



## PROJECT MANAGEMENT CENTER FOR EXCELLENCE

A.J. CLARK SCHOOL OF ENGINEERING  
*Civil & Environmental Engineering Department*

**PROJECT MANAGEMENT  
SYMPOSIUM  
APRIL 22-23, 2021**

# 2021 Project Management Symposium Papers

ISSN: 2378-9377

Papers are arranged alphabetically by title

## **A Case Study Analysis of Inter-Organization Interactions During BIM Adoption in European Infrastructure Mega- Projects**

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### **Abstract**

The transport sector accounts for a large share of global CO<sub>2</sub> emissions. To mitigate the impact of climate change, several sustainability-oriented large-scale infrastructure projects have recently been on the policy agenda around the globe, such as electric road systems and expanding rail systems. A parallel development that is expected to accelerate the transition of the transport sector is digitalization. Although ongoing for many decades, these initiatives have recently been augmented by virtual concepts such as artificial intelligence (AI) and smart city technologies. The integration of these digitalization tools at the organizational level poses both opportunities and challenges for the actors involved in infrastructure projects. An approach that is currently promoted in the infrastructure sector is Building Information Modeling (BIM). BIM supports decision-making that leverages various digitalization tools and applications.

Although the economic implications of BIM are widely discussed in the literature, the inter-organizational dynamics involving multiple actors in infrastructure projects are not fully grasped. Large infrastructure projects are sociotechnical endeavors embedded in complex institutional frames. The institutional norms, practices, and logics in them are significant. Responding to this scenario, the study conducted an institutional analysis putting the BIM approach in the inter-organizational context in infrastructure delivery. The paper, based on empirical data drawn from three organizations in infrastructure delivery in Spain, the Netherlands and other European countries, will share the analysis of the tensions among the key actors during BIM adoption and implementation.

The paper will address the results gleaned from the case studies of utilizing BIM as a decision support tool for infrastructure programs within an inter-organizational context, summarize the insights from the infrastructure delivery scenarios [case studies] applicable to other national scenarios (including the USA), and, opine on multi-attribute decision making addressing the *PEESTLE* factors – political, energy/environmental, ethical, social, technical, legal and economic, by infrastructure related inter-organizations.

### **Case Study – The Madrid-Barcelona HSL**

The **Madrid–Barcelona high-speed rail line** is a 621-kilometre (386 mi) standard gauge railway line inaugurated on 20 February 2008. Designed for speeds of 350 km/h

(217 mph) and compatibility with neighboring countries' rail systems, it connects the cities of Madrid and Barcelona in 2 hours 30 minutes. In Barcelona the line is connected with the Perpignan–Barcelona high-speed rail line leading into France which connects it to the European high speed network (La Vanguardia, 20 February 2020).

There was criticism during the construction of the Madrid-Barcelona line. A critical report by the consulting firm KPMG, commissioned by ADIF (*Administrador de Infraestructuras Ferroviarias*) at the behest of the Ministry for Public Works (*Ministerio de Fomento*) on 23 June 2004, pointed to a lack of in-depth studies and over-hasty execution of works as the most important reasons for the problems that dogged construction of the AVE line. For example, during the construction of the AVE tunnel near Barcelona, several nearby buildings suffered damage from a sinkhole that appeared near a commuter rail station, damaging one of its platforms. The construction committee of Barcelona's famed Sagrada Familia church lobbied for a re-routing of the tunnel; it passes within meters of the massive church's foundations. It also passes equally near the UNESCO-recognized Casa Milà also designed by Antoni Gaudí. Until 2005, both Siemens and Talgo/Bombardier train sets failed to meet scheduled speed targets. However, in a test run during the homologation tests of the new S102 trains of RENFE, a train-set Talgo 350 (AVE S-102) reached a speed of 365 km/h (227 mph) on the night of the 25/26 June 2006, and in July 2006 a Siemens Velaro train-set (AVE S-103) reached the highest top speed ever in Spain: 403.7 km/h (250.8 mph). At this time, it was a record for railed vehicles in Spain and a world record for *unmodified* commercial service trainsets, as the earlier TGV and ICE records were achieved with specially modified and shortened trainsets, and the 1996 Shinkansen record of 443 km/h (275 mph) was using a test (non-commercial) trainset (Martin & Nombela, 2007).



**Overview map of the high-speed connections from Barcelona towards France, with the year of opening**

The research study by Hetemi et al. (2020) utilizes the **Madrid-Barcelona HSL** [case study] to explore the process of knowledge-work in the inter-organizational setting of a large-scale infrastructure project. Taking a process perspective, it explores why an autonomous project-owner organization in the rail industry, finds difficulties to transform

and exploit the project network-related knowledge in a coopetitive [cooperative competition] context. Based on the longitudinal analysis, the authors put forth a contingency framework that proposes four contexts linking the transformation and exploitation of the knowledge from the interorganizational network to the project-owner organization; whether: i) the interplay between industrial and the project arrangement empowers product or process knowledge, and ii) the senior, and program management awareness to feed-forward learning relies on individual or institutionalized based learning. These four contexts and their underlying conditions pose different knowledge-work related problems and implications for practice in inter-organizational collaborations (Hetemi et al., 2020).

### ***Case Study / Research Conclusions***

The Hetemi study (2020) postulates a solid understanding of knowledge-as-practice, and reaffirmation of the Project ‘learning boundary’ concept. The empirical investigation makes the following observations:

- Little collective knowledge occurs due to disconnected task divisions.
- Actors [stakeholders] belief in their personal uniqueness [super ego/arrogance]; while simultaneously being unaware of useful knowledge that is available from other sources within the organization.
- Knowledge is codified as a *product* rather than the *process*, which supplants the valuable knowledge sharing.

**Case Study / Research Limitations.** Challenge of exploiting knowledge created within LIP context for reuse in other contexts / projects. Lack multi-perspective view of knowledge-sharing mechanisms and perception by different Project actors.

**Emergence of Lock-In in Large Scale Projects.** Poor decision-making due to escalating commitments. Need process view with long-term perspective versus confining decisions to single actor at front end.

**Embeddedness & Actors Behaviors.** Actor behavior affected by project public institutional context & contractual commitments. Escalation caused by: a) Timing mismatches and b) Owner’s passive behavior during implementation. Effective Owner-Contractor Collaboration is critical; savvy Owner deal with Contractors and manage contracts.  
(Hetemi et al., 2020)

### **Case Study – The Netherlands / ProRail – HSL South**

High-speed rail service in the Netherlands started at 13 December 2009 with the dedicated HSL-Zuid line that connects the Randstad via Brussels to the European high-speed rail network. In later years improved traditional rail sections were added to the high-speed network. Proposals for more dedicated high-speed lines were deemed too costly; plans for the HSL-Oost to Germany were mothballed and instead of the Zuiderzeelijn the less ambitious Hanzelijn was built to enable future high-speed service between the northern provinces and the Randstad. As per 2020 three high-speed train

services are operative in the Netherlands: Thalys, Inter City Express (ICE), and Eurostar; the short-lived Fyra service was cancelled in 2013 after severe reliability issues.

HSL-Zuid (Dutch: *Hogesnelheidslijn Zuid*, English: High-Speed Line South) is a 125 km (78 mi) high-speed railway line in the Netherlands. Using existing tracks from Amsterdam Centraal to Schiphol Airport, the dedicated high-speed line begins here and continues to Rotterdam Centraal and to the Belgian border. Here, it connects to the HSL 4, terminating at Antwerpen-Centraal. Den Haag Centraal (The Hague) and Breda are connected to the high-speed line by conventional railway lines. Services running at 160 km/h (100 mph) on the HSL-Zuid began on 7 September 2009 between Amsterdam and Rotterdam. From December 2009, Thalys trains from Amsterdam to Brussels and Paris have run on HSL-Zuid. From December 2012 to January 2013 (40 days in total) the Fyra V250 trains ran on HSL-Zuid between Amsterdam and Brussels, only to have service suspended because of the poor quality (and safety risks) of the Italian-made trains (Railway Gazette, 2018)



### HSL-Zuid, connected to Antwerp with the HSL 4

## Large Scale Projects - Common Issues

Both case studies on the Spain and The Netherlands HSL Mega-Projects show recursive interaction of institutional fields and managerial legitimation. This includes the institutional complexity bound Large Scale Project [LSP], and the management responses that are altered across both time and institutional pressures. These institutional pressures include the regulative, normative, dynamic, and cultural-cognitive (Hetemi et al, 2020 (2)).

### *Limitations of BIM on Large Scale Projects*

BIM as a decision-making tool is *economically* viable; however, the inter-organizational dynamics are *not* fully grasped. In particular, the emotional tensions of the actors [stakeholders] hamper BIM implementation and its value (Hetemi et al., 2020(3)).

## **Applicability to the [Sad] State of the USA Infrastructure**

Every automobile driver in America knows from personal experience the terrible state of the USA infrastructure. The political theater of the Federal Government budgeting, funding and approval process thwarts quick action and stymies meaningful discourse on appropriate long-term solutions. The considerations to be addressed by inter-organization decision makers include sifting through the Political, Ethical, Energy/Environmental, Social, Technical, Legal and Economic issues [PEESTL+E] of the proposed LSP.

### ***ASCE Infrastructure Report Card***

The comprehensive Infrastructure Report Card published every four years by the American Society of Civil Engineers [ASCE] consistently documents that the USA is *not* making the grade when it comes to its infrastructure. In 2017, USA earned the overall grade of D+; versus scoring a D in 2013 (ASCE, 2017). (The 2021 study is to be published on March 2, 2021.)

### ***Economic impact of status quo investment***

The recently issued ASCE/EBP Study entitled “Failure to Act” notes that “Over the next 20 years, the average American household will lose \$3,300 each year due to underinvestment in our infrastructure” (ASCE, 2021). Chilling.

## **Conclusions**

The European Case Studies on large scale infrastructure projects [LIP] addressing the inter-organization interactions during the adoption of BIM offers critical lessons learned for American stakeholders to seriously consider.

### ***LIP Stakeholder Analysis - “Lessons Learned”***

First the LIP Program Manager must learn how to learn. That is, cooperative collaboration versus constant competition. This ‘learning how to learn’ requires the LIP decision makers to embrace the complex ambiguity they encounter as part of the LIP genre.

In addition, LIP continuous improvement requires constant communication to build commitment. This is necessary to overcome the disfunction-junction that now encumbers the process.

### ***Implications for Improving Infrastructure Execution***

Sustainability requires reimagining cities [habitat], world of work [economy] and social support [infrastructure]. To improve the execution of large-scale infrastructure development requires the LIP constructors and designers to become agile in conceiving and constructing the built environment.

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## Appendix

### “The Netherlands / ProRail – HSL South” Case Study / Data Collection

Data collection method	Data collected
Semi-structured interviews	<p>first interval (1996-2010)</p> <p>9 interviews with the HSL PM, Adif Quality Controller, Head of Infrastructure Projects, Engineer at Organization B, project proponent and other relevant actors. Average duration was slightly over one hour.</p> <p>second interval (2015-2018)</p> <p>13 interviews with the program managers and other relevant actors (project managers, construction manager at Adif, Organization ‘A’ Contractor PM, Organization B Supplier, Organization C Contractor PM). Average duration was slightly over one hour.</p>

<b>(Participant) Observations</b>	<p>first interval (1996-2010)</p> <ul style="list-style-type: none"> <li>□ participant observations,</li> <li>□ group interviews,</li> <li>□ Extensive informal communication</li> </ul> <p>second interval (2015-2018)</p> <p>The insider spent 2–3 days per week at the organization’s offices and conducted observations:</p> <ul style="list-style-type: none"> <li>□ 7 management meetings;</li> <li>□ Extensive informal communication;</li> <li>□ Field notes for each of the days spent on site;</li> </ul>
<b>Document analysis</b>	<p>In total more than 20 documents:</p> <ul style="list-style-type: none"> <li>□ Internal program documents (internal financial and audit reports, overview presentations, internal organization and escalation matrices, lessons learned, and program tools, e.g., risk logs).</li> <li>□ Organization-wide guidelines and frameworks for project and program risk management.</li> </ul>



**UMD Project Management Symposium  
Building a World Class Team**

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**ABSTRACT**

An organization's success depends on the one resource that is a fully functioning response and in an anticipatory state of readiness, its people. The team that must be formed, and able to work together and advance the levels of talent and expertise requires leadership which knows what a world class team looks like, sounds like, how they communicate and most of all know why they are the team.

Team building is an essential practice for the program manager, requiring a strategic adaptation not only at the beginning of the project, but continuously re-evaluating, exemplifying the best of the team, cultivating the potential and managing the team dynamic.

The practice has essential elements, starting with vision. Too little value is placed on vision by teams and this presentation will make the point of vision as a more tangible and self guiding focus for the team.

A second team building element is the built in overhead of team effort to efficiently perform but to also prepare themselves and rely on the program investment in the team to extend their talent as outreach and demonstration.

A third element among more that will be covered in this presentation is the team makeup, considering both talent and personality. The techniques for position announcement, interviews, expectations, evaluations and feedback, and team structure will be discussed as leadership tasks towards building the world class team.

You are invited to examine your leadership role as a team builder and the practices to make yourself the most effective enabler for your program's success.

A Project Manager's most important responsibility and most time-consuming effort is building teams. The Project wide team is typically built with the aid of other leads on the team, however, the direct team reporting to the Project Manager is hers alone. The best possible team is not easily assembled, while entirely functional and can perform at acceptable levels, a world class team build is a monumental exercise.

As a Program Manager for over fifteen years, leading NASA teams for developing and maintaining a hardware/software system which ingests earth observing, satellite-based instrument data, I had the opportunity as a Program Manager to build such a team. The NASA customer evaluates the program every six months and provides scoring which has been earned through the performance of the team. One such evaluation included a statement by the NASA official that the mission was executed by "a world class team." The objective as a Program Manager was to build the most effective and empowering team for NASA, so reading this statement revealed the achievement after a twenty-five out of a current forty-two year career.

Having worked with any high performing team as a rare instance, most Project Managers will often state how lucky they felt to have been a part of the team. I have spent much time thinking about what it means to be lucky. If luck were associated with rewards and advantages, then how would one increase one's luck? I came across a definition of luck that answered this question for me. "Definition of luck – when preparation meets opportunity – Anonymous." Clearly then if I increased my preparation and then took advantage of every opportunity, my luck would increase. I have taken this to be my mantra in life and have seen many rewards and leveraged advantages. As a Program Manager and in the constant effort of building teams, I applied the luck definition and have built out practices of wide preparation and always seeking opportunity.

Here is a real life example when I was lucky. I was lucky to survive multiple motorcycle crashes as a full-time motorcycle commuter. After working a night shift, it was a winter night and I had to open the manual choke on the engine to start. The ride was at a slight decline into a valley with no reason to downshift until one elbow curve in town. Upon approach of the curve, I downshifted, but since the choke was still open, the motorcycle unexpectedly revved up and took off past the turn. I relied on practiced maneuver to dump the motorcycle, but when do I make the move? Too early, I would tumble on rough terrain, too late I would be decapitated by a low guy wire. I calculated the escape vector, held on some milliseconds and then dumped the motorcycle, bending into a tuck and rolled. Was I lucky? I had been prepared by having practiced dumping a motorcycle, I found the right opportunity to make the maneuver at the right location. Can you be lucky to get a highly competitive job of your dreams? The preparation of the right experience, education and focus on hire-ability is brought to an opportunity of monitoring employers for growth and having a likeable interview. Building a world class team requires a Project Manager's continual preparation and constructing the opportunity to attract and keep talent. This paper presents the elements of practice for a Project Manager to build a world class team, from the tenets of preparation and opportunity – luck.

The preparation of a world class team is a simple set of behavior skills which defines what a world class team would look like. With a client to serve, the team member has to be completely accessible through several means and being direct with the client to say "The best way to contact me is ....", and to always answer the call. One most often repeated positive review by a client is how responsive the team member is to requests. This behavior will distinguish an individual from others more often than the effort

requires.

Listening skills are the most powerful asset a team member can have, but to also promote listening opportunities by being attentive. Attentiveness is achieved through engagement both formal and casual. Sincerity and a genuine interest in a client are one of the most difficult requirements of a world class team as it means some measure of vulnerability. Separate from the basics of listening skills, including; avoiding interruption, making direct eye contact, nodding acknowledgement, and taking notes shows the team member has heard and captured the message. A good practice during listening is to make it a goal to formulate questions, even if for background or interest sake. This goes a long way to start building a relationship where the team member demonstrates they care.

The team member takes a position that there is more to the job than fulfilling what the job function requires, but what is required for the customer relationship. This relationship building means maintaining interest in helping the client look good. Preparation of the client relationship readies the team for any opportunity requiring trust due to having paved the path to accessibility and readiness to respond. A client will turn to the team that relates to their goals and objectives, demonstrating common understanding and a ready position to provide a solution.

A narrow view of team members who resort to the “that’s not my job” excuse, only serve to negatively impact the cohesiveness of the team. A prepared team will have staff who are quick to fill any observed gap in performance by anyone on the team. This supports a transparency where the client only sees the objective being met without knowing how the team adjusted to the need.

The common term to try to distinguish a team is innovation. This claim to being innovative is suffering fatigue and only applies to a practice of improvements. The Project Manager can prepare the team for imaginative thought and to dare to advance toward what would have been impossible and seed the client’s mind to create rather than modify.

The preparation to be client oriented and to practice this as a core skill takes the team to a level of performance that sets the culture for the team. The client is not only the paying client, but each member of the team is a client. Applying the same service to the teammate elevates and broadens the team as an organization of complete awareness and connected as a network of performers.

The Project Manager fills in the world class team through hires. The basic job description is not reviewed in the interview as the ultimate qualifying criteria, but the challenge is to present the job as the opportunity available to the candidate. The Project Manager addresses the talent application by explaining why what the candidate is going to do is important. Often, the interview lacks the background explanation and misses the opportunity for the candidate to visualize the greater enterprise and where they would fit. Presenting the opportunity where the objective for the candidate would become qualified and primed for their next job can be an option of high interest. The opportunity to receive real-time mentoring, receiving adjustment suggestions and tuning tips will quickly reveal demonstrated results. The team member, as a lead, will have ownership with autonomy, able to make important decisions, build their own teams and take the same approaches of the Project Manager to their teams.

The Project Manager encourages opportunities for the team member to get the most visibility time in with all stakeholders. This affords the opportunity to showcase leadership and representation of the team’s efforts. This also allows for the direct client relationship to occur through frequent interaction.

A final discussion with the candidate is the opportunity to have access to strategic discussion and be mentored in the process of increasing value and growth. The access to mature knowledge and proven experience is a rare feature but ensures world class quality.

The personal qualifications a Project Manager looks for in potential world class candidates include being process advocates and demonstrate an innate quality emphasis with their performance, as well as of others. Having had lessons learned from lack of process and weak quality standards allows for advocacy with the client and teammates. Soft skills are important and while there are so many that are espoused, one behavior can collectively validate a mastery of soft skills, and that is asking for feedback. Demonstrating a desire to improve and a readiness to adapt requires all the ancillary soft skills to make this happen.

A world class team member is inspirational in thought and action. To imagine the successful outcome and putting personal energy into an expressive and positive possibility with excitement is contagious.

Finding a candidate that will credit the team and avoid taking personal credit is important to the function of the entire team. The scrutiny of the behavior of the team leads is observable not only by the team, but the client as well. While pride can be demonstrated, it should be for the team's accomplishments.

The process for developing a product includes, understanding the client needs, developing requirements, building a design and developing the product with simulation, testing and valid data inputs. The candidate should be able to identify risks across the entire process, document and monitor and be courageous in elevating risks.

Finally, while a soft skill, it cannot be overemphasized how important the ability to mingle, generate conversation, approach cold calls, and take advantage of making connections and building network is to add leverage to the team's outreach.

The world class team masters the skill of listening. This is more than just paying attention, there are more complex underlying elements to listening. Listening is viewed as an opportunity and requires assessment and strategic thought to make listening the active execution of performance. The team member has to quickly evaluate the listening window, the duration of the listening opportunity to map out techniques to get the message completely. Observing the cadence of the speaking and determining whether there will be multiple points presented, or one and the possible pause points to interject questions builds an early assessment of the best approach to balance listening and asking questions.

Depending on the amount of information being heard, some control for the rhythm of the conversation may be necessary and is a required skill of the team member. This is a subtle manipulation which is part of the consultative skills the world class team members possess.

In order to have the speaker feel the listener is engaged and actively listening, the simple gestures of nodding frequently and repeating back what was heard validates the speaker. This can be observed during the interview with the candidate. A further observation is in note taking, the keywords that appear as important to the speaker would be noted and referred again in the conversation.

The world class team member can filter out the nuisance talk and find gems in the conversation that reveal perceived problems, hint at worries and key off "nice to have" statements to develop into future opportunities.

The daily practices which become habit for the team member include capturing information, what was heard and keep validating by echoing back in verse and text.

This is the re-retain to re-serve approach. Immediately sending acknowledgement of receipt of all email, limiting the email chain provides positive responses and lack of delay in resolving issues. Another strong habit is to keep a journal and organize the entries using indexing, keywords and representative doodles. A unique habit and inherent thought process are to constantly seek what defines “What does success look like?” Probing the stakeholders to navigate to this end is a mark of world class distinction. Most companies have a values statement which define the structure of the expected behavior of the team. The world class team demonstrates these values by identifying opportunities to play out the values, promote them with attention and document them in performance reviews.

One facet of the world class team is the use of vision in an effective manner to guide progress. Historically, leaders feel obligated to create a vision statement, but tends to be a cut and paste exercise, canned to fill the space, and done by the obligatory stuckee. The vision statement is presented and displayed on a powerpoint chart and on the webpage but is not heard spoken outwardly as part of the team vernacular.

The Project Manager of a world class team constantly returns to the vision statement as the guideline during execution. Vision is communicated as a visual impression and something that is tangible and physically performed. A vision is a direct result of the finished program deliverable and representative of the effort to do so.

One instance when I worked for the Department of Labor, I built a team that would finally migrate a system from a mainframe to servers. Previous companies had failed. I briefed the team on expectations and described a vision of having a celebratory party where there would be a scaled-down model of the mainframe and we would be giving the government manager a hammer and watch her destroy the mainframe model. Not only did the team deliver ahead of schedule and under budget, then the hammer went flying and left a pile of splinters. The vision realized.

Here are sample real life vision statements, can you determine which company they belong?

- To help people and businesses throughout the world realize their full potential.
- **“for every person to use their unique experiences and backgrounds, together – to spark solutions that create a better, healthier world.”**
- To be earth’s most customer centric company; to build a place where people can come to find and discover anything, they might want to buy online.
- Will lead the future mobility society, enriching lives around the world with the safest and most responsible ways of moving people. Through our commitment to quality, ceaseless innovation, and respect for the planet, we strive to exceed expectations and be rewarded with a smile.

These are the vision statements from Apple, Johnson & Johnson, Amazon and Toyota, respectively.

One of the first things to occur between the Project Manager and the team is to discuss expectations. This lays the basis of understanding of the relationship with the Project Manager and where to meet or exceed expectations during execution. The first expectation is to accept and practice empowerment. The team member is responsible for further team building and making decisions, owns the plan and the budget and is expected to beat schedule and perform under budget and use surplus for overachievement. The expectation to own problems and use all resources available to resolve and only when the only last measure is to get the Project Manager involved, the team can plan for intervention. The team member is expected to keep the pulse of the

morale of the team, organize team building, lead by example in participation of employee events. Remembering that people are THE asset and must be well taken care. Any client concerns are taken seriously and handled expeditiously. The world class team always has a plan B, and has means to develop get well plans, if needed. To communicate effectively, the team must think about communication in terms of the receiver not the sender. To claim communication occurred, is flawed as describing it as a message being sent. The true evidence of successful communication is in the receipt of the communication and the correct understanding of the communication.

Risk identification is an important expectation of the team and should be heard in every solution conversation. The risk statements should include the condition of the circumstances, the action that may occur and the impact. The likelihood of the condition being met should also be well communicated. Further, the following re-planning should already be discussed and considered for any additional resources. When allocating time to discuss status of events such as a daily status meeting, time allocated for risk discussion should be included.

The more recent management technique of failing forward really elevates what I have always attributed to the strength of American engineering. Throughout the academic journey and any competitive activity, we have subtly been expected to accept failure as a part of the learning experience. While there is no programmed fear of failure, cost pressures do not encourage failing scenarios as a part of product development. I have always planned for failure and right off the top, reserve budget to expend on failure recovery. The world class team knows that it can fail and still have support to recover, thus performing fearlessly, or failing forward.

Given the expectations above, the team can also expect constant feedback. Upon joining the team one of the first things that the Project Manager talks to the team member about is to expect to get feedback real-time. The team member knows some adjustment is needed and talked about immediately after an event, when the Project Manager says, "Can you come see me, I have some feedback?" The soft skill for the Project Manager is not to make the adjustment personal, but to talk through the situation and possible appropriate responses. The Project Manager can express any concern with "I felt like ...."

The Project Manager is always monitoring choice of words, decision results, and behavior. One phrase, often heard and corrected is when a lead says, "Hopefully we will deliver on time," or "I am hoping to make it work." This is an opportunity to adjust the thinking process towards a highly confident plan. The Project Manager response to this should be "We are not paid to hope."

Another flag in the word choice is saying "No," especially to the client. The answer should always be "Yes <,but>" to the client. While the first reaction may be "No" for all obvious reasons, but there is room for the not so obvious. Saying "Yes, but...>" allows for negotiation lead in.

Feedback in the form of speaking to consultative skills helps a team member grow with real world experience. Consultative skills are techniques to engender customer trust and likeability, reading and expressing body language and role acting. The Project Manager must be the expert at consultative skills to groom the team.

While focus so far has been on the team, there is the Project Manager who really is the Leader. This is a role, which most of the skills as a leader can feel natural and some learned. The world class team includes the world class leader which encompasses multiple and unique roles. This includes being the Enabler, having authority and influence and license to remove obstacles for the team. Further, examining how

bureaucratic processes and procedure can be a distraction and alleviating these from the team. The Visionary is the voice that tells the team WHY what they are doing is important. The Strategist designs the future path with a series of winning tactics using the talent, budget and growth opportunities. The Evangelist advocates for the team and the mission, maintaining momentum on the circular achievement of increased capability from new opportunity to increase capability. The Last Responder in being approached with issues that could not be resolved by the rest of the team and always leaning forward towards the positive win-win result. Given the challenges of the last-minute problems, making decisions without hesitation. Assurance to the team of thoroughness and full consideration by listening to both sides of stories.

The Project Manager must be bold with encouraging can-do attitude, courageous in addressing her own fear and challenging others' fear, an actor is playing out the roles separate from their true self, but anchored by their true self-belief, very approachable with sincere gratitude for any dialogue, being able to handle the loneliness at work as perceptions can go viral and be tireless as if each encounter is the most important.

Do you feel lucky enough to be on my world class team? I would be lucky to have you.

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## Building an Award-Winning, Metrics Based Program Management Office

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### Abstract

A unique approach to program and portfolio management that relies heavily on data and metrics to drive program outcomes led to DC Water's IT PMO winning several excellence awards, including the prestigious Project Management Institute PMO of the year award. While the PMO tracks over 70 different metrics for the many areas the PMO is responsible for, this paper focuses on how the PMO utilized and applied metrics to the demand, portfolio, estimation, and risk management disciplines to predict program outcomes and drive results. We discuss both the key metrics tracked in each discipline and how we apply probability density functions of beta and binomial distributions to better forecast and predict the outcomes.

## Building an Award-Winning, Metrics Based Program Management Office

Program Management Offices have become essential to organization's business transformation efforts (Dai & Wells, 2003) and are central to ensuring that the work an organization undertakes is aligned to its strategy (Andersen, Henriksen, & Aarseth, 2007). As organizations take on more transformation initiatives, they have come to rely heavily on PMOs to ensure the "right" initiatives are being executed the "right" way so that the "right" business outcomes are realized to make the transformations successful (Bible & Bivens, 2011).

A key aspect of DC Water IT PMO's approach to ensure these initiatives are successful is to incorporate predictive metrics in each of core process in the initiative lifecycle, from when a request for a new initiative is made and evaluated (demand management), to how its prioritized and funded (portfolio management), to how it is executed (program, estimate, risk, issue, quality, stakeholder management etc.) and, how program outcomes are measured (benefits realization). This paper will focus on the metrics, why they were chosen, how they were applied and how they help drive program outcomes.

### Demand Management

The demand management process kicks off when anyone in the company creates a request (aka "opportunity" in DC Water lingo) for some sort of product, service, or assistance. The opportunity is then reviewed by IT managers to ensure that the request is not out of the norm. Once approved, a business analyst from the PMO is paired with the requestor to develop a preliminary feasibility analysis that documents the business need/problem statement, viable solutions, estimated costs, and timelines at a high level to determine if the opportunity is worth pursuing. If promising and exceeds a predetermined threshold, then the business analyst continues to work with the requestor to develop a detailed business case that determines whether the opportunity helps move DC Water's strategic plan forward by mapping its business objectives to the company's strategic objectives and ensuring a return based on a 4.3% hurdle rate over a 5-year horizon. DC Water requires all business cases have objective measures that serve as a benchmark for benefits realization. The Enterprise Steering Committee (ESC)<sup>1</sup> reviews and approves both the preliminary feasibility and business case. Once the business case is approved, the opportunity becomes an official program or project.

Within demand management, there are two types of metrics; (1) operational metrics that measure how efficiently opportunities are evaluated and, (2) strategic metrics that measure whether we the demand management process is selecting the "right" opportunities that realize the stated benefits. Table 1 below lists the key metrics in demand management:

*Table 1: Demand Management Key Metrics*

Key Metric	Description	Type	Target Value	Current Value <sup>2</sup>
Total time to approve	Median time (in days) it takes to get an opportunity approved as a program/project from initial submission	Operational	45 business days or better	40.4 days
Feasibility approval time	Median # of days it takes a feasibility study to get approved	Operational	14 business days or better	13.5 days

<sup>1</sup> The ESC is comprised of the senior executives who evaluate feasibilities and business cases and approve funding for opportunities. They also set the annual funding thresholds for the PMO program portfolio.

<sup>2</sup> As of March 2020

	or rejected from the time an opportunity is created.			
Business case approval time	Median # of days it takes a business case to get approved or rejected from the time an opportunity is created.	Operational	25 business days or better	23.2 days
% of opportunities rejected	Tracks the % of opportunities that are rejected or cancelled.	Operational	Between 30 - 35%	38%
% of approved programs & programs w/business case and/or feasibility	Tracks the % of approved programs with a business case of feasibility	Operational	75% or better	89%
Demand management effectiveness	% of approved programs or programs that realize 1 or more measurable benefits in 2 years after implementation	Strategic	70% or better	86%
Strategic Alignment	% of approved programs or programs that fully align with at least 3 of the 6 DC Water strategic objectives <sup>3</sup>	Strategic	65% or better	73%

The first three metrics are designed to measure how quick and efficient the process is at getting opportunities approved. The metric that measures the percentage of opportunities that are rejected is intended to calibrate whether the process is weeding out the “wrong” opportunities. We have found the optimal range to be between 30% and 35%. Anything below indicates that the process may be letting through opportunities that it should not while anything above may indicate the ESC is being too aggressive and may be rejecting worthwhile opportunities. The idea behind the metric that tracks the percent of approved programs and programs with a feasibility and/or business case is to gauge the how frequently the ESC exempts opportunities from going through the rigor of the feasibility analysis and/or business case to ensure that the process continues to be followed in most cases and that we have documented the exceptions.

The demand management effectiveness measure gets to the core of the process by ensuring that the stated benefits in the business case or feasibility analysis are being met once the program has been implemented. The 70% benchmark was established by reviewing benefit realization rates for completed programs since 2015. The goal is to raise this to around 90% in the next two years. The other core metric is “strategic alignment”, which is designed to ensure that the process is driving towards making sure that the opportunities are correctly mapping<sup>4</sup> to strategic objectives. This is how we ensure that we are selecting the “right” work.

<sup>3</sup> See this [link](#) for Dc Water’s strategic objectives.

<sup>4</sup> Strategic objectives as outlined in the DC Water “BluePrint” strategic plan for FY 2019 - 2024

### Portfolio Management

At the beginning of each fiscal year, the ESC allocates CAPEX funds for IT programs through the regular company budgeting process. With the funds allocated, the ESC goes through prioritization of all approved and active programs to determine which ones get funded (AKA “above the waterline”). To prioritize, the ESC uses ranking criteria, developed with the PMO’s help, that are based on DC Water’s strategic goals, financial return (NPV, ROI, payback period etc.), program performance (schedule, cost, quality, etc.), individual program risk and program cost. Each approved program is ranked against these criteria (via voting by each ESC member) to come up with a ratio-scale, absolute score. This score is what is used to rank the program.

The ESC then allocates funds to the highest ranked programs until they run out. Any program not funded will move to “below the waterline”. When a new program is introduced during the fiscal year, all programs that have not started are re-prioritized using the same process. If the new program ranks higher than any program above the waterline, the ESC will either provide additional funding or adjust the priorities to achieve the desired portfolio. This process removes most of the subjectivity that we would otherwise encounter when trying to rank programs. The criteria themselves are weighted and ranked by the Board of Directors.

We use the Analytical Hierarchy Process to rank both the criteria and the programs because it was simple to implement within our PPM software tool and is easily understood by senior management and the board of directors (Saaty, 1980). In addition to prioritization, the PMO ensures that other portfolio constraints such as dependencies between programs (finish-to-start), grouping constraints (e.g., programs), coverage among strategic objectives (i.e., each strategic objective must be fulfilled by at least one program in the portfolio aka “balanced scorecard”) and portfolio risk are accounted for.

Once a program is implemented, the PMO works with the DC Water performance management office and the program sponsor to track and measure the key metrics that determine whether the benefits outlined in the business case are being realized. The metrics tracked by the PMO for portfolio management also fall in to the operational and strategic categories. Table 2 below lists the key metrics in portfolio management:

*Table 2: Portfolio Management Key Metrics*

Key Metric	Description	Type	Target Value	Current Value
% of completed programs with measurable benefits	% of programs that realize 2 or more measurable benefits within 2 years after completion	Strategic	70% or better	67% <sup>5</sup>
% of programs that meet financial return targets	% of programs that meet or exceed their financial performance (NPV & ROI) targets in their business cases 2 year after completion	Strategic	75% or better	73% <sup>6</sup>
Portfolio cost performance	Annual portfolio budget delivered within acceptable range.	Operational	Within ± 5%	1.2% over budget <sup>7</sup>

<sup>5</sup> Starting with FY19 (Oct 2018 – Sep 2019) portfolio

<sup>6</sup> Starting with FY19 (Oct 2018 – Sep 2019) portfolio

<sup>7</sup> For Fiscal Year 2020. Fiscal Year 2019 = 3.7% under budget, Fiscal Year 18 = 7.7% under budget

Portfolio Return	ROI of any given annual portfolio is positive over a 5-year planning horizon	Operational	All portfolios must have positive ROI	No Data
Portfolio Risk	The sum of expected losses for the individual programs in the portfolio compared to the total portfolio planned cost	Operational	8% of total portfolio planned costs or less	6.3% <sup>8</sup>

The goals for portfolio management are to ensure that the “right” programs selected during demand management are objectively prioritized, funded, and various constraints applied to ensure an optimal portfolio (Markowitz, 1952)

The first metric is similar to the demand management metric that measures the % of programs that realize at least one measurable benefit. Here we make the baseline more stringent by requiring at least two benefits be realized.

The financial return metric is straightforward as it requires that 75% of programs meet or exceed their NPV and ROI targets set in their business cases within 2 years. We picked these two measures because they are the gold standard for evaluating investment performance (Baker & English, 2011). The portfolio cost performance metric is also straightforward in that it requires that the actual cost of the portfolio come within the acceptable range.

The portfolio return metric measures the ROI of the *entire* portfolio and requires it to be positive over the 5-year planning horizon. This is one of the key portfolio management metrics as it measures how well the PMO is managing DC Water’s investment dollars. The portfolio risk metric is another key portfolio management metric in that it measures how risky the combination of programs in a portfolio are. Through quantitative risk analysis (Ekelhart, Fenz, Klemen, & Weippl, 2007) on individual programs and our ability to utilize our historical risk database, we can calculate the expected losses<sup>9</sup> for the entire portfolio based on the risk profiles of the individual programs in the portfolio.

The PMO also tracks other metrics related to how well the portfolio is resourced and metrics that compare how well individual portfolios perform against each other.

### Estimate Management (Schedule & Cost)

Most PMOs approach cost and schedule estimation in a linear fashion, i.e., review the scope of work and provide a discrete estimate. But our experience shows that rarely does this estimate materialize. At DC Water, we introduced probabilistic estimation where the program teams provide an estimate along with the confidence level (usually at 95% or better) on which the estimate is based.

To enable probabilistic estimation, we collect data on actual durations, effort hours and costs for programs, projects, and tasks in our estimates database. We also categorize by measures like project/program type (COTS, Infrastructure, App Dev or Business Process), program size (<\$100K, \$100 =< x =< \$500K, \$500 =< x =< \$1M, and >\$1M), methodology (Agile, Waterfall, Hybrid), risk profile (sliding scale of expected vs actual loss), task phase, and task technical complexity. We also collect estimates developed by the team in the database and those are categorized the same way. We can produce  $\beta$ -distributions<sup>10</sup> for durations, costs and work

<sup>8</sup> For Fiscal Year 2020. Fiscal Year 2019 = 9.1%, Fiscal Year 2018 = 12.3%

<sup>9</sup>  $P \times \text{Estimated Loss} = \text{Expected Loss}$  where  $p$  = probability of a risk occurring

<sup>10</sup> Research has shown that  $\beta$ -distributions (as opposed to normal distributions) are better representations of durations, costs, and effort hours because most projects and programs rarely come in under budget or ahead of schedule

effort that we can further drill down by the categories above. Figure 1 below is a  $\beta$ -distribution of actual durations for App Dev programs and projects (n=108):

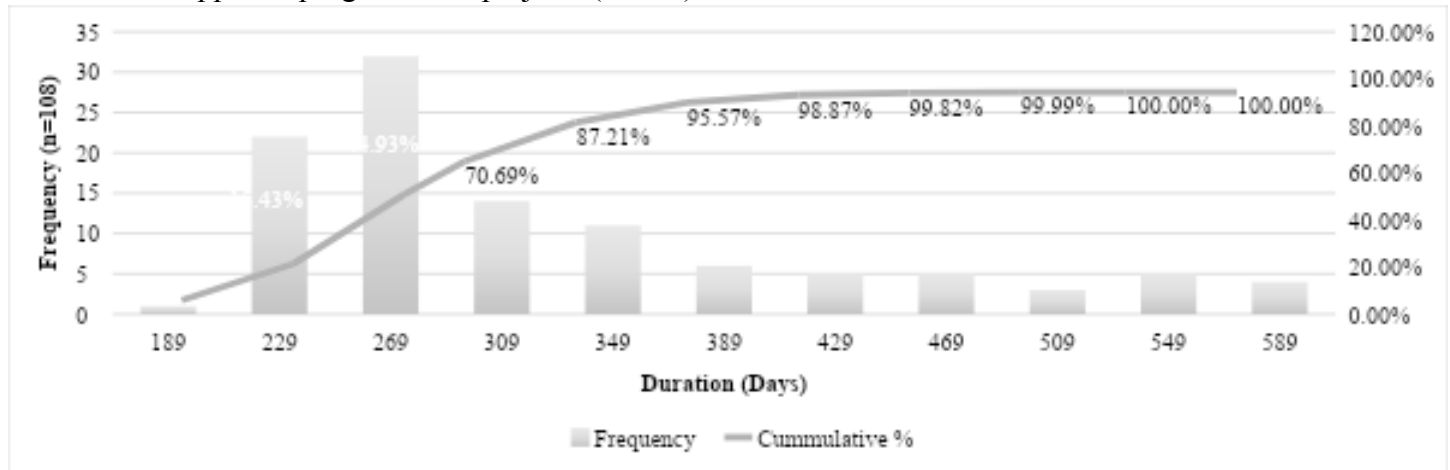


Figure 1: Frequency Distribution of Program Durations

The mean duration is 308.42 days, standard deviation is 102.63 and median duration is 267 days. Our PPM tool tracks the cumulative % for any subset of the data and can calculate how reliable an estimate is based on this. For example, using the above dataset, if an App Dev program or project has a total estimated duration of 269 days, the data tells us that the probability of that estimate coming in at 269 days (or less) is about 45%, or slightly worse than a coin toss. If this is a critical program, these are not good odds. Increase the estimate by 80 days and the odds go up to 87% which is better but not where you want to be for a critical program (90 – 95% is the standard for DC Water).

Not only is this a good tool for a PMO to use to guard against unreasonable or arbitrary deadlines, but it also serves as a baseline for the PMO that can be continuously improved upon. The goal is to reduce the “long right tail” to the point where the cumulative % is much closer to the mean by working to reduce the durations of individual programs, in other words, managing programs better. Figure 2 below is a  $\beta$ -distribution of actual costs for COTS programs and projects (n=125):

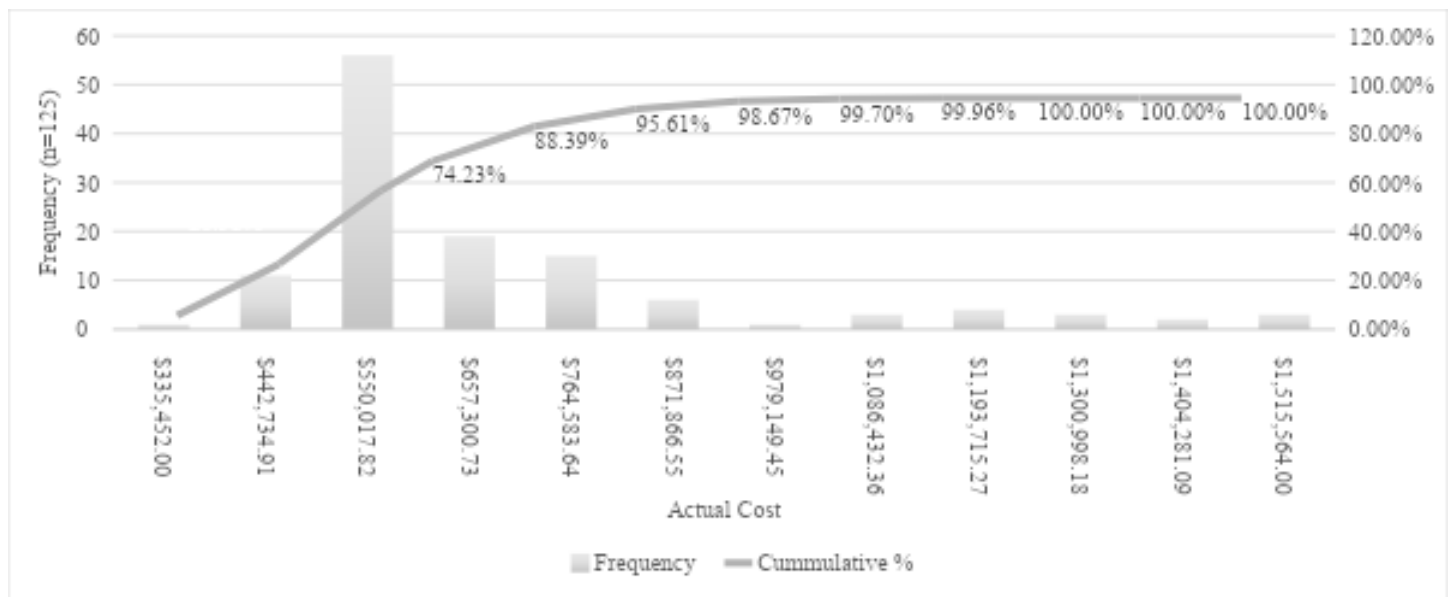


Figure 2: Frequency Distribution of Program Costs

The mean, standard deviation and median are \$633,762.57, 259,427.28, and \$540,431.00, respectively. We see a similar pattern as in figure 1 where the distribution has a long right tail and the highest frequency data is concentrated to the left. Like durations, this is a great tool to validate estimates and as mentioned before, the PPM tool used by the PMO automatically calculates the cumulative % for any subset of the data and can calculate how reliable a cost estimate is based on this dataset. The PMO applies the same procedure to the phase or task level in a program's work breakdown structure to estimate how much certain tasks should cost and how long they should take to complete.

The PMO also tracks the error (variance) between estimates and the actuals to determine how severe estimate misses are. The goal is to reduce this error to no more than 10% (i.e., 90% accuracy at the project or program level). The current error as of the end of fiscal year 2020 is 37%, so we have ways to go.

### Risk Management

Like schedule & costs management, the PMO has a risk database that contains all risks that occurred (fired) and did not. We have this data on active, completed, and cancelled programs. These risks are categorized in a hierarchy with the top level consisting of four categories (external, organizational, program management and technical), each with several sub-categories. During qualitative risk analysis (Emblemsvag & Kjolstad, 2006), the program team reviews the database of risks that fall into the same category as the risk being analyzed to determine the probability of firing. Like schedule and cost estimation, the PPM tool is configured to calculate the confidence level of the likelihood of the risk firing using the underlying risk database. The process is like the one discussed in the estimation management section of this paper with the difference being the distribution function (binomial vs. beta). This is because risks have two mutually exclusive outcomes, either they fire, or they do not.

During quantitative analysis (on risks with high probability as determined by the process above and high impact as determined by the program team), the program team estimates the loss (in dollars) the risk might have to the program if it were to fire, then they multiply that by the probability determined in qualitative analysis to come up with an expected loss. The PPM tool adds up the expected losses of all the risks on the program and then discounts that by an error factor that corresponds to the number of risks that have fired historically compiled from the risk database. The result is a risk rating (in dollars) for the program that is used by the PMO



to compare amongst programs as well as to set contingency budgets. The expected losses for the multiple programs managed by the PMO are rolled-up to the portfolio which is combined with other factors to calculate the portfolio risk rating and to help set portfolio contingency. Table 3 below lists the key metrics we track for risk management:

*Table 3: Risk Management Key Metrics*

Key Metric	Description	Type	Target Value	Current Value
Program risk rating	The program expected loss as a percentage of the total budget.	Operational	6% or less	Varies by program
% of programs that within risk rating thresholds	% of programs that are within the 6% risk rating threshold	Operational	70% or better	79%
% of program risks with “high” rating	The % program of risks with a score of 3.20 or above on a scale of 0.00 to 5.00	Operational	15% or less	Varies by program
% of programs that within “high” risk rating thresholds	% of programs that are within the 15% “high” risk threshold	Operational	20% or less	13%
% of program risks with “high” rating attached plans	% of program risks with “high” rating that have a contingency and/or mitigation plan with assigned resources	Operational	3% or less	Varies by program

The program “risk rating” metric is the most important for the PMO to measure risk because it quantifies the potential losses to the program and the organization. It is much easier to have a conversation with senior executives about program risks because the PMO can show exactly how much is on the line if risks fire. We have found that programs with a cumulative expected loss that is 6% or less of the program’s budget usually have better outcomes in our environment. Other studies have shown that quantifying risks and setting thresholds is the ideal way to correctly manage risks on programs and in other settings (Basak & Shapiro, 1999).

The program risks with “high” rating metric track the number of risks that require quantitative risk analysis and ensuring creation of contingency and mitigation plans for these risks. While this metric is intended to drive down the number of risks in this category, program teams are incentivized to identify risks that fall into this category to ensure that the PMO can focus on the most important risks.

### **Final Thoughts**

The DC Water IT PMO is at the forefront of innovation around applying statistical methods to traditional program and portfolio management. In addition to the metrics and methods discussed in this paper, the PMO is applying similar principles to program and product quality management, stakeholder management, resource management, procurement management, lessons learned and continuous process improvement disciplines. The PMO will continue to innovate in these areas to further drive program outcomes and positively contribute to DC Water’s continued success.

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# **Illegal and Unethical Conduct by Stakeholders in the Context of Construction and Civil Infrastructure Development Projects**

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## **Abstract**

A countless number of projects are being undertaken across the globe at any time in the crucial field of construction and civil infrastructure development. Over many decades, and even centuries, these projects collectively have both profoundly influenced as well as immensely improved the quality of all our lives. At the same time many of these schemes were plagued by controversies before, during and sometimes even long after their completion. One major source of controversy revolves around illegal or unethical actions and conduct of their stakeholders. These take place at the expense of projects and conflict with the legitimate interests and concerns of other stakeholders. From false promises and assurances, to cases of fraud, nepotism and corruption, to violent incidents of intimidation such actions and conduct span a broad spectrum which, although widely known and often reported about, appears to have attracted little if any systematic analysis in the project management research community.

Based on an extensive study of literature available in the public domain and interviews with project practitioners, and their own knowledge and experience, the authors discuss in this paper with the help of several examples some of the more commonly encountered illegal and unethical actions and conduct by stakeholders which in practice have historically overshadowed and today still continue to cast a deep shadow on projects in the construction and civil infrastructure development category. The authors also present their ideas and practical suggestions as to how such problems can be addressed by project executives. The authors firmly believe that by systematically attempting to prevent legal and ethical transgressions from occurring and effectively and promptly addressing them if and when they do occur, projects are more likely to succeed than otherwise and can move closer towards achieving a win-win solution which can immensely benefit both them as well as their stakeholders.

## **Introductory Comments**

For this research the authors have reviewed data which is available in the public domain on over two dozen large construction and civil infrastructure development projects

across the globe. The focus was primarily on projects undertaken and completed in the recent past. Projects in both developed as well as developing countries were selected for the review and these spanned various categories associated with construction and civil infrastructure development schemes including logistics and transportation, energy, water resource management, and mining.

This paper is divided into three parts. Part one discusses laws and ethics as two distinct yet very closely related concepts which both possess immense relevance for all projects regardless of where, when and by whom they are undertaken. They assume special significance for large construction and civil infrastructure development projects which are highly complex undertakings typically characterized by a large number of stakeholders, both in the primary and secondary stakeholder categories. The frequency, intensity, nature and time period of interactions which take place between such projects and their stakeholders offer many opportunities for occurrences of breaches of the law and/or ethical misconduct. Part two focusses on the types of often observed legal and ethical shortcomings which in practice occur on construction and civil infrastructure development projects and which were identified by the authors in their research for this paper. Several projects are highlighted for exemplification. Part three outlines a set of simple, practical and cost-effective ways and means by which projects can, especially from a preventative perspective, systematically attempt to address potential legal and issues.

The findings of this research can benefit project executives significantly by spreading awareness about the criticality of, as well as the considerable benefits stemming from, strict adherence to law and ethics on their projects, by pinpointing specific areas in which serious legal and ethical issues and shortcomings are often encountered in practice and by educating them about the effective mechanisms whose proper implementation can help prevent such issues and problems from occurring in the first place. Doing so can decrease project risk (including existential risk) and wastage of project resources and time, and the damage to reputation which would necessarily ensue from having to defend the project against allegations of legal breaches and ethical misconduct.

## **The Concepts of Law & Ethics in Project Stakeholder Perspective**

Laws have been laid down since ancient times and are presumably as old as mankind itself. They are not cast in stone but are location-specific and evolve over time as a result of myriad contextual influences, inter alia, societal transformation, shifts in public attitude and economic progression. Actions once considered socially generally acceptable and which were legal in the past may no longer be so in contemporary times. A classic case is the now universally shunned practice of child labour, a phenomenon which was common worldwide right until about the middle of the last century. Yet, despite being the focus of much concerted global eradication action in the past few decades, cases of child labour continue to crop up even today as the

occasional media reports and images of very young children toiling under hazardous conditions at project construction sites or in factories in developing countries lucidly remind us.

In terms of their scope, detail, strictness, discretionary space, implementational priority and penalty in the event of non-compliance, laws may differ, sometimes significantly, from jurisdiction to jurisdiction. For instance, laws which are applicable at the federal or state levels in the United States of America basically do not apply in another sovereign country. And vice versa off course.

Projects are not immune from laws. Laws apply as much to projects as they apply in non-project situations. The consequent practical implication is that projects are compelled to follow the relevant set of laws which are applicable to them in their own specific location or context. Sometimes there is the possibility of jurisdictional overlapping occurring such as mutually pre-agreed upon choice of alternative place of litigation should contractual disputes between stakeholders arise. Projects, therefore, do not operate on equal legalistic footing and some experience comparatively significantly more legal constraints than others.

Some laws in fact focus mainly on projects. This is especially evident for construction and civil infrastructure development projects which are embedded in an especially complex legal environment - notably more so in fact than projects in other categories. Construction and civil infrastructure development projects typically involve numerous organizations and groups of specialist individuals assigned a plethora of roles and responsibilities and tied to the project through a bundle of contracts. Contract formulation and administration assume great importance and failure on the part of contracting partners to meet their contractual obligations are oftentimes the focus of legal action in practice. Furthermore, projects in construction and especially civil infrastructure development involve acquisition and development of oftentimes enormous land spaces which inevitably sets them on a collision course with the natural environment and all living entities – communities, fauna and flora – already existing in these spaces. As public concern over the adverse social and environmental impacts of large-scale projects has grown over the years, projects in many places across the globe are encountering increasingly stricter legal requirements in numerous spheres, inter alia, public consultation, stakeholder engagement and respecting the rights of indigenous communities, bio-conservation, species and habitat preservation, environmental safeguards and the preservation of archeological and cultural heritage.

For this study the authors take a broad view of the concept of law which in their understanding encompasses not only the laws enacted through formal and prescribed procedure by federal, national, state or provincial legislatures but which also include the gamut of rules and regulations in the form of decrees, directives, ordinances etc. adopted by regions, counties, districts, municipalities, localities and so forth and which like laws also are enforceable and fully binding on projects taking place in their jurisdictions. As with violations of the law, failure by projects to abide by these rules and

regulations can result in serious consequences for them, on occasions even posing an existential threat.

Ethics, for its part, shares several fundamental commonalities with law. As an established branch of philosophy commanding growing interest, it too has a venerable tradition extending back at least to antiquity. Like law it holds relevance for virtually every sphere of life, such as, business and finance, medicine, media, politics, public administration, academia as well as programs and projects to name but a few. Both ethics and law overlap to a considerable degree. Two fundamental distinguishing features set ethics apart from law: firstly, while adherence to law is required at all times and violations if discovered and pursued are usually met with imposition of sanctions by the state on the violating entities in civil or criminal court, this is usually not the case in the event of ethical impropriety and, secondly, in our contemporary age law tends to exhibit a seemingly and comparatively faster rate of transformation than ethics over time. This is not to imply that ethics does not evolve over time which it can and obviously does. However, it is apparent that ethics does not exhibit the considerable level of variability across space which law evidently does and fundamental ethical principles and values also do not change as rapidly over time. At the same time, while peoples understanding of what constitutes ethical behavior and action is broadly consistent across space, there are culture-specific differences. What may be considered 'ethical' by many or even most people in one society may not necessarily be viewed as such in another. A case in point - and one frequently observed in practice - being the practice by project executives to award contracts to their immediate or extended family members resulting in them benefiting considerably financially or materially from projects. Whereas involving such entities may generally be frowned upon in western societies and viewed there as an undesirable practice because it smacks of favoritism which is deemed unfair and something to be avoided if and when possible, it may not be looked upon negatively in some other societies which take a more pragmatic view. There the reasoning could be that involving family members assures a relatively higher level of controllability over them due to their personal relationship which translates into consequently less risk and a higher likelihood of success for the project.

The nexus between law and ethics gives rise to a set of four distinct scenarios. For projects, these assume enormous and fundamental relevance as all actions, situations, events, interactions, behavior etc. involving the project stakeholders, both primary and secondary, over the course of the entire project life-cycle can be distributed among these scenarios which are:

*Legal & ethical:* Here stakeholder actions etc. over time are in strict observance of the law and they also respect ethical principles and values. This is the best of the four scenarios for the project and for its stakeholders. It reduces unnecessary, potentially serious risks to the project and steers it clear of public controversy. It also embodies good project stakeholder management and engagement and takes all stakeholders' respective interests into account and seeks to promptly, fairly and effectively address their legitimate concerns about the project.

*Legal & unethical:* in this scenario stakeholder actions etc. stay within the limits of the law but conflict with ethical principles and values. A good example is the payment of the minimum wage to project employees by a well-established and successful construction company. Though the minimum wage is permissible under law it can be viewed as inappropriate in ethical perspective if the company is in a long-term financially strong position and commands the resources to comfortably pay its workers a wage higher than the legally permitted minimum. The excessive and unjustified use, or misuse, of the instrument of eminent domain by governments is another example where law and ethics collide.

*Illegal & ethical:* This is perhaps the rarest and most unusual scenario encountered in the project context. Here stakeholder actions etc. fall afoul of the law but evidently do not conflict with ethical principles or values. For example, the law in country X may prohibit the import of personnel safety equipment used on construction activities from overseas, preferring to rely on and supporting domestic equipment manufacturers, although imported equipment may be comparatively superior to domestically produced ones, and assure users a higher standard of safety. If the project opts to acquire and use imported equipment at its site surreptitiously this would certainly constitute a violation of the country's law but it would not transgress ethical boundaries as the physical safety of its employees working on site assumes a higher priority on the ethical spectrum than the safeguarding of corporate interests.

*Illegal & Unethical:* This is definitively the worst scenario and in the best interests of the project must strenuously be avoided at all times. Public disclosure of such actions etc. by primary and secondary stakeholders - which are witnessed frequently in the context of large construction and civil infrastructure development projects - may not only generate immense negative publicity but can also culminate in strong legal or public administrative action against the project. In the extreme case this can lead to the premature termination of the project and overshadow future projects involving stakeholders found to have been indulging in such practices.

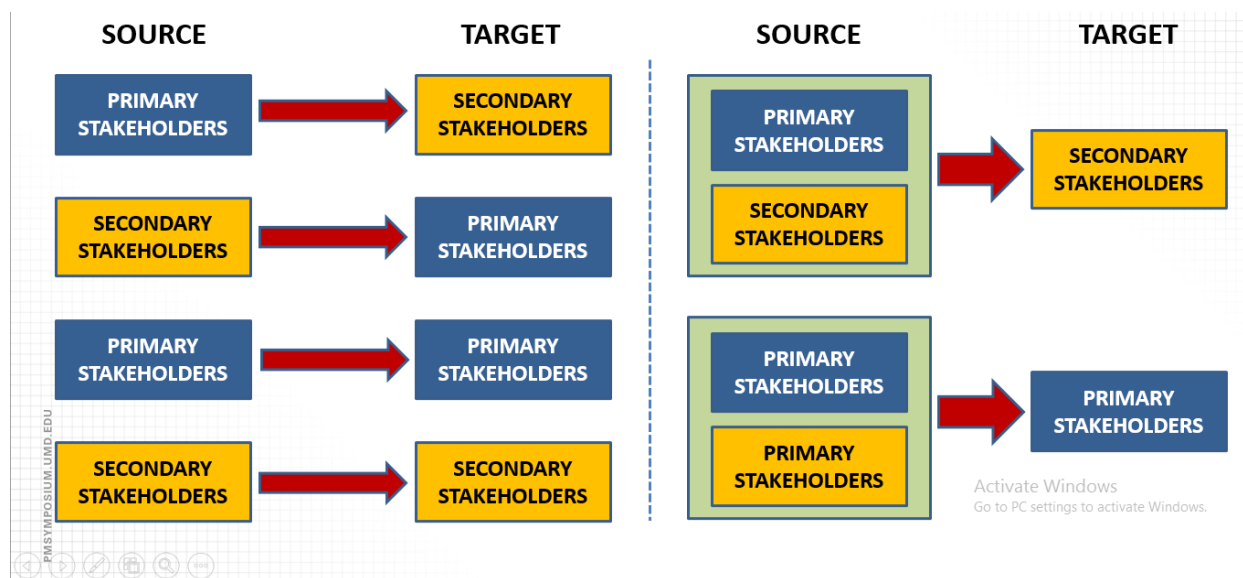
## **A Scenario-Based Approach for Analyzing Illegal and Unethical Conduct by Project Stakeholders**

To examine illegal actions and/or unethical conduct involving stakeholders occurring on construction and civil infrastructure development projects more systematically and specifically, the authors propose the following simple analytical framework based on the findings of their research for this paper as well as their decades-long study of and personal experience with projects. This framework encompasses six distinctive scenarios involving the two main stakeholder categories found on all large construction and civil infrastructure development projects, namely, the primary and secondary stakeholders. The difference between these two stakeholder categories lies therein, that primary stakeholders all have assigned roles and responsibilities on projects based on some contractual obligation or legal responsibility binding them to the schemes while

secondary stakeholders do not have such formal links to projects but are affected by them positively or negatively and financially, materially or in some other way or ways over time. Examples of primary stakeholders are the project owner or client, project manager and team, project consultants and advisors, financiers, contractors and subcontractors, vendors, and government bodies actively participating in projects; examples of secondary stakeholders are local communities and individuals, civil society organizations, media, academia and government bodies not actively participating in projects.

Depending on context, situation or circumstance during the project life-cycle, primary and secondary stakeholders both may serve as the source of illegal actions and/or unethical conduct directed against each other as well as against stakeholders within their own respective categories. Primary and secondary stakeholders can also jointly target other primary or other secondary stakeholders on occasions. The scenario-based analysis can be shown with the help of the following illustration:

**FIGURE 1: Sources & Targets of Illegal/Unethical Stakeholder Actions & Conduct**



**Source: Developed by the Authors**

Scenario 1: Primary Stakeholders (Source) → Secondary Stakeholders (Target): In this scenario Illegal actions and unethical conduct by primary stakeholders has a negative effect on secondary stakeholders. In the worst cases, the adverse consequences of such actions and conduct for the secondary stakeholders effected can be multi-faceted and enduring for a long time. This scenario is very common on large construction and civil infrastructure development projects. Common manifestations observed in practice include the display by project executives of a callous, uncaring and dismissive attitude towards secondary stakeholders and overlooking the opportunity to closely



communicate or consult with them about the project, intentionally misleading secondary stakeholders by understating the project's negative impacts and overstating its positive impacts on them, and failing to provide them with preferential job, investment and other opportunities on the project.

More serious manifestations include ignoring potential health, safety and other hazards which may result from the project as has on several occasions happened in the case of mining projects where contamination of the drinking water sources of local communities occurred culminated in severe illness. Also, many disturbing cases have come to light where secondary stakeholders were refused adequate compensation for the financial, material and other consequential losses experienced by them because of large construction and civil infrastructure development projects or where payment of compensation was delayed for an excessive period of time. Several highly publicized cases have come to light in recent years where projects resulted in the encroachment of land of indigenous tribes (such as oil and gas pipeline projects in the United States of America and Canada) or destruction of sites of cultural or spiritual importance to secondary stakeholders, the demolition of two 46,000 years old aboriginal cave sites in Australia by the Rio Tinto mining corporation in 2020 being a sad case in point. Oftentimes, and with a view towards suppressing opposition, construction and civil infrastructure development projects go hand in hand with the application of strong-arm tactics, usually in connivance with state entities and not infrequently having fatal consequences. Several documented murders of environmentalists, especially in the Latin American project context, aptly demonstrate this disturbing phenomena which is displaying an increasing trend with time.

Scenario 2: Secondary Stakeholders (Source) → Primary Stakeholders (Target): Illegal actions and/or unethical conduct directed by secondary stakeholders against primary stakeholders are also frequently experienced on large construction and civil infrastructure development projects. For projects this can result in cost and schedule overruns, unwanted scope or design changes and in extreme cases even their premature termination with the heavy financial losses and reputational damage this entails.

Illegal and unethical actions and conduct by secondary stakeholders also cover a broad spectrum of manifestations ranging in intensity from the mild to the serious. Milder ones include reneging on assurances, commitments and promises of support for projects prior to or in the pre-execution phase of their life-cycle, failing to prevent or help prevent avoidable losses to projects by withholding crucial information, unfairly tarnishing the project's image through disinformation, pursuit of excessive compensation for losses experienced or pursuit of fraudulent compensation claims. For instance, in the case of the Lyari highway project in Pakistan's largest city Karachi, the powerful land mafia allegedly settled groups of people in the area earmarked for the highway's construction in order to acquire relocation compensation.

Sometimes influential secondary stakeholders seek to gain personal benefit or benefits for their immediate or close family members from projects and as a means of pressure resort to subtle blackmail by hinting at administrative, political or other practical hurdles placed in the way of projects if their demands are resisted. Secondary stakeholders have on several occasions demonstrated an inclination towards violence, causing significant material losses through vandalization of construction and civil infrastructure project sites, facilities, machinery and infrastructure, and in more serious cases, resorting to verbal and physical intimidation and even kidnapping and murder of primary stakeholders. This has been particularly apparent in states having strong and active insurgent movements, such as Afghanistan, India, Iraq, and the Phillipines.

Scenario 3: Primary Stakeholders (Source) → Primary Stakeholders (Target): Here the illegal actions and unethical conduct of some primary stakeholders result in adverse and direct or indirect consequences, which at times can be quite severe, for other primary stakeholders. They are encountered frequently on large construction and civil infrastructure development projects. Sometimes the actions and conduct in question are not directed against other primary stakeholders specifically but can still result in significant damage to them nonetheless.

Illegal actions and unethical conduct by primary stakeholders which can damage other primary stakeholders or inflict damage on the project per se are typically observed in several areas, inter alia, in the award, formulation and administration of project contracts and in the project procurement system (irregularities), in project cost and schedule estimation (overestimates), in project communications (intentionally withholding or falsifying crucial information), in relation to specified quality standards (non-adherence), in upholding professional standards (disinterest), and through practices and dealings which are corrupt or fraudulent.

A pervasive and high-profile issue observed on many construction and civil infrastructure projects relates in particular to the mistreatment or exploitation of their human resources. This phenomena covers a broad spectrum of actions and conduct all of which may have long-term adverse and sometimes irreparable physical and psychological consequences for the persons affected. Some of the more 'milder' manifestations include, for example, displays of favoritism and nepotism towards well-connected project employees, unfair performance appraisals based on subjective or personal considerations, a lack of incentives and rewards in recognition of very good or outstanding performance, inconducive office environments and working conditions, snooping in the private sphere of employees and failing to offer employees adequate emotional counseling & mentoring.

These 'milder' manifestations pale however in comparison to the more serious observed ones observed on many construction and civil infrastructure development projects. Illegal actions and unethical conduct here appear to be comparatively less frequent but the physical and mental toll they exact on employees can also be much more significant. Examples range from discriminatory practices in hiring and promotions,

tolerating workplace harassment, bullying, aggression and coercion, to failure to uphold required workplace safety standards and, in more extreme cases, to sheer apathy for observing basic human rights standards at project sites. A case in point of the latter are the horrendous working conditions experienced by migrant labour from several Asian countries employed at construction sites in the Middle East. A particularly notorious and much debated example is the State of Qatar where according to a recent British study over 6,000 labourers have reportedly died in accidents at diverse project sites under construction in preparation for hosting the world football championship games scheduled to be held in Qatar at the end of 2022.

Scenario 4: Secondary Stakeholders (Source) → Secondary Stakeholders (Target): This usually happens when secondary stakeholders are bitterly divided and polarized either over their support for, or for their opposition to, the project and attempt to utilize every option available at their disposal to respectively push the project through to successful completion or derail it prematurely. While many of their options to support or oppose projects are within their rights (and therefore legal) and in ethical perspective are non-controversial, some of the measures they resort to on occasions may clearly transgress legal and/or ethical boundaries. Milder measures may include ostracization and boycotts the result of which create serious and enduring community divisions and a tear in social cohesion. More serious measures include intimidation and the spectrum of intimidatory measures used by project supporting or opposing secondary stakeholders against each other in the project context can be quite broad, ranging from harassment and verbal abuse against individuals or groups to subtle and direct threats directed against life and property to, in extreme cases, actual violent physical attacks resulting in destruction of property and the deaths of people.

Scenario 5: Primary Stakeholders & Secondary Stakeholders (Sources) → Secondary Stakeholders (Target): This scenario apparently is encountered comparatively less frequently than the four above-mentioned scenarios. A cross-category 'alliance' of this sort occurs usually when primary stakeholders join forces with passionately supportive and active secondary stakeholders with a view towards ensuring that projects are implemented at any cost against fierce and tenacious opposition from opposing secondary stakeholders. This can result in situations where both legal and ethical boundaries are heavily transgressed. In their research for this paper the authors discovered that in a few projects key project opponents were physically intimidated and in some documented cases others were murdered by contract killers hired by the project and who were helped by some secondary stakeholders.

Scenario 6: Primary Stakeholders & Secondary Stakeholders (Sources) → Primary Stakeholders (Target): This is probably the least common scenario and documented examples are rare, probably because the primary stakeholders involved would obviously seek to avoid disclosure of such situations in order to avoid possible legal recriminations by the project. The reasons why primary stakeholders, who because of their contractual relationship or legal responsibility to the project would normally would be expected to be fully supportive of it, would consciously seek to sabotage or cause

damage to the project can vary considerably according to situation or context. A hypothetical example is when disgruntled primary stakeholders who have turned against their projects - for instance, because they perceive having been unfairly treated by them or because the projects failed to uphold commitments made to them or because of a realization that their participation in the projects may probably result in significantly less net benefits than they originally anticipated - conspire with secondary stakeholders opposed to these projects. One way in which primary stakeholders can play their part would be through anonymous disclosure of highly sensitive or confidential information about their projects which can be used against the project by secondary stakeholders opposed to them. This can result in consequential delays and/or additional cost for the project, staff demotivation and stress, embarrassment and reputational damage to it which can be difficult if not impossible for the project to rectify or overcome over time.

### **Simple, Practical and Cost-Effective Suggestions for Preventing and Managing Illegal Actions and Unethical Conduct on Construction and Civil Infrastructure Development Projects**

As shown above, construction and civil infrastructure development projects offer many possibilities for actions and conduct by primary and secondary stakeholders which transgress legal and/or ethical boundaries and which constitute a significant risk factor for these projects. Yet, despite the obvious difficulty countering such challenges on large and complex projects over their life-cycle entails, there are many useful steps that projects can adopt to systematically attempt to prevent illegal actions and ethical misconduct from occurring in the first place. In the view of the authors, following simple, practical and cost-effective measures lend themselves for consideration:

- Sincerity and commitment by the key project stakeholders towards upholding both the law as well as the highest attainable standard of ethics at all times and in all spheres of their projects must be unequivocally expressed, formally documented and periodically reiterated by top-level project executives. As actions speak louder than words this expressed commitment must, more importantly, be translated into clear policies and practical steps to clearly signal to all primary stakeholders that any breaches of law and ethics on their part will not be tolerated and will attract swift and appropriate punitive countermeasures.
- All large construction and civil infrastructure development projects should develop a formal and documented project ethics policy and specific code of conduct to which all their primary stakeholders must be contractually obliged to abide by at all times and which is strictly and impartially monitored continually for compliance by the projects. Many organizations across the globe, especially in the commercial sector, have long adopted formal written codes of ethical conduct which their employees and business partners are expected or required to closely abide by when undertaking their operations, programs and projects. Several professional

associations have also developed codes of ethics for their members. A notable relevant example in this regard is the Project Management Institute's *Code of Ethics and Professional Conduct* which is an eight-page document outlining the importance of ethics for project management practitioners and identifying four values—responsibility, respect, fairness and honesty – for its members to abide by as its foundation, each of which include both aspirational and mandatory standards.

- Measures implemented by projects against their primary stakeholders for repeated non-compliance or serious violations of laws and the ethics code can and should include a broad spectrum of punitive actions, for instance, ranging from formal reprimands, suspension, transfer, removal or firing of individuals engaging in illegal or unethical practices to permanent blacklisting of organizations.
- Experience over time has shown that certain aspects of complex construction and civil infrastructure development projects are particularly susceptible to illegal actions and/or unethical conduct by stakeholders. The procurement process is an excellent example thereof and an area where inadequate safeguards or failure to implement safeguards effectively often results in the award of contracts on the basis of personal relationships or in exchange for payment of bribes and kickbacks, or special favors to project decision-makers. The consequences of such actions may on occasions be grave if, for instance, material inputs are of substandard quality and construction planning, design or execution deficiencies and flaws are hushed up or intentionally overlooked. Therefore, project procurement processes need to be especially carefully designed and implemented in a manner which at all times renders them highly transparent, fair and devoid of any conflicts of interest, and open to critical scrutiny. They must also operate in conjunction with a robust incident reporting and performance monitoring system.
- Compilation of and circulation among all primary stakeholders of a law & ethics reference handbook. Its content would contain detailed information on all laws which apply specifically to the projects as well as both the minimum and desired ethical standards which have been set for the projects and how primary stakeholders are expected to deal with other and with the secondary stakeholders. The handbook can and should also provide primary stakeholders with specific guidance how to handle legally or ethically difficult or challenging situations. By reviewing a set of both good and bad situational examples and case studies from past projects the handbook can contribute towards reducing the potential for unintentional or accidental breaches of the law or ethical conduct stemming from lack of awareness, knowledge and experience on the part of primary stakeholders.

- A brief and mandatory training course or workshop for all primary stakeholders can also be a helpful measure in spreading broad awareness and knowledge about specific project-relevant laws and the code of ethics which all primary stakeholders are expected to abide by for the duration of their respective participation in projects. As many primary stakeholders in complex construction and civil infrastructure projects tend to join the projects at different points in time over its project life-cycle, and are not usually part of a project throughout its entire life-cycle, these courses or workshops can be repeated over time for the benefit of new incoming primary stakeholders new and also with a view towards ensuring that all of them are familiarized to the same extent with the laws and ethical standards applicable to the projects they are participating in.
  
- Conducting periodic and anonymous surveys of, and interviews with, primary stakeholders throughout the project life-cycle to determine if any of them directly witnessed or are aware of any situations on projects in which laws were violated or the projects' standards of ethics were not upheld and to ascertain what the nature and perceived consequences of such transgressions for the projects were. Surveying and interviewing can also be helpful tools for acquiring constructive feedback from stakeholders and soliciting ideas and suggestions from them as to how existing safeguards against violations of the law and ethical misconduct can be consolidated and if feasible where more effective safeguards can be introduced.
  
- A complaint & suggestion box and a telephone or e-mail hotline for providing primary and secondary stakeholders with the opportunity to report illegal actions and ethical misconduct is a useful way of bringing issues quickly, easily, cheaply and, if desired, anonymously to the attention of projects. Many organizations already have such systems in place for a long time and their effectiveness has been shown time and again. Serious consideration may also be given to encouraging the practice of whistle-blowing and ensuring that would be whistle-blowers are protected from possible recrimination and future discrimination.
  
- Last, but not least, upon successful completion of projects consideration should be given towards rewarding primary stakeholders in recognition for, and in appreciation of, very good or excellent performance for upholding the law and ethical standards for the duration of their participation in a project. Consideration should also be given for according these stakeholders preferential access to future projects.

## **Concluding Remarks**

As shown in this paper, projects in construction and civil infrastructure development offer on numerous occasions opportunities for behaviors by stakeholders which can be

categorized as illegal or unethical. Such behaviors are not location-specific apparently. They can and do occur across the globe but research and experience appear to indicate that they tend to occur comparatively more frequently and intensely in places where laws, public governance and scrutiny are weak and their implementation is inadequate or inefficient which is often the case in lessor developed countries. While the problem is widely acknowledged, clearly much needs to be done in practice to redress this situation.

Throughout their years-long collaborative research on the subject of project stakeholder management and engagement the authors have argued consistently that upholding the highest standards of legality and ethics is an objective that all projects must consciously seek to attain under any and all situations and at all times. Besides constituting the right moral course of action it also fully serves the interests of the project especially by reducing threats which can consequently cast a deep shadow over projects or even threaten their very existence. Projects thus stand to gain immensely by seeking earnestly to prevent situations which are illegal or unethical from arising and, in the event that such do arise, by managing them promptly, fairly and effectively. Doing so will contribute towards achievement of a win-win situation for all stakeholders.

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## INTRODUCTION TO EARNED VALUE: A CASE STUDY

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### ABSTRACT

Earned value is an approach to track the value of a project's product as it relates to planned and actual spending. This session will introduce the audience to basic earned value concepts and how to use these concepts to forecast and report project costs. The material presented follows the foundation provided in the *Project Management Body of Knowledge (PMBOK® Guide)* established by the Project Management Institute (PMI®). We will follow a case study to demonstrate the concepts, challenge the audience and forecast estimate at completion.

### BIO: JOSEPH D. LAUNI, PMP

Joseph (Joe) D. Launi, PMP, is the President of Project Management Experts. He has over 35 years of project management and PMO experience supporting federal, state and local governments and contractors. He has worked tirelessly to develop a solid reputation for delivering successful projects and improving project management processes. Mr. Launi is a proven project management executive with extensive experience encompassing:

- Project Management Office (PMO) leadership;
- Development and management of PMO policies, best practices and methodologies;
- Development and presentation of project management training;
- Implementation of project management software solutions;
- Information technology project and program oversight;
- Research and development into motivation and morale building programs; and
- Profit and loss management of various consulting practice areas.

Joe has published numerous works in areas such as software implementation, project planning and team motivation. Project Management Experts specializes in providing progressive technical project management, leadership, and strategic and business management training specially to support PMI's Talent Triangle. He has delivered the following presentations to PMI Chapters:

- Managing Team Members with Servant Leadership: PMI Montgomery County, PMI Washington Chapter, PMI Roanoke
- Managing and Leading Millennials: PMI Montgomery County, PMI Baltimore (Feb. 2019)
- PMBOK 6 Overview: PMI Montgomery County Chapter



- Earned Value Management: PMI Washington Chapter and University of Maryland Project Management Symposium.
- Project Planning Principles: PMI NJ and PMI Metrolina

## INTRODUCTION TO EARNED VALUE: A CASE STUDY

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Earned Value is like the ghost that you can't see but everyone tells you exists. You know it's out there but don't truly understand what it does and why we as project managers need it.

Simply put, earned value is a comparison of what we planned to spend, what we actually spent, and the value of the project's product at any given point of time. We can then take that input to perform a cost and schedule analysis to determine project status. Using this data combined with a thorough understanding of our project's situation, we can forecast the completion cost of our project.

For example, consider Figure 1 below. This project is to build two military tanks. Each tank will cost \$1M for a total Budget at Completion (BAC) of \$2M. I know, not very realistic costs but the math works. 😊

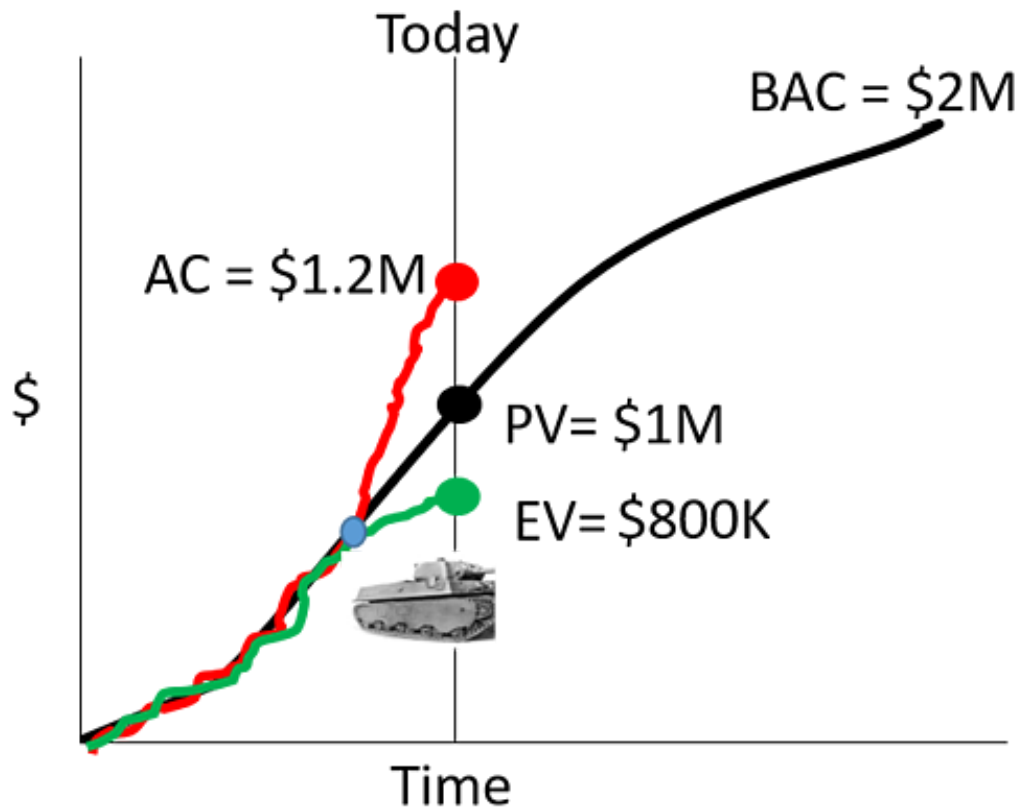


Figure 1: Earned Value Analysis

Following the diagram above, the project manager must report that the team had planned to spend \$1M and deliver one tank, but has actually spent \$1.2M to deliver 80% or \$800K worth of the first tank. This \$800K is called Earned Value. Clearly this is not good news and, utilizing some simple formulas, we can calculate just how bad.

- **Cost performance** can be calculated using **Cost Variance (CV)** which is a comparison of the earned value of tank one against the actual cost to-date to deliver that value.  $CV = EV - AC$  or (\$400K). My project is \$400K over budget. We can convert that variance into an index by calculating the **Cost Performance Index (CPI)**:  $EV/AC$  or \$.66. The CPI states that my project is spending at a \$.66 efficiency against the dollar. Not Good!
- **Schedule performance** can be calculated using **Schedule Variance (SV)** which is a comparison of the earned value of tank one against what we planned it would be worth at this point in time.  $SV = EV - PV$  or (\$200K). This project is behind schedule because tank one was planned it to be complete and worth \$1M but it's actually incomplete and worth \$800K at this point in time. We can convert this variance into an index by calculating **Schedule Performance Index (SPI)**:  $EV/PV$  or \$.80. The SPI states that my project team is delivering \$.80 worth of tank for every \$1 dollar we had planned for them to spend. Again, Not Good.

When I teach this in our *Earned Value* Course or our *PMP® Exam Prep.* course, the first question I'm always asked is "why is the tank worth \$800,000 when it doesn't function?" Good question! The military officer who is sponsoring your construction effort would certainly agree that the tank is worthless until it's complete. Addressing and assigning percent complete on any project product must be decided before the project begins and documented in the Cost Management Plan. There are many approaches that can be used to accomplish this.

- Firm fixed price contracts will often assign earned value upon the completion of project phases and acceptance of the deliverable at the end of that phase. This is called the "weighted milestone method". For example, if the Design Phase of a project makes up 25% of the project's work, the project will be awarded the dollar equivalent of 25% of the BAC. At that time a cost and schedule analysis can be done by calculating the actual cost and planned value.
- For cost reimbursable and time and materials contracts when more services and less products are being delivered and a detailed project schedule exists, earned value can be calculated for each activity on the project schedule. This is called the "fixed formula method". For example, if we are using the 50:50 formula, 50% of the value of an activity is earned the second that activity starts but the remaining value cannot be earned until the activity completes. This is great news when the activity starts, bad news when the activity is >50% complete and not yet completed, and great news again once the activity is completed on time.

- The “percent complete” method is used when the sponsor can look at the project’s product and fairly easily measure completion. This works well in construction when one can look at the building and using their experience in construction, understand the project’s completion and the subsequent earned value.

As you can see, measuring value is not an exact science but it does bring us closer to calculating some value at any given point in the project.

Let’s get back to our tank that is 80% complete and overbudget and behind schedule. The project manager needs to be able to answer some questions such as:

- What happened here?
- Can you complete this on time?
- Can you complete this for \$2M?
- Are you asking for more money? If so, how much?

The answers to these questions are heavily dependent upon what occurred on the project. First note the blue dot on the graph. The project’s performance up until that blue dot was stellar, on schedule and on budget. Something happened at that blue dot to cause the project to overspend and under-deliver. Let’s examine the possible causes and use that information to re-calculate the project’s BAC. We call that re-calculation the Estimate at Completion.

1. The senior technical lead was pulled off the project temporarily to work on a proposal at headquarters. The resource manager sent you two lesser skilled technical resources who were not as productive and added costs to your project. Once your technical lead returns, those unproductive resources are taken off the project. This is called an anomaly and when it occurs we can re-calculate the BAC using the formula  $AC + (BAC - EV)$ . Your revised BAC, or EAC is now \$2.4M and you will need to seek approval for an additional \$400K. I don’t think your sponsor will empathize with you so don’t expect approval for additional funding.
2. The vendor supplying materials offered some special bulk ordering pricing which you just couldn’t refuse. Thus, you didn’t follow your original spend plan and your team was forced to deviate from the development to store all of the parts you purchased for both tanks. You simply need to re-plan the remaining work and assuming no additional development time is needed, you should be able to communicate that no additional funds will be needed,  $BAC = EAC$ .
3. Starting at the blue dot, the cost of steel went up because of trade tariffs. Materials pricing will not come down for your project, so you are stuck with purchasing steel at a higher price than originally planned. Under this circumstance you can use the formula  $BAC / CPI$  to calculate the Estimate at Completion which will be \$2.9M. This change request of \$900K should be approved unless you are delivering under a firm fixed price contract and then some negotiations will be needed.

4. The last scenario is that spending and productivity will continue on its present path. This is bad news and you may want to start your resume. Under this circumstance you can use the formula:

$$AC + \frac{(BAC-EV)}{CPI*SPI}$$

Your \$2M project is now estimated to cost \$3.4M! This can be caused by many things including unmanaged scope (scope creep), unanticipated materials costs, unqualified resources, etc.

In summary, projects go bad for many reasons. As project managers, some of these issues we can control and others we cannot. Having the capability, knowledge and experience to communicate these metrics will give you and your sponsors the information they need to make informed choices, manage impact and control projects.

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University of Maryland Project Management Symposium  
**Knowledge Café: Unleashing Knowledge Culture & Learning Agility in a Project Economy**

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**ABSTRACT**

By 2030, 76 million baby boomers will walk out of our organizations, taking decades of intellectual capital with them. Hyper-job mobility has a great loss of knowledge cost associated with it. Gallup estimates that millennial's turnover alone costs the US economy \$30.5 billion annually. Learning agility, versatility, feedback, making sense of our experience, and collaboration meet at the café and are woven into the fabric of high-performing organizations—these should not be cumbersome, but as simple as walking into a corner café. The café is a learning agility mindset and a space for creating the right environment for successful knowledge management. Fact: you can't force people to share their knowledge. So, you have to create the right knowledge environment—in a café—where knowledge workers are incentivized for a free exchange of knowledge and rejuvenated. Knowledge café construct can unleash a knowledge culture, learning agility in today's project economy.

**Introduction**

Knowledge café is a knowledge management technique like lessons learned or after-action review, expertise locator database, or community of practice. The café is used to engage a group to identify, learn, exchange, share, and unleash relational knowledge power. How powerful is the knowledge that is pigeonholed, unshared, unrejuvenated, and locked up in databases and the minds of project managers? There has never been a time when the need for increased knowledge flow, agility, simplicity, and relevance than now. Don't you wish there's a space to bring ideas, including our crazy ones, right up our alleys for other caffeinated visitors to test them out? Café is a knowledge exchange attitude for learning where reflective and generative dialogue and discourse are covenanted; debate and diatribe are intentional outside the ground rules. Organizational culture or environment eats any innovation, strategy, or dream like a hamburger. **Knowledge Café is learning, exchange mindset, and space that creates the right knowledge transfer environment in a project economy.** My goal for the café is to stimulate the appetite and curiosity for knowledge culture in all types of organizations. Some of the excerpts from my book, *The Knowledge Café: Creating an Environment for Successful Knowledge Management* (Anyacho, 2021).

**SO, WHAT [THE HECK] IS A KNOWLEDGE CAFÉ?**

A Knowledge Café is a mindset and an environment for engaging, discussing, and exchanging knowledge within a group, whether face-to-face or virtual. It's a knowledge experimentation town square where it's easier to share and reuse knowledge. Café is the environment that supports knowledge circulation and increases its velocity—“breeding” grounds for innovation. You may have practiced the café or some of its elements if you have engaged in the digital discussion board, enterprise knowledge wiki library, brown-bag

lunch meetings, unstructured serendipitous exchanges, and water cooler conversations. A debate has its place but is not sustainable. Today's toxic and hostile culture that prefers debate to dialogue calls us for dialogue—in a café. **No amount of knowledge will equate to understanding. Café enables understanding. Everyone has a voice at the café.**

***The café space and mindset integrate face-to-face or virtual audio meetings with screen-sharing, whiteboarding/brainstorming, group chat for teams/projects, platforms for file sharing, social networking, collaborations, testing crazy ideas, idea generation, agile learning, honest questions, and answers (Anyacho, 2021, p2).***

In the café orbit, we are

- Making sense of the world
- Making meaning of what we know or what we think we know
- Building relationships and understanding
- Creating new knowledge
- Building coherence, maybe even consensus
- Improving dialogue
- Surfacing problems and opportunities
- Breaking down silos
- Engaging in personal development
- Creating new knowledge
- Innovating
- Sense-making, which is its primary purpose or benefit (Anyacho, 2021, p10).

Km and conversational leadership father David Gurteen has been a forerunner of the Knowledge Café through his online book, *Conversational Leadership*. If you want to know what already exists in terms of knowledge, walk around the café and check out the floorplan before sitting down. Take a break from the business of the day—work along with some other creative minds in a café. According to May Wong (2014), walking can boost creative output by 60 percent. Enter the space where what the organization knows and what it should know intersects. As you determine the best spot to sit, let's clarify the meaning of the term *knowledge*.

Describing my book, *The Knowledge Café: Creating an Environment for Successful Knowledge Environment*, Denise A. D. Bedford, professor at Georgetown University, said, "Indeed, all curious knowledge workers need space and a mindset to bring our crazy ideas for others to test them out and deepen knowledge and understanding—The Café. Knowledge cafes are essential tools in any era, particularly in social distancing, where interactions and exchanges have become more intentional and deliberate. Everyone needs a knowledge café in their world today!" (Anyacho, 2021).

### **Why do we need to café project knowledge?**

Hard or costly-to-copy intellectual capitals of the firm are sources of business returns and the means to achieve superior performance and competitive advantage (Barney, 1991; Rumelt, 1987; Conner, 1991, Prahalad and Hamel, 1990). Several thinkers agree that KM will symbolize the most considerable competitive advantage for organizations in the new millennium (Drucker, 1993; Quinn, 1992; Stewart, 1997; Toffler, 1990). I believe the knowledge transfer should be agile, simple, adaptive, iterative, and not cumbersome.

It should be as easy a walking into a street café to share your crazy ideas with like-minded

colleagues. Consider these facts:

- Knowledge culture creates a KM environment: you must be intentional, plan, and execute well, and make the process an organizational strategy
- For the first time in our lifetime, five generations interface in the project management space!
- Millennials will job-hop up to 20 times in their career—[Education Advisory Board](#)
- Organizations that are most effective at knowledge management improve project outcomes by nearly 35%—PMI 2015 Pulse of the Profession
- Employees get 50—75 percent of their relevant information directly from other people—*Gartner Group/CIBC World Markets*. Developing training doesn't guarantee a learning culture; a knowledge culture and café mindset do

#### WHAT IS KNOWLEDGE MANAGEMENT?

KM is a systematic approach for identifying, understanding and using knowledge to achieve organizational objectives and innovations. I have seen dozens of KM definitions; however, there's no single or agreed-upon definition of KM across the business, epistemology, social sciences, and psychology. In fact, author and professor John P. Girard gathered a collection of more than 100 KM definitions (Girard & Girard, 2015). If a concept like KM has so many definitions, it presupposes that it doesn't have a definition at all.

The Project Management Book of Knowledge (PMBOK) defines knowledge management: "It's all about making sure the skills, experiences, and expertise of the project team and other stakeholders are used before, during, and after the project" (*PMBOK® Guide*, sixth edition, 2017, p. 100).

***The means by which an organization builds sustains and leverages the know-how and experience of its employees and partners to deliver its projects and services and manage the systems for which they are responsible.***

***National Cooperative Highway Research Program (NCHRP, 2014)***

#### KNOWLEDGE CULTURE: CITY IMPACT ROUNDTABLE CONFERENCE

***People choose not to change their behavior because the culture and the imperatives of the organization make it too difficult to act upon the knowledge. Michael Schrage***

Etiologically, the word "culture" derives its meaning from a French term, which originally derives its meaning from another Latin word "colere," which means to tend to the earth and grow, or cultivation and nurture (Zimmermann, 2017). A culture is a way of life of a group of people—the behaviors, beliefs, values, and symbols that they accept, generally without thinking about them, and that are passed along by communication and imitation from one generation to the next. Culture can be a way of life or the midst of life. Structural capital is all about the knowledge within a group, community, or organization. Understand your group, city, or organization's prevailing culture if you want to create a KM environment.

I began to connect with nonprofit organizations in Austin, Texas, in 2002. Some of the nonprofits and compassion organizations in my network were feeding the homeless and taking care of the needy and helpless by responding to the physical, emotional, and spiritual needs of those at the edge of society. Cities, communities, and nations, just like organizations, can have a lot going for them but lack a culture where knowledge, not just information and data, freely flows. In many cities, you have villages of silos. People cannot work together for a common cause because there's no knowledge-sharing space. What if



there were a space for those who knew a lot and those seeking to know, those who have ideas, and those looking for ideas to advance our communities to converge?

“Let me tell you a story about homeless boys at the café. One day I met Larry Ball. This man had about eight young men in his van. Larry told me that he picks up homeless kids from the street, gives them a home, rehabilitates and trains them, and sends them back as meaningful members of society. Some of them don’t even know their parents. He takes them to his house. His organization provides these young men with a home, care, and emotional and spiritual support to get them back on their feet. They are mentored, educated, and then seek jobs. They begin to earn a living and finally become independent. He replaces them with other homeless kids. I asked him, “What is your success rate?” His response was an outstanding 98 percent!

I asked Larry how he gets support in doing this full time. His answer: “I receive little or no support. I’ve never received grants or major donations. I believe that I’m called to do this, and it’s producing fantastic results.” I met people from several other nonprofits from 2003 to 2008 through the nonprofit I founded, Apostolic Bridge Builders, Inc. I was also connected with several industry leaders and people in government who sincerely appreciate the roles and success of nonprofits like Larry Ball’s Hungry for God organization. I thought that I needed to bring these knowledge players into a café meeting. I had several such knowledge exchange/connection meetings. Somewhere, I felt that we need to have an intentional roundtable conference to know what’s going on in different communities and how nonprofits, governments, and leaders of industry can come together in a Knowledge Café—style roundtable and share knowledge and build synergy for greater community transformation. I needed to have a café project for city transformation” (Anyacho, 2021, p158).

Whether an organization is expanding or contracting, scaling up or downsizing, business continuity, process improvement, performance, and knowledge innovation are the priorities. Organizations must focus on preserving critical and technical knowledge required to conduct business. When KM is part of the organization’s culture, performance improves, the competitive advantage accelerates, and competition becomes *coopetition*. Coopetition is cooperating with your competitors, building synergy so that everyone wins.

**You can’t manage knowledge—nobody can. What you can do is manage the environment in which knowledge can be created, discovered, captured, shared, distilled, validated, transferred, adopted, adapted, and applied—Collison & Parcell (2005)**

While we do not have control over our employees’ heads, we control the machines’ knowledge and their various formats. Most importantly, we control the knowledge transfer environment, the knowledge culture supported by a clear KM strategy and processes. A robust knowledge ecosystem requires organizational nourishment that fosters a knowledge-savvy workforce.

Here is a gentle caution: Your knowledge is not your job security. Your knowledge is your value—it only grows or generates a return when invested in the work and others and when others invest in you.

## WHAT IS KNOWLEDGE ECONOMY

The knowledge economy is not the quality of data or information that matters but conversion and accessibility and converting information to knowledge and contextualizing it for decision-making. In a knowledge society, the creation, dissemination, and utilization of information and knowledge has become the most critical production factor (Encyclopedia.com).

Most innovative economies are both knowledge economies and societies. An example is South Korea. Bloomberg ranked it as the most innovative country in 2019 (Jamrisko et al., 2019). Finland is another example of a knowledge economy. Finland has the widely acclaimed transformative capacity to become a leading knowledge-based economy in the late 20th century. It transformed from an agriculture-based economy in the 1950s into one of the top innovation-driven, knowledge-based economies and high-tech producers in the 21st century. I recommend the Knowledge Economic guidebook, Finland as a Knowledge Economic 2.0: Lessons on Policies and Governance (Unger, 2019). This is also mainly due to Nokia and strong government support of the tech industry.

### **The Right Condition and Environment That Attract People to the Knowledge Café**

Everyone will come to the café if the following takes place:

- There's a grand rule that guarantees a dialogue, not a debate, and everyone has an equal voice.
- Everyone agrees to the why, what, when, and where of a café.
- There will be conversations, not a lecture.
- They have crazy ideas well up in their alleys they are dying to share.
- It's not a gathering of perfect ideas and too structured.
- Conversation is king.
- There's a space where people and systems talk *to* each other rather than *at* each other.
- There's a desire for simplicity.
- There's empathy rather than sympathy.
- They can leave sympathy behind and reconnoiter empathy.
- There's a willingness to learn agile.
- You see knowledge as a means of production.
- Hunger to steward and revivify knowledge.
- Third place: Café is that space outside home and office where one can collaborate.
- Fun: There's something that compliments a café experience (Anyacho, 2021, p9).

### **KNOWLEDGE WORKERS AT THE CAFÉ**

*In the digital age, you need to make knowledge workers out of every employee possible—Bill Gates.*

*Knowledge workers are neither farmers nor labor nor business; they are employees of organizations—Peter Drucker.*

Knowledge workers are the creators and users of knowledge. Every employee and everyone who uses knowledge to do their work is a knowledge worker. While there are a variety of reasons to converge at a physical café, the purpose is to engage in knowledge exchange. Every knowledge worker depends on the free flow of information to do his or her work. Let's café. It means let's begin the discussion. Let's talk about it. Let's share what we know. Let's brainstorm. Let's get caffeinated. Let's analyze what we have around

a saucer. Let's bring all this information into context. Can we bring the human element into it? Can we apply the knowledge we have acquired for discussion-making? The minder of the café is synonymous with sharing.

Several years ago, I managed a project and needed to organize project assets, processes, and policies; I searched the intranet of lessons learned repositories. I realized that every team had its repository for lessons learned and new knowledge from the café. I then searched our organization's intranet for a project template. Believe it or not, the result was fantastic, probably more than 10,000 results of everything but a project charter! Sometimes, it's like we are all swimming in a directionless swamp or pond (Anyacho, 2021, p130). This is a perfect definition of what knowledge management should not be to the knowledge worker. We need an intentional and clear-flowing river that has a direction and clarity of perception. Could it be that we had documented knowledge scattered across many repositories without managing the knowledge within the documents? It was not tagged, curated, filtered, rated, prioritized, synthesized, or combined into new documents such as guidance, best practices, or wiki content.

When I finally created templates for project management, I realized weeks later that other knowledge users in my organization had created similar templates. Knowledge workers work best with a free flow of information. This helped to ignite my passion for a paradigm shift in the way knowledge users use information. There was a need for a café for different repositories, content, organization, curation, and indexing in hindsight. A café relational mindset will make the information available one or two clicks away.

Every stakeholder is a knowledge user. Project managers and, indeed, all knowledge workers are the users of the project information and knowledge. That's why we need to get people thinking in a café way. Dr. Ed Hoffman, a strategic advisor to the Project Management Institute and senior lecturer at the Columbia University School of Professional Studies, has a motto: "People, People, People." People are the most crucial leg of your KM program.

Knowledge sharing is infectious! Knowledge workers are part of the precious assets of the organization. The most critical knowledge assets of an organization are human capital.

***More than 80% of a company's information exists on individual hard drives and in personal files—Gartner (n.d.)***

Some employees believe that sharing knowledge is additional work for them. Therefore, they think that it is a waste of time to make information available to other knowledge users or transfer their knowledge to others.

At TxDOT, during our KM development, we identified 50+ communities of practice, developed a knowledge interview program, and held regular Knowledge Café events that have attracted participation of 90 percent of knowledge managers from its 59 divisions and districts. The reason for the first knowledge fairs and cafés we had was to bring these CoPs together for knowledge exchange.

### **What Happens at a Café?**

Knowledge conversations. As said in the preface of my book, The Knowledge Cafe, knowledge creation, and transfer are incomplete without socialization and cross-pollination of knowledge from one state to another—when knowledge workers talk to each other and machines talk to each other, and when knowledge constantly changes states (Anyacho, 2021).

Nonaka and Takeuchi introduced the SECI model (Nonaka & Takeuchi 1996), which has become the cornerstone of knowledge creation and transfer theory, and Nonaka (1994) identified four mechanisms for knowledge creation:

1. Socialization: whereby an individual shares tacit (intuitive) knowledge like know-hows, know-whats, and know-whys—those personal knowledge used by knowledge workers to perform their work often makes sense only in their worlds. Sharing of experiences through observation, imitation, and practice.
2. Combination: whereby one piece of explicit knowledge like the knowledge that can be captured in the form of text, tables, diagrams, product specifications is combined with other;
3. Externalization: a process whereby tacit knowledge is made explicit; and
4. Internalization: a process of experiencing knowledge through an explicit source, where explicit knowledge is converted into tacit.

We want to make sense or meaning of our world, what we know, right? We want that “aha!” moment that doesn’t happen in instructions or one-dimensional settings. “Aha!” moments occur in dialogue, conversation, and a peer-learning knowledge exchange environment. The café is the space for this” (Anyacho, 2021, p8).

**We ask lots of questions at the café.** Richard Thalheimer, the founder of Sharper Image, once asserted, “It is better to look uninformed than to be uninformed. Curb your ego & keep asking questions” (Close & Close, 2018).

### **Ground Rules at the café**

“Café ground rules are among the differentiating factors between knowledge café and other forms of knowledge exchange engagement. They provide clarity and rules of engagement. It sets the expectation of the conversation, so there are no surprises. If you don’t have ground rules, everyone creates theirs because nature abhors a vacuum. Would you want to play a game where there are no rules, or you make the rules as you go? (Anyacho, 2021, p19). I hope not. That will suffice for a debate, not a dialogue. There will be fears, insecurities, and people who don’t like to be vulnerable unless they agree to protect everyone.

### **Critical Elements of a Café**

- Driven by a **powerful question dialogue, not a debate**
- Preserves **conversational** flow
- **Everyone has an equal voice**
- **Eliminates fear** of judgment or rejection
- **No preconceived outcomes**
- Does **not** allow **coercion**
- Deliverable is the **new learning**
- We are all in the learning process.

### **GURTEEN’S CAFÉ GUIDE**

The café usually runs for 1½–2 hours depending on how much time is available, but never less than one hour. The only hard and fast rule is that most of the time is spent in conversation—it is not about one person presenting to the group. The value of the café is in

the conversation itself and the learning that each individual takes away. Here is a typical Gurteen café session format.

1. The facilitator or host may give a presentation on what Knowledge Cafés are about and the role of conversation in business life (about 5 minutes)
2. One hour with a few conversational exercises, unless participants are already familiar with the concept of the café
3. The facilitator welcomes people to the café (about 5 minutes)
4. The facilitator spends 10–15 minutes outlining the subject or theme of the café and poses a single open-ended question. For example, if the theme is knowledge sharing, then the question for the group might be, “What are the barriers to knowledge sharing in an organization, and how do you overcome them?”
5. The group breaks into small groups of 3 or 4 (no more than 5) and discusses the questions for about 45 minutes, then comes back together as a whole group for the final 45 minutes, when the individual groups share their thoughts. If the café is a one-question café, it’s appropriate for small table discussants to rotate from their tables every 15 minutes.
6. Optionally, in the small group sessions, people change tables every 15 minutes to broaden the number of people they get to interact with and thus the differing perspectives of the group
7. Usually, no attempt is made to capture the conversation, as doing so tends to destroy the conversation. In some circumstances, it makes sense to capture things from the café depending on its purpose, and there are ways of doing this that minimally interfere with the dynamics of the conversation.

#### ANYACHO’S ENHANCED PROCEDURE FOR A KNOWLEDGE CAFÉ EVENT

To enhance the café as described by Gurteen, I recommend these procedures. You need to plan and have an objective and expectation that will be measured against the outcome of a café or fair event. At the café, everyone’s voice counts, fear is eliminated, and the environment preserves the conversational flow.

1. Walking into the café is like walking into any networking event. You get to know other knowledge-curious animals. Warning: Most people are not conversational whizzes. You have to make them talk.
2. Café can be face-to-face or virtual. Virtual café is a challenge since you have to log into different sessions and come back for plenary sessions.
3. Have a communication and training strategy; identify champions, experts, super users, or early adopters in the business who face similar knowledge and information challenges.
4. Choose a timekeeper and notetaker.
5. Choose your table. The café is better at tables. Allowing about 4–6 people at a table gives everyone at a table an opportunity to contribute. Everyone at the café should be able to share their knowledge. It helps to announce that people should choose a table after the first set of networking. I like to give attendees the first 15 minutes for

networking or use icebreakers. I encourage attendees from the same office to sit at different tables.

6. Participants can choose to sit, stand, or even sit on the floor. This is okay if everyone is comfortable and especially if this is an unstructured café.
7. Break the café into sessions or parts. When I have a 2-hour café, I break it down to three 45-minute sections or parts, according to the expectations or objectives of the café.
8. Café discussions are mostly held at the small table meeting, even though there are opportunities for general discussions after short table café exchanges. I've had several virtual cafes as a result of COVID-19. I used the chat section to encourage responses and made sure that everyone contributed in a café.
9. Collect notes and summaries from the tables: There is a designated notetaker for each table. Summaries of the discussions from the tables are collected at the end of each question discussed for everyone to be enriched from all small-group discussions.
10. Share best practice in terms of how to communicate with employees and reinforce the knowledge-sharing behaviors.
11. Compile knowledge-exchange notes, and new knowledge that emerges from fair and café are distributed through push and pull communication methods. These notes and summaries from the table are useful for the entire knowledge community, especially those who couldn't participate. I usually send out these notes to the whole of the knowledge community and post them on the Knowledge Café site (Wiki site) for the community.

Knowledge café will stir your curiosity for knowledge stewardship. Knowledge Café is my preferred technique or methodology to start the KM process—to bring people who know something and those who desire to know more to collaborate and broker intelligent ideas and share knowledge.

As a project manager, I always distribute a meeting agenda, including a column for action items. In the knowledge café, there is so much feedback, learning, sharing, and reinvigoration that takes place. In today's world of breathtaking changes, where we drink from a fire hose of information, constant and quick learning of new things, openness to new ideas, and adaptation are the sine qua non and necessary skills. Manage your knowledge or become irrelevant! Knowledge Café is the most logical mindset and space to begin KM exploration to increase knowledge interaction, metamorphosis, agility, exchange, velocity, findability, shareability, and usability. (Anyacho, 2021, p253).

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# Performance Measure Reality Check<sup>1</sup>

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## **Executive Summary**

*This paper will provide managers a practical “reality check” process for selecting the most relevant and implementable performance measures for their projects, programs, and organizations. We will cover how to:*

- *Evaluate data for relevance, quality, timeliness, and accessibility*
- *Evaluate measures for fit to strategic goals and ease of implementation*

*Additionally, the paper will cover tips for organizing your results for discussion with leadership, the benefits of the process and the time and resources required to implement.*

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<sup>1</sup> *The views expressed in this paper are those of the authors and do not necessarily represent those of the U.S. Census Bureau.*

## **The Reality Check**

Often as a manager you are asked to answer questions about the progress on your project. This is generally a straightforward task, but as you delve into data to support your answers you may find that the reporting process can quickly become overwhelming. In a perfect world you would have time and resources to produce measures of everything and anything to describe your project, but you are in the real world and in the real world you need a reality check.

In our experience we have found that there is always data collected (not directly related to performance measurement), and there are always questions from stakeholders/leadership. Performance Management is the marriage of the two. Typically, you are producing answers for a stakeholder audience and you will have many ideas and may receive many more ideas for measures to track progress for your project. This is where you need a process for identifying the best candidates for development and here is where we can help. In our work with performance measures, we practice a process to systematically review and rate measure choices to reduce the big list to a defensible and socialized list of the best and most feasible choices.

Our performance measure reality check process reviews two sets of criteria: those that describe a measure's purpose and those that quantify the feasibility of producing a measure. The review of purpose criteria is a conceptual process where you will identify insights, questions answered by the measure data and evidence-based actions and evaluate those data points against the goals and purpose of the project. This process will assign values to the measures and elevate those that are perceived to provide the most informative data. The review of the feasibility of producing a measure criterion will quantify your ability to produce each measure. This review evaluates the measures by organizational readiness, data availability, consistency and frequency, respondent and organizational burden and effort to analyze and format the measure. It then assigns values to each of the feasibility criteria to elevate those measures that are ready to be developed. The final step in our process is to combine the purpose and feasibility evaluation results and calculate a final score. The resulting scores then provide values to help you or leadership make decisions on how best to spend project or program resources producing and maturing performance measures.

## **Demonstration Examples**

We included some demonstration examples to help illustrate how to describe and rate the different criteria in our process. These examples are drawn from our work with performance measure development. Table 1 is a list of the measures used.

MEASURES
Percent of Research Proposals Accepted by Customer
Percentage of Change Requests Implemented
Planned Versus Actual Time to Complete Work
Budget Variance
Percent of Staff with Met Target Proficiency Level

Table 1 List of Demonstration Examples

## Measure Purpose Evaluation

The process to evaluate the purpose of your potential measures can seem like a superfluous step but with the engagement of leaders and stakeholders in the process will help identify measures that are worthy of the time you will invest to produce them and simultaneously gain leadership and stakeholder buy in of the results. This is an important consideration; measures are an investment. They require time and resources to develop, produce, maintain, and review and you will want those measures to be the right measures. Once you gather the purpose evaluation inputs, you will then use the insights into the program, leadership questions to be answered, and evidence-based actions to assign a value.

## Insight into the Program from the Data

We define Insight into the Program from the Data criterion as ways to answer the larger questions about the program and tie program data to the strategy and direction of the organization. Typically, the insights generated for your measures may be more closely tied to the overall strategy and direction of the organization than to the day to day operations of the program being measured. Decisions made because of these insights may be more sweeping and impactful over the long term and not solely focused on short-term progress.

MEASURES	INSIGHT Into the Program
Percent of Research Proposals Accepted by Customer	How desirable/ marketable is DSMD's work to our customer base
Percentage of Change Requests Implemented	The validity and scope of the change requests
Planned Versus Actual Time to Complete Work	Quality of the work planning, Accuracy of the work effort estimates
Budget Variance	Quality of the work planning, Accuracy of the budget estimates
Percent of Staff with Met Target Proficiency Level	Areas where we have needed proficiency, Efficacy of hiring and training programs

Table 2 Examples of Program Insight Responses

## Leadership Questions to Be Answered by the Data

As opposed to program insights, we define Leadership Questions to Be Answered by the Data criterion as the more operational, day to day questions that deal with the general health and execution of a given project or program. These questions (and answers) can help to guide the

small changes to keep a project executing at full potential. These questions may be typically tied to the triple constraints or could be focused on other facets of project execution that are more in line with stakeholder interests.

MEASURES	Leadership QUESTIONS to be Answered
Percent of Research Proposals Accepted by Customer	Are the proposals well defined? Do the proposals align with the actual needs of the customers?
Percentage of Change Requests Implemented	How are these requests impacting the overall level of service provided? Is the baselined scope of work incorrect?
Planned Versus Actual Time to Complete Work	Do the planning models work? Is the level of effort being adequately captured?
Budget Variance	Do the planning models work? Are all aspects of the project being adequately captured?
Percent of Staff with Met Target Proficiency Level	Where have we met our proficiency targets? Where do we need to concentrate our efforts?

Table 3 Examples of Leadership Question Responses

### Evidence-Based Actions Provided by the Data

We define Evidence-Based Actions Provided by the Data criterion as the potential changes to the operations or strategy that are informed by the answers to the leadership questions and the program insights. This generation of measures that enhance evidence-based actions will support the strategic use of resources and highlight those programs and projects that are working for the organization's strategy and goals and spotlight those that are not.

MEASURES	Evidence-Based ACTIONS
Percent of Research Proposals Accepted by Customer	Evaluate training/skills we need for providing the customers real value, tailor our proposals to feedback and external factors
Percentage of Change Requests Implemented	Review whether the change requests of a given project meet or exceed expectations, pay closer attention to project or management processes where indicated
Planned Versus Actual Time to Complete Work	Consider adjustments to the resource and budget plan, Review change requests to cover unplanned work
Budget Variance	Adjust the budget plan, Review change requests to cover unplanned work
Percent of Staff with Met Target Proficiency Level	Identify needs for hiring, training and knowledge sharing, Adjust training initiatives to new priorities

Table 4 Examples of Evidence-Based Decision Responses

### Scoring of Measure Purpose Criteria

The second step of the measure purpose evaluation process is to assign values to the details you captured about each criterion. For determining the values, we focused on the "priority" of the measure as a whole and Table 5 below shows the values in the scale. We have found that a scale of three values: high, medium, and low, is enough to produce a spread of values that is meaningful in the final scoring process. Having more "middle values" only adds confusion to the

scoring process. Table 6 below shows the values we have assigned to each of the demonstration examples.

Value	Priority Level
1	Low
2	Medium
3	High

**Table 5 Measure Purpose Scoring Definitions**

MEASURES	Score
Percent of Research Proposals Accepted by Customer	3
Percentage of Change Requests Implemented	1
Planned Versus Actual Time to Complete Work	2
Budget Variance	3
Percent of Staff with Met Target Proficiency Level	2

**Table 6 Example of Measure Purpose Values**

## Measure Development Evaluation

The second set of criteria in our process will help you assign a value for the feasibility level of developing each measure candidate. This process is valuable because it forces you to think about, and possibly research, the source of your measure data before you are committed to producing that measure. This evaluation also provides documentation of the effort required for a specific measure so that you may effectively communicate measure availability to your stakeholders.

Below you will find descriptions and examples of the Measure Development Criteria:

Organizational Readiness, Data Availability, Frequency and Consistency, Respondent and Organizational Burden, and Effort to Analyze and Format Data.

### Organizational Readiness

We define organizational readiness in terms of the maturity of the organization's processes in place to capture measure data. Although it is possible to gauge the performance of an organization operating with poorly formed or undocumented processes, such a measurement is likely to yield only gross information. Obtaining the detailed information necessary to focus the organization on performance improvement requires data collection processes and well understood definitions for the data responses. See Table 5 below for examples of how to assess organizational readiness.

Measures	Organizational Readiness
Percent of Research Proposals Accepted by Customer	Processes are in place to control the development of research proposals and track sponsor acceptance
Percentage of Change Requests Implemented	Processes are well defined, staff turnover has led to loss of trained PMs
Planned Versus Actual Time to Complete Work	Processes are in place to capture resource time, staff are trained and required to report their time
Budget Variance	Processes are in place to capture budget expenditures and for setting budget plan
Percent of Staff with Met Target Proficiency Level	Process and instrument are in place to collect data, staff are trained on platform

**Table 5 Example of Organizational Readiness Responses**

### **Data Availability, Frequency and Consistency**

We define data availability as both the existence of the data and the ability to access the data. This criterion may seem like operational readiness, but it is there to capture situations where you may not have access to data, or the data has yet to be collected. We included frequency to capture a situation where the data is not collected frequently enough to be useful for your measure. We included consistency to capture any situations where the data collected are not well defined, well understood or there has been a change in definitions in the data series. See Table 6 below for examples of how to assess data availability, frequency, and consistency.

Measures	Data Availability, Frequency and Consistency
Percent of Research Proposals Accepted by Customer	Available, annual, well defined
Percentage of Change Requests Implemented	Available, On Demand, Well Defined
Planned Versus Actual Time to Complete Work	Data is stored on database, data is available by day, collection platform produces consistent data
Budget Variance	Data is mostly reliable; data may not be available at project level
Percent of Staff with Met Target Proficiency Level	Data is downloadable, recent data is not available, platform produces consistent data

**Table 6 Examples of Data Availability, Frequency, and Consistency Responses**

### **Respondent and Organizational Burden**

We define respondent burden as the effort it takes for staff to provide measure data and more specifically, how staff perceive the burden of providing measure data. This can be as simple as filling out a timesheet or completing a questionnaire. We define organizational burden as the effort it will take for an organization to generate the measure data. If a process is in place to collect or generate the data and staff are available and trained, then the burden/difficulty would be low. Medium effort could be defined as a more time-consuming process such as compiling data from multiple systems and spreadsheets or requesting data from other staff. If a system must be designed and developed and staff must be trained, then the burden/difficulty would be much higher. See Table 7 below for examples of how to assess respondent and organizational burden.

Measures	Respondent and Organizational Burden
Percent of Research Proposals Accepted by Customer	Staff are socialized to develop research ideas into formal proposals, organization has provided resource time to develop and manage research proposals
Percentage of Change Requests Implemented	New staff need to be trained on process; organization will need to find resources for training
Planned Versus Actual Time to Complete Work	Staff is socialized to provide input; organization has invested resources into developing and implementing collection process
Budget Variance	Organization has invested resources to put processes in place to collect cost data, need to estimate budget data if costs not captured at project level
Percent of Staff with Met Target Proficiency Level	Organization has invested resources to put processes in place, Staff will have to go in and update their responses

**Table 7 Examples of Respondent and Organizational Burden Responses**

### Effort to Analyze and Format Data

We define the effort to analyze and format data as the level of difficulty required to format the data from its current form to meaningful measure data and the level of difficulty required to interpret the data into an accurate representation of the situation. This criterion can and should be influenced by the technical skill available to produce the measures. If you have a person that is experienced with accessing and formatting data, then the difficulty would be low. If you have someone with only a basic knowledge, then the difficulty would be high. Additionally, if you have too much data, too little data, or data values with a very large spread, then this too would influence how you rate this criterion. See Table 8 below for examples of how to assess effort to analyze and format data.

Measures	Effort to Analyze and Format
Percent of Research Proposals Accepted by Customer	Research proposals are on SharePoint site which produces measure data in Excel format
Percentage of Change Requests Implemented	Some effort required to format data into final metric
Planned Versus Actual Time to Complete Work	Some effort and expertise required to retrieve data from database and format data into measure
Budget Variance	Data will need to be keyed into new measure, may need to estimate project budget data if costs are not captured at the project level
Percent of Staff with Met Target Proficiency Level	Data will need to be formatted into new measure

**Table 8 Examples of Effort to Analyze and Format Data Responses**

### Scoring of Measure Development Criteria

The second step of the measure development evaluation process is to assign values to the details you captured about each criterion. For determining the values, we focused on the “feasibility” of development and Table 11 below shows the values in the scale. We have found that a scale of



three values: easy, moderate, and hard, is enough to produce a spread of values that is meaningful in the final scoring process. We have found that having more “middle values” only adds confusion to the scoring process. You can add weights to the criteria values, but they need to be large enough to make a significant difference. Table 12 below shows the values we have assigned to each of the criteria. Note that we have added up the values to produce a total for the measure development score.

Value	Feasibility Level
1	Hard
2	Moderate
3	Easy

**Table 11 Measure Development Ranking Value Definitions**

Measures	Organizational Readiness	Data Availability, Frequency and Consistency	Respondent and Organizational Burden	Effort to Analyze and Format	Total Score
Percent of Research Proposals Accepted by Customer	3	3	3	3	12
Percentage of Change Requests Implemented	2	3	2	3	10
Planned Versus Actual Time to Complete Work	3	3	3	2	11
Budget Variance	3	2	2	2	9
Percent of Staff with Met Target Proficiency Level	3	2	2	2	9

**Table 12 Example of Feasibility Evaluation Values**

### Final Scoring of the Measures

Now that all the hard work is done, we generate a final score by combining the development score and the purpose score. In table 13, we have the formula for the final score which is a straight multiplication of the development score by the purpose score. Table 14 shows the results of combining the two scores.

We purposely call this a scoring process and not a ranking process because it is the combination of scores that will provide the final values that can then be used to make decisions. The scores highlight some different results based on the combinations. On table 14, the front runner on the development score, Percent of Research Proposals Accepted by Customer, stays on top with a high purpose score. Whereas a measure with a low development score, Budget Variance, is elevated to second place by a high purpose score. These score combinations help to show the



“low hanging fruit” measures that can be quickly put in place and the heavier lift of some important but more difficult to develop measures.

<b>Development Score</b>	<b>X</b>	<b>Purpose Score</b>	<b>=</b>	<b>Final Score</b>
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Table 13 Formula for Final Score

<b>Measures</b>	<b>Development Score</b>	<b>Purpose Score</b>	<b>Final Score</b>
Percent of Research Proposals Accepted by Customer	12	3	<b>36</b>
Percentage of Change Requests Implemented	10	1	<b>10</b>
Planned Versus Actual Time to Complete Work	11	2	<b>22</b>
Budget Variance	9	3	<b>27</b>
Percent of Staff with Met Target Proficiency Level	9	2	<b>18</b>

Table 14 Matrix of Assigned Evaluation Ranking Values and Final Scores

### Final Considerations for Your Measure Program

We hope you have found our reality check process enlightening and a promising application for your work environment. Implementing a performance management program can be as challenging to implement as it is beneficial to your program management and with that knowledge, we would like to leave you with some questions to think about when developing and managing a measure program.

**Priorities** - How much support do you have in your organization to keep producing the data needed by the measures? Will that continue with a change in leadership?

**Initiation** – Who has the authority to initiate your measure program? When do they need for the measures to be up and running?

**Resources** - What resources do you have to develop the measures? What resources will you have to maintain the measures and dashboards? What resources do you have to report the measures?

**Platform** – Where will you house your measures? What resources do you have to develop and maintain a platform for developing and reporting your measures?

**Maintenance** - Will your organization be committed to reviewing the data and updating the measures? What access will your stakeholders have to the measures? How frequently do you need to provide measure data?

**Updates** - Does the measure point of view still resonate with stakeholders? Should the measure be expanded or contracted? Are any of your measures outdated and ready for retirement?

## **Retaining Agility When You Work in a Waterfall**

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### **ABSTRACT**

Federal agencies undertake projects (however named) large and small on a daily basis, but often feel constrained by exceedingly rigid frameworks, such as in the Federal Acquisition Regulation (FAR), the unpredictability of the appropriations process, shifting strategic priorities, and bureaucratic internal processes. These limitations can handicap the ability of programs to adapt to fast-changing realities, something which is exacerbated in an international environment. This paper illustrates how USDA/FAS has built an operating environment in which it employs a full suite of tools to react quickly to emerging opportunities, respond to unanticipated needs, and adapt to an ever-changing global context – all while staying true to the laws, bureaucracy, and rigidity that defines the federal space.

### **INTRODUCTION**

The federal government, an organization not known for its agility, has increasingly promoted the use of project management practices within its portfolio of activities. At the same time, government bureaucracy does not acknowledge project management as a standalone technical proficiency, instead classifying project management as a supplemental knowledge area under existing technical umbrellas. This has a variety of impacts – mostly negative – on mission success and PM integration in to agency operations.

The USDA Foreign Agricultural Service (FAS) has embraced project management for decades, in volatile environments with unpredictable funding and variable political commitment. FAS has developed a culture of project management practices without worrying about whether they are “standard” across the government, and as a result, has been able to advance its mission by utilizing the full legal framework of the federal enterprise. The resources and practices to do so are mostly available to any federal agency that has the will and patience to build such a culture, however, bureaucratic resistance cannot be underestimated. For that reason, the costs and benefits of this approach need to be fully understood, in order for agencies to determine whether it is useful or appropriate to attempt to build such an environment.

### **WHO IS FAS?**

The Foreign Agricultural Service is an agency of the United States Department of Agriculture, responsible (inter alia) for acting as a liaison between the U.S. agriculture sector and foreign markets, collecting global market data, and providing technical assistance to foreign states.<sup>1</sup> As with any government agency, it has been reformulated many times over the last century, but its more or less current incarnation dates to 1993, with the merger of several previously separate units.

This history is important, in that each of those units brought with them their own independently-developed processes, procedures, history, and culture – of which they were fiercely protective against harmonization. The legacy of this merger left a cultural cleft in the agency, in which the successor units of the predecessor organizations operated largely independently of each other – no more clearly illustrated than that the two were, as late as 2020, physically located in different parts of USDA’s enormous headquarters complex.

These offices are responsible for implementing three broad portfolios of programming, with an aggregate annual budget of over \$700 million,<sup>2</sup> authorization pulling from 5 different parts of the U.S. Code,<sup>3</sup> and categorized into somewhere over two dozen programs – the precise number dependent on how one counts a “program.”<sup>4</sup>

Without burdening the reader with excruciating details, these programs (broadly speaking) support agricultural trade, improve food security, and make agricultural markets operate more efficiently. Each program has its own specific legal mandate; some are more focused on improving scientific capacity, others on nutrition and education, others on trade barriers. As a collective, however, they work together to support the world’s most efficient agricultural system to feed the world.

Despite the potential for programmatic synergies, only in the last decade or so was any sustained effort made to create a consistent identity across the agency, through structured practices such as promoting an agency networking group for junior staff, and by changing personnel policies to enable staff to rotate through different offices – something previously possible only at some difficulty, and which often came at substantial cost to an employee’s career. This recognizes that a successful enterprise encourages regular small-scale interactions (or “networking”) across the organization.<sup>5</sup>

This notwithstanding, even today each portfolio largely maintains its own processes, policies, and even distinct IT systems, to perform analogous functions. This decentralization may seem inefficient; indeed, the agency periodically establishes task forces or committees charged with determining the extent to which comparable processes might be consolidated or made consistent across these offices. However, in practice, the circulation of personnel,

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<sup>1</sup> 5 USC § 5693

<sup>2</sup> as of FY2020; for several reasons, FAS’ total annual budget is ambiguous until after the fact

<sup>3</sup> Includes Chapters 41, 64, and 87 of Title 7; Chapter 15 of Title 15; and Chapter 22 of Title 22

<sup>4</sup> The Government Performance Modernization Act of 2010 required, inter alia, that this be standardized and catalogued across the government. As of this writing, there is no indication that this effort has made any material progress.

<sup>5</sup> For a discussion of this phenomenon, see Axelrod (1984), 158

combined with a strong sense of purpose, enables staff to operate in any of these environments, in a manner that best achieves the objectives of each program.<sup>6</sup>

FAS' efforts towards integration has illustrated that there is no inherent reason why different objectives should be pursued in a uniform way for the sake of conformity. This, fundamentally, is what makes project management in FAS unique in the federal landscape: Pursuing each individual component of the agency's mission in the way best suited for that component results in a stronger and more resilient totality.

## **THE STEREOTYPE OF GOVERNMENT**

The federal government is not known for being nimble. When the government was confronted with an increasing need for professionalization of project management as a standalone discipline, it responded with the development of a supplemental (or collateral) project management certification, firmly under the aegis of acquisition and procurement.<sup>7</sup> Similarly, notwithstanding an (admittedly ambiguous) legislative directive to do so, the federal Office of Personnel Management has not created a dedicated career track for project management, arguing instead that it a subsidiary function of other technical competencies.

That the federal mindset would equate project management with acquisition – a notoriously rigid and inflexible instrument in the federal toolbox – is not especially surprising. Acquisition has become the default answer to a great many questions in the federal operating sphere, and contractors are increasingly used to fulfill virtually all federal functions, excepting those few deemed “inherently governmental.”

To be sure, there are certain benefits with taking this approach. First and foremost, it is inherently standardized – any federal employee can “plug and play” and be familiar with the policies and procedures. It also has the benefit of the Federal Acquisition Regulation,<sup>8</sup> which despite its rigidity is widely familiar to the government and non-federal organizations alike, and accompanied by a great deal of settled case law that accounts for a wide variety of scenarios that might arise during the course of implementation.

The challenge, however, with using acquisition in this way is that federal acquisition, especially at a large scale, requires a well-defined scope and a substantial lead time. To be sure, there are many contexts in which this is not problematic. If an agency needs to procure new computers for its staff, for example, it should encounter no difficulty using an acquisition tool to do so.

FAS, however, has a great deal of programming that is responsive and iterative in nature, i.e. for which even in ideal conditions, the final outcome of each effort is not necessarily predictable, and for which subsequent stages must be adjusted based on that outcome. The lengthy lead times and firm scopes that can easily be used to procure goods, are ill-equipped to accommodate this reality

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<sup>6</sup> see Epstein (2019)

<sup>7</sup> Known as the FAC-P/PM, it is administered by the same office responsible for other contracting and acquisition certifications.

<sup>8</sup> Title 48 of the Code of Federal Regulations (48 CFR)

– even before considering the environmental risk factors of political shifts, coups, and other strategic elements that can shift rapidly and without warning.

In short, the government mandates that project management be conducted in a ‘waterfall’ environment – with meticulous planning aforethought, and execution thereafter following a firm path. Yet the world in which FAS programs operate is not so predictable, and requires the agency to maintain a tremendous amount of agility in every regard – any day could bring a shift to where it operates, what it does there, who it interfaces with, and what it seeks to achieve.

## **WHO ARE PROJECT MANAGERS**

Although the term “agile” has a specific meaning within project management, agile project management is not quite so agile as the name would imply. To be certain, it represents an approach which, by virtue of its short iterative internal cycles, is better suited than traditional (‘waterfall’) project management in the environments where FAS operates, but still rests on an implied clear understanding of what the outcome will be.

Bearing in mind the government viewpoint of project management as an acquisition function – and notwithstanding that the majority of this paper argues against that very designation – it is worth noting that the FAR itself encourages agencies to be innovative in policies, procedures, strategies, and practices, when such innovation is in the government’s interest and not expressly prohibited.<sup>9</sup>

To that end, FAS embraces its different portfolios – while standardization may be useful in some regards, standardization for the sake of standardization is in nobody’s interest. Each project manager wields a suite of tools, instruments, and vehicles, that allow them to best achieve the objectives of their program(s). This represents a break from generic government practice: Project managers are assigned to projects based on anticipated workload, with the clear understanding that workload is not proportional to dollar value, and then afforded autonomy to implement their projects.

FAS project managers are generalists – assigned to personnel series 0301 or 0343;<sup>10</sup> outsiders are often surprised to learn that many have little to no background in agriculture; rather, their expertise is in foreign affairs, law, communications, or history. Although many have accrued some agricultural experience – for example, through the Peace Corps – this is not, in and of itself, necessary for a project manager to succeed.<sup>11</sup> FAS understands that the project management skillset is one in which PMs generally not the ones implementing activities day-to-day.

To this end, FAS uses a broad range of hiring authorities, mixing and matching depending on anticipated short- and long-term needs; a given project team often includes a mixture of staff hired as ordinary civil servants, those on term appointments, and some in the excepted service. FAS has maintained for

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<sup>9</sup> 48 CFR 1.102-4(e)

<sup>10</sup> In federal HR lingo, series 0301 represents “Miscellaneous Administration and Program” while series 0343 represents “Management and Program Analysis”

<sup>11</sup> see Stretton (2013); and Hauschildt, Keim, and Medcof (2000)

many decades a special excepted service appointment authority for “positions of a project nature involved in international technical assistance activities.”<sup>12</sup> While this is unique to FAS and requires OPM approval to establish, agencies with a variable project management footprint may wish to pursue a similar authority.

FAS does not, however, outsource its project management. Unlike many contemporary federal project organizations, which consist of a mix of federal employees and contractors, there are no contractors within FAS’ project management staff. To be sure, many of the larger overseas projects – which operate as autonomous, independently coherent entities – maintain contracted staff; these however are not integrated with FAS. Project management is a core function, and core functions should not be outsourced.<sup>13</sup>

### **WHAT EVEN IS SCOPE?**

Project managers work collaboratively with other cooperating partners – which, depending on the particular project, could include any combination of federal agencies, non-governmental organizations, international bodies, foreign governments, and the private sector – to guide projects throughout their implementation, and adjust as needed. This represents the most challenging aspect of operation in a federal environment: a precise scope is often impossible to write *ab initio*, because operating conditions may not be fully known or understood; and yet many agencies insist upon doing so, only for every adjustment to be complex and costly.

In contrast, by defining scope as progress towards an outcome, rather than a specific output, and working cooperatively with the concerned parties, FAS is able to guide projects through implementation; in many cases, even significant adjustments do not require a formal change action. This has the added benefit of enabling opportunistic extensions of activities when openings unexpectedly appear.

Similarly, FAS understands that, when the goal often requires action by foreign governments, any schedule is going to be a “best guess.” As such, although all activities begin with a defined period of performance, extensions are neither frowned upon nor discouraged; when a deadline cannot be met, the PM will determine whether the best course of action is to downscope, extend, or both – many of these deadlines aren’t really important in terms of programmatic outcomes.

Although this goes against the premise of “SMART” goal-setting, in that outcomes are general rather than specific, and time-boundedness is ambiguous, the progress made can be measured, and otherwise follows those principles to a large extent. Competitive projects are funded based in no small part on whether the progress anticipated is plausible and relevant to the larger mission.

For this reason, “firm fixed” pricing is rarely used, other than for small, discrete activities within larger umbrellas. While this may make sense in the “flexible scope” context described above, this is antithetical to standard approaches to contracting. In addition, FAS generally avoids firms with “loaded

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<sup>12</sup> 5 CFR 213.3213

<sup>13</sup> see Lankford and Parsa (1999)

rates,” instead working with entities whose costs are more broadly representative. This adds a degree of complication to financial oversight, but generates an overall cost savings through transparency. For example, the GSA CALC gives the average rate for a consultant economist at \$149/hour; in contrast, FAS pays closer to half that, even for a highly-experienced senior economist, and itemizes other related expenses that may be incurred along the way.

While now a standard practice in the agency, this was initially established in response to the variety of statutory and regulatory limitations that exist on FAS’ many funding streams; several are subject to cost limitations, especially related to consultant personnel; in some cases, “maximum payable rates” – which cannot be waived – may be as low as \$69/hour. Many commercial firms would balk at such a figure; however, itemization of expenses, despite a minor administrative cost to the agency, results in this being viable for non-federal implementers, as well as resulting in a cost savings to the agency in virtually all cases.

The other side of the “cost” coin – pun not intended – is quality. FAS’ experience is that there is no correlation between cost and quality. Some initiatives have been extraordinarily expensive, yet achieved nothing; others have been budgetary rounding errors, yet still resonate years later. The nature of these programs is such that quality is often binary: either an objective was advanced, or it wasn’t; either that advance is sustainable, or it isn’t. It is recognized from inception that it is improbable for a single project to achieve “mission accomplished,” and expectations are scaled accordingly.

In short, these four key elements – scope, schedule, cost, and quality – are deliberately flexible, recognizing that the number and scale of exogenous influences create a sufficiently ambiguous environment that a firm scope and fixed schedule would all but guarantee failure. Rather than expecting reality to conform to expectations, FAS matches expectations to the fog of reality. This requires a more hands-on approach, but also enables a higher degree of success.

## **TAKING RISKS**

The past year has highlighted, to an extent never anticipated, the scale of risk that comes with operating in an international arena. The coronavirus pandemic has had direct impact on food security,<sup>14</sup> and a variety of reactionary policy actions that, in some cases, undid years of progress made by previous FAS programming. While disappointing, operating in an international environment, by necessity, requires certain risks, and FAS has built an internal culture to accommodate that.

The government standard for risk management is to avoid risks where possible, whatever the cost, and transfer them where avoidance is impossible. While this avoids the uncomfortable publicity of a negative outcome – as FAS has experienced first-hand, for example, in Senator James Lankford’s 2015 edition of *Federal Fumbles*<sup>15</sup> – this approach comes with significant and

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<sup>14</sup> Baquedano, Zereyesus, Christensen, and Valdes (2021)

<sup>15</sup> Lankford (2015), 66-67

under-appreciated costs that ultimately hinder mission success.

Risk avoidance means that government programs only operate on solid ground. In some contexts, this is well-advised, especially if lives are on the line. FAS programming does not have such high stakes; although global food security is important, a single failed project in FAS' portfolio will not result in death or destruction. In practice, avoiding risks to this extent requires years of meticulous and detailed study. Conducting such study reduces, if not eliminates, the ability of the agency to be responsive to opportunities that arise – to say nothing of incurring the risk that circumstances may change before the study is actionable.

Opportunism sometimes sounds uncouth, but in the context of FAS programs, it is an essential ingredient for efficiency and impact. The sheer volume of issues that FAS programming seeks to address is staggering; even with the hundreds of millions of dollars in financial resources referenced previously, priority triage is routine. There are only so many resources, and they must be devoted to those places where they can be expected to have the greatest impact.

To that end, if an opportunity – or a crisis – arises, it is in many cases more important to act swiftly than perfectly. In 2018, for example, concern about retaliatory tariffs affecting the U.S. agriculture industry required a robust response to prevent lasting damage to the sector; in response, FAS quickly stood up a new program valued at over \$100 million. The program attracted criticism from all directions, with arguments that it was too big, too small, too targeted, not targeted enough, and so on. Yet undertaking meticulous study of the market environment to carefully craft a perfect program, would have taken years – by which point, the beneficiaries would no longer benefit.

When the government can't avoid a risk, it prefers to transfer the risk to its contractors. This is an "easy" solution, but comes at tremendous cost – the government often (somewhat infamously) pays dearly for this risk transfer, sometimes orders of magnitude above real costs, as contractors must take the same risk mitigation strategies that the government is avoiding.

FAS accepts that risks are real and cannot always be avoided. For example, earlier in 2021, Burma (Myanmar) experienced a coup d'état. This freezes (and, in most cases, terminates) non-humanitarian U.S. Government programming in the country. By definition, individual coups cannot be predicted; but they will occur.<sup>16</sup> Similar circumstances may occur with other types of conflicts, or even natural disasters. In FAS' case, other relevant risks include agricultural trade agreements to which the U.S. is not party, and occasional underhandedness at ports. If these risks realize, projects will not achieve their goals. That is accepted as a risk of operating in the international environment: After all, any projects that is never initiated, also won't achieve its goals.

FAS' other consideration in risk management is to have backup plans, if the primary path is cut off. This includes severability in activities – so if a single activity or implementer is unexpectedly cut off, the remainder can continue – and a focus on different aspects of a long-term need. These backup plans need not be formally written *ab initio*, but simply having that concept available can

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<sup>16</sup> Belkin and Schofer (2003)



salvage an unenviable situation and create something out of nothing.

## **STAKEHOLDERS AND COMMUNICATION**

Preparing a list of stakeholders can fill any government PM with dread – virtually everybody is a stakeholder, every one of them holding different stakes, promoting different interests, and expressing an unshakeable insistence that they are more knowledgeable (or at least more important) than the others.

It will come as no surprise, then, that many federal employees instinctively recoil when they hear the word “interagency.” It evokes the image of lengthy meetings filled with clichés and pre-prepared talking points. As a consequence, there is often an innate hesitation to communicate beyond a given PM’s immediate silo, lest any activity be drowned in such a morass.

That stereotype is not wholly inaccurate, but can be overcome by empowering and encouraging PMs and other front-line staff to build working relationships with their counterparts. While executives can continue to hold their regularly-scheduled quarterly meetings, working-level staff with strong peer-to-peer connections can put those executives on the same page before that meeting even starts – and, in turn, garner their support by giving them something to show that they’re cooperating... even if they didn’t know about it before reading the pre-meeting brief.

FAS has the particular benefit of having a comparatively well-defined set of stakeholders for most of its programs; as such, many formal and semi-formal associations and groups exist, containing mixes of federal and non-federal entities, through which such matters can be discussed. While each suite of programs has a different set of stakeholders, PMs need not start *ex nihilo* when establishing who the stakeholders are for their projects.

This approach is no less important internally to the agency. FAS, like many large organizations, struggles to manage internal communication. The most effective PMs are those who, just as with the ‘interagency,’ maintain their own peer-to-peer networks across different offices. While this cannot overcome all obstacles, it can reduce inefficiencies, and more crucially, prevent a late-emerging veto-holder from emerging after considerable effort has been expended.

An important lesson FAS instills in its PMs, particularly when contending with internal stakeholders, is that nobody speaks for everybody. This is often forgotten in stakeholder management: No matter who a particular individual ‘represents,’ there is invariably a chorus of nuanced and differing feelings within that organization. It may be time-consuming to account for all, but they are ignored at a project’s peril.

The most successful PMs are in regular contact with stakeholders. Formal updates – i.e. quarterly meetings – may serve as calibration mechanisms, but no stakeholder wants to be surprised in such a forum. By building and maintaining these strong working relationships across units, PMs are able to generate broader support for their projects, and better alignment among programming within the agency and beyond.

One of FAS’ innovations in internal project management is understanding

that generalist PMs may not necessarily be versed in the highly specific lingo of all the various offices they may interact with. This lingo could be technical (for example, “SPS/TBTs”), contextual (for example, “Farm to Fork”), or bureaucratic (for example, “General Ledger 4802”). To overcome this barrier, FAS has designated liaisons – or translators, as it were – to facilitate communication between units where misunderstandings regularly occur.

## **CONCLUSION: CAN THIS BE REPLICATED?**

Perhaps another federal agency reading this description of FAS’ project management practices and wondering if they could replicate this within their own organization. Anyone attempting to answer this question briefly would be wise to mumble. However, if one is to embark on such an endeavor, this assessment can offer a few pieces of advice.

First, this cannot be attained through a one-off training or series of webinars. Building this “can-do” organizational culture, in which PMs are empowered with authority and tools to do their jobs, takes years – if not decades. Such a culture requires sustained buy-in at all levels of the organization, from senior executives to the greenest junior professional. This requires not only training, but ongoing support that encourages PMs to use independent judgement and manage their resources most efficiently.<sup>17</sup>

Second, don’t underestimate the resistance. Governments are notorious for rewarding a “paper-pusher” culture, in which it is deemed more important to have the correct forms (each, of course, bearing an OMB control number) properly completed and in the designated sequence, than to achieve the mission. FAS is not immune to this tendency; the agency often finds itself in a tug-of-war regarding whether to prioritize the paperwork or the mission.

This is not to say that legalities and details are unimportant; certainly, no one in the agency, nor any of the stakeholders, has any desire to be non-compliant, nor to land in Senator Lankford’s annual report of wasteful spending. However, agencies have a great deal of discretion – often more than they realize – as regards implementation. With an appropriate (non-zero) level of risk tolerance, and instilling a culture of working cooperatively, rather than adversarially, with non-federal partners, greater impacts are possible program-wide, even if some individual projects fall short.

Third, it must be emphasized that while many of the operating authorities FAS uses are available to any civilian federal agency, there are several which are limited to subsets of the Department of Agriculture, or to FAS specifically. To have additional authorities extended, whether by legislation or by regulation (as applicable), is not a trivial undertaking; agencies may find that more cumbersome processes are still less complex than seeking out these authorities.

Finally, it is important for any organization, especially in the public sphere, to understand that their mission and priorities can change, due to global circumstances, new political mandates, or any number of other factors. However, PMs are often hesitant to establish backup plans, lest they create the appearance that there is a lack of confidence in the principal plan. Management

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<sup>17</sup> see Brinkerhoff (2006)

must have the sustained commitment to this practice to encourage and reward resilient thinking, rather than overconfidence.

In short, many of these lessons can be adopted, in whole or in part, to improve project management practices at federal agencies, and to an extent, throughout the public sector. Doing so, however, is not a matter of flipping a switch – cultural change is a lengthy process, requiring sustained commitment across administrations. It can be done, however, and FAS is an example of that.

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**UMD Project Management Symposium**  
**Testing Validity of Agile framework on**  
**Construction Project Management in the Middle East**

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## **ABSTRACT**

Agile is spreading! Although its origin has been in IT but recently an increasing number of forward-looking companies in different industries adopted agile techniques responding to market trends to sustain their competitive edge.

This research paper aims to demonstrate the validity of implementing the agile framework in the construction industry in the middle east arena. It will begin by a brief basic definition of agile manifesto going through some values and principles for its use.

Also, one of the main objectives of this study is to understand the difference between being agile and doing agile in an iterative or sequential project management process - witnessed in the construction field. Among many agile tools, the scrum master, one of the prominent agile techniques in construction, will be taken as an example to test the validation in a construction project. This will be illustrated in a case study in Egypt, showing and accepting all the challenges, understanding the concerns and presenting the results.

After going through the example, the research will let us question the validation of the agile framework, should we go agile or stay by the waterfall process in the construction industry!

## **INTRODUCTION**

“Agile”, one of the latest ideas in management, has its roots in IT, where it’s used as a method for developing software. In recent years it has spread beyond IT departments to become an operational mode for an increasing number of forward-looking companies that want to respond to market volatility in ways that create competitive advantage. With this background in mind, some construction companies are enhancing the performance of their project teams to improve their competitiveness and increase the added value to their clients and themselves.

This paper aims to look into the implementation of an agile tool like scrum framework from the IT sector into the construction industry. Conducting a case study, the implementation and application of Scrum was analyzed through the evaluation of its different artifacts. This research covers the following questions: Can Scrum be implemented in the design phase of the construction industry? What adaptations are needed to use Scrum to improve the design phase of construction projects? How and where could Scrum, or parts of it, be used by the design and planning departments of construction companies?

In the construction industry, one of the biggest challenges when creating a building is to account for the unforeseeable. In order to reduce the number of unforeseeable events, project managers typically use templates, checklists and often models with phases, sub-phases and sub-sub-phases, as indicated for example in. This so-called sequential project management approach aims to plan the project in detail and tries to carry it out without any deviation. The creation of this plan often takes up significant resources before the actual construction has even started. In many cases, these processes are so long that by the time the execution phase has started, the plan needs to be revised because of modified project requirements. Constant modifications of the project requirements coupled with occurring problems in defining the original product requirement causes cost overruns and schedule delay and lowers the product quality. As a countermeasure, agile project management was created, whereas agility is defined.

The results from this study show that Scrum has great potential in the design and planning departments of construction firms. From the analysis of the applications of Scrum in the case study, tangible benefits and weaknesses of the implementation, and its different artifacts, were identified. Finally, this paper gives recommendations about the use of Scrum in the design phase and proposes an outlook to implement Scrum in other phases of construction projects.

## **BASIC AGILE DEFINITION AND WHY WE USE IT**

By definition, agile is an iterative approach to project management and software development that helps teams deliver value to their customers faster and with fewer headaches. And it was evolved due to the need for quick and responsive actions in order to adapt to change requirements. And change here can reflect risk or any unforeseeable events. The agile team delivers work in small, but consumable, increments.

More than fifteen years after its founding, agile practices remain as relevant as ever and the businesses that embrace agile continue to lead the pack.

## **AGILE MANIFESTO VALUES AND PRINCIPLES**

Agile is the ability to adapt and respond to change. It is the way of handling, and ultimately succeeding in an uncertain conditions and turbulent environment.

It's really about thinking through how you can understand what's going on in the surroundings, identify what uncertainty you're facing, and figure out how you can adapt to that as you go through the process.

The Agile Manifesto incorporates 4 foundational values and 12 supporting principles which lead the Agile approach to software development. Each Agile methodology applies the four values in different ways. The 4 values are:

### **1. Individuals and Interactions Over Processes and Tools**

Appreciating people more than processes or tools because it is the people who respond to business needs and guide the development process. If the process or the tools drive development, the team is less responsive to change.

### **2. Working Software Over Comprehensive Documentation**

The list of documents was extensive and was a cause for the long delays in development. Agile does not neglect documentation, but it organizes it and summarize it to the developer to know what is needed without getting decelerated. Agile documents requirements as user stories, which are sufficient for a software developer to begin the task of building a new function. The Agile Manifesto values documentation, but also it values working software more.

### **3. Customer Collaboration Over Contract Negotiation**

With development models such as Waterfall, customers negotiate the requirements for the product, often in great detail, prior to any work starting. This meant the customer was involved in the process of development before development began and after it was completed, but not during the process. The Agile Manifesto describes a customer who is engaged and collaborates throughout the development process making. This makes it far easier for development to meet their needs of the customer. Agile methods may include the customer at intervals for periodic demos, but a project could just as easily have an end-user as a daily part of the team and attending all meetings, ensuring the product meets the business needs of the customer.

### **4. Responding to Change Over Following a Plan**

Traditional software development regarded change as an expense (change request), so it was to be avoided. It aims to develop detailed plans, with a defined set of features and with a large number of dependencies on delivering in sequence so that the team can work on the next piece.

In Agile process, the time taken in one iteration means priorities thus it can be shifted from one iteration to another with the addition of new features in the coming iteration. The agile view is that changes always improve a project; changes provide additional value.

Perhaps nothing illustrates the agile positive approach to change better than the concept of Method Tailoring, defined in An Agile Information Systems Development Method in use as: “A process or capability in which human agents determine a system development approach for a specific project situation through responsive changes in, and dynamic interplays between contexts, intentions, and method fragments.”

Here are some important agile principles:

1. Our highest priority is to satisfy the customer through early and continuous delivery of valuable software.
2. Welcome changing requirements, even late in development. Agile processes harness change for the customer’s competitive advantage.
3. Deliver working software frequently, from a couple of weeks to a couple of months, with a preference to the shorter timescale.
4. Business people and developers must work together daily.
5. Build projects around motivated individuals. Give them the environment, support and the trust they need.
6. The most efficient and effective method of conveying information is face-to-face conversation.
7. Working software is the primary measure of progress.
8. Agile processes promote sustainable development.
9. Continuous attention to technical excellence and good design.
10. Simplicity—the art of maximizing the amount of work not done—is essential.
11. The leading architectures, requirements, and designs emerge from self-organizing teams.
12. At regular intervals, the team reflects on how to become more effective, then tunes and adjusts its behavior accordingly.

The intention of agile is to orient development with business needs, and the success of Agile is apparent. Agile projects are customer focused and encourage customer guidance and participation. As a result, agile has grown to be an overall view of software development throughout the software industry.

## TYPES AND DIFFERENCES BETWEEN AGILE TECHNIQUES

Agile is everyone's favorite project management and delivery buzzword, but what agile techniques can you use to help successfully run an agile project? Is it Scrum, Kanban, Scrumban, or other hybrid agile methods? Here is a comparison between scrum and kanban, most common tools.

Comparative analysis between Scrum and kanban

	<b>Scrum</b>	<b>kanban</b>
<b>What</b>	a process that helps to deliver the business value in the shortest time. It rapidly and repeatedly inspects the actual work. It emphasizes on teamwork and iterative progress.	a visual system for managing work. It visualizes the process and the actual work. It identifies potential bottlenecks in the process and fix them. its goal is to handle the work process smoothly at an optimal speed.
<b>Why</b>	it addresses complexity in work by making information transparent. These help team to inspect and adapt based on current conditions, instead of predicted conditions.	designed to meet minimal resistance. It allows continuous small incremental and evolutionary changes to the current process to achieve improvements.
<b>When</b>	used in a project where the requirement is rapidly changing. It works on a self-organizing, cross-functional team principle.	help the team to understand complex information like processes and risks associated to complete work on time.

From this comparison, we can come up with the fact that, the construction industry by nature is very demanding in requirements and it happens to have many change requirements by various stakeholders and new conditions that may appear while doing the work. Accordingly, scrumming in construction is the best tool for using agile.



# SCRUM IMPLEMENTATION IN CONSTRUCTION PM

Scrum is a framework for product development where different processes and techniques can be applied to complex projects. A typical Scrum framework is illustrated below. The Scrum framework consists of the Roles, Artifacts and Events.

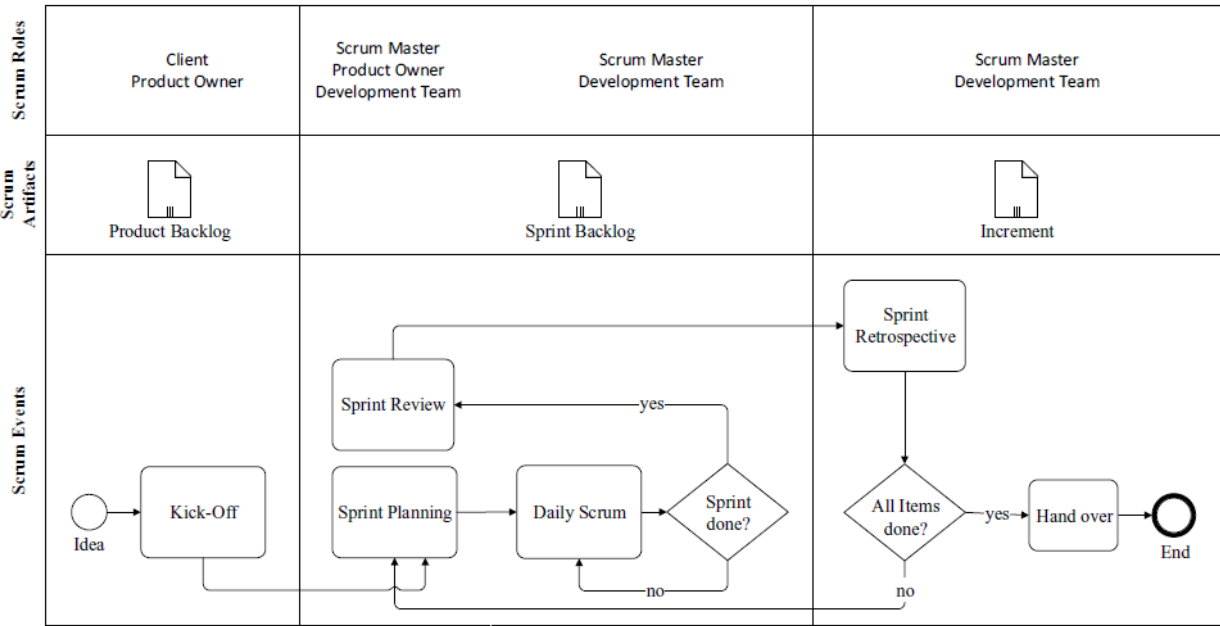


Figure 1. Scrum Framework

**Scrum Roles:** simply, roles are mainly the key project’s stakeholders which consists of the client (product owner), scrum master and the development team.

The product owner, is the one representing the client and he is responsible for maximizing the project value. He is in charge of creating, updating, and prioritizing the Product Backlog Items. In addition, other responsibilities include optimizing the work performance of the Development Team, to ensure that the Product Backlog Items are clear, transparent and understood by everyone. Also, he takes into account other stakeholders’ interests and is the only one who can make changes to the Product Backlog Items.

The scrum master, is the one who sets all the Scrum Events and demonstrates to individuals outside the Scrum Team how they can / can’t interact with the development Team. He is mainly in charge of removing any obstacles brought to the Scrum Team so that the Development Team can focus on their work and are not slowed down by insignificant changes. He also enforces the framework given by Scrum and the changes made considering new information.

The scrum development team, are the individuals who actually do the work. All team members are all equal (no project manager), self-organized and cross functional.

The number of team members varies depending on the area of operations, but a size of seven ( $\pm$  two) members has proven to be successful.

**Scrum Artifacts:** these are mainly the documents issued by the scrum roles and they are described as elements within the scrum framework. These elements as shown in the figure above are as follows

The product backlog: issued by the product owner in which you can find all the various items categorized by priority. These product backlog items are then sliced up into tasks. These tasks as defined by the PMBOK as the work packages addressed by the development team member and ideally it should take from one to two days to be submitted.

The sprint backlog: this contains a list of some items that are selected by the product owner and the development team from the product backlog. The team choose these items according to their beliefs (planning poker) that they can reach the state of done during a Sprint. When an item is checked as done, it is then moved from the sprint backlog to the increment section. Hence, the increments part is a total of the checked as “done” items.

The Development Team approximates the amount of work needed using points instead of time (ex: man-hours). This is done because Gantt-Charts are never accurate so there is no point to assume a number of hours for a task if it is not going to be met. For example, these points merely stipulate that an Item with an eight is more work than an Item with a three or five. However, this information could be used at a later time by the Product Owner to estimate project durations (ex: completion dates).

**Scrum Events:** its main objective is to uphold to the scrum keys factors mentioned earlier, transparency, adaptation and inspection.

Normally, a Kick-Off meeting is held – based on the client’s demands – and the Product Owner documents the Product Backlog to fulfil all requirements.

The Sprint Planning has a maximum duration of 8 hours for a Sprint. During this Planning phase, the Development Team guesses the amount of work for the most important Items of the Product Backlog with Planning Poker. After that, they choose the Items they think can be done in the Sprint, starting with the most important one; this list is called the Sprint Backlog. While considering all the Items from the Sprint Backlog, the Sprint goal has to be defined. This enables the Development Team to

always ask themselves and inspect: Is this work I am currently doing really necessary for this Sprint to reach the goal?

After finishing the sprint planning, the Development Team can start working on the Items during the Sprint in a fixed timeframe in which it aims to reach completion for each Item. During the Sprint no changes are permitted to the Items, unless the value or the scope of the items is increased, and this has to be consulted with the product owner. By the end of the Sprint, the items that were not completed are moved to return back to the Product Backlog and will be re-assessed in the next sprint.

The framework displayed in the above figure uses incremental steps on a daily basis which we refer to it as Daily Scrum, to finish the sprint and corresponding Product Backlog. The key advantage of this progressive approach is that focusing on one task always leads to speeding up the process of work completion.

The use of Scrum has proven treasures in projects with high complexities especially those where the requirements are not yet very mature as will be elaborated in the following case study.

## **CASE STUDY IN EGYPT – SUEZ CENTRAL HUB**

In Sinai - Egypt

Briefly the project was about creating a new canal, parallel to the existing one, to maximize benefit from the present Canal and its by-passes, and double the longest possible parts of the waterway to facilitate traffic in the two directions and decrease the waiting time for transiting ships. This will certainly reduce the time needed for the trip from one end of the Canal to the other, and will increase the numerical capacity of the waterway, in anticipation of the expected growth in world trade.

The Egyptian armed forces helped in digging and designing the canal. The enlarged capacity allows ships to sail in both directions at the same time over much of the canal's length. Beforehand, much of the canal was only one shipping lane wide, with limited wider basins for passing. This is expected to decrease waiting time from 11 hours to 3 hours for most ships, and to increase the capacity of ships to pass along the Suez Canal from 49 to 97 ships per day.



**Figure 2. Suez Canal Master Plan – before and after**

Project Initiation: On August 5, 2014, with no previous planning or studies; Egypt president announced the actual start of constructing a new water channel 72 km long branching from the already existing Suez Canal, deepening the current shipping lane and developing the entire Suez Canal axis, with the objective of developing and broadening the role of the whole area economically, urban and environmentally integrated global logistical and industrial center and seeks to make a central hub in that area. This project will sustainably compete globally in the field of logistic services, trade and tourism. Normally, a big project like this should take three years on average in excavating the new water channel and developing the surrounding area, but due to the complex political situation at the time, it was announced by the President that this project should not take more than one year, so it has to be submitted around the same time in 2015. As the revenues of the canal will increase from 5 billion dollars to 12.5 billion dollars annually. Therefore, on August 7, 2014 (2 days after the announcement) they started the dry drilling phase. This is the point where technical problems started to arise due to the type of soil and no soil samples were taken to be examined before excavating. Further difficulties were like seepage of the old canal to the new one which led to flooding!

At the end the project was submitted on two phases. Phase one was in February 2015, it includes constructing the city, industrial zone, technology valley and fish farms.



**Figure 3. Building Phases**

Then phase two in July 2015, it includes the new water channel and deepening the old one with a total cost of 30 Billion Egyptian Pounds.

## **CONCLUSION**

I believe that Scrum could also be applied in the construction phase with Daily Scrums on-site to reduce waste of time. For example, Daily Scrum could be useful to inform construction companies about the work progress and the daily goal (Sprint) of other construction companies also working on site.

Agility in mindset is a key strategy going forward. And the ability to manage that change successfully separates good organizations from ones who are not competitive. If you take these three foundational tenets; change management, innovation and organizational alignment and you blend them together along cultural aspects, that basically is the foundation for a successful project management, explained by Prof. Paul Tumolo, MBA, Harvard University

Needless to say, that it is useful to study new tools and techniques but also its more important to learn best practices because being agile when it comes to construction or any sequential projects is not any more about applying the tools, however it's about adapting the mindset to continuously improve and develop the process.

## **KEY TAKEAWAYS**

Hence the case study was extremely challenging yet it was delivered successfully, here are the takeaways

- Learn the difference between being agile Vs doing agile
- Mindset flexibility and tailoring are significant factors in the construction field
- Innovation & tailoring is a key point in project management

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**UMD Project Management Symposium  
The Art of Data-driven Forecasting**

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**ABSTRACT**

Forecasting when an agile-developed product or service might be released, or how much of the product or service might be ready by a hard delivery date, requires both art and science. The science of forecasting includes statistics calculated from an agile team's historical record of past performance and a statistical model to forecast the uncertainty of the team's future performance. The art of forecasting includes the team's estimates of all remaining work and the subjective judgment of the forecaster. However, forecasters must recognize their own cognitive biases which can adversely affect their forecasts. In this whitepaper, six questions are raised to assist the agile development forecaster in deciding when to apply subjective judgment to adjust or override statistics gathered from historical records.

## INTRODUCTION

Forecasting is a critical business capability that helps organizational leaders evaluate return-on-investment (ROI) options and select project portfolios that optimize ROI and the use of scarce organizational resources. In traditional project management, project teams decompose project charter scope statements into a work breakdown structure that later informs the project team's detailed schedule and budget estimates.

In agile project management, project sponsors often agree to fund an agile team for a set duration that is aligned with the project charter's schedule constraint, which itself is a function of the organization's judgment of how long it will take to achieve some larger goal. The resulting project budget is simply a product of the agile team's average weekly cost and the number of weeks that the sponsor agrees to fund the agile team (with necessary adjustments for other costs, such as hardware, software licensing, or costs related to the project endeavor).

Value-stream funding—where an organization chooses to fund value streams rather than projects—is like agile project funding because the organization chooses to fund multiple value-streams for a given time period, such as quarterly, semi-annually, or annually. This whitepaper refers to “agile projects” but applies equally to non-project, value-stream management, too.

While both the *schedule* and *cost* constraints are, for agile development efforts, often inflexibly held, the *scope* constraint is usually the most flexible constraint of the project's so-called “Triple Constraint.” Since agile projects expect work to emerge over time, and agile teams decompose only the work that they will imminently bring into their upcoming sprints or iterations, neither the project sponsor nor the agile team can say with certainty *what* the team will deliver or *when* they will deliver completed scope items.

This uncertainty over what will be delivered and when it will be delivered is a source of anxiety for most project sponsors, product managers, product owners, and other interested stakeholders. Product owners using Scrum—the most popular agile method for creating products, services or other results (State of Agile, 2020)—rely on forecasts to maximize the value of a Scrum team's development efforts. Project sponsors and organizational leaders also use forecasts to assess whether the project charter's constraints should be firmly held or relaxed, and where the organization's scarce resources should be deployed now and in the future.

Forecasting an agile development effort is essentially no different than any other type of forecasting. The goals of forecasting are always the same: to align expectations about an uncertain future, and to make better decisions today to optimize the likelihood of maximizing desirable future outcomes.

Forecasters of agile projects use algorithms, historical data and statistics to prognosticate the future performance of an agile team—just like forecasters from any other industry would do. That is because judgmental forecasting without *science* is a largely a fruitless effort. Phillip Tetlock, a political scientist, authored a landmark study that found judgmental forecasts alone are usually of dubious accuracy (Tetlock, 2005). In fact, “Human beings who spend their lives studying the state of the world, in other words, are

poorer forecasters than dart-throwing monkeys...” (Menand, 2005).

Tetlock’s study does *not* mean that all judgmental forecasting is meritless, however. When a forecaster has access to information that is not evaluated by a statistical model and has made similar forecasts within a stable environment, the result informs decision-makers (Kavanagh and Williams, 2014). Good forecasting, then, starts with a good-fitting statistical model and then adjusts the model’s algorithms by carefully applying expert judgment to further enhance both the forecast’s informativeness and accuracy.

This paper will explore the *art* of data-driven forecasting within an agile product development context using Scrum. Using the built-in statistical functions inside Microsoft Excel® and a freely licensed, pre-built spreadsheet called Statistical PERT® (Normal Edition), an agile forecaster can use a pre-built algorithm to forecast product delivery dates (the *science* of forecasting). Then, the forecaster can employ subjective judgment to improve their forecast while being cognizant to avoid or mitigate common cognitive biases that can degrade the quality of their forecast (the *art* of forecasting).

## **FORECASTING OBJECTIVES**

If the overarching *goals* of forecasting are to align expectations and to make better decisions that maximize the likelihood of desirable future outcomes, then what are the specific *objectives* of forecasting future outcomes?

The forecasting function can have numerous objectives based upon the forecasting context. For instance, meteorologists (weather forecasters) create forecasts with the objective of informing people so they can make good decisions considering upcoming weather changes, especially when a weather storm is threatening property and human life. Operational forecasts help an organization anticipate demand so the firm can ensure it has enough inventory and production capacity to meet that demand.

With agile-developed product forecasting (referred to henceforth as “agile forecasting”), the objective usually is to estimate the delivery date of new product features, or to estimate how many new features an agile team can deliver by an inflexible delivery date. Product owners rely on agile forecasts to align customer and stakeholder expectations and to modify product feature sets that satisfy delivery date constraints whenever they exist.

## **DATA-DRIVEN AGILE FORECASTING**

Agile team forecasters rely on the team’s actual performance of converting product backlog items to completed work requests. An agile team may use different units of measure to calculate “done” work requests. Story points, story cards, and ideal days are three such ways that agile teams size their work items. Importantly, agile forecasting does not stipulate the unit of measure to use; any of these units of measure can work well.

In the University of Maryland’s 2020 Project Management Symposium, William W. Davis explained how to use a pre-built Microsoft Excel® spreadsheet called Statistical PERT® to create an agile forecast using an agile burn-up chart (Davis, 2020). This visual, data-driven, and probabilistic approach to forecasting requires the forecaster to have access to the agile team’s historical record of completed work items from each finished iteration or sprint, and



an estimate of all remaining work on the team's product backlog. Excel's built-in statistical functions for the normal probability distribution and Excel's charting capabilities create a visual forecast—a burn-up chart—that sponsors and stakeholders can easily interpret.

The algorithms used in the Statistical PERT spreadsheet are the *science* behind agile forecasting using this particular forecasting technique. But forecasting is a blend of *science* and *art*, and agile forecasters need to employ subjective judgment to improve their forecasts beyond what a data-only forecast can do. However, applying subjective judgment to adjust a statistical model—in hopes of improving the model's informativeness and accuracy—comes with its own set of perils: cognitive biases. Cognitive biases inject irrational conclusions into any kind of forecast that human beings create (Kavanagh and Williams, 2014).

## COGNITIVE BIASES

Human beings suffer from a multitude of cognitive biases. Among dozens of cognitive biases that social science has identified since the 1974 seminal work by social scientists Amos Tversky and Daniel Kahneman, two of the most impactful to forecasters are overconfidence in range estimation (*overconfidence*) and *anchoring* (Welsh and Begg, 2018).

With *overconfidence*, forecasters use range estimates that too narrowly describe all future possible outcomes and fail to recognize that the true value may lie outside the forecaster's range estimate. *Overconfidence* hides possible-but-improbable outcomes from decision-makers and makes values within the range estimate appear more probable than they actually are.

With *anchoring*, forecasters are unduly influenced by any initial number that is currently at hand, even if that number is irrelevant to the estimation problem. For agile forecasting, *velocity*—the arithmetic mean of an agile team's historical record of completed work items—acts as an anchor upon which an agile forecast is usually built, even if the agile team's velocity is not a good predictor of their *future* performance. The standard deviation of completed work items is another anchor, although not all teams calculate their standard deviation.

## SIX QUESTIONS FOR ARTFUL AGILE FORECASTING

Agile forecasters can improve their forecasts by raising, then answering, six important questions about their data-driven forecasts. When adjusting data-driven forecasts, agile forecasters must avoid the cognitive biases which could result in forecasts that are *worse* than unadjusted, data-driven-only forecasts. With prudent application of subjective judgment, agile forecasters can expand their range estimates to overcome *overconfidence*, and they can choose to override an easy-to-calculate *anchor* when the *anchor* value is not a good predictor of the agile team's future performance.

The six questions every agile forecaster should ask when preparing a forecast for an agile-developed product or service are:

- 1) How much team history should I include?

- 2) When should I anticipate reduced team capacity to work?
- 3) How should I adjust for product backlog growth?
- 4) How wide should my “cone of uncertainty” be?
- 5) When should I modify my team’s historical velocity?
- 6) When should I modify my team’s standard deviation?

## HOW MUCH TEAM HISTORY SHOULD I INCLUDE?

Some agile teams work for years on the same project (or value-stream). However, it is generally not a good idea to include *all* the agile team’s historical record of completed sprints when creating a delivery forecast for new product features. Agile teams perform regular self-inspection to evaluate ways where they can improve the way they work together to create a new product or service. Through this process of continual improvement, agile teams ought to be increasingly more efficient and effective in how they work together. This increased efficiency and effectiveness should result in an increased ability to deliver greater value more quickly over time. Therefore, an agile team’s recently completed iterations or sprints are more reflective of how quickly a team converts product backlog items into a “done” increment than what the team completed many months earlier.

An agile forecaster is faced with making a difficult decision of how much team history to include when calculating the velocity for a mature team that has spent many months (or years) working together. The objective is to select as much history of completed iterations or sprints as necessary to calculate a true measure of the team’s current velocity (mean) and standard deviation but avoid including team history that is no longer relevant or reflective of how the agile team is currently working.

This is a difficult, *subjective* judgment call. The agile forecaster must evaluate the team’s historical record to determine how much of that historical data is *relevant* and *reflective* to the conditions under which the agile team currently works.

As a general rule, it is preferable to use all the historical data from the last three-to-six most recently completed months because recently completed sprints are likely to be both *relevant* to current working conditions and *reflective* of how efficiently the agile team converts product backlog items to a new product increment. For agile teams using two-week iterations, using more than six months of history may materially change the delivery dates of new product releases based on old ways of working together. Using less than three months may cause the delivery date range to be too narrow (or possibly too wide) if the most recently completed sprints were consistently (or inconsistently) delivered.

Sometimes there appears to be “outliers” in the agile team’s historical record. These “outliers” may appear to be very small or very large relative to the team’s velocity. Here is another opportunity for the agile forecaster to adjust their forecast by either retaining or excluding data “outliers.” Generally, it is *not* a good idea to exclude “outliers” in the data because the supposed rare conditions under which the outliers were created are often not as rare as agile teams, sponsors, and stakeholders think them to be—this is the *overconfidence* bias that an agile forecaster must guard against.

## WHEN SHOULD I ANTICIPATE REDUCED TEAM CAPACITY TO WORK?

Sometimes an agile team's capacity to work in the future is reduced from their recent past. This could be for many possible reasons: upcoming holidays, upcoming school schedule breaks, summertime vacations, non-project training opportunities, business conferences, production support duties, and other, non-project efforts which diminish the team's capacity to work on their agile-developed product.

The agile team's historical record may not reflect these conditions which erode the team's capacity to work on their project endeavor. When that is the case, an agile forecaster must anticipate declines in the agile team's capacity to work and adjust the team's expected, future performance. This is especially true at the end of the calendar year when project teams to have little or no capacity to work because of end-of-year, holiday time-off.

Using Statistical PERT, the agile forecaster indicates the reduced capacity to work by choosing a percentage value under the "Team Capacity" column for the sprints where the team will have reduced capacity to work. For example, choosing "0%" means the team has no capacity to do any work at all, while choosing "50%" means the team expects to work at half its normal capacity.

Iteration (Sprint) Finish Dates	Team Capacity	Product Backlog	Actual "Done" This Iteration	Total "Done" All Iterations
7/13/2020		300	40	40
7/27/2020		260	30	70
8/10/2020		230	50	120
8/24/2020		180	45	165
9/7/2020		135	30	195
9/21/2020		300	10	205
10/5/2020		290	25	230
10/19/2020		265	45	275
11/2/2020		150		
11/16/2020				
11/30/2020				
12/14/2020				
12/28/2020	0%			
1/11/2021	50%			
1/25/2021				
2/8/2021				
2/22/2021				
3/8/2021				
3/22/2021				

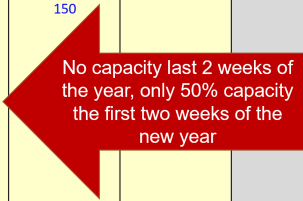


Figure 1 – Team Capacity Adjustment

## HOW SHOULD I ADJUST FOR PRODUCT BACKLOG GROWTH?

Agile teams do not identify all the expected work to complete like a traditional project team would do using a work breakdown structure. Product backlogs are dynamic. Teams will add, reprioritize, and remove backlog items as the project progresses. Usually, work emerges over time and the totality of the work to finish a product is greater than what the team first thought. In traditional project management, this is called "scope creep." In agile projects, product backlog dynamism is welcomed so it is the responsibility of the product owner to ensure that the team's efforts always maximize the value of the product.

Agile forecasters can anticipate work emergence over time. To do that, there are several techniques to use. The simplest technique is to add one or more unnamed epics to the product backlog, sized like other named epics are typically sized. This makes visible the team's expectation that new, as-yet-unknown work will emerge over time.

Another technique is to add a growth factor to the existing product backlog. For instance, if the current product backlog has 100 story points of work identified, the agile forecaster can assume 10% growth over the next few sprints and add 10 additional story points to each of the next imminent sprints. Then the total amount of work to complete over, say, the next three sprints is 130 story points ( $100 + (100 \times 10\% \times 3 \text{ sprints})$ ). This technique, however, does not make the forecaster's assumption of product backlog growth as visible as does adding unnamed epics to the product backlog.

## HOW WIDE SHOULD MY “CONE OF UNCERTAINTY” BE?

The “cone of uncertainty” is determined by two factors: the standard deviation and the confidence interval selected by the agile forecaster. The standard deviation is easily calculated using the agile team's historical record of completed work and Excel's standard deviation function, STDEV.P (standard deviation of a population).

But the agile forecaster also has control over the width of the “cone of uncertainty.” Meteorologists who create hurricane forecasts use a “cone of uncertainty” where the probability of the hurricane staying within the cone is only 60-70% (NOAA, n.d.). But since stakeholders may not understand that the actual performance of an agile team may fall *outside* the cone of uncertainty, it is preferable to construct a “cone of uncertainty for an agile forecast that is either 70% or 80% probable, leaving a small amount of uncertainty falling outside the cone.

Using the Statistical PERT burnup chart worksheet, an agile forecaster may specify a confidence interval by choosing “optimistic” and “conservative” percentiles. The example in Figure 2 shows how to create a 70% probable “cone of uncertainty” where the cone's forecast lines are drawn at the 15<sup>th</sup> and 85<sup>th</sup> percentiles. Finish dates for future product releases are 30% likely to occur outside the date range determined by the “cone of uncertainty.”

Statistical PERT® (SPERT®) Normal Edition Agile Burnup Chart									
ID	Iteration (Sprint) Finish Dates	Team Capacity	Product Backlog	Actual "Done" This Iteration	Total "Done" All Iterations	Prod. Backlog: All To-Do + Total "Done"	Expected Value	Optimistic 15.0%	Conservative 85.0%
1	7/13/2020		300	40	40	300		37.8	12.2
2	7/27/2020		260	30	70	300			
3	8/10/2020		230	50	120			#N/A	#N/A
4	8/24/2020		180	45	165			#N/A	#N/A
5	9/7/2020		135	30	195			#N/A	#N/A
6	9/21/2020		300	10	205			#N/A	#N/A
7	10/5/2020		290	25	230			#N/A	#N/A

Set the probabilities for each forecast line here

**Figure 2 – Confidence Interval Settings for the “Cone of Uncertainty” Forecast Lines**

If an agile forecaster wants to convey a greater sense of uncertainty to their stakeholders, the forecaster can widen the “cone of uncertainty” by using an 80% confidence interval (Optimistic = 10%, Conservative = 90%). This will usually suggest a more conservative finish date on the burnup chart but may not materially change the optimistic finish date.

## WHEN SHOULD I MODIFY MY TEAM'S HISTORICAL VELOCITY?

One of the cognitive biases to avoid is *anchoring* bias. Calculating a team's velocity (arithmetic mean) and standard deviation creates two anchors for an agile forecaster. Nearly every agile team knows their velocity—it is their average that is computed from their historical record of completed iterations or sprints.

Since an agile forecaster will judiciously compute statistics using team history that is both *relevant* and *reflective* of their future work capability, this question involves deciding whether the resulting anchor (*historical* velocity) is likely to be reflective of their *future* work performance.

There are many reasons why it may not be. For example, if the team's composition is going to change in the future, their velocity may not be reflective of their future ability to complete work items. If the context is using a scaled agile approach where more than one team is developing a solution, the forecaster must know whether the scaling approach might change in the future—whether new teams will join those already formed, or whether an existing agile team will cease working with other teams to collectively build an agile-developed product using a scaled approach.

Velocity is an anchor value. The agile forecaster must recognize this as an anchor and decide whether it properly frames the range of possible, future outcomes. If it does not, the agile forecaster should carefully use their own judgment to override the anchor so a better-fitting range of possible outcomes are included in their forecast.

## **WHEN SHOULD I MODIFY MY TEAM'S STANDARD DEVIATION?**

If a team has wide variations in what they finish each sprint, their standard deviation will be larger. If a team consistently delivers finished work items that are comparable to prior sprints, their standard deviation will be smaller. When an agile team has a small standard deviation, the unadjusted result is a narrow “cone of uncertainty” and the illusion that steady *past* performance is indicative of *future* performance. Even without injecting subjective judgment into the forecast, a too-narrow standard deviation may cause *overconfidence* in an agile forecast. The calculated “optimistic” and “conservative” forecast delivery dates may be closer to the mean than what they should be. This is a condition that an agile forecaster must evaluate and sometimes adjust to ensure their forecast does not suffer from *overconfidence*.

There are many reasons why an agile forecaster might want to override the standard deviation that is calculated from the agile team's historical record. Here are examples where an agile forecaster may want to deliberately increase the standard deviation to create a wider “cone of uncertainty” that reflects the forecaster's greater uncertainty about the team's future performance:

- The team's composition of individual contributors is going to change
- The team's availability or capacity to work on the project is subject to unexpected changes
- The team's historical record is, for other reasons, irrelevant or non-reflective of the team's likely future performance

There may also be reasons to override the calculated standard deviation by changing it to a

*smaller* value. For instance, if the team's historical record is highly inconsistent but the factors causing the inconsistent performance are identified and now controllable, the agile forecaster may choose to shrink the calculated standard deviation to reflect the expectation that those causal factors will not continue to cause inconsistent future performance. However, overriding an agile team's calculated standard deviation should be done cautiously, since this may be the source of the agile forecaster's *overconfidence* bias, one of the many cognitive biases which degrade the quality of a forecast.

In Figure 3, the agile team's historical velocity of 34.4 and standard deviation of 12.4 is not reflective of their expected future performance. The forecaster has overridden the velocity with a value of 25 and increased the standard deviation to 15. The result of this action is that the expected performance in the future will be about 2/3<sup>rd</sup> of what the team has historically achieved, and there is greater uncertainty about how consistently they will deliver completed work items in upcoming sprints.

Avg Work Completed All Iterations	Standard Deviation All Iterations	Historical velocity and std. deviation
34.4	12.4	

Use Only History since Iteration ID	Average Work Completed Since Then	Standard Deviation Since Then
	34.4	12.4

Average (Velocity) Override	Standard Deviation Override	Overridden velocity and std. deviation
25.0	15.0	

SPERT Average (Velocity)	SPERT Standard Deviation
25.0	15.0

**Figure 3 – Overriding an Agile Team's Velocity and Standard Deviation**

## CONCLUSION

Forecasting is a blend of art and science. Statistical models like Statistical PERT will use an agile team's historical record and estimates of all remaining work to calculate statistics to build an initial forecast. By asking and answering six key questions about their forecast, an agile forecaster can use their subjective judgment to adjust—and hopefully improve—their data-driven forecast. They do that by incorporating information which is not evaluated by their statistical model. This extra effort by the agile forecaster can better align stakeholder expectations about the uncertainty of agile development endeavors and can foster improved decision-making that maximizes the likelihood of obtaining desirable future outcomes.

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## **UMD Project Management Symposium**

### **The Evolution from Project to Business Manager**

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#### **ABSTRACT**

Project success is no longer just delivering the scope on time and within budget. What clients want from project managers and teams is delivery of the expected business benefits. Project managers who also have business skills greatly increase their value since they can assist the client in defining and delivering the project benefits. This paper will review key strategic planning concepts, including goals and objectives and how the project manager can support the client in selecting the projects that provide optimum value. A major focus of this paper is the importance of establishing a business case based on quantitative benefits, along with key performance indicators for defining project success. In addition, value achievement—that is, ensuring the project benefits are realized post-implementation—will be discussed. This paper provides a roadmap for project managers to evolve into business managers by describing the skills needed to help define and deliver the project benefits.

#### **TYPES OF PROJECT ORGANIZATIONS**

Project managers work for one of three types of project organizations:

1. **Owner Businesses:** These are public or private companies and educational entities that produce consumer products and services and do projects to support business objectives. Examples include IBM, Wells Fargo, DuPont, Pfizer, Marriott, Disney, and the University of Maryland. Project managers have a vested interest in delivering project benefits since they help both the business and their careers to flourish. They should therefore be fully aware of the project business case and should ideally be involved in building the business case.
2. **Government Agencies:** These are federal, state, or local agencies that provide services to citizens and do projects to support new or existing services. Examples include the Department of Energy, the Environmental Protection Agency, the Department of Transportation, and the Department of Parks & Recreation. Projects in this environment can be influenced by politics, but project managers with financial analysis skills can still influence the cost effectiveness of the solution approach.



3. **Project Suppliers:** These are public or private companies that exist solely to provide project services to owner businesses and/or government agencies. Examples include engineering, construction, software development, and data management companies. Project managers who work for project suppliers often have profit/loss responsibility for projects, and their career progress is tied to delivering successful projects for clients. In addition, these project managers may be asked by clients to evaluate solution alternatives to determine the approach that is most cost-effective, which requires financial analysis skills.

Regardless of the type of project organization that employs the project manager, having business skills makes the project manager more valuable. In all types of project organizations, the project manager should be involved in the pre-project phase, assisting in the solution approach and the business case, and involved in the post-project phase to ensure that the project benefits are achieved.

## STRATEGIC PLANNING AND PORTFOLIO MANAGEMENT

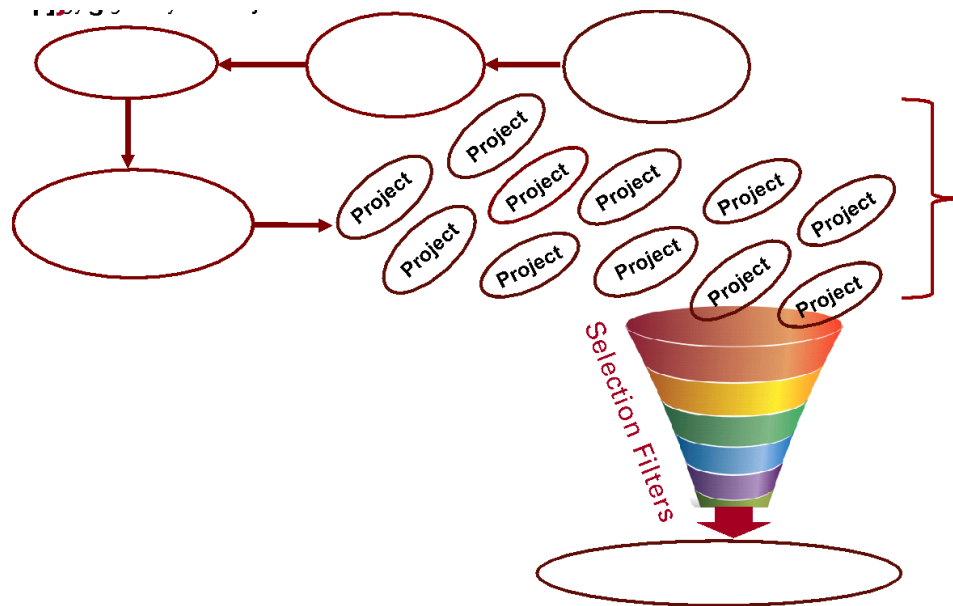
Organizations typically develop a strategy to move from the current state toward a desired future state (vision). A good strategy contains goals, which are general statements of desired achievement. For each goal there are one or more specific objectives, which are the steps to move toward the future state. Objectives lead to the identification of problems and opportunities, and from this potential projects are identified. An example of how a goal and objectives lead to projects is shown in Figure 1:



**Figure 1. Goals, Objectives, and Opportunities Example**

In this example only two projects are shown for each opportunity tied to objective #1. In reality, each opportunity typically generates a long list of potential projects. Unfortunately, the many potential projects typically exceed the available resources and money within the organization. Therefore, a project selection process is needed, and potential projects go through a selection filter that considers things like strategy alignment, financial return, success probability, and customer reaction. This “road to

projects” is shown in Figure 2. The goal is to pick the projects aligned to the strategy that will add the most value and have the highest probability of success.



**Figure 2. The Road to Projects**

A key in project selection should be the business case evaluation using financial analysis techniques, which looks at the future revenue and future expenses associated with an investment, minus the initial cost of the investment. This concept of life-cycle cost analysis sums all recurring and one-time costs and revenue over a specified life span of a product or service. This includes the initial project cost, operating costs, maintenance and upgrade costs, revenues, and any remaining salvage value at the end of the product’s or service’s useful life.

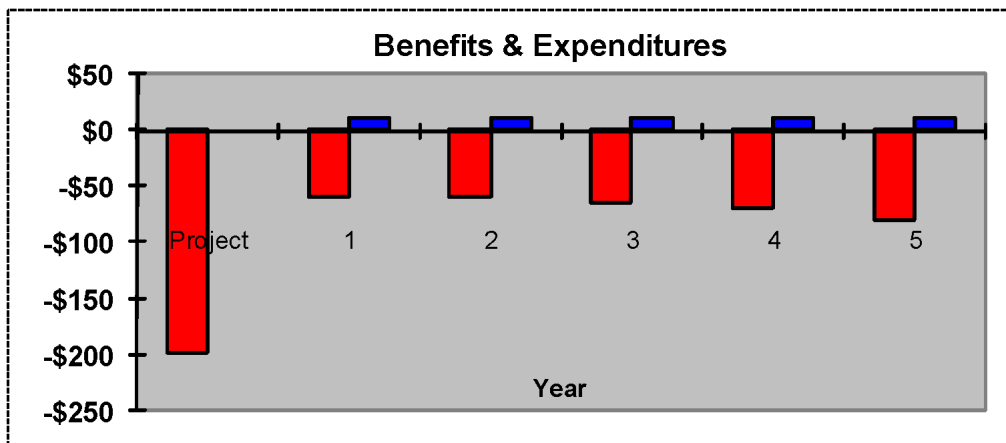
Financial analysis also uses the time value of money, which recognizes that money received in the future is not the same value as money received today, and is dependent on the interest rate. For example, \$1,000 today is equivalent to \$1,050 in one year at 5% interest, and \$1,100 at 10% interest.

Using the life-cycle cost analysis and time value of money permits the evaluation of investments for money flows that occur at different points in time. Financial analysis is used to determine whether a project investment is justified. The two most commonly used techniques are (Lukas, 2014, p. 4-5):

- **Net Present Value (NPV):** present value (PV) of all current and future cash outflows & inflows for a given cost of capital (interest rate). If the NPV is positive, the investment will add value to the organization.
- **Internal Rate of Return (IRR):** interest rate at which the PV of all future cash flows of an investment equals the cost of the investment. If the cost of capital is 5%, and the IRR is calculated to be >5%, the investment will add value to the organization.

There are limitations in using financial analysis for making project selection decisions. First, the accuracy of financial analysis is dependent on the accuracy of the cost and benefit estimates. Ideally, only quantitative benefits such as a decrease in operating costs or an increase in product sales should be considered since they are more easily estimated. Qualitative benefits, such as a productivity increase for software developers with new computers or higher customer satisfaction, are subjective and very difficult to measure.

Second, financial analysis can easily be done for projects such as expanding manufacturing capacity for existing products, introducing new products, and productivity projects. However, financial analysis is not as helpful for legal and regulatory projects, social needs, environmental projects, and technology improvement projects. For example, Figure 3 shows the business case summary for a project that was regulatory required. Even though the NPV was -\$212,000 and had an IRR of <0%, the project had to be done to meet new regulatory reporting requirements. In this case, alternatives were investigated to find the best solution with the least negative NPV.



**Figure 3. Cash Flows Timeline for a Regulatory Compliance Project**

## **WHAT CLIENTS WANT...AND WHY**

What clients want are successful projects that deliver the expected benefits. Unfortunately, numerous studies done over the years still show that successful projects are not the norm. The Standish Group studies done over the years still show most IT application development projects are challenged or failed, which means the project does not meet the schedule, cost, and/or scope (Mersino, 2018). Forrester Consulting did a study in 2013 that shows almost half the time product solutions fail to meet the real needs of the customer (Forrester, 2013, p.5). Finally, the Project Management Institute (PMI) has done multiple studies and continues to find that, on average, money wasted runs over 10% of the project investment due to poor project performance (PMI-2016).

In 2013 the Project Management Institute conducted a study of directors, managers, and practitioners who design and/or administer talent management for their project organization (PMI-2013). This study identified the three critical skillsets project

organizations want from project managers to deliver successful projects. The three skillsets are:

- Technical project management
- Leadership
- Strategic and Business Management

This is a role change from the project manager being responsible for “doing projects right”. Now there is some responsibility for “doing the right projects”. What clients want is talent with a broader range of skills to support strategic goals and objectives that contribute to the bottom line of the organization, and this requires a role in the pre-project and post-implementation phases. This involvement can be called business analysis, which includes (5-PMI, 2015):

- Determine problems and identify business needs
- Identify and recommend viable solutions for meeting needs
- Elicit, document, and manage stakeholder requirements in order to meet business and project objectives
- Facilitate the successful implementation of the product, service, or end result of the project

The International Institute of Business Analysis (IIBA) was formed in 2003 to support the business analysis community. IIBA provides global practice standards and certification as a business analyst. However, in many organizations the role of the business analyst is limited to requirements definition, with little or no involvement in the pre-project or post-implementation phases. Business analysis is a clear requirement wanted by client organizations, but how it gets done today is frequently not optimal. The void needs to be filled, and the PMI talent management study suggests this could be a role for the project manager with the requisite skills.

## **KEY PERFORMANCE INDICATORS**

Key Performance Indicators (KPIs) for a company or organization are quantitative measures on how effectively the company or organization is achieving business goals and objectives. Examples include growth in revenue, gross or net profit margin, operational cash flow, inventory turnover, customer and/or employee satisfaction, and employee retention.

KPIs can also be established for projects, and should provide specific quantitative measures indicating how effectively the project team is achieving both the project and product goals.

Project KPIs typically include measures for cost, schedule, quality, and functionality. Cost and schedule measures are easy to quantify, but more thought may be needed for quality and functionality to ensure the measures are quantitative. For example, stating that all scope items must be successfully completed is broad and non-specific. A functionality KPI stating the water recycle system must demonstrate a

flow of 100 gallons a minute is quantitative. Other project KPIs may be appropriate, such as safety on a construction project, measured by the number of loss-time accidents.

Product KPIs should relate to achieving the planned benefits, meeting the business requirements, and operational criteria. Another very useful KPI is user satisfaction, which can be easily measured using a concise survey.

Some project managers have the opinion that their role is confined to just “doing projects right”, which means finish on time, meet the budget, and deliver the functionality meeting the quality standards. Taking that viewpoint would suggest product KPIs are not a concern of the project team, but that is a mistake. There have been projects that meet or beat the measures for cost, schedule, quality, and functionality, yet are deemed failures by the client. How does this happen? One possibility is a poor relationship between the team and client, which relates to stakeholder management and is a responsibility of the project manager. However, the more frequent reason a project is deemed failed by the client is because the product benefits are not realized, which can result from incomplete, missing, or even wrong requirements. It is easier for the client to take the position that the project team should have caught this problem during project definition.

The best way to understand project and product KPIs is to see actual examples. The example shown in Table 1 was a call center renovation project, which included a renovated work area, new office furniture, new hardware, and new customer support software. The project KPIs covered cost and schedule, which are commonly used. The unique KPIs were having no scope changes, which meant obtaining all requirements before defining the project scope and plan; and completing all training on the new customer support hardware and software before implementation.



**Table 1. KPIs for Call Center Renovation Project**

There were five product KPIs for the call center renovation project including software availability and response time for pulling up a client account, which was a major issue with the old system. The project was justified on achieving a productivity



The final product KPI was the rating of the new equipment installation by the operators. As mentioned earlier, this is always a good product KPI to include, but it was probably unfair on this project. The polyester recovery facility was a waste facility with no air conditioning, so it was always dirty and also hot in summer weather. Getting a high operator rating was not obtainable. However, notice the weights on this project, with 65% for project KPIs and only 35% for the product KPIs. That was done since the design-build companies had total control of the project KPIs, but limited control over the product KPIs since the client specified and bought the polyester shredder with the involvement of the design-build companies.

One logical question on product KPIs is why not include the financial measures (NPV, IRR) used to justify the project? This can be done, but in both of the examples covered in this paper the project teams were not employees of the owner organization. In both cases the owner company shared a high-level summary of the business case with the project team, but did not want the business case details showing up in the project documentation.

Establishing project and product KPIs is an important step on every project, and involves collaboration and negotiation between the client and project team. KPIs should be defined during the project planning process. The one caution is to keep it simple, no more than 3-5 KPIs for product and for project KPIs. Also, the KPIs should be measurable within three months of project completion.

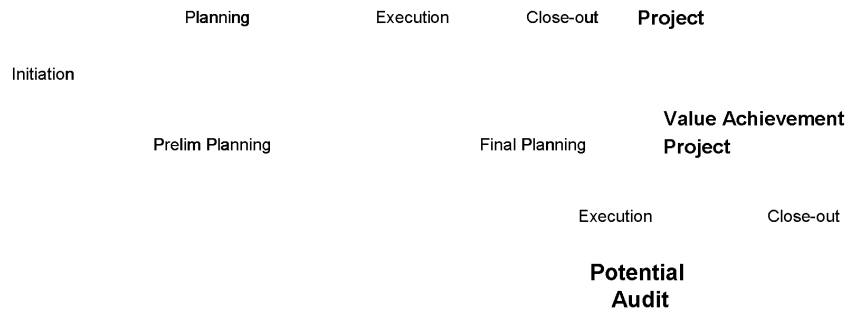
## **VALUE ACHEIVEMENT**

Organizations need to verify that the project product, once implemented, provides the expected benefits. This is called value achievement, but also goes by other names such as benefits realization, post-implementation review (PIR), solution performance evaluation, and post-implementation assessment. Around the same time PMI was developing the talent triangle in 2013, Forrester Consulting released a study of product development and marketing based on information from business-side decision makers. One topic was the percent of projects where the problems listed below were encountered in bringing the project product into use (Forrester, 2013, p.8):

- The expected and actual value of the product do not match – 30%
- Product value is not communicated within the organization – 29%
- An effective go-to-market strategy is not used – 27%
- Product value is not communicated to the customer – 26%

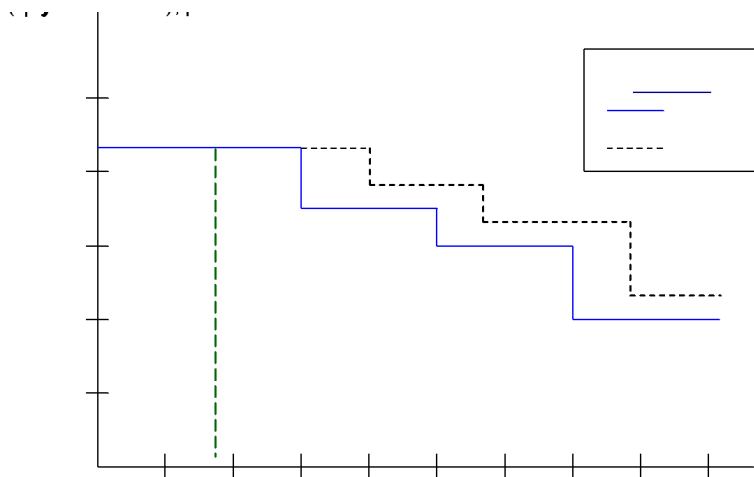
Only 27% of the projects reported no problems in bringing the project product into use. What this implies is that on most projects there is no plan for ensuring value achievement after project implementation. The business sponsor has accountability for the project benefits, but this person often needs help with the planning and implementation of activities to ensure the project benefits are realized. Project managers have that skill in project planning!

As shown in Figure 4, there are really two parallel projects and both need to be planned. The first is the project to create the product. The second is the value achievement project, which is the plan to ensure the benefits are achieved. Planning for value achievement should start when the project plan is prepared, and should be finalized before project implementation.



**Figure 4. Parallel Planning for the Project and Value Achievement**

A value achievement plan should include what needs to be done (scope), when (schedule), who (resources), plus any resource costs. The plan should also include plans for communications, dealing with any post-implementation risks, and metrics to show the progress in achieving the project benefits. Figure 5 shows the contractor staffing level by month for the call center renovation project. After implementation of the new hardware and software, the business needed fewer contractors than planned and was able to make the reductions sooner. Having the graph made progress on reaching the desired staffing level visible.



**Figure 5. Contract Labor Level by Month Post-Implementation**

Note in Figure 4 the use of an audit near the end of value achievement. An audit is appropriate for projects such as expanding manufacturing capacity for existing products, introducing new products, and for productivity projects. This can be done by the internal financial organization or by an outside accounting firm. Information for an



audit typically includes a brief report on how the project benefits were achieved, and updated financial information comparing the plan to the actual results as shown in Table 3.

<b>Project Financial Summary</b>	<b>Project Plan</b>	<b>Actual Results</b>
Project Costs	\$605k	\$586k
Operating Costs/year	\$40k	
Total Expenditures (5 years)	\$805k	\$686k projected
Net Benefits (5 years)	\$750k	\$770k projected
After Tax IRR	86%	98%
After Tax NPV	\$160k	\$195k
Payback Period, years	2.7	2.3

**Table 3. Comparison of Plan and Actual Project Results**

## CONCLUSION

A project is not successful unless the project benefits are realized by the business, even if completed on time, under budget, and with all functionality delivered per the project requirements. Project managers need to change their role from just delivering the project to delivering the project benefits.

Project managers should have the skills to assist the client in estimating quantitative project benefits and using financial analysis techniques to determine the project business case so sound decisions can be made on whether a project is worth the required investment. Key performance indicators should be established for both the project and product, since this ensures alignment between the project team and client on what defines project success. Finally, the project manager should be actively involved in planning and executing the value achievement phase, which is where the work is done to ensure that all project benefits are realized. Project managers who can expand their role into these pre-project and post implementation phases will deserve the title business manager.

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# **The Human Factor: How to consider it in Decision-Making for a Successful Management**

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## **Abstract**

Projects in all industries both public and private need proper management to be successful. Proper management may sound easy at a first glance, but in practice it has many difficulties as unforeseen events and actions that turn the project to a success or to a failure. To some extent the difficulties in the projects are related to the human factor as level of uncertainty or lack of experience, understanding or simply stated the lack of knowledge for certain situations. These are the voids in the management practice that if filled wisely may improve the potential of successful project delivery. Depending on a project the issues may start right from the initiation phase of the project and carry over the rest of the project phases. Stakeholders, technical issues, financing, contracting, risk management, negotiations, procurement are some of the important areas for a careful consideration. The question is: How to analyze these for informed decision-making and how to count for the human factor or preference in such decisions? This paper proposes the application of the management science techniques for quantitatively assessing and addressing the human factor impact on project management decision-making that can allow to plan in advance and maximize the chances of success.

## **Introduction**

Every project manager has a goal in mind for their project be it in construction industry or elsewhere. The goal is to get the project completed on time, within budget and within acceptable quality requirements while complying with all contractual documents both from technical and nontechnical perspectives. Such a goal, while it is extremely desirable, is almost always hard or impossible to achieve. The question is: why? Many times it is believed that for failed projects there was a lack of communication, lack of understanding of the project scope and requirements, lack of details in specifications, owners' bias and so on. Certainly, these are aspects that are closely related to the success or failure of projects, but some projects fail if above mentioned components were in place. The question again is: why? To justify the failure some will refer to

the soft skills that project manager lacked to keep the team motivated, engaged, cooperative, and many more. Another angle of view for failed projects would be the possibility of a cooperative and non-cooperative behavior of involved parties. Is it actually the surrounding world causing the preferential justification of actions that later lead to a failure or is it a result of self-empowerment and feeling of authority and unnecessary self-confidence that causes the ill decisions followed by failure? Overall, it can be said that in such instances the project manager did not consider the human factor. Human factor depending on the conceptual use may refer to different things. In some instances if a product or a machine is not well designed then the user who fails operating it may not be accountable for the failure because there was a design flaw. The ergonomic designers would take additional steps for understanding on what needs to be improved to reduce the cases of failure due to the ineffective design. Can this same approach be adopted in Project Management and if so what are the possibilities and ways for doing so?

Some researchers tried to define the human factor in decision-making process. This is not a new concept and for decades it is extensively documented also by military industry that humans behave differently under certain conditions, they tolerate pressure differently, they take risk differently, they think differently, and most importantly human does all of it inconsistently. It is also documented that training can improve the decision-making capability of a human in order to improve the overall outcome of detail evaluation and response under given circumstances (Jacobs, 1998). Yet even after all the training people will act inconsistently under specific circumstances that are unique for every project. Many times humans will rely on heuristic options for figuring out the possible action plan. In many cases the heuristic approach will be based on the experience and past performance (Dietrich, 2010; Shah and Oppenheimer, 2008; Juliusson, Karlsson, and Gärling, 2005).

It was also documented that the human judgment significantly varies from what would have been resulted from decision theory based analysis (Anderson, 1970; Hammond et al 1975). Some algebraic models were developed and used to highlight how the information is being processed and evaluated the impact of information source on the final decision-making (Wallsten and Barton 1982, Wilkening and Anderson 1982). In contrast Payne (1982) suggested that in fact a human can use any number of possible strategies for cost-benefit analysis in order to arrive to a decision.

Based on extensive analysis there seems to be a possibility of considering a human factor in decision-making process with a more structured approach compared to traditional yet probably biased heuristic method. It can be achieved through evaluation and assessment of circumstances for projects combined with analysis of possible preferences of a decision-maker to maximize the potential of a successful and consistent decisions making. The proposed method can be used for informed decision making at any stages and steps along the lifespan of a project. The proposed approach is based on applications of modified Analytical Hierarchy Process (AHP) and Game Theory. The next section describes the steps and details for development of human factor in decision making for a successful project management (SPM) technique.

## **Methodology**

In 1970s Thomas Saaty developed Analytical Hierarchy Process (AHP) to help in making complex decisions using math and psychology concepts. The method allows selection among different options where the trivial heuristic approach would not provide the possible best outcome.

AHP allows to check for the decision-maker's consistency of pairwise comparisons of attributes and if the decision-maker is not consistent they would need to revise the evaluation and check for

the consistency again to proceed with evaluation. The process was further improved over the years. Reader is referred to Saaty (1994) for further details on the steps involved in AHP. In this research we will refer to the original steps but will also present the initial steps before adopting the AHP to generate results.

The problem with decision-making in management using AHP is related to the cumbersome evaluation process of relative importance values for comparison parameters or attributes. For instance if a person in charge has to make a decision for selecting a project to proceed with and if there are only five attributes or parameters to consider in decision making then the traditional AHP method requires values to be decided for 5 by 5 comparison matrix. To decide on 25 relative importance values and keep those choices consistent without use of any technique is a challenging or unachievable task even for a well-trained and analytical thinking person. The situation is even worse for someone whose training is not from such a perspective. The sample problem below demonstrates the traditional AHP and then expands on certain aspects of the proposed SPM technique principles without diving into specific details due to space limitations.

*Sample problem:*

The decision-maker needs to decide on a selection of a project to proceed with for a company. The choice must be based on reliable approach that requires consistency in the evaluation of projects. The decision-maker decides to set up some attributes for comparing the project and then decide which project meets the needs most. From this perspective the attributes are decided to be:

A – Stakeholder satisfaction potential

B – Profit generation potential

C – Technical feasibility potential

D – Early completion potential

E – Immediate resource availability potential

To be able to compare projects according to the identified attributes the decision-maker would first need to prioritize the importance of attributes. For instance, the decision-maker needs to identify how important is the “stakeholder satisfaction potential” attribute over to “early completion potential” attribute. Similarly all possible combinations among attributes must be evaluated for their relative importance. If the decision-maker is not consistent in defining the relative importance values of attributes within acceptable range as described in AHP the decision-maker needs to revisit their choices of relative importance values and adjust again and again with a hope of reaching the acceptable consistency. This is where the process can become challenging, time consuming or even unachievable. Then the decision-maker will move forward with some other self-developed approach, justified or unjustified beliefs for making “right” the decision. Such process can rely on a heuristic approach or other feasible options and in fact may result to ill decisions by leaving better options on the table. Table 1 presents a possible data in pairwise comparison matrix that a decision-maker may come up with when trying to follow the AHP method in order to select a project.

Table 1: AHP attributes pairwise comparison matrix with traditional setup

Attribute s	A	B	C	D	E
A	1.0	7.0	6.0	5.0	3.0
B	3.0	1.0	5.0	7.0	4.0
C	2.0	0.2	1.0	3.0	1.0
D	0.2	1.0	0.3	1.0	0.3
E	0.2	0.2	1.0	4.0	1.0

From the table data, it is easy to observe that the diagonal elements of a pairwise comparison matrix are one. That will always be the case as it is the attribute’s comparison to itself. Yet, other

values in the matrix need to be decided by the decision-maker. For instance the row A and column B indicate that the decision-maker has significant preference towards “stakeholder satisfaction potential” attribute over to “profit generation potential” attribute. Similarly, from the data it can be observed that attribute D over B is set to one, meaning equal importance. At this stage it is important to notice that the decision-maker also indicated that attribute B over D is significantly important with a value of seven. This matrix has many inconsistencies similar to the one discussed here. The beauty of AHP is that it still allows to make the correct choice if such inconsistencies are not too much and/or many.

AHP defines that the decision-maker is consistent if Consistency index (CI) ratio to Random Index (RI) is less than 0.1 and if the value is larger than 0.1 then the decision-maker needs to revisit their choices of relative importance values for the attributes. Completing the calculations for the data in Table 1 it is found that the CI/RI is 0.9024, meaning that there are significant inconsistencies in the pairwise comparison matrix. After extensive trial and error the acceptable range was reached through calculations, but not as a result of preference adjustment.

In reality such pairwise comparisons are hard to manage in mind or follow on paper, which eventually needs to be revisited and adjusted. In fact the less effort put the decision-maker in confusing procedures the better would be the time spent on doing something useful for the project in hand and more desire there would be to rely upon useful techniques. Given the observations as described in the reviewed literature a person might have a better judgment in assigning value ranges to attributes rather than exact numbers. A person might be have a better capability of recalling the best outcomes resulted from certain choices or the worst outcomes based on such choices. Yet, there will be cases that the decision-maker came across more frequently than others. With incorporation of such approach on selecting or defining values for



attributes the first segment of successful project management (SPM) technique was developed. As such the SPM technique allows the decision-maker to define the optimistic relative importance values for attributes in pairwise comparison matrix. Similarly the decision-maker needs to define the pessimistic and most likely values and the estimated value then would be calculated by making it the most accurate approach given the expertise and experience level of the decision-maker.

The second segment of successful project management (SPM) technique is allowing the decision-maker to define the most important attribute for them and then compare other attributes by defining their preference level in relation to the most important attribute. Then SPM tool completes the rest of the values for a consistent pairwise comparison matrix. As such if refer to Table 1 data and apply the first to segments of SPM we get Table 2 that is now perfectly consistent. Due to space limitations, some steps omitted from the rest of this document.

Table 2: AHP attributes pairwise comparison matrix with SPM setup

Attributes	A	B	C	D	E
A	1.0	7.0	6.0	5.0	3.0
B	0.1	1.0	0.9	0.7	0.4
C	0.2	1.2	1.0	0.8	0.5
D	0.2	1.4	1.2	1.0	0.6
E	0.3	2.3	2.0	1.7	1.0

With similar approach, the decision-maker will compare the project to project per defined attribute and SPM tool will detect which project to select as the best option that satisfies defined attributes as closely as possible. After calculations, one can arrive to the outcome that may look as given in Table 3.

Table 3: Final output from SPM complemented AHP

Attributes i	A	B	C	D	E
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Weights i	0.54 3	0.07 8	0.09 0	0.10 9	0.18 1	Alpha
Project j						
Project 1	0.21	0.12	0.5	0.63	0.62	0.349
Project 2	0.55	0.55	0.25	0.3	0.24	0.440
Project 3	0.24	0.33	0.25	0.07	0.14	0.211

From the data in Table 3, Project 2 will have the highest final Alpha score indicating that is the project the decision-maker should select as it satisfies their preferences per attribute the most. Then Project 1 will be the next best option, yet Project 1 will be the least desirable project to select. Likewise, if the decision to make is for selecting an action item instead of a project the SPM tool will help the decision-maker to detect the right action to adopt. The decision-maker can decide the attributes that are important for such decisions by the level of importance and proceed similarly.

The following section analyzes on how to use the Game Theory to reach to a point in discussions or negotiations that both parties will prefer not to deviate from and reach an agreement. In project management, negotiations when considered from Game Theory perspective can be a non-cooperative game where the gain of one party is a loss of another.

SPM complements Game Theoretic analysis and allows considering the human factor in even more advanced level in the process of decision-making. As such, the scenario below explains the process of application. The scenario is about two potential Prime Contractors (K and J) brought into the picture for their professional opinion and recommendation to stakeholders to decide which project to support. Due to the limited resources, not every project is possible to support, but stakeholders announced that given the magnitude of the projects they would be able to support two projects. For continuity let's assume that contractor K is the decision-maker in the SPM example analysis above who now knows which project to push forward given their attribute

preferences. Similarly, J has his own analysis and knows which project to target given the results in Table 4. Yet, both K and J know that if they get their most desirable project funded they can contract the other contractor as a general contractor. This means that each of these contractors still benefit if any of the projects receive funding. To apply Game Theoretic setup the payoff matrix is set as presented in Table 5. Numbers in Table 5 come from Alpha values obtained by both Primes Contractors K and J using SPM.

Table 4: Contractor J's output from SPM complemented AHP.

Project j	Alph a
Project 1	0.411
Project 2	0.340
Project 3	0.249

Payoff matrix allows adjusting the strategies that both potential Prime Contractors may exercise. The options for assigning the same project to both Primes would be infeasible and the decision-maker cannot select it as an acceptable outcome. From the payoff matrix the numbers indicate that Project 3 is not desirable by both K and J. Therefore, the payoff matrix will be reduced to Table 6.

Table 5: Contractors K and J payoff matrix

		J		
Alpha Values		Project 1	Project 2	Project 3
K	Project 1	0.349 /	0.349 /	0.349 /
		0.411	0.340	0.249
		0.440 /	0.440 /	0.440 /
	Project 2	0.411	0.340	0.249
		0.211 /	0.211 /	0.211 /
	Project 3	0.411	0.340	0.249

Table 6: Contractors K and J reduced payoff matrix

		J	
Alpha Values		Project 1	Project 2
K	Project 1	0.349 /	0.349 /
		0.411	0.340
	Project 2	0.440 /	0.440 /
		0.411	0.340

If analyze information in Table 6 and given the stakeholders announcement for funding two projects both Project 1 and 2 could be selected. The next question would be to strategize who gets which project and how to strategize the steps at this point. Given the Alpha values in Table 6 the discussions would be targeted in assigning the projects accordingly for the overall preference of both Primes.

## Conclusions

It is noticeable that if Project 1 gets funding then J will be more interested in getting it, as K's payoff is lower for Project 1 compared to Project 2 (Table 6). Similarly, J prefers Project 2 less than Project 1. Without such evaluation, even if both projects get funding but assigned in the opposite way, both Primes would be worse off. Clearly, both Primes will still get a project to proceed with, but the outcome would be completely different. Given the attributes defined for prioritizing, the projects many problems would materialize later on that can decide the success or failure of the projects. Many situations are present in all projects and programs and therefore the applications of the developed methods for consistently evaluating the human preference in the decision-making while applying it in business strategy development could benefit all informed parties.

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# Why Good Execution is Not Enough

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## ABSTRACT

Project metrics across multiple industries continue to show a performance gap between baseline expectations actual results. Practitioners should persist in seeking innovative solutions to this performance gap, rather than accepting established paradigms and practices, which routinely result in cost and schedule overruns. One such paradigm is the view each project as a unique endeavor, unrelated to other similar production processes. Relating project execution to other production processes allows observation of similarities in the impacts of variation on output delivery. Recognizing this impact and using tools to mitigate the effects is a major step in closing the performance gap. One such tool is a renewed commitment to implementation of risk management, including quantitative risk analysis. WE can also borrow approaches from other verticals, including buffering and root-cause variation mitigation.

## INTRODUCTION

It is a generally accepted observation within project management as a profession, as well as an experience from project sponsors in general, that we have a problem with project execution. The assertion that projects are delivered late and over budget is rarely, if ever, contested. One study by McKinsey & Company indicates that large construction projects “take 20 percent longer to finish than scheduled and are up to 80 percent over budget.” (Agarwal, et al., 2016) Construction as an industry is one of the more deterministic industry verticals, with systems and components that are generally well understood. One would expect this phenomenon to be even more acute in industry verticals with more iterative and undefined processes, such as software or technology development. There are many theories surrounding the cause of this deficient performance, but there has never been a definitive solution implemented.

There appears to be two distinct issues wrapped up in the assumption that projects are not performing according to plan. The first is a framing issue. What constitutes effective on time, within budget performance? What is the validity of the baseline budget and associated budgets? If we are to measure project performance against an

established baseline, we should be sure that the baseline is valid and accounts for the totality of project scope and risk impacts. The second is an execution performance issue. Is the execution of project activities aligning with the planned values in an effective manner? If the project baseline plan is valid and accurate, well executed activities that start on time and finish within budget should then result in a well-executed project.

Project management as a discipline is filled with numerous intelligent and creative practitioners. Why is it, with all the collective talent and subsequent effort to deliver high-performing projects, we still experience this divergence of results from expectations? Within this paper we will explore one of the causes of this performance diversion and propose mitigation measures that will better align expectations with actual performance.

### **PROJECTS AS UNIQUE ENDEAVORS**

Project Management Institute (PMI), within the first four pages of the Project Management Body of Knowledge (PMBoK), defines a project as “a temporary endeavor undertaken to create a unique product, service, or result.” (PMI, 2017). One aspect of this definition often overshadows the process groups contained throughout the additional six hundred thirty-four pages of project management knowledge. This is the classification of projects as unique. While it is indeed true that no two projects are exactly the same, the notion that all projects are unique in every way must be false. How could a project management standard possibly be published if this were true? So, it is here we must agree to a common starting point for developing an understanding of project divergence. Projects are undertaken to produce a unique result, but are delivered using standardized processes, tools, and techniques which are common within project management.

### **THE PROJECT PLANNING PROCESS**

Projects are initiated using various methods and levels of formality particular to an industry or organization. Regardless of the specific process, once a project is initiated it quickly moves into the planning process. The accepted practice of planning a project starts with defining the entire scope of the project, most often defined within a work breakdown structure (WBS). It is this structure that enables the project manager to define the various elements of work for further planning and tracking. Once the scope of work is defined, the WBS can be decomposed into major subdivisions, systems, components, subcomponents, and finally to activities. PMBoK states the “key benefit of this process is that it decomposes work packages into schedule activities that provide a basis for estimating, scheduling, executing, monitoring, and controlling the project work.” (PMI, 2017)

The activities defined by the decomposition become the most detailed level of work used in the subsequent planning processes. Once the activities are defined, the path is clear to begin a number of additional process steps. One of the processes enabled is cost estimation and the development of the project budget. Another process



is schedule development, which encompasses sequencing the activities using proper schedule logic, estimating activity durations, reviewing the network diagram and critical path for procedural compliance, and generating the baseline project schedule. The definition of activities at this lowest level is intended to facilitate higher accuracy in the estimating and scheduling process, but this accepted practice is also one initial source for the divergence within project execution.

The implied theory underlying this approach is firstly, that decomposed elements are of sufficient granularity to generate an accurate and achievable cost and time estimate to completion. And secondly, that once these decomposed elements are reassembled into a network of dependencies, we will have an accurate model for the completion of the project in terms of both schedule and budget. The cost-loaded schedule and associated network diagram represent the most likely case for project execution performance developed through the planning process. If each activity is completed according to the scheduled start time, duration, and budget, the theory implies that our project will be completed on time and within budget. This also leads to the belief that well-executed project management can achieve the plan as modeled.

### **VARIATION IN PROJECT DELIVERY**

Since we have previously acknowledged the lack of project performance compared to project plans, we must look at this project planning paradigm critically. When doing so, the first item that comes to our attention is the deterministic nature of the activity estimates. Dr. W. Edwards Deming, often recognized as the “Father of Quality,” points out in his work, The New Economics for Industry, Government, Education, that all processes are part of nature and as such are affected by variation. (Deming, 2018) Variation for the purposes of this analysis should be defined as the difference between expected outcome and actual results. The deterministic estimate of both cost and duration fail to account for this ever-present natural phenomenon. At the outset, one must acknowledge the base elements of our planning model do not account for the variation acting upon them.

#### *ACTIVITIES AS IPO MODELS*

Secondly, project management as commonly practiced and reinforced by the PMBoK uses the transformation theory of production. (Koskela, 1999) Project management processes as well as the activities themselves are defined by taking a set of inputs and transforming them into one or more outputs. This input-process-output (IPO) model of production is an effective way to define the requirements of a process, but it also highlights a weakness of our accepted planning process. The network diagram and planning process are generally effective in defining the activity process and resulting component output. In construction, an activity is often defined in a verb-noun manner identifying the process and resulting output. For example, “form, reinforce, pour slab-on-grade” may be one activity that defines the process steps and resulting deliverable.

The weakness of our accepted planning process introduced by the IPO model is caused by the input side of the model. Inputs are rarely introduced into the project schedule, and if so, are seldom comprehensive. The primary reason for this is that the introduction of such detail would make the schedule so large the schedule would be unusable. It is assumed that the task leader will take all necessary steps to ensure the inputs are ready for the intended start date of the activity.

If we pause to consider the diverse nature of these inputs, the risk involved in that assumption will become apparent. In construction, a single activity will have inputs as diverse as material selection and procurement, labor quantity staffing, craft skill and knowledge, project-specific information requirements, logistical support, space requirements, cross-trade coordination requirements, pre-work completion and acceptance, third-party inspections, safety requirements, and administrative requirements. The collection of all the input requirements into a single merge point on the start date of the activity presents an elevated level of risk that one or more of the inputs will push the scheduled start later in time. The method in common use to model the project schedule assumes away this risk, which applies to each activity using the IPO model and having multiple merging inputs which are outside the schedule model.

#### *INTERDEPENDENCY BY NETWORK*

Finally, the high-level view of the network diagram reveals that each of these individual activities are interconnected. Merriam-Webster defines a system as “a regularly interacting or interdependent group of items forming a unified whole.” The interdependent nature of project activities as defined in the network diagram presents a view of the project as a system of production. This production system combines the outputs from an interdependent set of activities into a unique production output that satisfies the goals and objectives of the project. A focus on the temporary and unique aspects of a project can often disguise this fact. The interdependent nature of the activity components creates a systemic impact beyond just the immediate effect on the next activity in sequence.

These three levels of interaction, activity cost and duration estimates, the activity IPO model, and network interdependency, show us the three levels at which variation occurs or can be introduced into our production system. This variation is one of the primary sources of project results diverging from the baseline project planned values.

Dr. Walter Shewhart, credited by Dr. Deming with originating the paradigm, identifies two distinct types of variation acting upon a system. (Deming, 2018) Common cause variation is that type of variation caused by natural effects on production processes. Common cause variation is part of the system as designed and presents itself as background noise within the recorded data. Special cause variation, on the other hand, is not part of the system. Special cause variation is identified as variation created by an identifiable causal element acting from outside the system.

Both types of variation can act independently or jointly upon each level of our systems model.

## **PROJECT RISK MANAGEMENT**

PMBok acknowledges the effects of uncertainty within the project delivery process through the project risk management knowledge area. The generally accepted process of project risk management is consistent regardless of industry silo or practice category. First, the risk management process itself is planned, allowing for adjustment to the intensity of the risk management effort tailored to the project size and importance. The next step is the initial identification of specific project risks using appropriate tools and techniques. Once the risks have been identified, they can be characterized and ranked according to probability of occurrence and impact on the project budget and or schedule. This qualitative analysis serves as a basis for addressing project risks throughout the life of the project.

Once the project risks have been identified and defined qualitatively, the process can move on to assigning specific quantities to each risk, and correlations to each activity for further quantitative analysis. There are a variety of techniques utilized in quantitative risk analysis with the current standard being simulation through Monte Carlo risk model analysis. The simulation model provides an opportunity to run thousands of simulations of project performance accounting for the range of possible results surrounding estimate metrics, such as unit costs, quantities, and durations. Monte Carlo simulation uses probability distributions to assign values to target metrics on each iteration of the simulation. Analysis software is then used to evaluate the aggregation of each of the simulation runs to provide a picture of the risks and uncertainties inherent in a particular project.

Once the qualitative and quantitative risk analysis is complete, the project team can move forward to plan mitigation and follow-on risk responses. Risk mitigation is intended to reduce the probability, impact, or a combination of both probability and impact of the risk on project outcomes. Risk response plans are intended to provide a backup or contingency plan in the case that a risk is realized in spite of previous mitigation efforts.

The project risk management process is intended to account for the effects of risk and uncertainty on project performance. One of the drawbacks to this process is the scalability of risk management effort. Since the level of risk management effort is intended to be scaled according to the size and importance of the project, the process is often economized in an effort to reduce the burden on project management staff operating near capacity limits. Risk management often does not receive the level of care and rigor required to sufficiently mitigate project risks. Secondly, the unique nature of project outputs means there is often a lack of historical data for use in analyzing project risks. This creates a reliance on expert judgement and subjective opinion within the risk assessment process which can reduce the accuracy of the

results. Despite these drawbacks, the project risk management process remains the most effective means of mitigating project risk and uncertainty.

### **VARIATION AS RISK AND UNCERTAINTY**

It is through the quantitative risk analysis process where the alignment between project risk and uncertainty and system variation is exposed. Uncertainty is often described as an unknown-known in that project participants are unable to define the degree to which uncertainty will affect a given activity, but they are sure that it will have some effect. While risks are often described as known unknowns in that project participants can identify the risk but remain unsure if the risk will occur and impact the project. (Kim, 2012)

This view of uncertainty brings alignment between common cause variation, which always exists due to the nature of systems, and project uncertainty, which is introduced both in the estimating and execution processes. Likewise, there is an alignment between special cause variation which has a proximate cause, and project risks which can be defined as proceeding from similar root causes. The alignment between common and special cause variation and project risk and uncertainty allows us to observe both gaps in our current project execution process, as well as to identify some potential solutions to those gaps.

It seems that within the current body of knowledge we have a mechanism for accounting for risk and uncertainty within the project planning process. But it is here that we discover a breakdown in the implementation as typically conducted on projects. As previously identified, there can be issues with lack of rigor and lack of relevant data, but these issues can be overcome through observing best practice techniques. Despite the application of best practices, we continue to see a reluctance to apply the results of quantitative risk analysis back into the project planning process as additional contingency and mitigation budgets. It is only through the application of the results of quantitative risk analysis that we will begin to see project results converge with project plans.

As we consider the view of a project as a special case of a production system, and of project risk and uncertainty as a form of variation, we can start to relate the project delivery process to other unrelated production processes. It can be beneficial to look at these dissimilar production processes for useful tools and techniques that may assist in improving our project execution process. When taking that perspective, we can turn to manufacturing to provide some potential solutions to improving our results.

### **BUFFERING**

One immediate action taken in a manufacturing setting to mitigate the effects of variation is buffering. A buffer can take several forms: inventory, work in progress, capacity, budget, etc. If we consider buffering as a mitigation measure in the project setting, we may quickly see the applicability. Nearly every project approved for execution has a line item in the project budget for project contingency, which is a

financial buffer. These funds are set aside to account for those unknown knowns. We know that additional funds will be required, but do not know exactly when or how much will be required. There are multiple methods in use for estimating the extent of these project contingency funds, including policy, historical precedent, thumb-rules, and expert opinion, among others. In fact, most project managers would not think of proceeding with project execution without some level of cost contingency.

If we concede that buffers are necessary for effective execution, and proactively identify cost contingency amounts within the planning process, why do we not do the same for time? Time contingency and supporting policy are conspicuously absent from accepted practice. We have observed the three levels at which variation can be introduced into the execution model, but we do not acknowledge the need for mitigating this variation within our execution plan. Applying both cost and time buffers is the first step towards correcting the divergence of execution from planned values.

In order to appropriately size these buffers, we can turn to our recognized process of quantitative risk analysis. When using quantitative risk analysis best practices, including Monte Carlo simulation, we can estimate the required buffer sizing to achieve a given confidence level in a resulting cost and duration performance. This gives us the ability to move beyond heuristic approaches in buffer sizing to a more robust method for determining appropriate buffer size.

There are multiple arguments against this approach. One such argument is that schedule float is already present within the schedule as a buffer. Our counterargument is that schedule float is not a proactive management technique, but an artifact of the critical path method and network scheduling in general. The project manager is not able to insert float within a project schedule as a proactive means of buffering without invalidating the scheduling process itself. Proper scheduling technique dictates that activity relationships and durations must dictate the nature of the schedule.

Likewise, there is an argument that time contingency is included within the activity duration estimates. This may, in fact, be the case during the initial planning process. But once the execution phase begins, this distinction becomes invisible. Because the project execution team cannot visualize actual duration and time buffer within the planned duration, thus, it becomes irrelevant. Parkinson's law comes into effect and the work extends to consume the allotted time. Without an explicit time buffer in the project schedule, the project manager is unable to monitor, control, and conserve this valuable project resource. Removing embedded contingencies from within duration estimates and creating a placeholder activity identified as a time buffer at the end of the project is a proactive step towards solving this problem. The draw-down of this buffer can then be monitored and controlled by the project manager in a comparable manner to project cost contingency treatment.

One final argument against the process is simply a belief in the achievability of the results from the current planning process. Turning back to the belief that if each activity is completed according to plan through excellence in project management, the plan should be achievable. For this argument, we must turn to a simple demonstration. We take a simple project plan of five sequential activities with assigned durations between 25 days and 50 days. We then assign a simple triangular uncertainty distribution to each activity of -5% to +10% representing that common cause variation is present in all systems.

This uncertainty level represents a difference of -1.25 days to +2.5 days for the shortest 25-day activity while the other activities have results in proportion to their respective durations. Once the schedule is modeled and this conservative uncertainty level assigned, we run a Monte Carlo simulation with 5000 repetitions of the simulation, with the software selecting values at random from the identified probability distribution. The results of this simulation can be viewed in the accompanying table and graph in *Figure 1*. Were we to execute this project, we would have only a 46% confidence level in achieving the planned results. While we acknowledge that a project could theoretically be completed according to planned values if the stars align, we do not hold a 46% confidence level out as a responsible target metric.

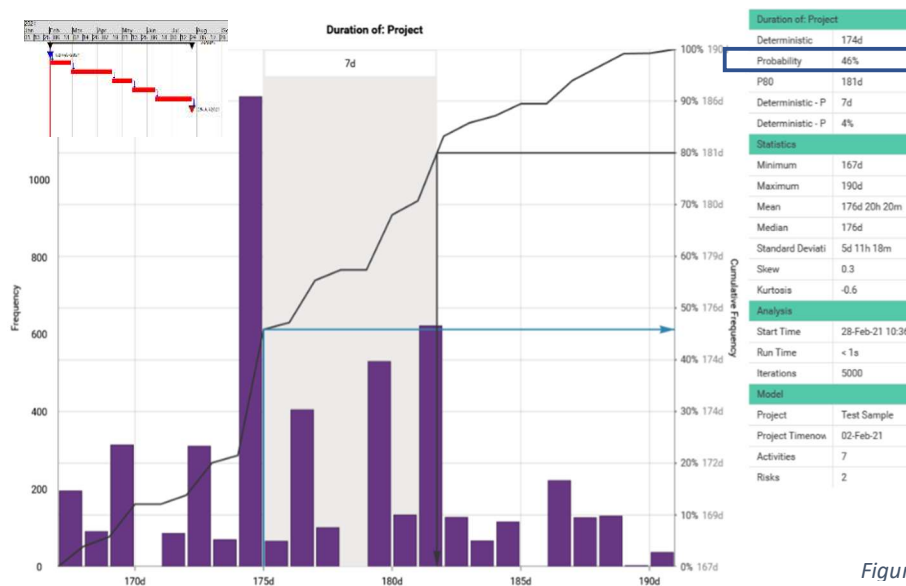


Figure 1

## ROOT CAUSE ANALYSIS

We have identified the need to insert buffers to address common cause variation. This approach is effective since we know that uncertainty will affect the project, but we do not know exactly when or to what degree. Dr. Shewhart, as recounted by Dr. Deming, identified the mistake in conflating the reaction to common cause variation with the appropriate response to special cause variation. Special cause variation requires a separate tool for mitigating effects on project outcomes.

Special cause variation and project risks are similar in that we can identify a root cause. An effective qualitative risk management and mitigation planning process will identify these potential causes and develop countermeasures. Implementing these risk countermeasures is part of an effective project management effort. The quantitative risk analysis process enables the project team to quantify any residual risk remaining after mitigation measures have been put in place so an appropriate buffer can be added to project cost and time. It is at this point that one remaining gap can be identified in consideration of the difference between a project risk and pure special cause variation.

The remaining difference is that a project risk has yet to occur. Once a risk has been realized it becomes an issue to manage rather than a risk, as well as becoming a measurable instance of special cause variation. The appropriate response to an issue is not to simply use identified contingency buffers to mitigate disruption effects and proceed with project execution. The appropriate response is to conduct a root cause analysis to determine the source of variation and develop additional mitigation measures. For instance, a root cause analysis may identify special cause variation created by a lack of timely project information through request for information (RFI) responses. One potential solution might be a regular joint information review meeting in which the project team can coordinate and clarify immediate information needs. If this mitigation step is not taken, the root cause is likely to remain to continue causing disruption to project progress and further divergence from project plans. Utilize the time buffer not just to avoid disruption, but to provide time to conduct root cause analysis and develop countermeasures to reduce future occurrences. This step allows a project manager to reduce the amount of “firefighting” efforts on a project and to focus on improving overall project performance.

## **CONCLUSION**

Project performance when compared to baseline budget and schedule estimates continues to be a problem across multiple industries. Practitioners should persist in looking for solutions to this performance gap, including questioning accepted paradigms and practices. One such paradigm is the view of the project as a unique endeavor, unrelated to other similar production processes. When we compare project execution to other production processes, we can see the effects of variation, both common cause and special cause, on various levels of the project execution process. These moments at which variation could be introduced into the system should be addressed using tools adapted to mitigating variation. One tool for mitigating common cause variation is the introduction of cost and time buffers. These buffers can be appropriately sized using quantitative risk analysis and Monte Carlo simulation. Some tools for addressing special cause variation already exist within the risk management process but should be enhanced with the application of root cause analysis to realized risks. Providing time buffers to balance disruption caused by uncertainty and to provide time to conduct root cause analysis and countermeasures will move project performance estimates and actual results closer together.

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