by activity three are also the same as those for activity two. Now each activity is competing for a highly constrained resource and the overall project suffers. This is an example of constraint coupling and an area where identification and categorization of assumptions can help identify potential future problems.

**Identify Key Driving Forces Potentially Affecting Assumptions**


Identifying the driving forces which may affect assumptions in systemic ways is an under used technique to foresee adverse changes in the assumption set underpinning the project. But what are driving forces. Driving forces includes key internal forces such as knowledge and competence of management and workforce and external forces such as economy, competitors, and technology that act on our assumption set and shape the future trajectory of the project.

There are a range of possibilities in identifying and evaluating potential driving forces acting on the project. One way is to consider these forces from the perspective of the assumption categorization system you have selected. Another is to use one of the recognized frameworks that supplement Porter's five forces such as PEST (political, economic, social, technological), STEEP (adds environment to PEST), and STEEPLE (which adds legal and ethical)

On a personal note I have always preferred my ESPRIT framework where economic, social, political and technological encompassed PEST and legal may be considered under political or social and ethical was very much part of religious/cultural. Intellectual in ESPRIT went farther encompassing emergent ideas which may run the gambit from emerging environmental thoughts to social justice.

A driving force analysis may be carried out at the earliest stages of a project when strategy is still being formed and risks being assessed especially under scenario analysis. The use of a driving forces analysis informs a challenge of the assumptions we have made and may be developed earlier to inform the collection of assumptions. By their very nature a driving forces analysis requires a deeper consideration of stakeholder inputs setting the stage for deeper stakeholder engagement.

When identifying critical and impactful driving forces we must assure all megatrends have been considered and understand the impact that changes in a driving force may

have on other driving forces. We should also closely examine what other driving forces may be impacting the one that is the subject of our examination. Understanding the potentially impactful driving forces with respect to the project will help us in developing a controls framework that measures key factors related to the most important of these forces.

### Challenge Assumptions


"Assumption is the mother of all screw-ups."[1] They bind us to a way of thinking and create a sense of certainty that at best is unfounded. The assumption management process described in this paper requires us to enumerate these assumptions, understand their context and challenge them. Nothing is to be spared in this process. We must challenge common beliefs such as our project management model which rests on the notion of a bounded project that is readily decomposed.

> ***Begin challenging your own assumptions. Your assumptions are your windows on the world. Scrub them off every once in a while or the light won't come in.***
>
> ***Alan Alda***

We must ask questions that help us discover the true nature of these assumptions and put them into sharper perspective. Some questions to consider include:

- Where did the assumption come from?
- How did we arrive at the assumption?
- How certain are we?
- What is the evidence they are right?
- What would happen if they were wrong?
- What can we do to improve the certainty?
- Are they essential in defining the outcome?
- How sensitive are outcomes to the identified uncertainty?
- Does the assumption rise to the level of a project or business risk?

Ask open ended questions and be prepared to refine your assumptions as required. Similarly, modify project plans as required to account for the uncertainty you expose. Importantly, capture and document the challenge process to support checkpoint and post-project reviews.

[1] Wethern's Law of Suspended Judgement

One useful technique is to assess the project team's overall confidence before and after the challenge process.

### Document Assumption Framework


Having identified and challenged assumptions we must now document them to provide a basis for tracking and subsequent reassessment as they migrate. Assumption migration remains a major challenge in large complex projects, especially long duration ones.

One tool for tracking assumptions is a so called RAID log. RAID stands for risks, assumptions, issues and dependencies. Strong risk management focused organizations often lose focus on these other elements (assumptions and dependencies) with issues being tracked as part of other elements of the project management system. The focus of this paper is on assumptions but it is worth a comment that inadequate awareness of dependencies contributes to at least one class of white space risks, namely, constraint coupling.

There are many schema for documenting assumptions including both event focused and assumption focused schemes:

- Event/Cause/Underlying Assumptions/Response/Comments
- Assumption/Reason/Basis/Certainty/Importance/Activity Affected/Impact if Wrong/Checkpoint/Responsibility/Status/Actions

Whatever documentation approach is selected, it is important to at least make a first pass at identifying critical uncertainties. Even this identification should be subject to review at checkpoints established to review continuing assumption validity.

### Assure Continuing Validity of Assumptions


Assuring the continuing validity of assumptions requires consideration of a range of contextual and performance indicators as well as an assessment of assumption migration.

Context indicators measure conditions, such as economic, social, and political conditions, that have a potential bearing on strategy and project performance and implementation. Context indicators can measure assumptions as well as risks and game changers.

Organizational performance indicators need to consider factors such as continuing SBO validity and alignment; continued relevance of the employed strategy and effectiveness of ongoing governance efforts (conformance, frequency, relevance); and decision

making performance and framework and the continuing validity of the underlying assumptions.

Assumptions related to project performance indicators such as productivity, various unit rates, permitting periods and so forth need to be confirmed for continuing validity.

Our prior documentation of assumptions provides the necessary basis for comprehensively assuring the continuing validity of assumptions.

We must also pay attention to those assumptions which have begun migrating even if still within project tolerances. Once moving the need to track more closely rises in importance. The significance and potential impacts of this assumption migration must be assessed and potential management and mitigation measures put into place. It is at this stage that deeper root causes for the assumption migration need to be pursued with an eye towards identifying underlying drivers including driving forces not previously considered. Additionally any anticipated coupling between assumptions that was previously considered and the emergence of any other coupling through assumptions or developing constraints needs to be explored.

Reconfirmation of assumptions for continuing validity should occur on a scheduled basis (checkpoints or significant milestones or transitions) or when the project is experiencing any impacts from emergent flows such as what we might expect from driving forces.

**Post Project Assumption Assessment**


Finally we must learn. Assumption management is like all other effective management processes, incorporating appropriate knowledge capture through feedback loops. Large complex programs may encompass multiple large complex projects and learnings from one must be shared with all others, ideally on an ongoing or checkpoint basis, but as a minimum as part of a formal post project assessment.

Assumption confidence should be updated from experience and in some instances fundamentally different strategies employed on future projects where high assumption uncertainty exists.

A key element of this post project assumption assessment must be an assessment of the effectiveness of the overall assumption management process. What did we miss – migration, driving forces, coupling or underlying process assumptions, to name just a few.

Have we recognized both potential as well as actual impacts in a timely manner or did we assume a causal effect that did not recognize changes in underlying assumptions?

We must review the adequacy of our uncertainty assessments, questioning sources of over confidence and identifying potential improvements in all aspects of our assumption management efforts.

Our focus on risk management is necessary in large complex projects but it is not sufficient. We must recognize the effects of complexity and the importance of uncertainty over time. This will require new risk tools and perspectives but also a comprehensive consideration of areas often not adequately addressed such as opportunities, precedences and dependencies, and as described here, assumptions.

Where possible, improvements must be identified to address today's large complex project challenge – ***2 out of 3 fail!***

## About the Author

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**Bob Prieto** is a senior executive effective in shaping and executing business strategy and a recognized leader within the infrastructure, engineering and construction industries. Currently Bob heads his own management consulting practice, Strategic Program Management LLC. He previously served as a senior vice president of Fluor, one of the largest engineering and construction companies in the world. He focuses on the development and delivery of large, complex projects worldwide and consults with owners across all market sectors in the development of programmatic delivery strategies. He is author of eight books including "Strategic Program Management", "The Giga Factor: Program Management in the Engineering and Construction Industry", "Application of Life Cycle Analysis in the Capital Assets Industry", "Capital Efficiency: Pull All the Levers" and, most recently, "Theory of Management of Large Complex Projects" published by the Construction Management Association of America (CMAA) as well as over 570 other papers and presentations.

Bob is a member of the ASCE Industry Leaders Council, National Academy of Construction, a Fellow of the Construction Management Association of America and member of several university departmental and campus advisory boards. Bob served until 2006 as a U.S. presidential appointee to the Asia Pacific Economic Cooperation (APEC) Business Advisory Council (ABAC), working with U.S. and Asia-Pacific business leaders to shape the framework for trade and economic growth. He had previously served as both as Chairman of the Engineering and Construction Governors of the World Economic Forum and co-chair of the infrastructure task force formed after September 11th by the New York City Chamber of Commerce. Previously, he served as Chairman at Parsons Brinckerhoff (PB).

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