PROJECT MANAGEMENT
CENTER FOR EXCELLENCE
A.J. CLARK SCHOOL OF ENGINEERING
Civil & Environmental Engineering Department

TURNING KNOWLEDGE
INTO PRACTICE
May 10-11, 2018

2018 Project Management Symposium Papers

ISSN: 2374-9377

Papers are arranged alphabetically by title

Agile Quantitative Risk Analysis

I. S. Parente[1]

[1]Susan Parente, MS Engineering Management, PMP, CISSP, PMI-RMP, PMI-ACP, CSM, CSPO, PSM I, ITIL, RESILIA, CRISC, MS Eng. Mgmt.;

S3 Technologies, LLC, Principal Consultant; parente@s3-tec.com

ABSTRACT

In today's world of fast paced technology and continually changing requirements and project scope, the need for Agile Project Management has greatly increased. This calls us to ask how do standard critical project management methodologies like Risk Management fit into Agile Practices.

What is Agile Risk Management and when does it make sense to use it? How does Quantitative Risk Analysis relate to Agile and how it is incorporated into Agile Practices, will be evaluated. Recommendations for implementing Agile Risk Management will be provided along with best practices and how organizations are applying this into practice.

The nuances of how Risk management is incorporated into agile practices is what generates project success. When requirements and environmental conditions are in flux, our ability to anticipate risk and plan for it, is critical to managing projects with agility.

OVERVIEW

The objectives of this paper on Agile Quantitative Risk Analysis are to explain what Agile risk management is, discuss risk analysis for Agile and provide recommendations for implementing Agile risk management. Lastly, the objective of this paper is to present risk as an opportunity to successful Agile project management!

With Agile project management replacing traditional project management in many organization and on many projects, it is important to understand how risk management is done in Agile projects.

WHAT IS AGILE?

In discussing Agile risk management, it is important to first clarify what we mean by Agile. Agile is a set of principles that guide teams and guide product development. It is a culture shift not a particular methodology or framework, but it consists of a number of methodologies/ frameworks. Agile is a great solution for some types of projects, but may not be the best solution for all projects. Agile entails open communication between teams, stakeholders, and customers. Agile is different from traditional project management in a number of ways, which will be detailed below.

Agile guidance consists of the Agile Manifesto and its 12 Principles, see the site www.agilemanifesto.org for the 4 values of Agile and its 12 Principles. Although Scrum is the most common framework of Agile, it is not by far the only framework. There are also other aspects of a project that make it an Agile project, versus a traditional project. These may include one or more of the following: rolling wave planning, iterative or incremental delivery, rapid and flexible response to change, and/ or open communication. Examples of Agile methodologies/ frameworks include: Scrum, XP (eXtreme Programming), Lean and Test-driven Development (TDD), Kanban, and many others.

Why should you use Agile principles and practices for project management? Agile principles and practices are used to manage change, improve communication, reduce cost, increase efficiency, provide value to customers and stakeholders, and decrease project risk. One should consider an agile approach when 1 or more of the following conditions are present:

- Uncertainty (particularly in requirements and changing conditions)
- Complexity (in content, integration, stakeholder management, or solution)
- Innovation (new technology, content, or system)
- Urgent (high priority or short timeline)

COMPARING TRADITIONAL TO AGILE

The triple constraint of time cost and scope operates differently in traditional project management and Agile project management. The project management triple constraint (iron triangle) consists of: scope, time and cost (denoting the management of these project aspects). Often quality is show in the middle of this triangle and Risk may be show as a cloud around the triangle, or in the background, as it is shown in figure 1 below.

Figure 1. The Triple Constraint.

Fundamentally, only 2 of the 3 aspects of the triad can be selected (or detailed). The third is then determined by the aspects which are selected. This is particular critical when changes occur to the project. The project performance baseline includes the baselines for these 3 project objectives: the scope baseline, the schedule baseline and the cost baseline. If any aspect of the approved project performance baseline is modified (through a change request, or otherwise), then at least one of the other 2 baselines will be affected. For example, if the project schedule is reduced by a month, either the budget must be increased or the scope of work schedule must be adjusted or the scope of the work must be decreased to meet the project objectives.

The other project objective of quality (also known as customer satisfaction) must be met but as a best practice is never changed to accommodate a change to time, scope or cost. What a customer requires to be satisfied is what they require. A customer will not generally agree to less than their interpretation of good project quality, even if the budget or schedule is reduced, or the project scope is increased.

In Figure 2 below, Traditional versus Agile Triple Constraint, you can see that traditional project management is *plan driven*, where cost and schedule are estimated based on fixed requirements (which mean a fixed project scope). In Agile or adaptive project management is *value driven*, where cost and schedule are fixed and features are estimated based on the time and resources allocated for the project iteration or increment.

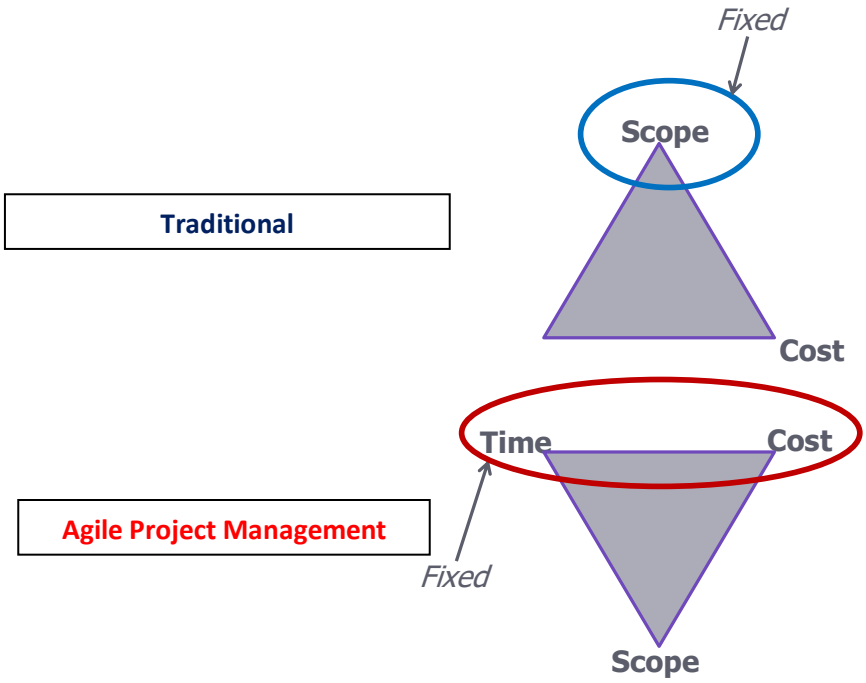


Figure 2. Traditional versus Agile Triple Constraint.

Agile Scrum is the most common and most pervasive of the Agile frameworks. Scrum is an agile framework which is used to manage a project. It uses an iterative approach and allows for requirements gathering throughout the project. Requirements are listed and prioritized in the product backlog. The Scrum framework consists of 3 roles, 4 meetings (ceremonies), and 3 artifacts. They are:

Roles:

- Scrum Master
- Product Owner
- Team Member

Meetings:

- Sprint Planning
- Daily Stand-up
- Sprint Review

- Sprint Retrospective

Artifacts:

- Product Backlog
- Sprint Backlog
- Product Increment

There is much to say and learn about Scrum and what it entails, but for this paper, a brief summary only is being provided. Below is a diagram of the Scrum Sprint process. See Figure 3, for details on the Sprint process.

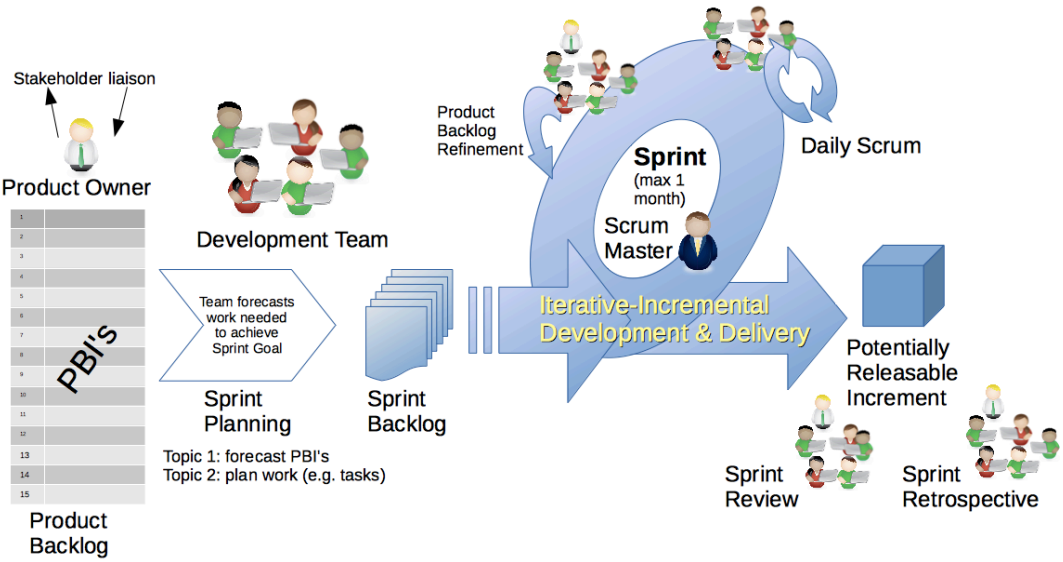


Figure 3. Scrum Sprint Process.*

*Reference: Mitchell, Dr. I. (11/9/2015) Schematic of the Scrum Framework process. Retrieved from: https://commons.wikimedia.org/wiki/File:Scrum_Framework.png

RISK MANAGEMENT DEFINED

Risk Defined. A Risk is an uncertain event or condition, which if it occurs, has a positive or negative effect on at least one objective. A risk is denoted using the properties of probability and impact. Probability is the likelihood of a risk occurring. It is the possibility of a project objective not being met using the current project plan. Impact is the consequence of a risk occurring. It details the penalty incurred, if the project objective, associated with the risk, is not obtained.

Risk exposure is calculated by multiplying a risk's probability of occurring times the impact (usually denoted in days or dollars).

Probability x Impact = Risk Exposure

As shown in Figure 4 below, increased probability and/ or impact increases the exposure of a risk.

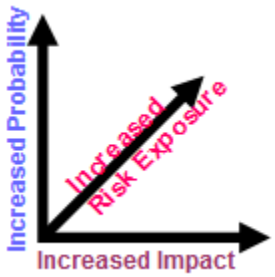


Figure 4. Probability and Impact.

It is important to understand the distinction between a risk and a problem/ issue. A Risk is an event that may occur in the future. A Problem or Issue is something which has already occurred and is being dealt with or has been resolved.

Project Risk Management Defined. Risk Management is an organized, systematic decision-making process that efficiently plans, assesses, handles, monitors, and documents risk to increase the likelihood of achieving project goals and decrease the likelihood that a risk would become a future problem

Project Risk Management has one inquire in uncertainty within their project: What are our project unknowns; what are the project's known unknowns; or what are the project's unknown unknowns? Risk Management provides a capability to quickly and effectively communicate risk information up and down the management chain.

The Risk Management Process. The risk management process includes the following: identification, assessment, response planning, execution, and planning, monitoring, documentation and communication. See Figure 5 below for how these work together.

Figure 5. The Risk Management Process.

The focus of risk identification is the discovery of potential risks to the project. In particular, in includes distinguishing any uncertain event which may positively or negatively affect the obtainment of project objectives. The process of risk assessment includes the review, analysis, and prioritization of project risks. This may include qualitative and/ or quantitative risk analysis. Qualitative Risk Analysis uses a subjective assessment; while quantitative risk analysis uses values for risk impacts, usually days or dollars.

After identified risks are prioritized, response planning can be developed for risks. As a best practice this is completed for higher exposure risks first. Since there are generally limited resources for risk management, it is important to focus on risks which are most urgent (could potential occur sooner) and highest (due to a high level of probability and/ or impact). Threat risk response strategies include: mitigate, avoid, transfer or accept. Opportunity risk response strategies include: enhance, exploit, share, and accept. After these response strategies have been planned, they are executed, while continuing to monitor and control these risks and identify an emergent risks (new risks which have appeared which were not initially identified. Throughout the project risk management process, planning, monitoring, documentation and communication of risk also occur. These are foundational to the risk management process and are essential to repeat iteratively throughout the project. They are also part of continuous process improvement for the project's Risk Management Plan.

AGILE RISK MANAGEMENT

Agile risk management is inherent in the practice of continued 'Inspection and Adaptation'. The focus of Agile risk management is on maximizing value (opportunity), in addition to minimizing threats. Regular and iterative inspection should be

completed. (This may be part of the iteration retrospective.) Regular capturing of lessons learned is also important, as agility is the team's ability to respond to change. The focus of Agile is Value, as previously discussed. An area for implementing quantitative risk management in Agile is within Software Development Performance Agility. This entails both Response Efficiency (evaluating: time, cost, and resources to respond to changes) and Response Extensiveness (for example a metric of 80% changes are incorporated). With both of these, it is important to measure the effectiveness of the metrics used. Keep in mind that response efficiency effects: scope, time and cost; whereas response extensiveness only effects scope (functionality of the product developed).

Risk Management is built into Agile Practices. It is integrated in Agile, but not transparent. Risk is constantly reviewed throughout the project. Risk is related to customer value. Risk and value are evaluated together for the project. The product backlog should be reviewed and adjusted based on risk. (This is called the risk adjusted backlog.) Another way to integrate risk management in agile is by using the Risk Burn Down Chart (see Figure 6 below). To note, as the project progress risk decreases.

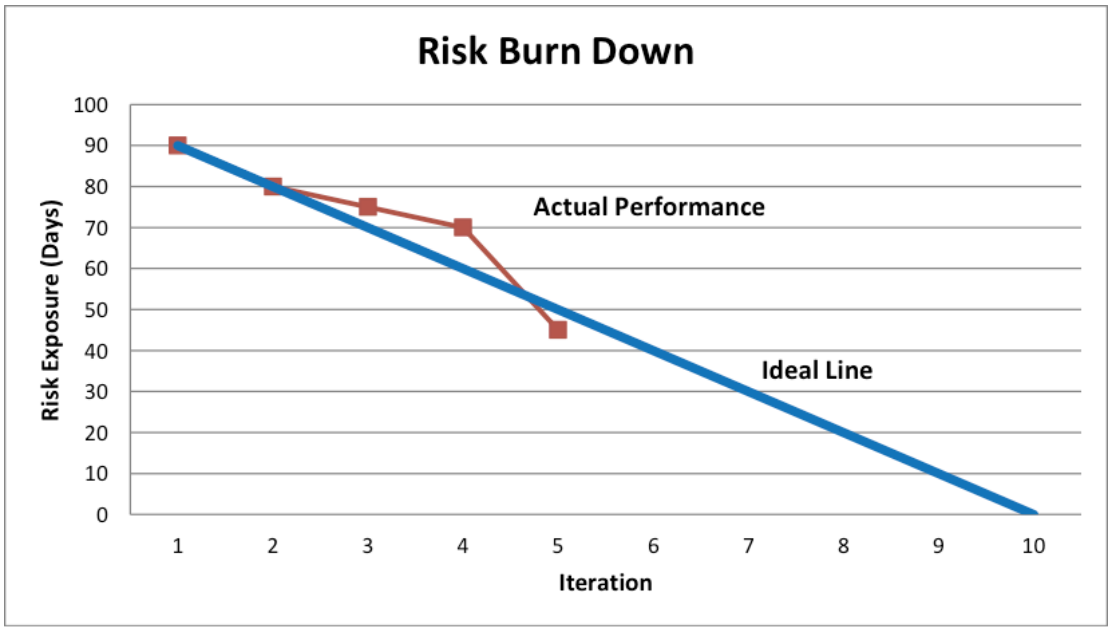


Figure 6. Risk Burn Down Chart.*

*Reference: Cagley, T., (10/42013) Agile and Risk Management: Prioritization and Measurement Techniques, Part 2, Retrieved from: https://tcagley.wordpress.com/2013/10/04/agile-and-risk-management-prioritization-and-measurement-techniques-part-2/

Keep in mind that the Agile team's assessment in regards to risk management is done of the team and done by the team. This should be part of the iteration retrospective.

Agile Risk Management Implementation. To successful manage risk for an Agile project involves risk identification by everyone on the team, not only the PM. It also entails being conscious of risk, intentional about risk planning, completing risk assessment as a separate process from risk identification. It also entails planning, including the following:

- Using iteration planning meetings to manage iteration risks
- Team communicates with Customer- escalating high risks
- Work with the Customer to identify concerns and reduce risk

As part of incorporating risk management into iteration planning, risks are evaluated for each iteration and for the next 2-3 iterations. A risk adjusted product backlog should be used for the project. What this means is that the product backlog prioritization should account risk for each user story (or feature). Daily Stand-up meetings are used by taking the barriers or impediments vocalized and using these for risk response planning for the project risks. Another example of incorporating risk management into an Agile project is using a Spike, which is a time-boxed quick experience or investigation, which is used to support the estimation of a user story (or feature). A Spike is used to reduce user story uncertainty (or risk). A Spike may also be used for implementing a risk response strategy (for example, mitigation). The iteration review/ Retrospective is another area where risk management can be implemented for an Agile project. Within the iteration review/ retrospective, we can evaluate the following is support of Agile risk management:

- How were risk successful handled?
- What risk were not Identified?
- What risk responses, or process could be used in the future?

Agile Principles and Practices are used on projects to: manage change, improve communication, reduce cost, increase efficiency, provide value to customers and stakeholders, and decrease project risk.

SUMMARY OF AGILE RISK MANAGEMENT

In summary, Project Risk Management is an organized, systematic decision-making process that efficiently plans, assesses, handles, monitors, and documents risk to increase the likelihood of achieving project goals and decrease the likelihood that a risk would become a future problem.

Agile Risk Management is about incorporating risk management into the Agile framework as part of the iterative process to increase the likelihood of achieving product goals and decrease the likelihood that a risk would become a future problem.

In short, Risk Management is everyone's job and it starts with you!

REFERENCES

Cagley, T., (10/42013) Agile and Risk Management: Prioritization and Measurement Techniques, Part 2, Retrieved from: https://tcagley.wordpress.com/2013/10/04/agile-and-risk-management-prioritization-and-measurement-techniques-part-2/

Hamilton-Whitaker (2011) "Agile Risk Management for Projects and Programmes", Canada

Lee, G., & Xia, W. (3/2010) "Toward Agile: An Integrated Analysis of Quantitative and Qualitative Field Data on Software Development Agility", MIS Quarterly, Vol 34 #1

PMI. A Guide to the Project Management Body of Knowledge (PMBOK). Newtown Square, PA: Project Management Institute, Inc., Sixth Edition, 2017.

Sliger, M (2011) "Relating PMBOK Practices to Agile Practices", Retrieved from: http://www.stickyminds.com/sitewide.asp?Function=edetail&ObjectType=COL&ObjectId=11133

Applying 1970 Waterfall Lessons Learned Within Today's Agile Development Process

Johnny D. Morgan, PhD
General Dynamics Information Technology; johnny.morgan@gdit.com

ABSTRACT

While working for TRW in 1970, Dr. Winston Royce, published an IEEE paper that described the waterfall development process. In his paper he states "I believe in the concept but the implementation described is risky and invites failure." He then "presents five additional features that must be added to this basic approach to eliminate most of the development risks." This paper reviews these five additional features recommended in 1970 and describes how they are incorporated into today's agile development process to reduce agile project development risks.

Key Words: Agile, architecture, design, Manifesto for Agile Software Development, project management, software development, waterfall, Winston Royce

This paper is based on empirical observations, current literature, and engineering and project management experiences.

INTRODUCTION

Since the publishing of the Manifesto for Agile Software Development in 2001, many books and journal articles have been published that first characterizes the waterfall software development process and then identifies process steps that attempt to separate and uniquely characterize agile development practices as different and better. In many cases, each of these publications either references or directly draws the basic waterfall development process shown in Figure 1 and then attempts to make a comparison of historical project management concepts and agile project management concepts. For example, one publication states:

> "In the historical approach, which locks the requirements and delivers the product all in one go, the result is all or nothing. We either succeed completely or fail absolutely. The stakes are high because everything hinges on work that happens at the end...of the final phase of the cycle, which includes integration and customer testing...In the testing phase of a waterfall project, the customers get to see their long-awaited product. By that time, the investment and effort have been huge, and the risk of failure is high. Finding defects among all completed project requirements is like looking for a weed in a cornfield…The following list summarizes the major aspects of the waterfall approach to project management:
>
> - The team must know all requirements up front to estimate time, budgets, team members and resources…
> - The customer and stakeholders may not be available to answer questions during the development period, because they may assume that they

provided all the information during the requirements-gathering and design phases…

- The team needs to resist the addition of new requirements or document them as change orders, which adds more work to the project and extends the schedule and budget…
- Full and complete customer feedback is not possible until the end of the project when all functionality is complete." (Layton and Ostermiller 2017)

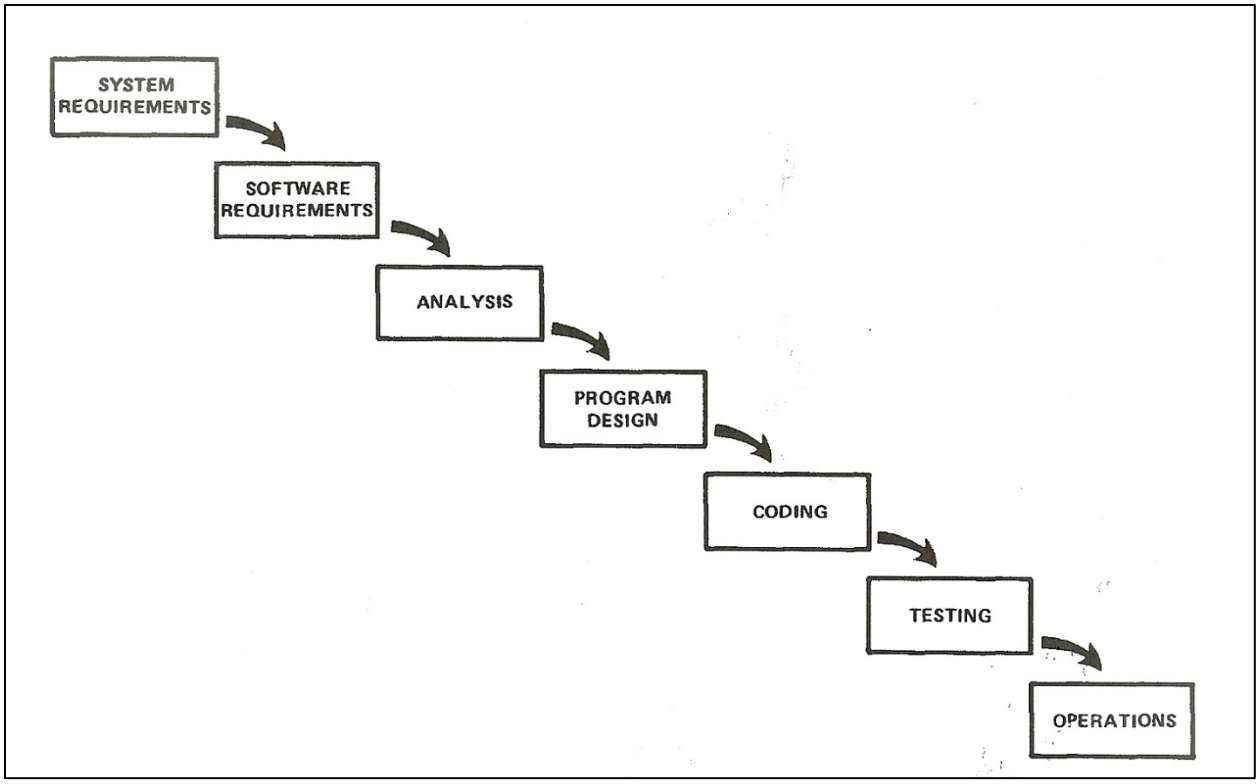


Figure 1 – The Basic Waterfall Development Methodology (Royce 1970)

In another publication, the abbreviated comparison shown in Table 1 is made to distinguish the characteristics between agile and non-agile development methodologies.

Table 1: Abbreviated Comparison of Agile versus Non-Agile Methodologies (Schuh 2006)

Project Environment Variable	Agile	Non-Agile
Communication Style	Regular Collaboration	Only When Necessary
Continuous Learning	Embraced	Discouraged
Team Participation	Mandatory	Unwelcome
Planning	Continuous	Up Front
Feedback Mechanisms	Several	Not Available
Customer Involvement	Throughout the Project	During Analysis Phase

The diagram in Figure 1 was published in 1970 by Dr. Winston W. Royce in a paper entitled "Managing the Development of Large Software Systems." It is actually one of ten figures within the paper but the diagram in Figure 1 is the most cited. As one author now states:

> "Unfortunately, Royce's paper was widely misunderstood. He presented the above model (Figure 1) as '**risky and invites failure**' and was proposing modifications to make it much more iterative and incremental. However, that element of his work is largely forgotten, and his waterfall picture remains in common use, although the names of the stages have changed a little over time." (Girvan and Paul 2017)

This paper examines Royce's paper and proposed modifications and discusses how they are now applied to agile development practices. However, it is important to understand that the steps identified in this paper are highly relevant to all software development methodologies.

INTRODUCING WILLIAM ROYCE AND HIS PAPER

Wikipedia states that Winston W. Royce was born in 1929 and went to college at the California Institute of Technology where he received a Bachelor of Science in physics, and both a Master of Science and Doctor of Philosophy in aeronautical engineering. In 1961 he started as a project manager in the aerospace division of TRW. Having managed multiple large, complex software development projects, he published the paper "Managing the Development of Large Software Systems" in 1970. In the 1980s, he became a Director at the Lockheed Software Technology Center in Austin, Texas. He retired in 1994 and died the following year. (Anonymous2017)

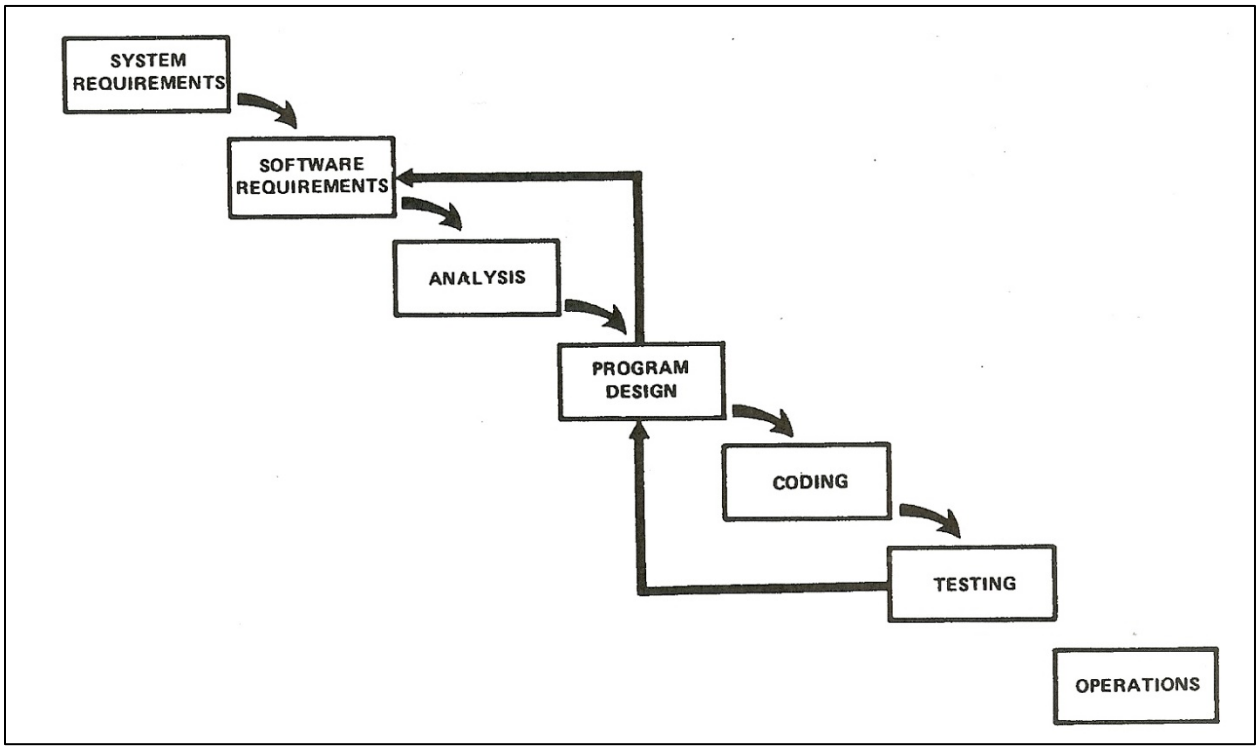


Figure 2: If Testing is the First Event for Assessing Key Elements (Royce 1970)

In this paper, Royce states:

> "I am going to describe my personal views about managing large software developments. I have had various assignments during the past nine years...In these assignments, I have experienced different degrees of success…I have become prejudiced by my experiences and am going to relate some of these prejudices in this presentation…(An) approach to software development is illustrated in (Figure 1). I believe in this concept but the implementation is risky and invites failure. The problem is illustrated in (Figure 2). (If) the testing phase which occurs at the end of the development cycle is the first event for which timing, storage, input/output transfers, etc., are experienced…the required design changes are likely to be so disruptive that the software requirements upon which the design is based and which provides the rationale for everything are violated. Either the requirements must be modified, or a substantial change in the design is required. In effect, the development process has returned to the origin and one can expect up to a 100-percent overrun in schedule and/or costs…However, I believe the illustrated approach to be fundamentally sound. The rest of this discussion presents five additional features that must be added to this basic approach to eliminate most of the development risks." (Royce 1970)

ROYCE WAS A LEAN THINKER

Nearly all agile practices are based on Lean thinking, many dating back to W. Edwards Deming's work in Japan in the 1950s. For example, today's Scaled Agile Framework (SAFe)® provides multiple sections on the development and usage of Lean thinking in the execution of this agile framework. (Leffingwell and others 2017)

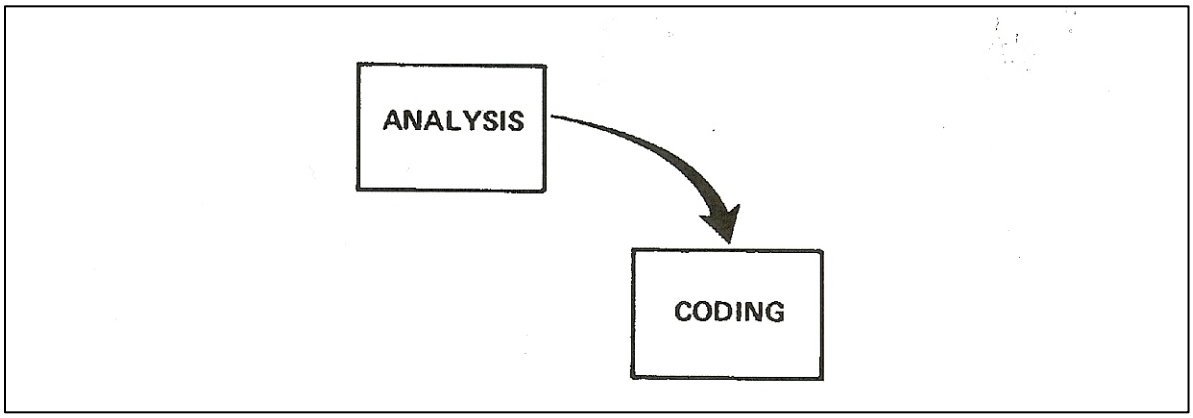


Figure 3: Two Step Process Described in Royce's Paper (Royce 1970)

Dr. Royce also discussed Lean thinking in his paper:

> "There is first an analysis step, followed by a coding step as depicted in (Figure 3). This sort of very simple implementation is in fact all that is required if the effort is sufficiently small and if the final product is to be operated by those who built it…It is also the kind of development effort for which most customers are

happy to pay, since both steps involve genuinely creative work which directly contributes to the usefulness of the final product."

But Dr. Royce then provides a warning to project managers:

> "An implementation plan to manufacture larger software systems, and keyed only to these steps, however, is doomed to failure. Many additional steps are required, none contribute as directly to the final product as analysis and coding, and all drive up the development costs. Customer personnel typically would rather not pay for them, and development personnel would rather not implement them. The prime function of management is to sell these concepts to both groups and then enforce compliance on the part of development personnel." (Royce 1970)

INTERACTIVE INTERSECTION BETWEEN THE VARIOUS PHASES

Today's agile development practices employ short development cycles to:

- Incorporate customer feedback on the product
- Incorporate lessons learned from within the development team
- Allow for the insertion and prioritization of new customer requirements and priorities into the development process

In some cases, agile teams use the term "fail fast" to describe the process for incorporating these traits into the software development process.

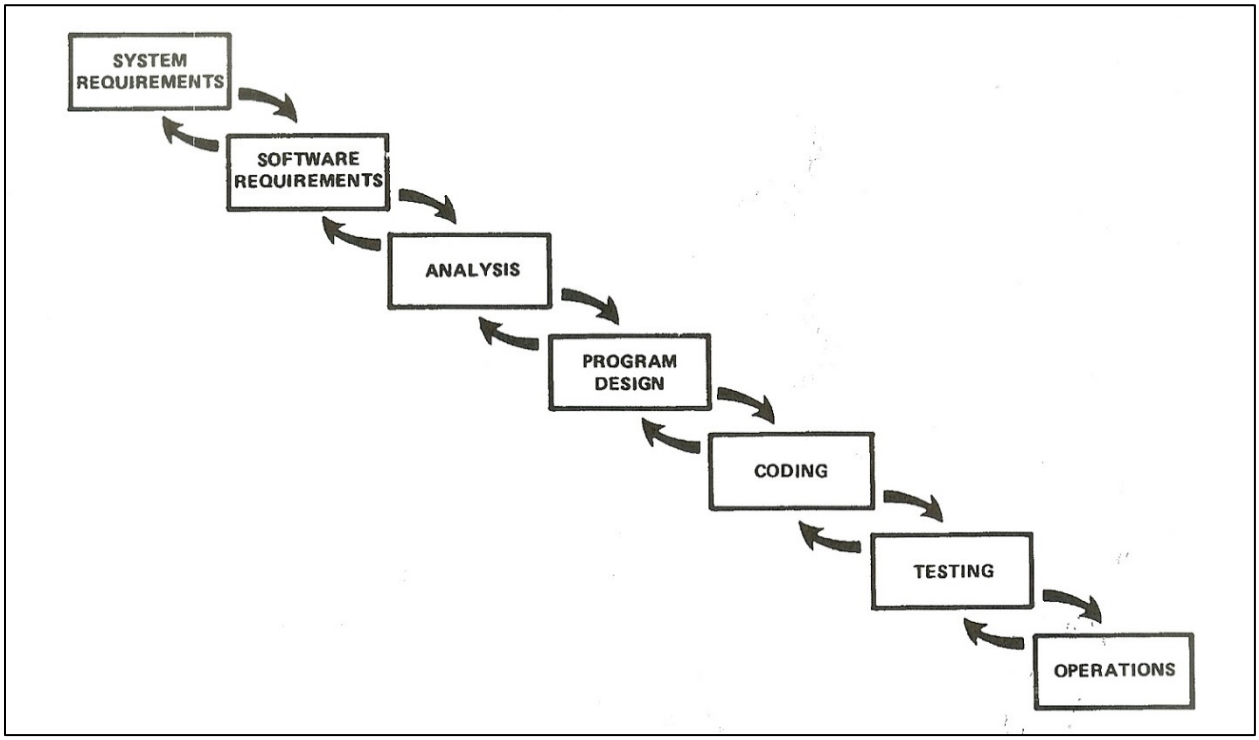


Figure 4: Iterative Relationship Between Successive Development Phases

Equally important to a waterfall development process is the iterative relationship between successive development phases as shown in Figure 4. As described by Royce:

> "The ordering of steps is based on the following concept: that as each step progresses…there is an iteration with the preceding and succeeding steps but rarely with the more remote steps in the sequence. The virtue of all of this is that as the design proceeds the change process is scoped down to manageable limits. At any point in the design process after the requirements analysis is completed there exists a firm and closeup, moving baseline to which to return in the event of unforeseen design difficulties. What we have is an effective fallback position that tends to maximize the extent of early work that is salvageable and preserved."

Based on personal experience, this author has found that an effective change process is key to any organization and supporting software development process being agile or responsive. This change process incorporates the concept of moving, or versioning baselines in which to return to in the event of unforeseen difficulties and includes the ability to incorporate changes in a timely manner resulting from:

- Changing requirements from any stakeholder source
- Results from modeling, simulation, prototyping and user feedback
- Inability to translate paper-based concepts into working, performant software

STEP 1: PROGRAM DESIGN COMES FIRST

The first feature that Royce recommends is to complete a high-level program design of the system. He states:

> "The following steps are required.
>
> 1) Begin the design process with program designers, not analysts or programmers.
> 2) Design, define and allocate the data processing modes even at the risk of being wrong…
> 3) Write an overview document that is understandable, informative and current. Each and every worker must have an elemental understanding of the system. At least one person must have a deep understanding of the system which partially comes from having to write an overview document."

In today's terminology, a high-level program design refers to establishing the solution architecture for a system and to accomplish this before any major software coding efforts commence as shown in Figure 5.

The agile manifesto has one value statement and two principles that affect architecture. One states that "the best architectures, requirements, and designs emerge from self-organizing teams" while the other two state that the team should welcome and respond to change for the customer's competitive advantage. (Anonymous2001)

Implementing these elements without applying energy to architecture can have serious consequences. As Roger Sessions states:

> "Architectures naturally seek the maximum possible level of complexity all on their own. If it is a complex architecture you are after, you don't need architects. You might as well just fire them all and let developers work on their own. This observation that architectures are naturally attracted to complexity is actually predicted by physics—in particular, the law of entropy. This fundamental law of physics states that left to their own, all systems evolve into a state of maximal disorder (entropy). It takes a constant inflow of energy into a system to keep the disorder at bay. In this regard, enterprise architectures are just another natural system, like gas molecules in a balloon. The law of entropy tells us that the battle for simplicity is never over. It requires a constant influx of energy to keep enterprise systems simple. It isn't enough to design them so that they are simple. It isn't enough to even build them so that they are simple. You must continue working to prevent an erosion of simplicity for the life of the system. In this sense, the work of the enterprise architect is never done." (Sessions 2008)

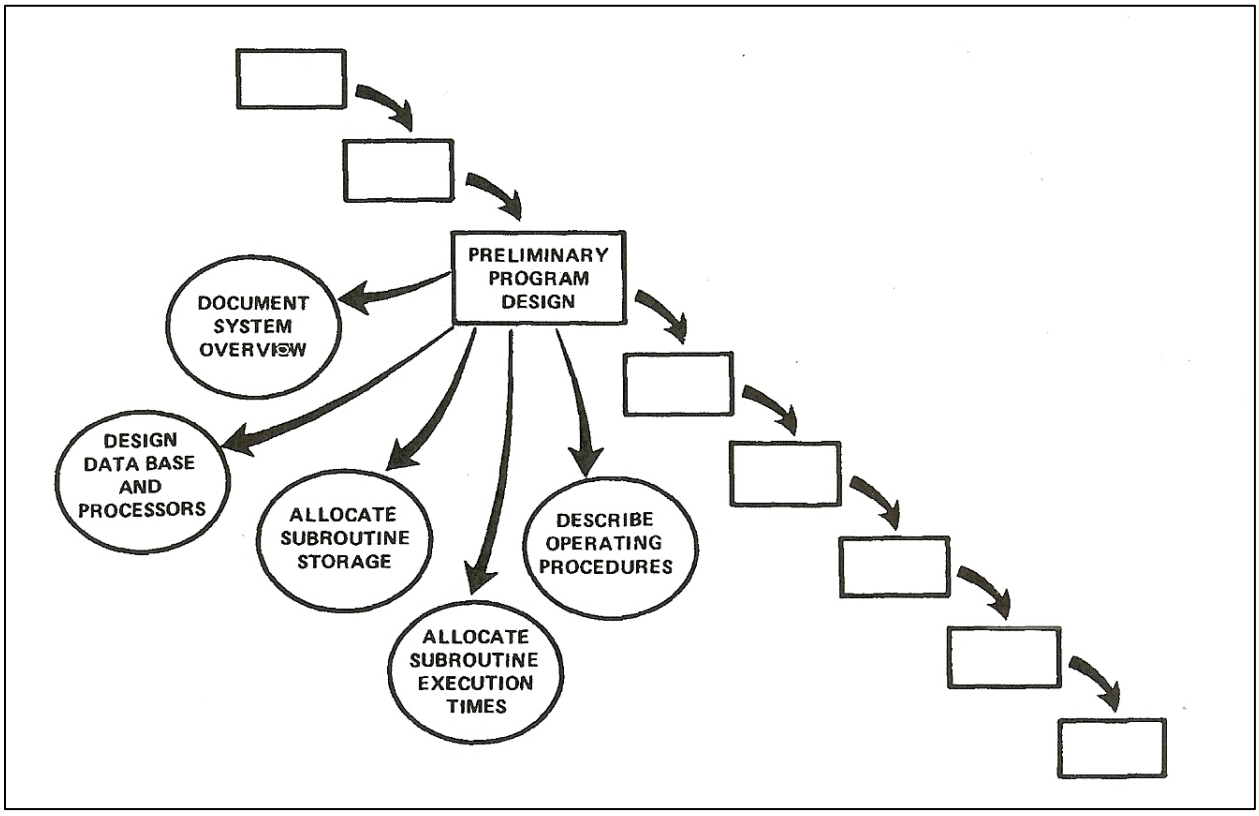


Figure 5: Complete a High-Level Design of the System

Successfully incorporating architecture into agile projects is a difficult balancing act.

> "Companies where architectural practices are well developed often tend to see agile practices as amateurish, unproven, and limited to very small, Web-based sociotechnical systems. Conversely, proponents of agile approaches usually see

> little value for a system's customers in the upfront design and evaluation of architecture. They perceive architecture as something from the past, equating it with big design up-front (BDUF)—a bad thing—leading to massive documentation and implementation of YAGNI (you ain't gonna need it) features. They believe that architectural design has little value, that a metaphor should suffice in most cases, and that the architecture should emerge gradually sprint after sprint, as a result of successive small refactoring…The tension seems to lie on the axis of adaptation versus anticipation. Agile methods want to be resolutely adaptive: deciding at the 'last responsible moment' or when changes occur. Agile methods perceive software architecture as pushing too hard on the anticipation side: planning too much in advance." (Abrahamsson, Babar, and Kruchten 2010, 16-22)

Grady Booch provides insight into the birth and maturing of many systems and the need for architecture:

> There are many examples of notable systems that began with the code of one or two people and grew to become a dominant design: the packet-switched multiple-protocol router, first developed by Bill Yeager; a graphics editing system, first developed by Thomas and John Knoll; a social network, first popularized by Mark Zuckerberg. The list goes on. In each of these cases, architecture was not a primary concern. I'd be surprised if it was on their radar at all, save for the reality that each of these developers had the chops, the experience, and the intuition to deliver something Good Enough that could be grown...Quite often, the developers who did the internal exploration are not the most skilled at production. Furthermore, the risk profile changes, and the success of a system is less dependent on rapid innovation and much more dependent on quality and efficiency in manufacturing and delivery…it's also these times that intentional architecting becomes intensely important." (Booch 2011, 10-11)

The following discussion provides insight into the application architecture processes into an agile activity:

> "Do not dilute the meaning of the term architecture by applying it to everything in sight. Not all design decisions are architectural…(apply architecture) early enough because architecture encompasses the set of significant decisions about the structure and behavior of the system. These decisions prove to be the hardest to undo, change, and refactor, which means to not only focus on architecture, but also interleave architectural 'stories' and functional 'stories' in early iterations...User stories in agile development relate primarily to functional requirements; this means that nonfunctional requirements can sometimes be completely ignored. Unfulfilled nonfunctional requirements can make an otherwise functioning system useless or risky. A main objective of integrating architectural approaches in agile processes is to enable software development teams to pay attention to both functional and nonfunctional requirements." (Abrahamsson, Babar, and Kruchten 2010, 16-22)

The Scale Agile Framework ® incorporates the concept of Architecture Runway in its agile practice. The framework states:

> "Architectural runway provides one of the means by which SAFe implements the concepts of Agile architecture. The runway provides the necessary technical basis for developing business initiatives and implementing new features and capabilities. An architectural runway exists when the enterprise's platforms have sufficient technological infrastructure to support the implementation of the highest priority, near-term features without excessive, delay-inducing redesign." (Leffingwell and others 2017)

STEP 2: DOCUMENT THE DESIGN

Royce's second feature or step is to document the design. In describing this feature, Royce provides the following insights:

> "At this point it is appropriate to raise the issue – 'how much documentation?' My own view is "quite a lot" certainly more than most programmers, analysts, or programmers are willing to do if left to their own devices…Why so much documentation?
>
> 1) Each designer must communicate with interfacing designers, with his management and possibly with the customer. A verbal record is too intangible to provide an adequate basis for an interface or management decision…
> 2)…If the documentation does not exist there is as yet no design, only people thinking and talking about the design which is of some value, but not much…
> 3) The real monetary value of good documentation begins downstream in the development process during the testing phase and continues through the operations and redesign phase." (Royce 1970)

As shown in Figure 6, Royce recommends six documents that are developed and updated throughout the system's life cycle.

In reviewing the current literature, the phrase "comprehensive documentation" is directly associated with the concept of big up-front design (BUFD) where all elements of a system's design are completely thought out and documented before any software coding begins. This massive amount of documentation then quickly falls out of sync soon after development starts (Erdogmus 2009, 2-4). As previous discussed, agile teams need to be concerned about the system's architecture but "what is architecture" versus "what is design" may not be obvious.

> "What does a particular project or organization mean by architecture? The concept has fuzzy boundaries. In particular, not all design is architecture. Agreeing on a definition is a useful exercise and a good starting point...Do not dilute the meaning of the term architecture by applying it to everything in sight. Not all design decisions are architectural. Few are, actually, and in many projects, they're already made on day one." (Abrahamsson, Babar, and Kruchten 2010, 16-22)

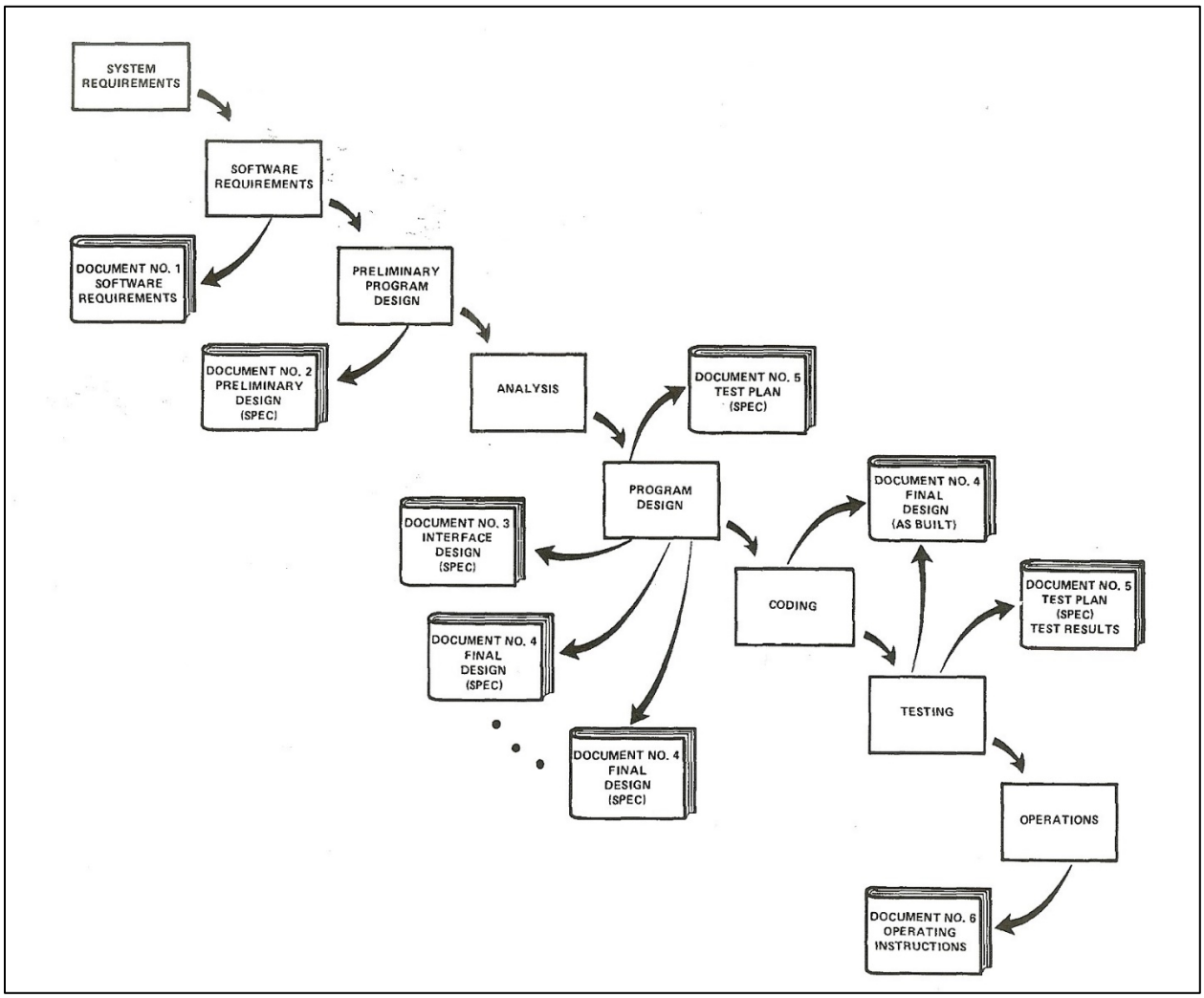


Figure 6: Royce Recommends Six Documents for a System (Royce 1970)

Grady Booch offers these insights:

> "As I've often said, the code is the truth, but not the whole truth, meaning that there are certain architectural decisions that cannot easily be discerned in the code itself. This is so because such decisions are manifested as mechanisms that are either scattered or tangled throughout the code, their meaning and presence are in the heads of the code's creators and not easily evident by staring at it (the code)...It's these bits of architectural decisions that are best documented elsewhere, external to the code base. Such decisions often live in tribal memory, in the heads of people. This is fine when the team is small, but when the system grows to economic significance, tribal memory is a particularly noisy and inefficient repository of architecture.
>
> The architectural mechanisms that are not baked into the code and thus are in the heads are the things you want to (a) take time to document and, where possible,

> (b) create a domain-specific language that is baked into the code to implement it. My experience is that every reasonably software-intensive system will have a couple dozen such architectural mechanisms…These are the kinds of decisions that can be documented in a static document of two or three dozen pages—any longer and no one will read it…this artifact becomes a vehicle for orienting new folks to the code based as well as attending to some degree of architectural governance, whose simple goal is getting people to continue to grow the system according to those architecture principles." (Booch 2011, 10-11)

Alistair Cockburn shares similar advice:

> "the designer's job is not pass along 'the design' but to pass along 'the theories' driving the design. The latter goal is more useful and more appropriate. It also highlights that knowledge of the theory is tacit in the owning, and so passing along the theory requires passing along both explicit and tacit knowledge."

Cockburn promotes a Theory Building View of a system and then summarizes by providing these recommendations for what should be put into documentation:

> "*That which helps the next programmer build an adequate theory of a program*. This is enormously important. The purpose of the documentation is to jog memories in the reader, set up relevant pathways of thought about experiences and metaphors. This sort of documentation is more stable over the life of the program than just naming the pieces of system currently in place. The designers are allowed to use whatever forms of expression are necessary to set up those relevant pathways…Experienced designers often start their documentation with just:
>
> - The metaphors
> - Text describing the purpose of each major component
> - Drawings of the major interactions between the major components
>
> These three items alone take the next team a long way to constructing a useful theory of the design…Documentation cannot—and so need not—say everything. Its purpose is to help the next programmer build an accurate theory about the system." (Cockburn 2007)

For a client who had incurred tremendous amounts of technical debt caused by the absence of credible explicit knowledge and about his technical systems, the author was asked to identify, in priority order, those items that need to be explicitly described and the following was recommended:

1. Any knowledge that defines to users, operators, and maintainers how to operate and maintain the system
2. Any knowledge that describes how to rebuild and redeploy all of the system, should a disaster occur
3. Any knowledge that is used to verify that the system has been successfully rebuilt and redeployed such that it can again support the business
4. Any knowledge that allows future personnel to modify the system over its life cycle

STEP 3: DO IT TWICE

Both Royce and today's agile methods agree that incorporating knowledge and feedback into the development process is essential. Many of today's agile practices identify the term Minimum Viable Product (MPV) which is a minimum operationally acceptable product that a customer can field and use in operations. Furthermore, many agile processes describe the process of "failing fast," to denote the concept of building something quickly to see if it works and then incorporating the knowledge gained by successes and failures back into the agile development process. Figure 7 shows the diagram Royce used in his paper and he describes this feature or step as follows:

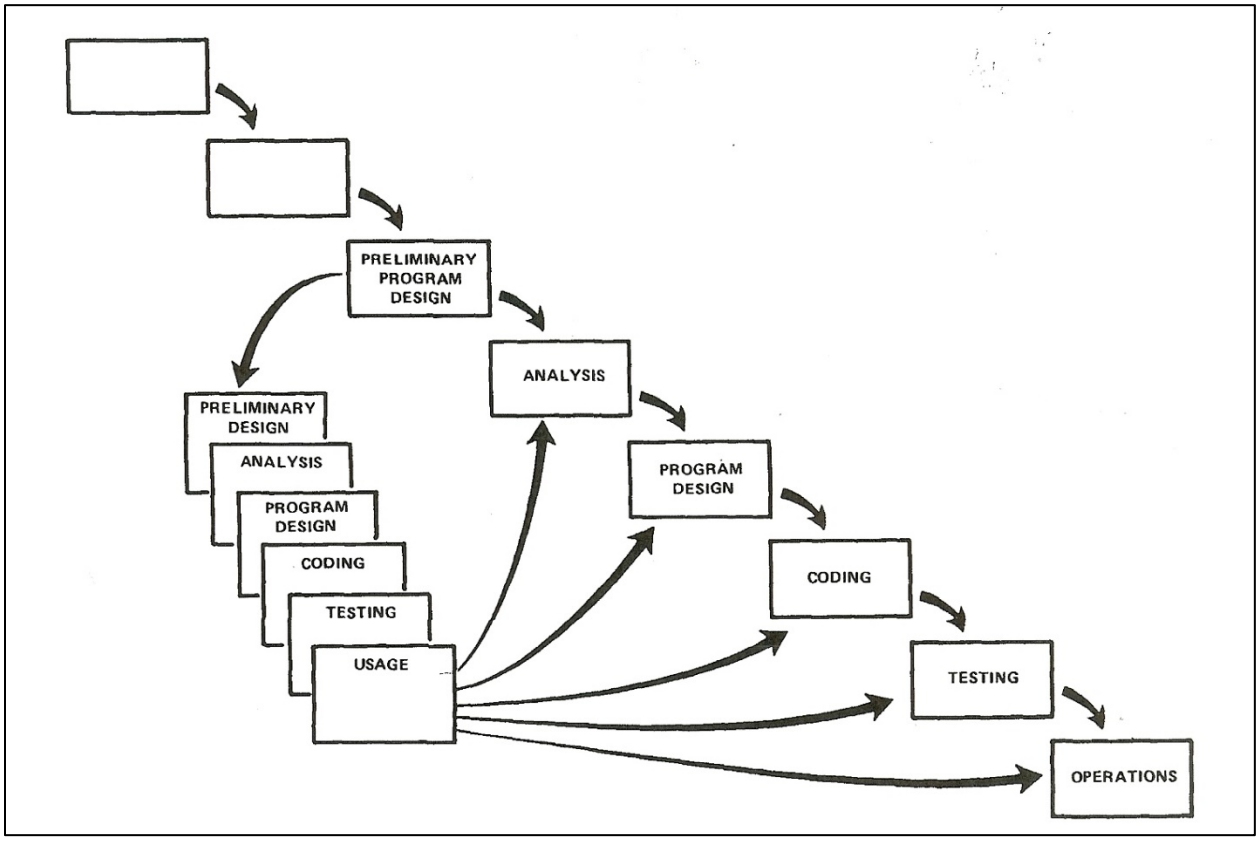


Figure 7: Build the System Twice (Royce 1970)

> "If the computer program in question is being developed for the first time, arrange matters for the version finally delivered to the customer for operational deployment is actually the second version insofar as critical design/operations areas are concerned…Figure 7 illustrates how this may be carried out by means of a simulation…This pilot effort could be compressed…in order to gain sufficient leverage to the mainline effort. In this case a very special kind of broad competence is required on the part of the personnel involved. They must have an intuitive feel for analysis, coding, and program design. They must quickly sense the trouble spots in the design, model them, model their alternatives, forget the straight forward aspects of the design which aren't worth studying at this early

point, and finally arrive at an error-free program…Without this simulation the project manager is at the mercy of human judgement." (Royce 1970)

STEP 4: PLAN, CONTROL AND MONITOR TESTING

Of the five features discussed by Royce, feature or step four is to plan, control and monitor testing. Royce provides the diagram in Figure 8 and writes:

> "Without question the biggest user of project resources, whether it be manpower, computer time, or management judgement is the test phase. It is the phase of greatest risk in terms of dollars and schedule. It occurs at the latest point in the schedule when backup alternatives are least available, if at all. The previous three recommendations to design the program before beginning analysis and coding, to document it completely, and to build a pilot model are all aimed at uncovering and solving problems before entering the test phase. However even after doing these things there is still a test phase and there are still important things to be done." (Royce 1970)

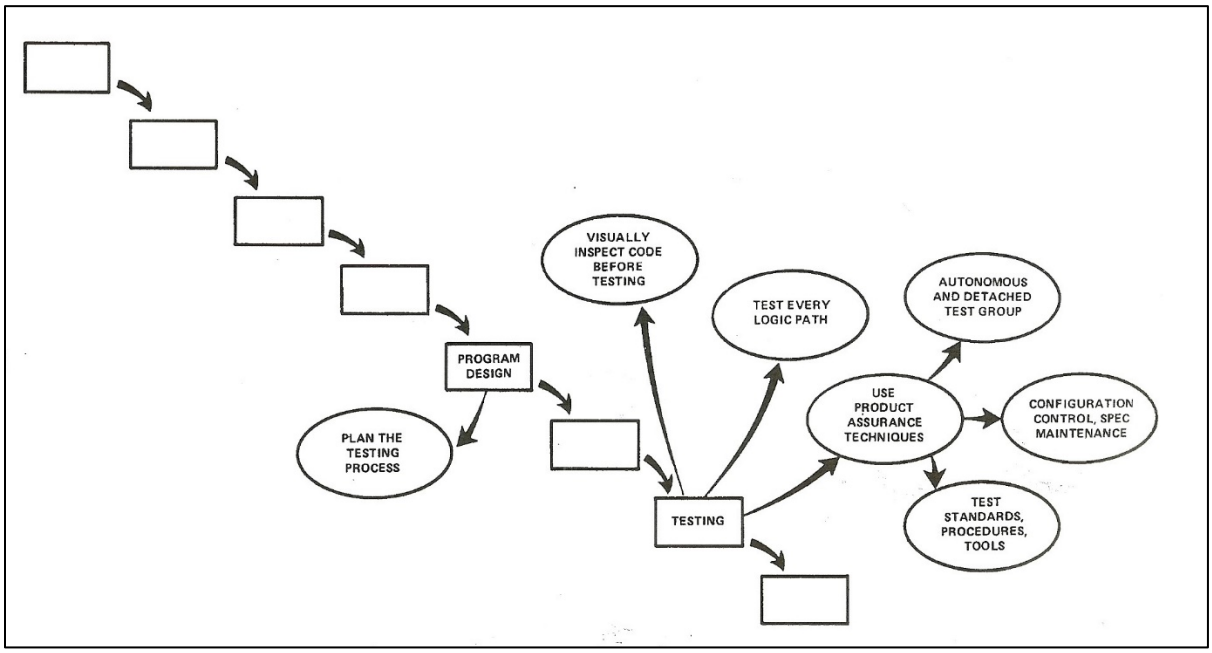


Figure 8: Recommendations for Planning, Controlling and Monitoring Testing (Royce 1970)

Many agile methods, such as Test-Driven Development (TDD) focus on writing the test first, before actually writing the software. As Royce states:

> "Many parts of the test process are best handled by test specialists who did not necessarily contribute to the original design. If it is argued that only the designer can perform a thorough test because only he understands the area he built, this is a sure sign of failure to document properly. With good documentation it is feasible to use specialists in software product assurance who will, in my judgment, do a better job of testing than the designer." (Royce 1970)

Some agile methods include the concept of Pair Programming which has one person writing the code while another person is sitting by the coder and reviewing his work and enhancing it through an interactive dialog. Then periodically, the two software engineers switch roles, but both continue writing and reviewing the software as a team. Royce writes:

> "Most errors are of an obvious nature that can be easily spotted by visual inspection. Every bit of the analysis and every bit of code should be subjected to a simple visual scan by a second party" (Royce 1970)

Royce also recommends to "test every logic path in the computer program at least once with some kind of numerical check." In 1970 when his paper was written, this was a very difficult and time-consuming recommendation, but today's software development tools provide mechanisms for tracking code coverage during the execution of a test procedure. Royce also states "while this (recommendation) sounds simple, for a large, complex computer program it is relatively difficult to plow through every logic path with controlled values of input. In fact some would argue that is every nearly impossible." (Royce 1970) Today's automated testing tools support the low cost, re-execution of test procedures to ensure that existing software is not broken while new software is being developed.

STEP 5: INVOLVE THE CUSTOMER

Royce's final recommendation is to involve the customer. He states:

> "For some reason what a software design is going to do is subject to interpretation even after previous agreement. It is important to involve the customer in a formal way so the customer has committed himself at earlier points before final delivery. To give the contractor free rein between requirement definition and operation is inviting trouble." (Royce 1970)

As figure 9 depicts, Royce provides multiple points in the software development life cycle where the insights and judgement of the customer can strengthen the development effort.

Today's agile methods typically include a Product Owner as an active member within each agile team who provides the voice of the customer to team. As a member of the agile team, the Product Owner participates in all agile team activities.

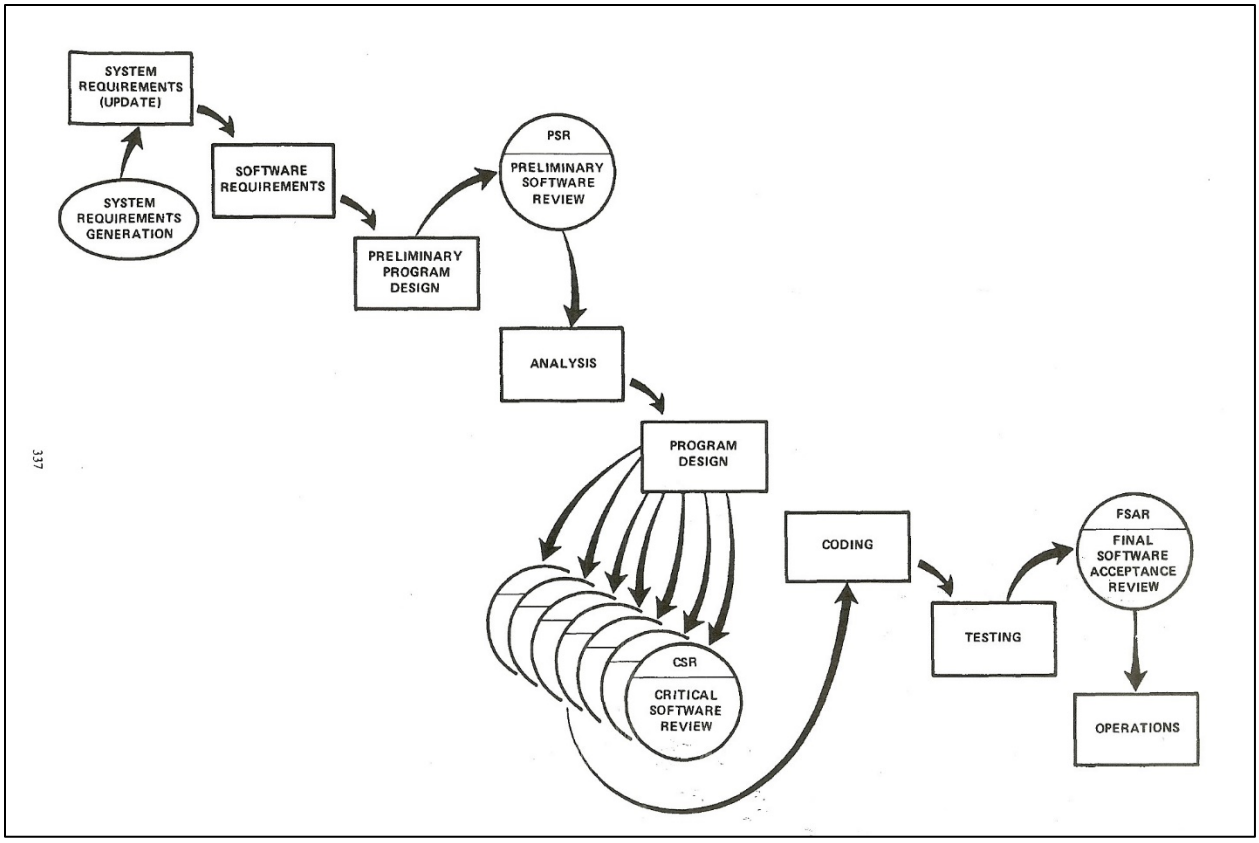


Figure 9: Involve the Customer at Multiple Points in the Development Effort (Royce 1970)

CONCLUSIONS

As previously stated, nearly everyone that publishes agile software development practices refer to the concepts identified in Figure 1 of this paper. Figure 10 shows the last figure provided in Royce's 1970 paper. It has many more steps and interactions and is based on implementing the five recommendations that significantly reduce the development risk inherent in a waterfall development process. Today's agile practices incorporate many of these recommendations to some degree. But irrespective of the software development process that a project manager and his development team selects, the following attributes need to be included within the software development methodology:

- Invoke a method of baselining and versioning the project and execute a change process that can receive, assess and execute changes from multiple sources into the baseline in a timely and responsive manner.
- Recognize the interactive relationship of the entire software development process and that previous steps may need to be re-executed based on new information obtained while executing a downstream activity.
- Establish a high-level architecture (program design) for the system, write it down, and ensure that all parties understand this architecture.
- There are elements of the system that need to be documented. Make a conscious decision of what documentation, actually information transfer, will be required and use whatever forms of expressions are necessary to setup and execute this information transfer.

- Be willing to model, simulate, and prototype high risk areas of the system to obtain a thorough understanding and resolution of key technical areas early within the design of the system. Incorporate the lessons learned from these activities into the design and software development process for the system
- Testing should commence early in the software development process and become a continuous activity throughout the software development process.
- Keep your customer involved and committed throughout the entire development process.

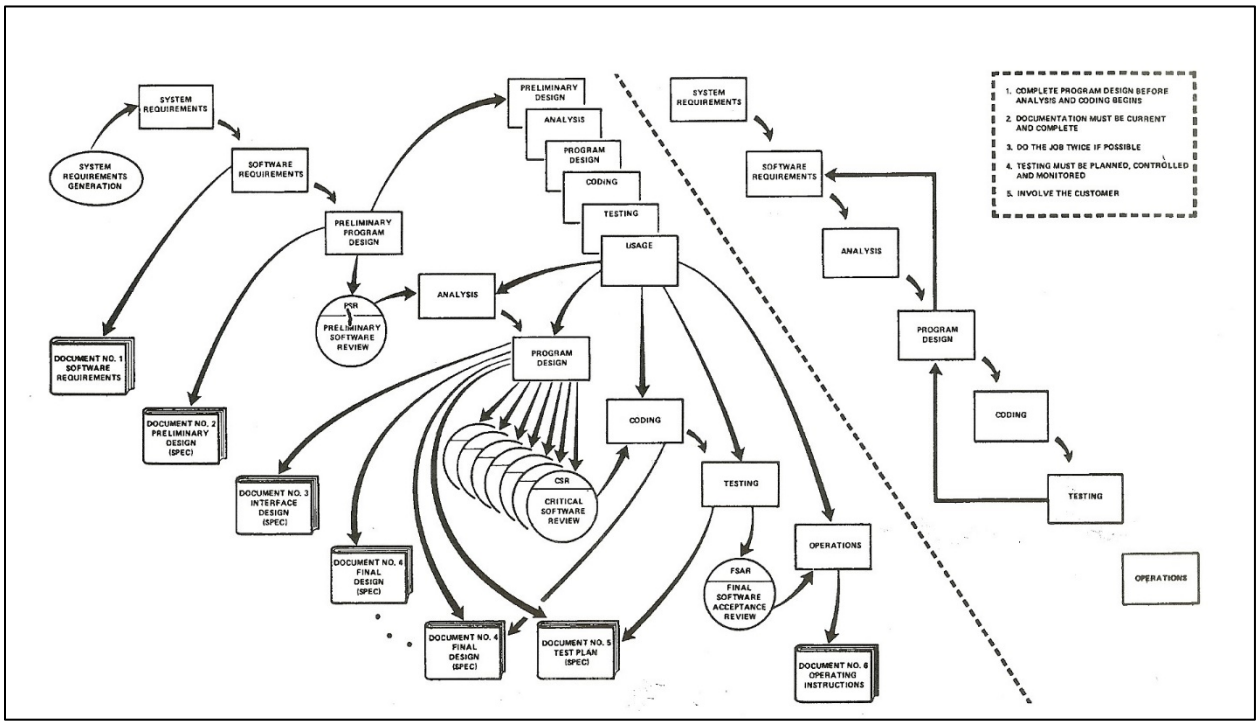


Figure 10: Adding Royce's Recommendations to the Waterfall Development Methodology (Royce 1970)

When written down, these attributes appear to be common-sense, but in 1970 Dr. Royce felt the need to present a paper that described how to invoke a few common-sense recommendations into a step-wise software development approach. Then in 2001, a group of highly experienced software developers felt the need to write down a Manifesto for Agile Software Development that again described a set of common-sense recommendations into a software development approach. Since that time, many agile practice books and guidelines have been published that demonstrate now to implement these common-sense recommendations.

BIBLIOGRAPHY

"Manifesto for Agile Software Development.", http://agilemanifesto.org.

"Winston W. Royce.", accessed 3/17, 2018, https://en.wikipedia.org/wiki/Winston_W._Royce.

Abrahamsson, Pekka, Muhammad Ali Babar, and Philippe Kruchten. 2010. "Agility and Architecture: Can they Coexist?" *IEEE Software* 27 (2): 16-22.

doi:http://dx.doi.org/10.1109/MS.2010.36.
http://search.proquest.com.proxygwa.wrlc.org/docview/215836934?accountid=33473.

Booch, Grady. 2011. "The Architect's Journey." *IEEE Software* 28 (3): 10-11.
http://search.proquest.com.proxygwa.wrlc.org/docview/862912221?accountid=33473.

Cockburn, Alistair. 2007. *Agile Software Development; the Cooperative Game*. Second Edition ed. Boston, MA: Pearson Education, Inc.

Erdogmus, Hakan. 2009. "Architecture Meets Agility." *IEEE Software* 26 (5): 2-4.
doi:http://dx.doi.org/10.1109/MS.2009.121.
http://search.proquest.com.proxygwa.wrlc.org/docview/215837170?accountid=33473.

Girvan, Lynda and Debra Paul. 2017. *Agile and Business Analysis - Practical Guidance for IT Professionals*. Swindon, UK: BCS Learning & Development Ltd.

Layton, Mark C. and Steven J. Ostermiller. 2017. *Agile Project Management for Dummies*. Hoboken, NJ: John Wiley and Sons, Inc.

Leffingwell, Dean, Alex Yakyma, Richard Knaster, Drew Jemilo, and Inbar Oren. 2017. *SAFe Reference Guide: Scaled Agile Framework for Lean Software and Systems Engineering*. Vol. 2017. Willard, Ohio: Pearson, Education, Inc.

Royce, Winston W. 1970. "Managing the Development of Large Software Systems." *Proceedings, IEEE WESCON*.

Schuh, Peter. 2006. *Integrating Agile Development in the Real World*. Hingham, Massachusetts: Charles River Media, Inc.

Sessions, Roger. 2008. *Simple Architectures for Complex Enterprises*. Redmond, WA: Microsoft Press.

Case Study: Portfolio Management in the 2020 Census Program[1]

Susan Hostetter and Sherri Norris
U.S. Census Bureau, Washington, DC, USA

Executive Summary

The Decennial Census is the United States oldest and most comprehensive source of information about the U.S. population. Most people know that the Census Bureau manages this very large, complex, multi-billion-dollar program and are familiar with the program and its purpose but they don't understand that, while the 2020 Census will be conducted on April 1 2020, the planning, staging and operations of the Census happen over a timespan of more than 10 years. This case study will focus on the Portfolio Management structure that the 2020 Census Program has in place to select and manage the many investments needed to conduct such a large and complex operation. It will profile the types of investments, the governance and processes used to select, initialize and manage those investments and the investment and budget challenges affecting the 2020 Census Program.

In this paper, we will present:

- The current structure of 2020 Census Program portfolio management
- Our 2020 Census Portfolio Management questionnaire, a tool designed to gather information about 2020 Census portfolio management programs
- Feedback from professionals involved with 2020 Census portfolio management processes

Key findings include:

- Portfolio management is being actively practiced by the 2020 Census Program.
- Decisions are being made by the 2020 Census Program governance structure.
- Key processes are at different level of maturity.
- Overall, stakeholders believe that portfolio management processes work reasonably well.

Introduction

In this paper, we describe the current 2020 Census Program portfolio management processes and the maturity of those processes. Figure 1 shows governance structure for the 2020 Census Program. From

[1] *This paper is released to inform interested parties of ongoing operations and to encourage discussion of work in progress. Any views expressed on operational issues are those of the authors and not necessarily those of the U.S. Census Bureau.*

its charter (U.S. Census Bureau, 2018), the 2020 Census Portfolio Management Governing Board (PMGB) provides key oversight and decision-making support for the 2020 Census Program. It oversees 2020 Census Program investments and escalates matters to the Executive Steering Committee (ESC) when appropriate or when a specified threshold is met for cost, risk, or impact has been reached. Currently, most 2020 Census Program Governance Meetings meet weekly but as 2020 operations ramp up historically meeting frequency typically increased with additional operations focused meetings added. Weinberg (2012), discusses 2010 census management challenges many which help inform 2020. In our interview discussions and other research, we learned that a 2020 census program management plan focusing on the operational phase which documents procedures and provides information on how decisions are made and will be resolved regarding the 2020 Census is in the approval process. It will document key project management processes including risk management, schedule management, issue management, and change management.

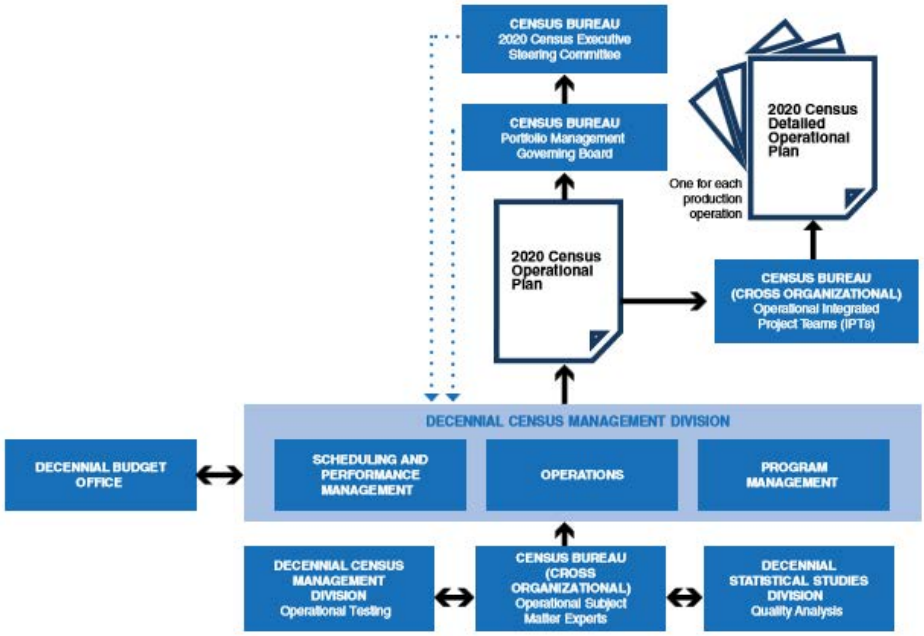


Figure 1: Organizations and Governance Boards for the 2020 Census Operational Plan
Source: U.S. Census Bureau (2017)

According to the Census Bureau's 2020 Census Operation Plan (2017), the 2020 Census includes 35 operations. Figure 2 show them organized into eight major areas the correspond with the standard Census Bureau Work Breakdown Structure. Operation refers to both support and business functions.

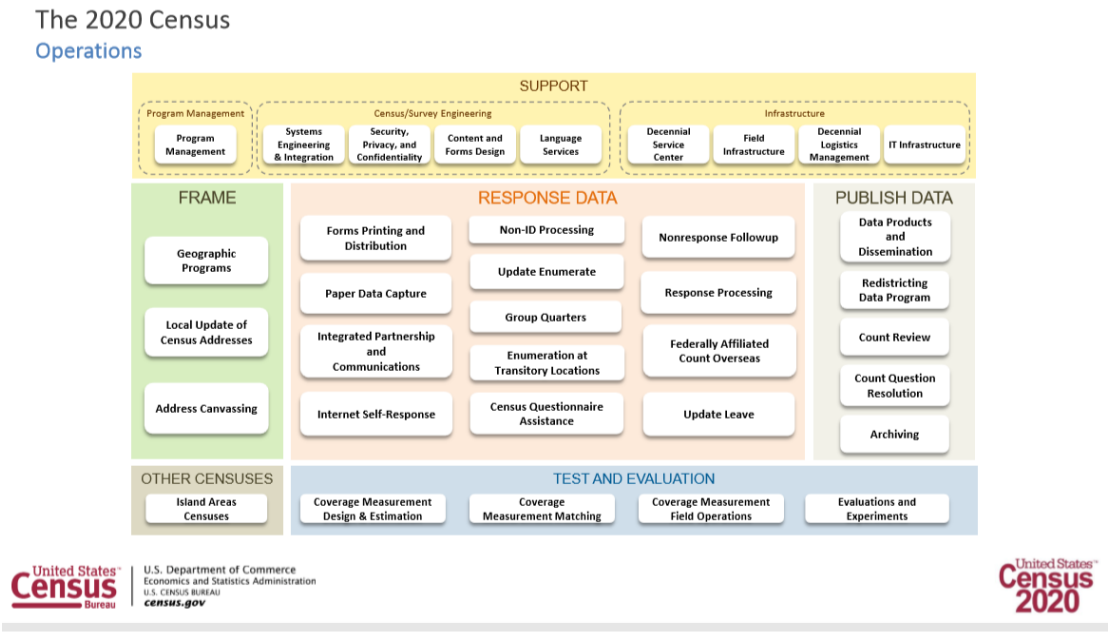


Figure 2: The 2020 Census Operations
Source: Stempowski (2017)

Documented in the Operational Plan are an inventory of 350 redesign decisions that 2020 Census Program maintains which are part of the planning for cost-effective 2020 Census (Census Bureau, 2017). Figure 3 shows the decisions that had been made as of October 27. 2017.

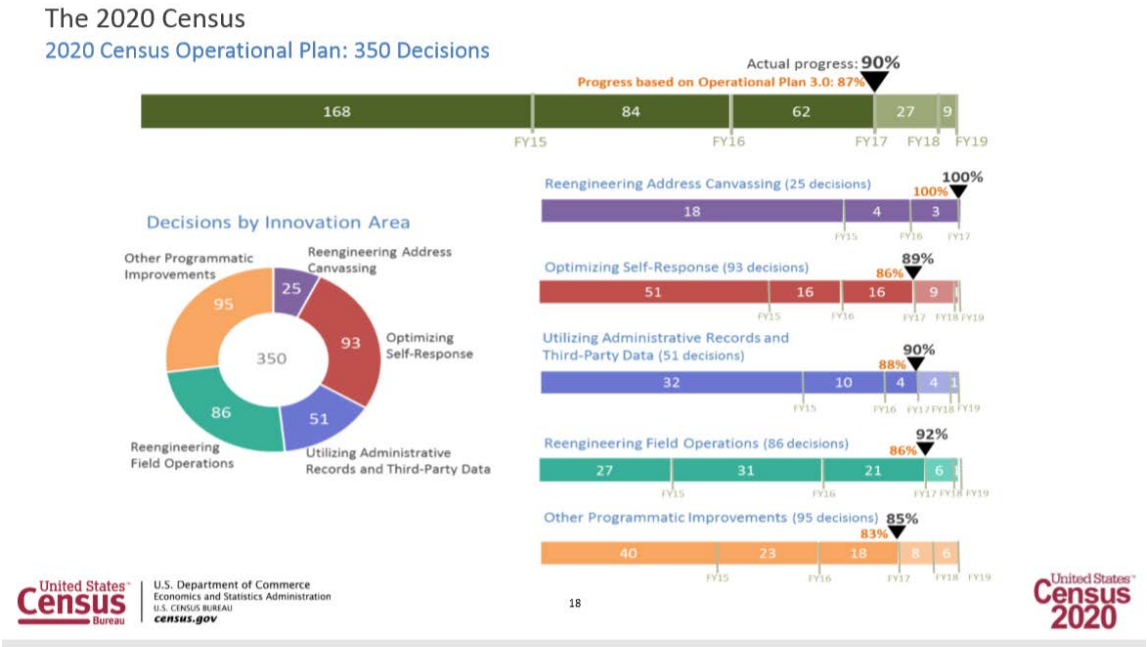


Figure 3: The 2020 Census: 2020 Census Operational Plan 350 Decisions
Source: Stempowski (2017)

Questionnaire Development and Invited Respondents

We used the process areas that we developed for our previous portfolio management maturity model research as the starting point for developing the questionnaire. The process areas were identified during previous interviews with Census Bureau portfolio management experts. They were slightly revised for the purposes of this study.

We invited 2020 Census Portfolio Management Board members (Phone interview requested, some accepted) and alternates (sent link to online form in most cases) plus a few select others who were heavily involved with governance in 2010 or now and are still attending meetings in some capacity to complete our questionnaire and assess how well the selected portfolio processes worked and their maturity. Since 2012, the Census Bureau has made portfolio management a strategic priority across the enterprise with a few program areas ahead of the enterprise push. We were fortunate to interview people who have seen their programs evolve and change with leadership turnover as well as people who have participated in more than one governance program. Most of our participants were PMGB members, some managed portfolio management processes from a program management office, some were program managers who are participating as subject matter experts for the PMGB. We conducted 11 phone interviews. In addition, 14 people completed our online questionnaire. Five of the people we interviewed on the phone also complete the online form. Overall, we had about 20 respondents including both phone interviews and the online questionnaire. One notable comment regarding the questionnaire was that it would be helpful to add a brief description of each process area.

Evaluation of 2020 Census Portfolio Management Processes

We selected participants for our case study with the intent of getting knowledgeable portfolio management professionals to provide feedback on how well each process works and its maturity. We developed participant instructions and a script to standardize the interview. We also developed an online questionnaire after feedback from a senior manager as an alternative way to respond. The online questionnaire was structured to ask the same questions as the questionnaire used during the phone interviews. 2020 Census Program portfolio management professionals were asked to use a scale of 1 to 5 to rate how well 10 portfolio management process areas are functioning and also give them a maturity score based on the maturity model that that we previously introduced and refined. The paper, *Ranking Portfolio Management Maturity* (Hostetter and Norris, 2017) details the updated model. The ten process area were:

1. Portfolio Management Governing Board (PMGB)
2. PMGB Members
3. Portfolio Management Process
4. Portfolio Inventory
5. Portfolio Management Process Documentation
6. Investment Management Process
7. Strategic Planning
8. Investment Performance Review

9. Staff Acceptance
10. Staff Training

In the following sections, the general results from the online questionnaire is shown. Key participant feedback on the process areas is reviewed. The number of responses varied by item. Every respondent did not rate every item.

Portfolio Management Wellness and Maturity Ratings for 10 Processes

Figure 4 provide an overview of the wellness levels.

1-Not well at all	2	3	4	5-Extremely well

Figure 4. Portfolio Management Wellness Levels

Figure 5 provides an overview of the maturity levels.

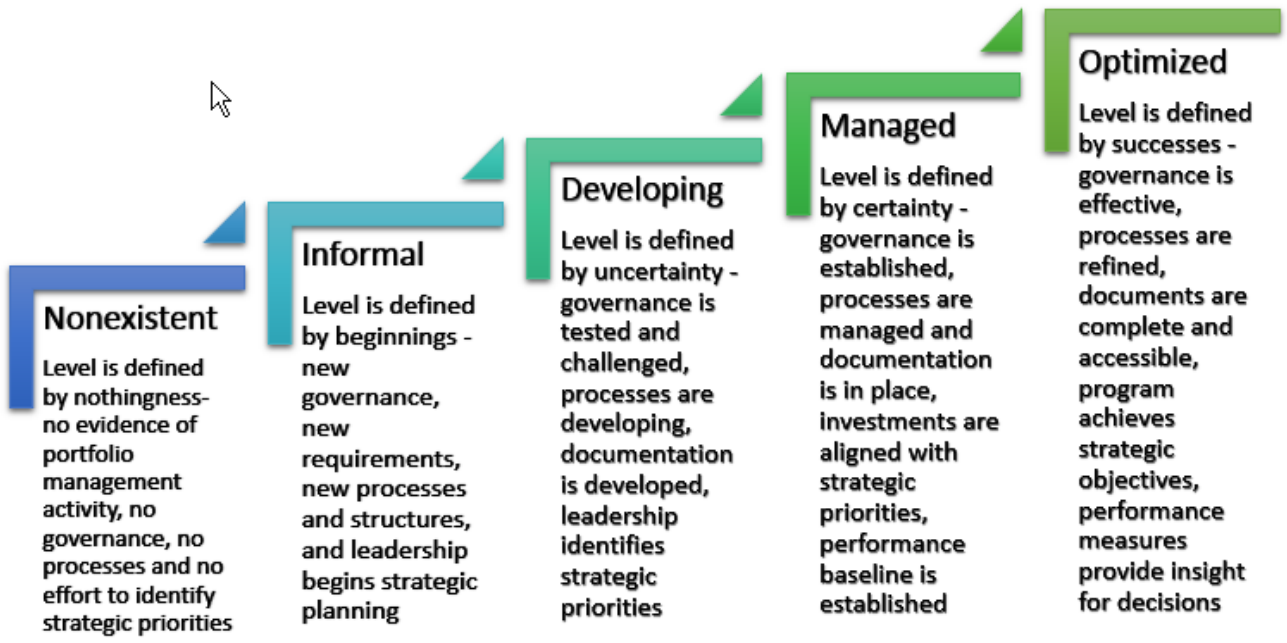
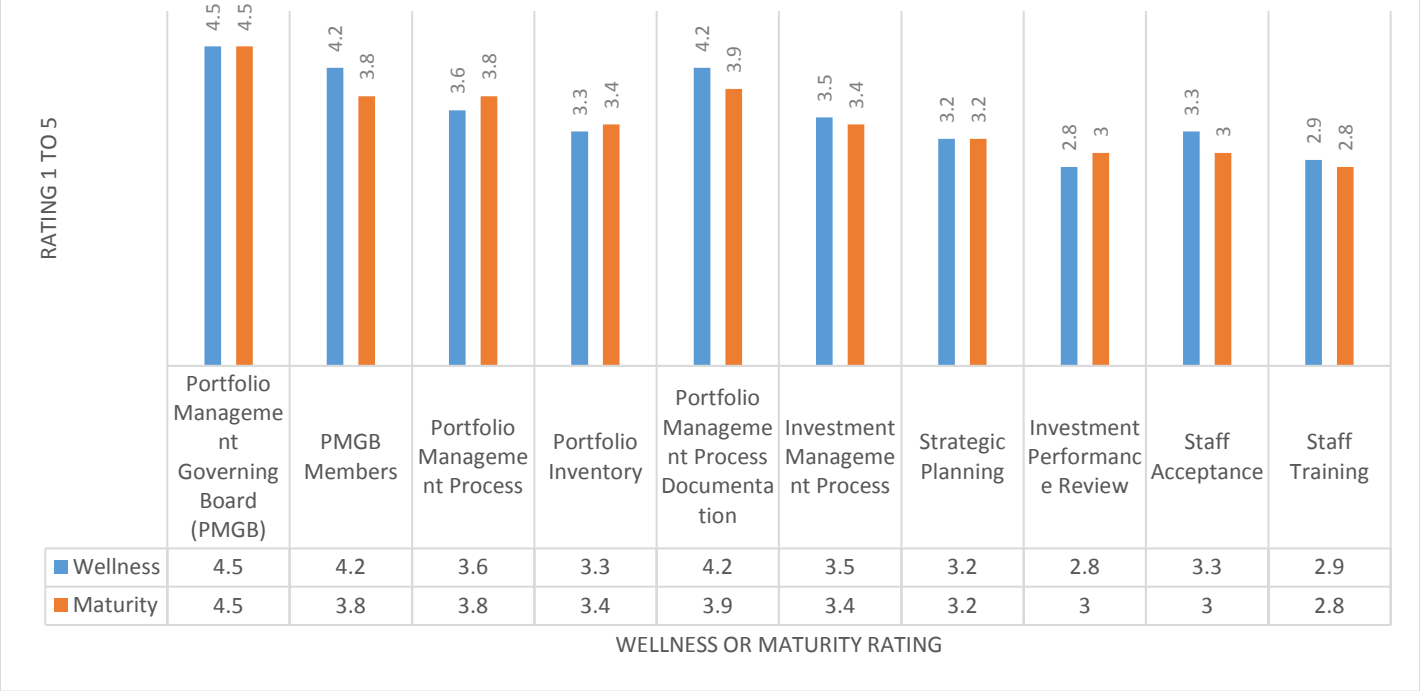


Figure 5. Portfolio Management Maturity Levels

Chart 1 shows how the portfolio management professional rated the ten processes on Wellness and Maturity. Overall, all process areas were rated as performing Well to just about Extremely Well. In terms

of maturity, all process areas were rated as Developing to almost Optimized. The highest wellness rating average was 4.5 approaching Extremely Well for the Portfolio Management Governing Board (PMGB) process area. The lowest wellness rating which was still rated about Well at 2.8 for the Investment Management Process area. The highest maturity rating was 4.5 approaching Optimized for the Portfolio Management Governing Board (PMGB) process area. The lowest maturity rating was 2.8 for the Staff Training Process Area. Its important to note that for some process areas responses varied over a range versus being centered around a few response categories.



	Portfolio Management Governing Board (PMGB)	PMGB Members	Portfolio Management Process	Portfolio Inventory	Portfolio Management Process Documentation	Investment Management Process	Strategic Planning	Investment Performance Review	Staff Acceptance	Staff Training
Wellness	4.5	4.2	3.6	3.3	4.2	3.5	3.2	2.8	3.3	2.9
Maturity	4.5	3.8	3.8	3.4	3.9	3.4	3.2	3	3	2.8

Chart 1. Portfolio Management Wellness and Maturity Ratings for 10 Processes

Feedback on Ten Process Areas

In addition to rating the ten process areas, participants were asked to provide comments about each area, including how it could improve. Those comments are valuable communications from key portfolios executives. One or two key comments was selected for each process area to give readers a feel for the types of comments that was provided for the item.

Portfolio Management Governing Board (PMGB)

Respondent feedback was positive about the PMGB. Comments included “it is a good board for managing 2020 Census.” One person wrote that it is “maturing over time and getting better from an operational perspective.” It should also be noted that it was reported that “2020 census is currently re-evaluating our governance structure to streamline and empower decision making at the lower levels so the PMGB doesn't get so bogged down with low level decisions.”

PMGB Members

Respondents noted that “those who are active take it seriously and participate regularly, but we do have stakeholders who are not as engaged.” It was suggested that because member time is a big issue that “perhaps key topics could be delegated to key members responsible for work related to the delegated key topic.”

Portfolio Management Process

While respondents generally felt like this process is functioning well, it was noted that “2020 Census is relooking at this area to improve definitions, roles and responsibilities and clarity levels of decision making.”

Portfolio Inventory

There were a range of comments regarding the portfolio inventory. One comments was that it is “well defined for the 2020 Census.” Another felt that “many investments never come to PMGB.”

Portfolio Management Process Documentation

Respondents generally felt that “the documentation area is well maintained, organized, and updated.” It was noted “we do a good job here.” One suggestion was to work towards a paperless office.

Investment Management Process

There were a range of comments about the investment management processes. Key comments included that” the current process is effective. It meets deadlines and prepares reports accurately.” Another commented that “we have made great strides over the past 2 years to manage investments, but the process is done with a subset of the full PMGB.”

Strategic Planning

It was noted that the 2020 Census Program needs to work on the year beyond 2020. Another comment was that strategic planning conversations should be brought to the PMGB.

Investment Performance Review

There were a variety of comments on this topic but most notable is that “recently the 2020 Census Program has made great strides to institutionalize regular performance reviews.”

Staff Acceptance

Respondent comments generally noted that staff are open to portfolio management process but that not all interact with the process regularly.

Staff Training

Respondent comments generally noted that staff training varies from area to area in regards to the portfolio management process.

Feedback on Challenges and Successes

When asked what they needed from the portfolio management system? Notables responses included:

- “Info on the investments - performance measures.”
- “At minimum, understanding what investments are made and why.”
- “Awareness and approach to 2020 Decennial Operations and Decisions.”
- “Deeper understanding of priority work moving along.”

Respondents felt that successes of the portfolio management process were:

- “Informing leadership and stakeholders of issues, status, and decisions needed.”
- “Having all the right people in the room to make a decision and hearing input from the areas that are effected.” And,
- “operations are aligned to the WBS so they can be tracked and decisions are transparent.”

Areas where respondents felt the portfolio management process could do better included “more training and attention to the out years”, and “communication about strategic approach.”

Respondents defined success for portfolio management as:

- “Doing the right work at the right time to reach strategic goals and fulfill the mission.”
- “Investments are defined and prioritized based upon available budget. Once approved and funded, status is monitored and adjustments are made based upon data and not feelings.”
- “Information shared and decisions discussed and documented.”

How respondents evaluate success of portfolio management is” in addition to process areas, the results of using the data to course correct, control scope within cost and schedule constraints.” And “all efforts directed and aligned the strategic goals and objectives of the organization and updated on a continual basis.”

Overall, respondents seemed to view the 2020 Census Portfolio management program as “a good process for the Decennial Directorate.”

Conclusions

This case study provides information about the current state of portfolio management for the 2020 Census Program. Governance structures are in place and working according to plan. 2020 Census Program portfolio management professionals rated the program as functioning well for 10 key process areas. In general, these process areas are managed by the 2020 Census program. The feedback provided by the portfolio management professionals was very helpful. Their insight can help tweak current portfolio management practices as the 2020 Census Program shifts into operational mode for the 2020 Census. It was reported that 2020 Census Program is looking to improve the portfolio management program in preparation for peak operations such as empowering decision making at lower levels. It is expected that the wellness and maturity ratings of the ten process areas will change as changes are made to the 2020 Census portfolio management program. Our results reflect the current state 2020 Census portfolio Management Program.

REFERENCES

Hostetter and Norris. 2017. *Ranking Portfolio Management Maturity*. University of Maryland PM Symposium.

Stempowski, Debra. Decennial Census Management Division. U.S. Census Bureau. October 27, 2017. 2020 Census Operational Plan, Version 3.0 presentation at Program Management Review.

U.S. Census Bureau. September 2017. 2020 Census Operational Plan: A New Design for the 21st Century. Version. 3.0.

U.S. Census Bureau. February 8, 2018. *2020 Census Portfolio Management Governing Board Charter*. Version 3. 95(draft).

Weinberg, Daniel. (2012). *Management Challenges of the 2010 U.S. Census*. Journal of Official Statistics, Vol. 28, No. 2, pp. 199-220.

Appendix A: 2020 Census Portfolio Management Questionnaire

2020 Census Portfolio Management Questionnaire

Thank you for taking the time to fill out our questionnaire.

We are conducting this review as part of a paper for the 2018 UMD Project Management Symposium. This paper is a follow-up to our 2016 & 2017 papers on a maturity model for portfolio management. This year we are doing a case study of the 2020 Census Program's practice of portfolio management.

Please send copies of any relevant documents describing the metrics or processes, and examples of reports or displays (e.g., dashboards) to us (susan.lynn.hostetter@census.gov & sherri.j.norris@census.gov)

Name_____

Portfolio Management Role

- o **2020 Census Portfolio Management Governing Board (PMGB) voting member or alternate including chair or co-chair**
- o **2020 Census PMGB advisory member (Decennial ADCs, Decennial office representative, etc...)**
- o **2020 Census Program portfolio management professional (DPMO staff, SPPM staff, etc...)**
- o **Other_____**

Appendix A: 2020 Census Portfolio Management Questionnaire Continued

The Current Process

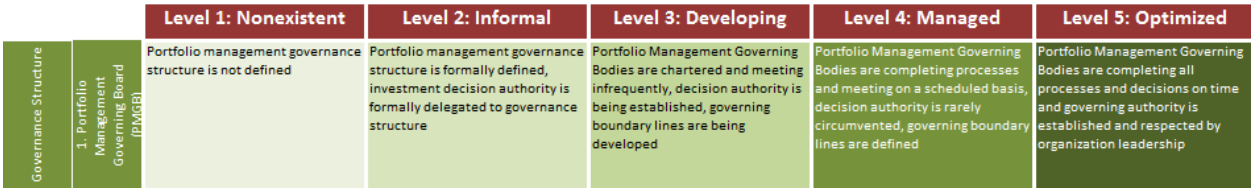
We'd like to learn about the portfolio management process as you understand it and interact with it. We have a list of ten areas and would like to get your impressions of each

1. What do you think of the **2020 Census Portfolio Management Governing Board (PMGB) process?**

1A. How well does the PMGB process area work?

1-Not well at all	2	3	4	5-Extremely well

1B. How would you assess the maturity of the PMGB process area?



	Level 1: Nonexistent	Level 2: Informal	Level 3: Developing	Level 4: Managed	Level 5: Optimized
Governance Structure – 1. Portfolio Management Governing Board (PMGB)	Portfolio management governance structure is not defined	Portfolio management governance structure is formally defined, investment decision authority is formally delegated to governance structure	Portfolio Management Governing Bodies are chartered and meeting infrequently, decision authority is being established, governing boundary lines are being developed	Portfolio Management Governing Bodies are completing processes and meeting on a scheduled basis, decision authority is rarely circumvented, governing boundary lines are defined	Portfolio Management Governing Bodies are completing all processes and decisions on time and governing authority is established and respected by organization leadership

Level 1: Nonexistent	2	3	4	Level 5: Optimized

1C. How could the PMGB improve?

2. What do you think of the **PMGB Members** process?

2A. How well does the PMGB Members process area work?

1-Not well at all	2	3	4	5-Extremely well

Appendix A: 2020 Census Portfolio Management Questionnaire Continued

2B. How would you assess the maturity of the PMGB Members process area?

	Level 1: Nonexistent	Level 2: Informal	Level 3: Developing	Level 4: Managed	Level 5: Optimized
2. PMGB Members	PMGB members are not identified	PMGB members are identified and educated on their roles	Most to all PMGB members are attending meetings	PMGB members are prepared and ask probing questions	PMGB members actively refine and improve the portfolio management process

Level 1: Nonexistent	2	3	4	Level 5: Optimized

2C. How could the PMGB Members improve?

3. What do you think of the Portfolio Management process?

3A. How well does the Portfolio Management process area work?

1-Not well at all	2	3	4	5-Extremely well

3B. How would you assess the maturity of the Portfolio Management process area?

		Level 1: Nonexistent	Level 2: Informal	Level 3: Developing	Level 4: Managed	Level 5: Optimized
Management Tools	3. Portfolio Management Process	Management tool requirements are not identified	Management tool requirements are identified	Developing management tools, beginning to incorporate use of tools into processes	Some management tools are completed and incorporated into processes	Management tools are fully operational and incorporated into portfolio management processes

Level 1: Nonexistent	2	3	4	Level 5: Optimized

3C. How could the Portfolio Management process improve?

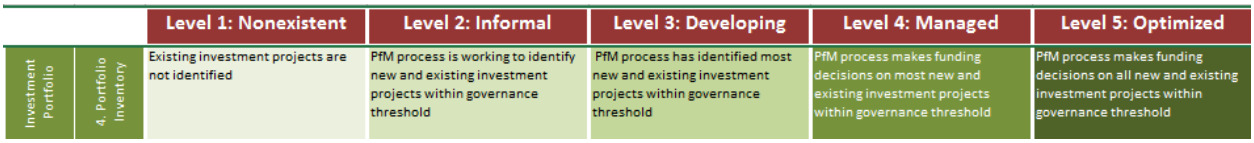
Appendix A: 2020 Census Portfolio Management Questionnaire Continued

4. What do you think of the Portfolio Inventory process?

4A. How well does the Portfolio Inventory process area work?

1-Not well at all	2	3	4	5-Extremely well

4B. How would you assess the maturity of the Portfolio Inventory process area?



	Level 1: Nonexistent	Level 2: Informal	Level 3: Developing	Level 4: Managed	Level 5: Optimized
Investment Portfolio / 4. Portfolio Inventory	Existing investment projects are not identified	PfM process is working to identify new and existing investment projects within governance threshold	PfM process has identified most new and existing investment projects within governance threshold	PfM process makes funding decisions on most new and existing investment projects within governance threshold	PfM process makes funding decisions on all new and existing investment projects within governance threshold

Level 1: Nonexistent	2	3	4	Level 5: Optimized

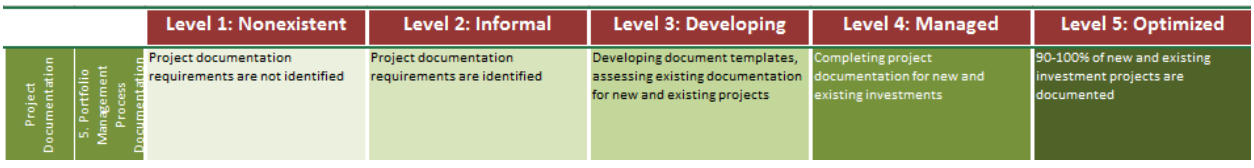
4C. How could the Portfolio Inventory improve?

5. What do you think of the Portfolio Management Process Documentation process?

5A. How well does the Portfolio Management Process Documentation process area work?

1-Not well at all	2	3	4	5-Extremely well

5B. How would you assess the maturity of the Portfolio Management Process Documentation process area?



	Level 1: Nonexistent	Level 2: Informal	Level 3: Developing	Level 4: Managed	Level 5: Optimized
Project Documentation / 5. Portfolio Management Process Documentation	Project documentation requirements are not identified	Project documentation requirements are identified	Developing document templates, assessing existing documentation for new and existing projects	Completing project documentation for new and existing investments	90-100% of new and existing investment projects are documented

Level 1: Nonexistent	2	3	4	Level 5: Optimized

5C. How could the Portfolio Management Process Documentation improve?

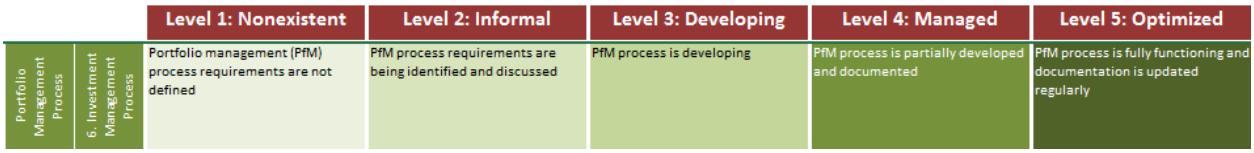
Appendix A: 2020 Census Portfolio Management Questionnaire Continued

6. What do you think of the Investment Management process?

6A. How well does the Investment Management process area work?

1-Not well at all	2	3	4	5-Extremely well

6B. How would you assess the maturity of the Investment Management process area?



Level 1: Nonexistent	2	3	4	Level 5: Optimized

6C. How could the Investment Management improve?

7. What do you think of the Strategic Planning process?

7A. How well does the Strategic Planning process area work?

1-Not well at all	2	3	4	5-Extremely well

7B. How would you assess the maturity of the Strategic Planning process area?

Level 1: Nonexistent	2	3	4	Level 5: Optimized

7C. How could the Strategic Planning improve?

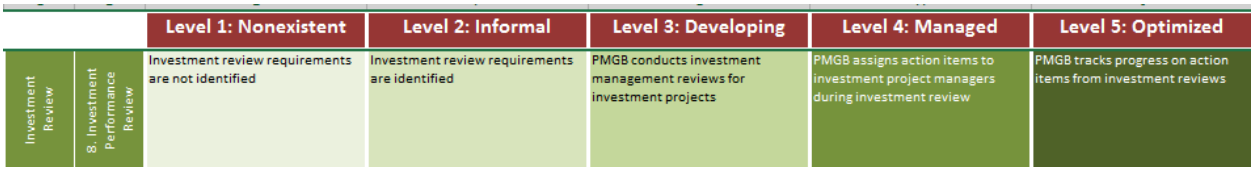
Appendix A: 2020 Census Portfolio Management Questionnaire Continued

8. What do you think of the Investment Performance Review process?

8A. How well does the Investment Performance Review process area work?

1-Not well at all	2	3	4	5-Extremely well

8B. How would you assess the maturity of the Investment Performance Review process area?



	Level 1: Nonexistent	Level 2: Informal	Level 3: Developing	Level 4: Managed	Level 5: Optimized
Investment Review / 8. Investment Performance Review	Investment review requirements are not identified	Investment review requirements are identified	PMGB conducts investment management reviews for investment projects	PMGB assigns action items to investment project managers during investment review	PMGB tracks progress on action items from investment reviews

Level 1: Nonexistent	2	3	4	Level 5: Optimized

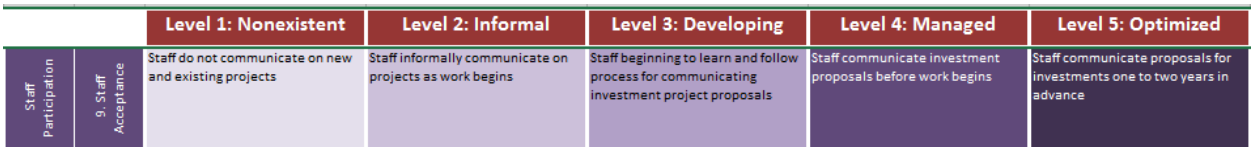
8C. How could the Investment Performance Review improve?

9. What do you think of the Staff Acceptance process?

9A. How well does the Staff Acceptance process area work?

1-Not well at all	2	3	4	5-Extremely well

9B. How would you assess the maturity of the Staff Acceptance process area?



	Level 1: Nonexistent	Level 2: Informal	Level 3: Developing	Level 4: Managed	Level 5: Optimized
Staff Participation / 9. Staff Acceptance	Staff do not communicate on new and existing projects	Staff informally communicate on projects as work begins	Staff beginning to learn and follow process for communicating investment project proposals	Staff communicate investment proposals before work begins	Staff communicate proposals for investments one to two years in advance

Level 1: Nonexistent	2	3	4	Level 5: Optimized

9C. How could the Staff Acceptance improve?

Appendix A: 2020 Census Portfolio Management Questionnaire Continued

10. What do you think of the Staff Training process?

10A. How well does the Staff Training process area work?

1-Not well at all	2	3	4	5-Extremely well

10B. How would you assess the maturity of the Staff Training process area?

Level 1: Nonexistent	2	3	4	Level 5: Optimized

10C. How could the Staff Training improve?

Challenges and Successes

We would like your feedback on the portfolio management process, as a person involved, so that we may understand how well the process is working.

11. What do you need from the portfolio management system? What do you get out of it?
12. What do you think are the successes of the portfolio management process?
13. Where do you think the process could do better?
14. How do you define success for portfolio management?
15. How do you evaluate success?

General Comments

16. Do you have anything you would like to add?

CLOSING STATEMENT

- Thank-you for sharing this information with us.
- Our paper will be presented at the UMD PM Symposium on May 10. Please let us know if you would like to see a copy once it is published.

Case Study: Portfolio Management in the 2020 Census Program[1]

Susan Hostetter and Sherri Norris
U.S. Census Bureau, Washington, DC, USA

Executive Summary

The Decennial Census is the United States oldest and most comprehensive source of information about the U.S. population. Most people know that the Census Bureau manages this very large, complex, multi-billion-dollar program and are familiar with the program and its purpose but they don't understand that, while the 2020 Census will be conducted on April 1 2020, the planning, staging and operations of the Census happen over a timespan of more than 10 years. This case study will focus on the Portfolio Management structure that the 2020 Census Program has in place to select and manage the many investments needed to conduct such a large and complex operation. It will profile the types of investments, the governance and processes used to select, initialize and manage those investments and the investment and budget challenges affecting the 2020 Census Program.

In this paper, we will present:

- The current structure of 2020 Census Program portfolio management
- Our 2020 Census Portfolio Management questionnaire, a tool designed to gather information about 2020 Census portfolio management programs
- Feedback from professionals involved with 2020 Census portfolio management processes

Key findings include:

- Portfolio management is being actively practiced by the 2020 Census Program.
- Decisions are being made by the 2020 Census Program governance structure.
- Key processes are at different level of maturity.
- Overall, stakeholders believe that portfolio management processes work reasonably well.

Introduction

In this paper, we describe the current 2020 Census Program portfolio management processes and the maturity of those processes. Figure 1 shows governance structure for the 2020 Census Program. From

[1] *This paper is released to inform interested parties of ongoing operations and to encourage discussion of work in progress. Any views expressed on operational issues are those of the authors and not necessarily those of the U.S. Census Bureau.*

its charter (U.S. Census Bureau, 2018), the 2020 Census Portfolio Management Governing Board (PMGB) provides key oversight and decision-making support for the 2020 Census Program. It oversees 2020 Census Program investments and escalates matters to the Executive Steering Committee (ESC) when appropriate or when a specified threshold is met for cost, risk, or impact has been reached. Currently, most 2020 Census Program Governance Meetings meet weekly but as 2020 operations ramp up historically meeting frequency typically increased with additional operations focused meetings added. Weinberg (2012), discusses 2010 census management challenges many which help inform 2020. In our interview discussions and other research, we learned that a 2020 census program management plan focusing on the operational phase which documents procedures and provides information on how decisions are made and will be resolved regarding the 2020 Census is in the approval process. It will document key project management processes including risk management, schedule management, issue management, and change management.

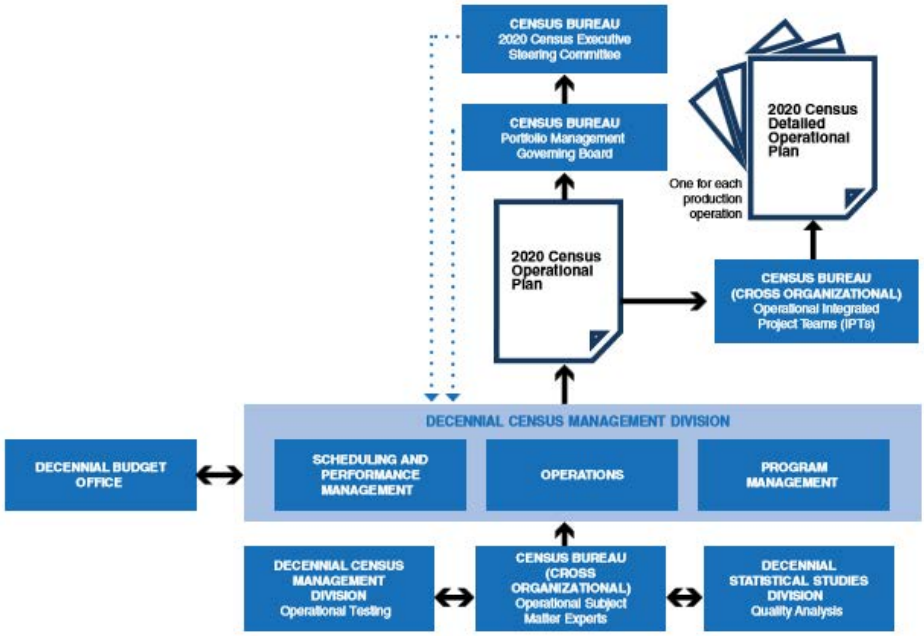


Figure 1: Organizations and Governance Boards for the 2020 Census Operational Plan
Source: U.S. Census Bureau (2017)

According to the Census Bureau's 2020 Census Operation Plan (2017), the 2020 Census includes 35 operations. Figure 2 show them organized into eight major areas the correspond with the standard Census Bureau Work Breakdown Structure. Operation refers to both support and business functions.

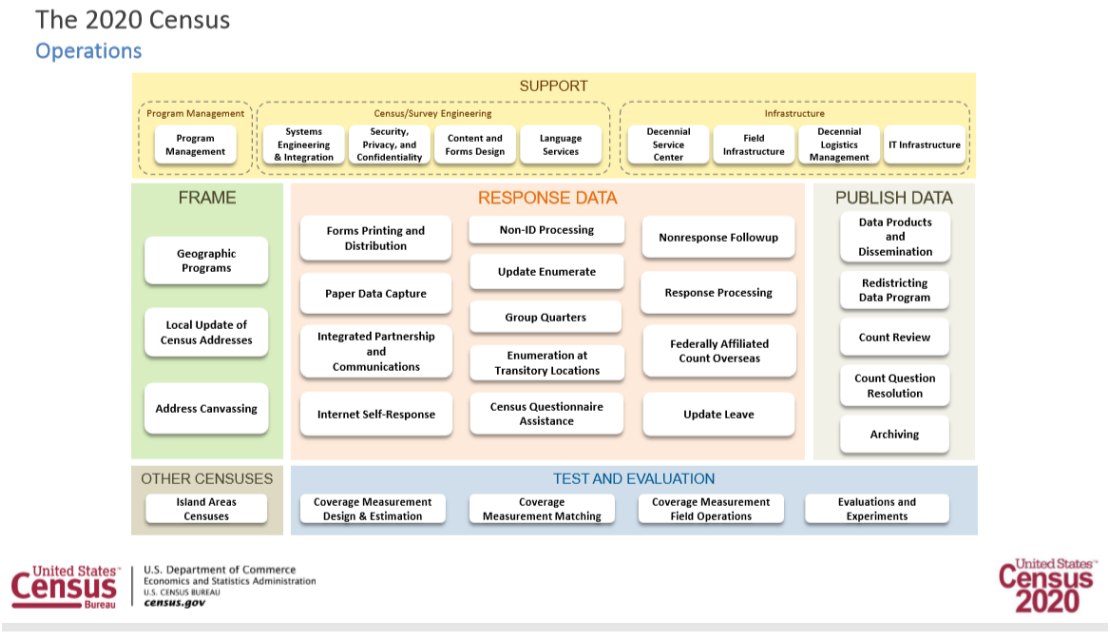


Figure 2: The 2020 Census Operations
Source: Stempowski (2017)

Documented in the Operational Plan are an inventory of 350 redesign decisions that 2020 Census Program maintains which are part of the planning for cost-effective 2020 Census (Census Bureau, 2017). Figure 3 shows the decisions that had been made as of October 27. 2017.

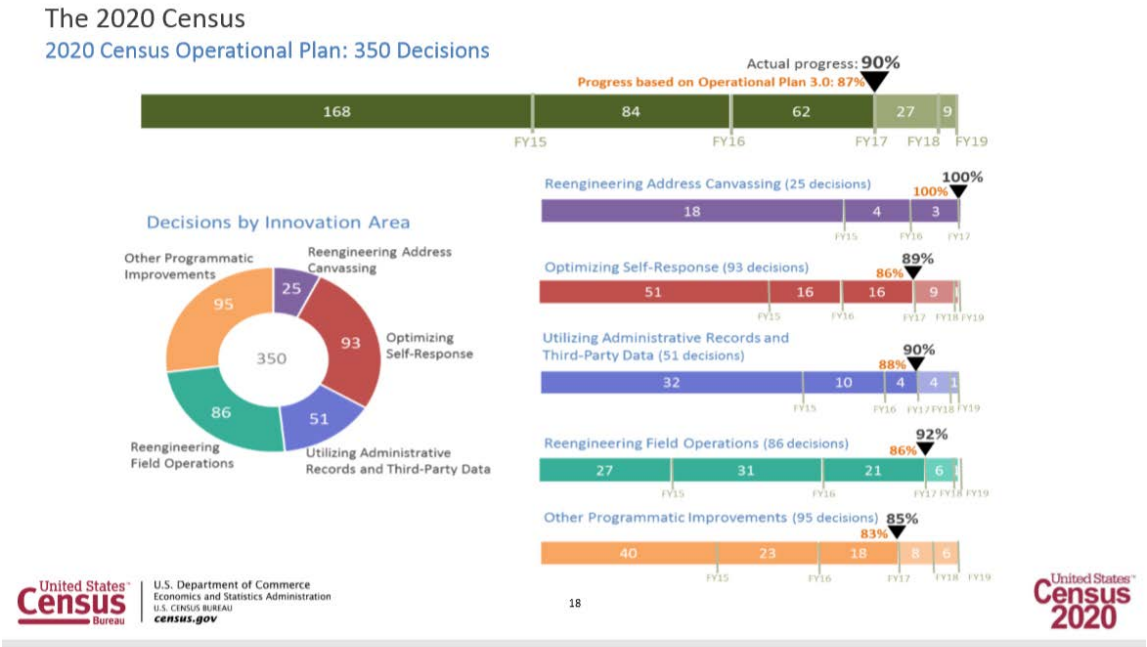


Figure 3: The 2020 Census: 2020 Census Operational Plan 350 Decisions
Source: Stempowski (2017)

Questionnaire Development and Invited Respondents

We used the process areas that we developed for our previous portfolio management maturity model research as the starting point for developing the questionnaire. The process areas were identified during previous interviews with Census Bureau portfolio management experts. They were slightly revised for the purposes of this study.

We invited 2020 Census Portfolio Management Board members (Phone interview requested, some accepted) and alternates (sent link to online form in most cases) plus a few select others who were heavily involved with governance in 2010 or now and are still attending meetings in some capacity to complete our questionnaire and assess how well the selected portfolio processes worked and their maturity. Since 2012, the Census Bureau has made portfolio management a strategic priority across the enterprise with a few program areas ahead of the enterprise push. We were fortunate to interview people who have seen their programs evolve and change with leadership turnover as well as people who have participated in more than one governance program. Most of our participants were PMGB members, some managed portfolio management processes from a program management office, some were program managers who are participating as subject matter experts for the PMGB. We conducted 11 phone interviews. In addition, 14 people completed our online questionnaire. Five of the people we interviewed on the phone also complete the online form. Overall, we had about 20 respondents including both phone interviews and the online questionnaire. One notable comment regarding the questionnaire was that it would be helpful to add a brief description of each process area.

Evaluation of 2020 Census Portfolio Management Processes

We selected participants for our case study with the intent of getting knowledgeable portfolio management professionals to provide feedback on how well each process works and its maturity. We developed participant instructions and a script to standardize the interview. We also developed an online questionnaire after feedback from a senior manager as an alternative way to respond. The online questionnaire was structured to ask the same questions as the questionnaire used during the phone interviews. 2020 Census Program portfolio management professionals were asked to use a scale of 1 to 5 to rate how well 10 portfolio management process areas are functioning and also give them a maturity score based on the maturity model that that we previously introduced and refined. The paper, *Ranking Portfolio Management Maturity* (Hostetter and Norris, 2017) details the updated model. The ten process area were:

1. Portfolio Management Governing Board (PMGB)
2. PMGB Members
3. Portfolio Management Process
4. Portfolio Inventory
5. Portfolio Management Process Documentation
6. Investment Management Process
7. Strategic Planning
8. Investment Performance Review

9. Staff Acceptance
10. Staff Training

In the following sections, the general results from the online questionnaire is shown. Key participant feedback on the process areas is reviewed. The number of responses varied by item. Every respondent did not rate every item.

Portfolio Management Wellness and Maturity Ratings for 10 Processes

Figure 4 provide an overview of the wellness levels.

1-Not well at all	2	3	4	5-Extremely well

Figure 4. Portfolio Management Wellness Levels

Figure 5 provides an overview of the maturity levels.

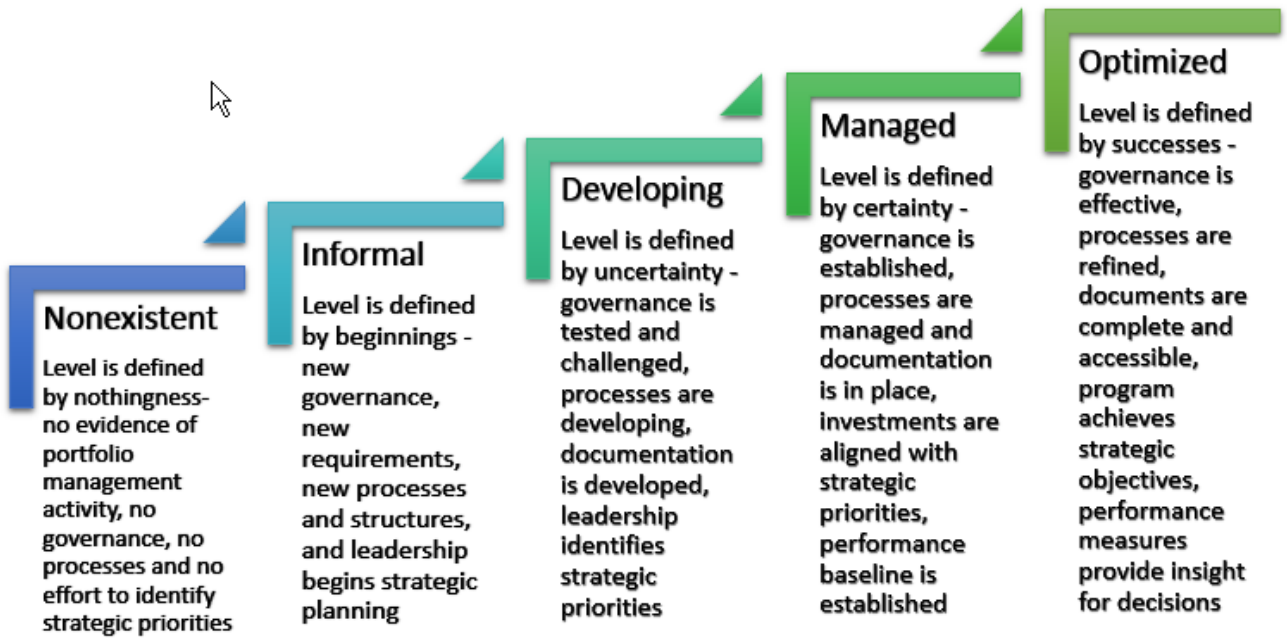
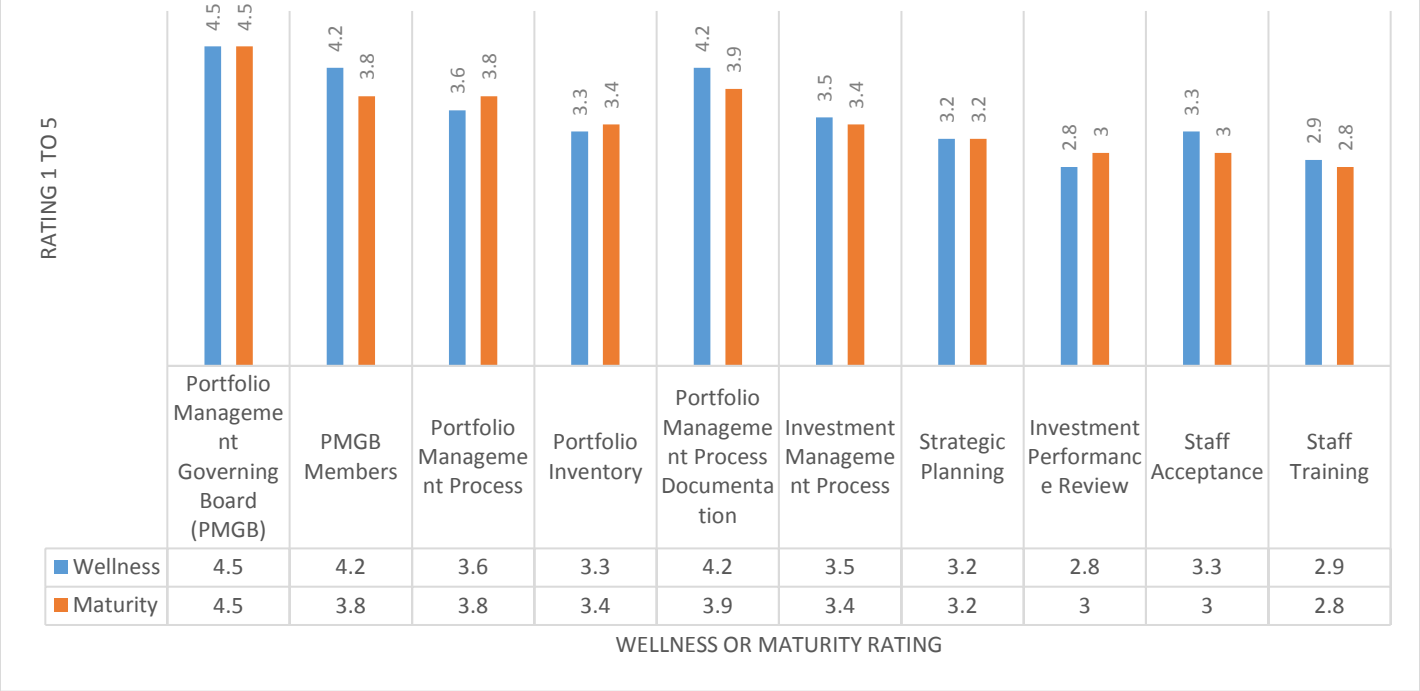


Figure 5. Portfolio Management Maturity Levels

Chart 1 shows how the portfolio management professional rated the ten processes on Wellness and Maturity. Overall, all process areas were rated as performing Well to just about Extremely Well. In terms

of maturity, all process areas were rated as Developing to almost Optimized. The highest wellness rating average was 4.5 approaching Extremely Well for the Portfolio Management Governing Board (PMGB) process area. The lowest wellness rating which was still rated about Well at 2.8 for the Investment Management Process area. The highest maturity rating was 4.5 approaching Optimized for the Portfolio Management Governing Board (PMGB) process area. The lowest maturity rating was 2.8 for the Staff Training Process Area. Its important to note that for some process areas responses varied over a range versus being centered around a few response categories.



	Portfolio Management Governing Board (PMGB)	PMGB Members	Portfolio Management Process	Portfolio Inventory	Portfolio Management Process Documentation	Investment Management Process	Strategic Planning	Investment Performance Review	Staff Acceptance	Staff Training
Wellness	4.5	4.2	3.6	3.3	4.2	3.5	3.2	2.8	3.3	2.9
Maturity	4.5	3.8	3.8	3.4	3.9	3.4	3.2	3	3	2.8

Chart 1. Portfolio Management Wellness and Maturity Ratings for 10 Processes

Feedback on Ten Process Areas

In addition to rating the ten process areas, participants were asked to provide comments about each area, including how it could improve. Those comments are valuable communications from key portfolios executives. One or two key comments was selected for each process area to give readers a feel for the types of comments that was provided for the item.

Portfolio Management Governing Board (PMGB)

Respondent feedback was positive about the PMGB. Comments included “it is a good board for managing 2020 Census.” One person wrote that it is “maturing over time and getting better from an operational perspective.” It should also be noted that it was reported that “2020 census is currently re-evaluating our governance structure to streamline and empower decision making at the lower levels so the PMGB doesn't get so bogged down with low level decisions.”

PMGB Members

Respondents noted that “those who are active take it seriously and participate regularly, but we do have stakeholders who are not as engaged.” It was suggested that because member time is a big issue that “perhaps key topics could be delegated to key members responsible for work related to the delegated key topic.”

Portfolio Management Process

While respondents generally felt like this process is functioning well, it was noted that “2020 Census is relooking at this area to improve definitions, roles and responsibilities and clarity levels of decision making.”

Portfolio Inventory

There were a range of comments regarding the portfolio inventory. One comments was that it is “well defined for the 2020 Census.” Another felt that “many investments never come to PMGB.”

Portfolio Management Process Documentation

Respondents generally felt that “the documentation area is well maintained, organized, and updated.” It was noted “we do a good job here.” One suggestion was to work towards a paperless office.

Investment Management Process

There were a range of comments about the investment management processes. Key comments included that” the current process is effective. It meets deadlines and prepares reports accurately.” Another commented that “we have made great strides over the past 2 years to manage investments, but the process is done with a subset of the full PMGB.”

Strategic Planning

It was noted that the 2020 Census Program needs to work on the year beyond 2020. Another comment was that strategic planning conversations should be brought to the PMGB.

Investment Performance Review

There were a variety of comments on this topic but most notable is that “recently the 2020 Census Program has made great strides to institutionalize regular performance reviews.”

Staff Acceptance

Respondent comments generally noted that staff are open to portfolio management process but that not all interact with the process regularly.

Staff Training

Respondent comments generally noted that staff training varies from area to area in regards to the portfolio management process.

Feedback on Challenges and Successes

When asked what they needed from the portfolio management system? Notables responses included:

- “Info on the investments - performance measures.”
- “At minimum, understanding what investments are made and why.”
- “Awareness and approach to 2020 Decennial Operations and Decisions.”
- “Deeper understanding of priority work moving along.”

Respondents felt that successes of the portfolio management process were:

- “Informing leadership and stakeholders of issues, status, and decisions needed.”
- “Having all the right people in the room to make a decision and hearing input from the areas that are effected.” And,
- “operations are aligned to the WBS so they can be tracked and decisions are transparent.”

Areas where respondents felt the portfolio management process could do better included “more training and attention to the out years”, and “communication about strategic approach.”

Respondents defined success for portfolio management as:

- “Doing the right work at the right time to reach strategic goals and fulfill the mission.”
- “Investments are defined and prioritized based upon available budget. Once approved and funded, status is monitored and adjustments are made based upon data and not feelings.”
- “Information shared and decisions discussed and documented.”

How respondents evaluate success of portfolio management is” in addition to process areas, the results of using the data to course correct, control scope within cost and schedule constraints.” And “all efforts directed and aligned the strategic goals and objectives of the organization and updated on a continual basis.”

Overall, respondents seemed to view the 2020 Census Portfolio management program as “a good process for the Decennial Directorate.”

Conclusions

This case study provides information about the current state of portfolio management for the 2020 Census Program. Governance structures are in place and working according to plan. 2020 Census Program portfolio management professionals rated the program as functioning well for 10 key process areas. In general, these process areas are managed by the 2020 Census program. The feedback provided by the portfolio management professionals was very helpful. Their insight can help tweak current portfolio management practices as the 2020 Census Program shifts into operational mode for the 2020 Census. It was reported that 2020 Census Program is looking to improve the portfolio management program in preparation for peak operations such as empowering decision making at lower levels. It is expected that the wellness and maturity ratings of the ten process areas will change as changes are made to the 2020 Census portfolio management program. Our results reflect the current state 2020 Census portfolio Management Program.

REFERENCES

Hostetter and Norris. 2017. *Ranking Portfolio Management Maturity*. University of Maryland PM Symposium.

Stempowski, Debra. Decennial Census Management Division. U.S. Census Bureau. October 27, 2017. 2020 Census Operational Plan, Version 3.0 presentation at Program Management Review.

U.S. Census Bureau. September 2017. 2020 Census Operational Plan: A New Design for the 21st Century. Version. 3.0.

U.S. Census Bureau. February 8, 2018. *2020 Census Portfolio Management Governing Board Charter*. Version 3. 95(draft).

Weinberg, Daniel. (2012). *Management Challenges of the 2010 U.S. Census*. Journal of Official Statistics, Vol. 28, No. 2, pp. 199-220.

Appendix A: 2020 Census Portfolio Management Questionnaire

2020 Census Portfolio Management Questionnaire

Thank you for taking the time to fill out our questionnaire.

We are conducting this review as part of a paper for the 2018 UMD Project Management Symposium. This paper is a follow-up to our 2016 & 2017 papers on a maturity model for portfolio management. This year we are doing a case study of the 2020 Census Program's practice of portfolio management.

Please send copies of any relevant documents describing the metrics or processes, and examples of reports or displays (e.g., dashboards) to us (susan.lynn.hostetter@census.gov & sherri.j.norris@census.gov)

Name_____

Portfolio Management Role

- o **2020 Census Portfolio Management Governing Board (PMGB) voting member or alternate including chair or co-chair**
- o **2020 Census PMGB advisory member (Decennial ADCs, Decennial office representative, etc...)**
- o **2020 Census Program portfolio management professional (DPMO staff, SPPM staff, etc...)**
- o **Other_____**

Appendix A: 2020 Census Portfolio Management Questionnaire Continued

The Current Process

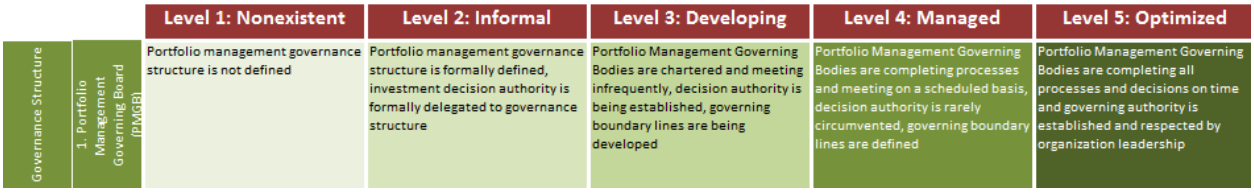
We'd like to learn about the portfolio management process as you understand it and interact with it. We have a list of ten areas and would like to get your impressions of each

1. What do you think of the **2020 Census Portfolio Management Governing Board (PMGB) process?**

1A. How well does the PMGB process area work?

1-Not well at all	2	3	4	5-Extremely well

1B. How would you assess the maturity of the PMGB process area?



	Level 1: Nonexistent	Level 2: Informal	Level 3: Developing	Level 4: Managed	Level 5: Optimized
Governance Structure – 1. Portfolio Management Governing Board (PMGB)	Portfolio management governance structure is not defined	Portfolio management governance structure is formally defined, investment decision authority is formally delegated to governance structure	Portfolio Management Governing Bodies are chartered and meeting infrequently, decision authority is being established, governing boundary lines are being developed	Portfolio Management Governing Bodies are completing processes and meeting on a scheduled basis, decision authority is rarely circumvented, governing boundary lines are defined	Portfolio Management Governing Bodies are completing all processes and decisions on time and governing authority is established and respected by organization leadership

Level 1: Nonexistent	2	3	4	Level 5: Optimized

1C. How could the PMGB improve?

2. What do you think of the **PMGB Members** process?

2A. How well does the PMGB Members process area work?

1-Not well at all	2	3	4	5-Extremely well

Appendix A: 2020 Census Portfolio Management Questionnaire Continued

2B. How would you assess the maturity of the PMGB Members process area?

	Level 1: Nonexistent	Level 2: Informal	Level 3: Developing	Level 4: Managed	Level 5: Optimized
2. PMGB Members	PMGB members are not identified	PMGB members are identified and educated on their roles	Most to all PMGB members are attending meetings	PMGB members are prepared and ask probing questions	PMGB members actively refine and improve the portfolio management process

Level 1: Nonexistent	2	3	4	Level 5: Optimized

2C. How could the PMGB Members improve?

3. What do you think of the Portfolio Management process?

3A. How well does the Portfolio Management process area work?

1-Not well at all	2	3	4	5-Extremely well

3B. How would you assess the maturity of the Portfolio Management process area?

		Level 1: Nonexistent	Level 2: Informal	Level 3: Developing	Level 4: Managed	Level 5: Optimized
Management Tools	3. Portfolio Management Process	Management tool requirements are not identified	Management tool requirements are identified	Developing management tools, beginning to incorporate use of tools into processes	Some management tools are completed and incorporated into processes	Management tools are fully operational and incorporated into portfolio management processes

Level 1: Nonexistent	2	3	4	Level 5: Optimized

3C. How could the Portfolio Management process improve?

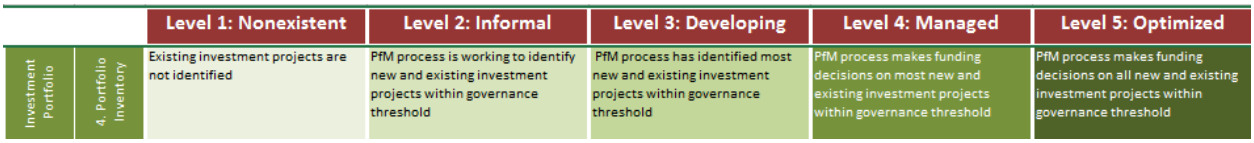
Appendix A: 2020 Census Portfolio Management Questionnaire Continued

4. What do you think of the Portfolio Inventory process?

4A. How well does the Portfolio Inventory process area work?

1-Not well at all	2	3	4	5-Extremely well

4B. How would you assess the maturity of the Portfolio Inventory process area?



	Level 1: Nonexistent	Level 2: Informal	Level 3: Developing	Level 4: Managed	Level 5: Optimized
Investment Portfolio / 4. Portfolio Inventory	Existing investment projects are not identified	PfM process is working to identify new and existing investment projects within governance threshold	PfM process has identified most new and existing investment projects within governance threshold	PfM process makes funding decisions on most new and existing investment projects within governance threshold	PfM process makes funding decisions on all new and existing investment projects within governance threshold

Level 1: Nonexistent	2	3	4	Level 5: Optimized

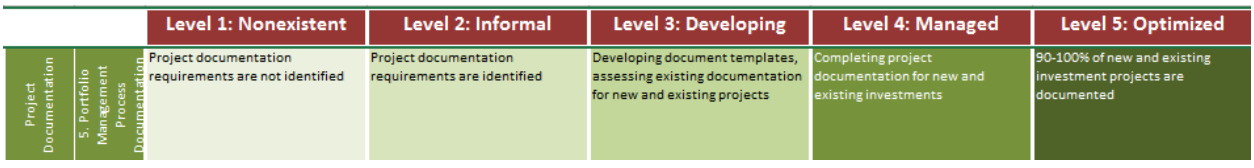
4C. How could the Portfolio Inventory improve?

5. What do you think of the Portfolio Management Process Documentation process?

5A. How well does the Portfolio Management Process Documentation process area work?

1-Not well at all	2	3	4	5-Extremely well

5B. How would you assess the maturity of the Portfolio Management Process Documentation process area?



	Level 1: Nonexistent	Level 2: Informal	Level 3: Developing	Level 4: Managed	Level 5: Optimized
Project Documentation / 5. Portfolio Management Process Documentation	Project documentation requirements are not identified	Project documentation requirements are identified	Developing document templates, assessing existing documentation for new and existing projects	Completing project documentation for new and existing investments	90-100% of new and existing investment projects are documented

Level 1: Nonexistent	2	3	4	Level 5: Optimized

5C. How could the Portfolio Management Process Documentation improve?

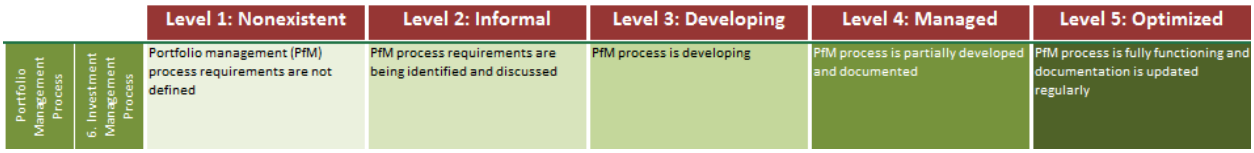
Appendix A: 2020 Census Portfolio Management Questionnaire Continued

6. What do you think of the Investment Management process?

6A. How well does the Investment Management process area work?

1-Not well at all	2	3	4	5-Extremely well

6B. How would you assess the maturity of the Investment Management process area?



Level 1: Nonexistent	2	3	4	Level 5: Optimized

6C. How could the Investment Management improve?

7. What do you think of the Strategic Planning process?

7A. How well does the Strategic Planning process area work?

1-Not well at all	2	3	4	5-Extremely well

7B. How would you assess the maturity of the Strategic Planning process area?

Level 1: Nonexistent	2	3	4	Level 5: Optimized

7C. How could the Strategic Planning improve?

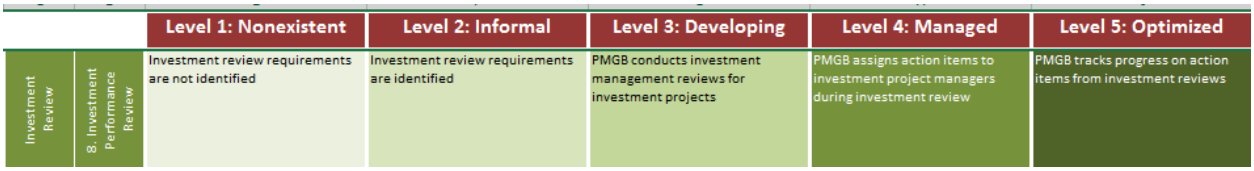
Appendix A: 2020 Census Portfolio Management Questionnaire Continued

8. What do you think of the Investment Performance Review process?

8A. How well does the Investment Performance Review process area work?

1-Not well at all	2	3	4	5-Extremely well

8B. How would you assess the maturity of the Investment Performance Review process area?



	Level 1: Nonexistent	Level 2: Informal	Level 3: Developing	Level 4: Managed	Level 5: Optimized
Investment Review / 8. Investment Performance Review	Investment review requirements are not identified	Investment review requirements are identified	PMGB conducts investment management reviews for investment projects	PMGB assigns action items to investment project managers during investment review	PMGB tracks progress on action items from investment reviews

Level 1: Nonexistent	2	3	4	Level 5: Optimized

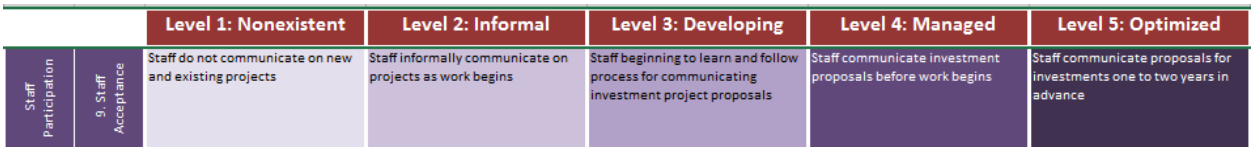
8C. How could the Investment Performance Review improve?

9. What do you think of the Staff Acceptance process?

9A. How well does the Staff Acceptance process area work?

1-Not well at all	2	3	4	5-Extremely well

9B. How would you assess the maturity of the Staff Acceptance process area?



	Level 1: Nonexistent	Level 2: Informal	Level 3: Developing	Level 4: Managed	Level 5: Optimized
Staff Participation / 9. Staff Acceptance	Staff do not communicate on new and existing projects	Staff informally communicate on projects as work begins	Staff beginning to learn and follow process for communicating investment project proposals	Staff communicate investment proposals before work begins	Staff communicate proposals for investments one to two years in advance

Level 1: Nonexistent	2	3	4	Level 5: Optimized

9C. How could the Staff Acceptance improve?

Appendix A: 2020 Census Portfolio Management Questionnaire Continued

10. What do you think of the Staff Training process?

10A. How well does the Staff Training process area work?

1-Not well at all	2	3	4	5-Extremely well

10B. How would you assess the maturity of the Staff Training process area?

Level 1: Nonexistent	2	3	4	Level 5: Optimized

10C. How could the Staff Training improve?

Challenges and Successes

We would like your feedback on the portfolio management process, as a person involved, so that we may understand how well the process is working.

11. What do you need from the portfolio management system? What do you get out of it?
12. What do you think are the successes of the portfolio management process?
13. Where do you think the process could do better?
14. How do you define success for portfolio management?
15. How do you evaluate success?

General Comments

16. Do you have anything you would like to add?

CLOSING STATEMENT

- Thank-you for sharing this information with us.
- Our paper will be presented at the UMD PM Symposium on May 10. Please let us know if you would like to see a copy once it is published.

Running Head: Conflict Resolution Practices for the 21st Century

Conflict Resolution Practice for the 21st Century in the Federal Workforce

Maryland University Project Management Symposium 2018 Conference Paper

By

Pamela Davis-Ghavami

Research Conflict Resolution Practices in the Federal Workplace

10957 Bucknell Drive

Silver Spring, MD 20902

Telephone: 240-481-2094

Email: Pdghavami@aol.com.gov

Abstract

Federal organizations hire individuals of all generations, beliefs and backgrounds. Understanding and having the necessary skills to practice conflict management strategies effectively is critical today more than ever. Whether operating as a program or project manager, team leader, team member or stakeholder in the workplace, having the skills to take conflict in stride and resolve differences in ways that build trust and confidence is not happening enough. This gap in knowledge creates an environment of disgruntled employees, high turnover, resentment, antagonism, and hostility. At a time when budget cuts are at an all-time high managing conflict constructively is a skill all employees need to master and organizations must take notice.

This research will address the basic strategies and skills to manage conflict. This research will also address how many federal agencies in the DC metro area that purposefully use these practices. This researched information is also presented with the hopes that more organizations will seriously consider making conflict management training a core competency for all employees not just for Senior Executives, Managers and Team Leads. There is a great need to develop conflict literacy, measuring conflict styles, building conflict management skills which involves top management, and using conflict focused team building and interventions for practical application in the workforce.

Table of Contents

Introduction

Federal organizations spend thousands of dollars on job specific training for federal employees. Depending on the amount of funds available for training or the specific job series, some employees may receive conflict management training and others may not. The federal government can impose mandatory training for all federal employees. The Office of Personnel Management (OPM) currently enforces mandatory training for the following subject matters: "ethics; contracting officer requirements; document management; computer security and telework." (OPM, 2018) Several federal agencies have also created their own learning portals. These learning portals allow federal employees to complete their training online at their desk or while teleworking. This allows federal managers to track mandatory training requirements in a timely fashion for thousands of employees each year or bi-annually.

In my opinion, conflict management training needs to be mandatory. All federal employees should take conflict management workshops, webinars and perform role play exercises yearly or bi-annually. Federal employees need to learn and understand their own conflict management style and know when to use another conflict style based on any given situation. This document will discuss the types of conflict that exist in the workplace, the conflict styles and why the federal workforce needs to purposefully build these skills in all employees. Examples of the advantages and disadvantages to each of these conflict styles will also be described. The source and cause of conflict in the workplace will be discussed and information will be provided to help recognize the signs of a toxic workplace and how an employee can become a target for bullying.

Regular conflict management training will provide critical skill necessary to build trust in the workplace and a since of community. Employees need to be empowered to fully utilize their conflict management skills, communication skills, listening skills and emotional intelligence. Organizations that embrace these skills will create a work culture that promotes a win-win scenario versus win-lose, lose-win or lose-lose. Emotional intelligence training will help employees develop empathy as they seek to understand the perspective of their peers while in conflict. When employees have these skills they will be able to optimize working relationships with their colleagues in the workplace regardless of their disagreements. Some workplace conflicts are created by conscious and unconscious biases. Dealing with difficult people and having difficult conversations can escalate conflicts without the proper conflict management skills.

This document will share research that illustrates what the federal government has accomplished to support conflict management training for all employees and ideas to advance competent conflict skills for the 21st Century. When these type of tools and techniques are provided in the workplace often, employees can navigate through these situations with confidence and maintain optimal work performance. The organization's that prioritize conflict management literacy for their organization will be able to reduce issues with high turnover, grievances, legal arbitration, and unforeseen employee retaliations that could be deadly. All federal agencies follow the OPM core competencies model for senior level federal positions and conflict management training is required for technical supervisory level.

The Types of Conflict in the Workplace

Conflict continues to escalate in the workplace and impact people personally, and professionally. Poor working relationships can cause a great deal of harm to an employee and the organization. "According to Flanagan and Ruden (2008), research over the past fifteen years has determined that there are two essential types of conflict in organizations: task conflict and relationship conflict. "Task conflict concentrates on how to resolve problems caused by differences in viewpoints, ideas and opinions. Researchers have discovered that conflict can result in innovation, creativity and improved decision-making processes. It is another way to acknowledge conflict in a positive light because you are focused on the task not the people." (J. H. Lim and R. Yazdanifard, 2012, p. 3)

The second type of conflict is known as relationship conflict. Examples of relationship conflict are disagreements about values, personal or family norms, or about personal taste. People refer to relationship conflict in negative terms. There is a reason why people always use negative words to describe relationship conflict. This is because most people are often involved in relationship conflict with their family, friends, co-workers or bosses. "Relationship conflict could lower the productivity and motivation amongst the parties involved. Poor communication between team members can lead to wrong choices and poor decisions. Team members may be inclined to agree to a decision without thinking of the impact and quality of implementation to avoid conflict." (J. H. Lim and R. Yazdanifard, 2012, p. 3)

Conflict in the workplace can also be broken down further and classified into the following four types:

- **"Interpersonal conflict** refers to a conflict between two individuals. This occurs typically due to how people are different from one another. We have varied personalities which usually results to incompatible choices and opinions. Apparently, it is a natural occurrence which can eventually help in personal growth or developing your relationships with others. In addition, coming up with adjustments is necessary for managing this type of conflict. However, when interpersonal conflict gets too destructive, calling in a mediator would help so as to have it resolved.

- **Intrapersonal conflict** occurs within an individual. The experience takes place in the person's mind. Hence, it is a type of conflict that is psychological involving the individual's thoughts, values, principles and emotions. Interpersonal conflict may come in different scales, from the simpler mundane ones like deciding whether or not to go organic for lunch to ones that can affect major decisions such as choosing a career path. Furthermore, this type of conflict can be quite difficult to handle if you find it hard to decipher your inner struggles. It leads to restlessness and uneasiness, or can even cause depression. In such occasions, it would be best to seek a way to let go of the anxiety through communicating with other people. Eventually, when you find yourself out of the situation, you can become more empowered as a person. Thus, the experience evoked a positive change which will help you in your own personal growth.

- **Intragroup conflict** is a type of conflict that happens among individuals within a team. The incompatibilities and misunderstandings among these individuals lead to an intragroup conflict. It is arises from interpersonal disagreements (e.g. team members have different personalities which may lead to tension) or differences in views and ideas (e.g. in a presentation, members of the team might find the notions presented by the one presiding to be erroneous due to their differences in opinion). Within a team, conflict can be helpful in coming up with decisions which will eventually allow them to reach their objectives as a team. However, if the degree of conflict disrupts harmony among the members, then some serious guidance from a different party will be needed for it to be settled.

- **Intergroup conflict** takes place when a misunderstanding arises among different teams within an organization. For instance, the sales department of an organization can come in conflict with the customer support department. This is due to the varied sets of goals and interests of these different groups. In addition, competition also contributes for intergroup conflict to arise. There are other factors which fuel this type of conflict. Some of these factors may include a rivalry in resources or the boundaries set by a group to others which establishes their own identity as a team." (Green, 2017)

Conflict may seem to be a problem to some, but this isn't how conflict should be perceived. On the other hand, it is an opportunity for growth and can be an effective means of opening up among groups or individuals. However, when conflict begins to draw back productivity and gives way to more conflicts, then conflict management would be needed to come up with a resolution.

Conflict styles explained and when to use them

According to the Foundation of Coalition Jeffery Froyd, "physiologically we respond to conflict in one of two ways we want to "get away from the conflict" or we are ready to "take on anyone who comes our way." Think for a moment about when you are in conflict. Do you want to leave or do you want to fight when a conflict presents itself? Neither physiological response is good nor bad it's a personal response. What is important to learn, regardless of our initial physiological response to conflict, is that we should intentionally choose our response to conflict. Whether we feel like we want to fight or flee when a conflict arises, we can deliberately choose a conflict mode. By consciously choosing a conflict mode instead of to conflict, we are more likely to productively contribute to solving the problem at hand." (Froyd, 2018)

The conflict style a person has is not always known by an employee or their peers. Unless they have had conflict management training they will primarily be operating with the conflict style they developed from their parents, siblings or extended family members. Assessment instruments or tests developed to uncover a thinking pattern is useful to make employees self-aware of how they may respond to conflicts in the workplace. Self-awareness is critical for anyone to understand why they respond to conflict in a particular fashion. This skill is necessary to understand why you feel angry, sad, afraid, physically sick or even hostile toward another person in the workplace when dealing with conflict. These emotions are triggers that

help give insight to your true feelings and what matters most to you. Responding the wrong way while in conflict can prevent proper communication which ultimately can develop into unresolved conflict. The consequences of unresolved conflict can impact job satisfaction, performance and employee loyalty to the organization. Conflict management skills will help employees develop a proactive plan to control these emotional triggers that may cause them to be unproductive while at work.

Emotional triggers teach us about ourselves and creates the opportunity to prepare a communication strategy that relates to the most appropriate conflict style when emotional triggers are evoked. Each individual has the responsibility to figure out where these emotions come from and how to handle them in a constructive manner. Recognizing conflict types and the other person's conflict style you are in conflict with will also give employees an advantage in applying the most appropriate conflict resolution strategy. Depending on an employee's intentions in a given situation, the behavior of conflicting parties can range from full cooperation to complete confrontation.

The Thomas-Kilmann Conflict Mode Instrument (TKI) is a widely used assessment for determining conflict modes. The assessment takes less than fifteen minutes to complete and yields conflict scores in the areas of avoiding, competing, compromising, accommodating, and collaborating. (Floyd, 2018). Each of the conflict modes can be characterized by two scales: assertiveness and cooperation. None of these modes is wrong to use, but there are right and wrong times to use each. The following selections describe the five modes:

> "The *competing* conflict mode is high assertiveness and low cooperation. Times when the competing mode is appropriate are when quick action needs to be taken, when unpopular decisions need to be made, when vital issues must be handled, or when one is protecting self-interests.
>
> The *avoiding* mode is low assertiveness and low cooperation. Many times people will avoid conflicts out of fear of engaging in a conflict or because they do not have confidence in their conflict management skills. Times when the avoiding mode is appropriate are when you have issues of low importance, to reduce tensions, to buy some time, or when you are in a position of lower power.
>
> The *accommodating* mode is low assertiveness and high cooperation. Times when the accommodating mode is appropriate are to show reasonableness, develop performance, create good will, or keep peace. Some people use the accommodating mode when the issue or outcome is of low importance to them.
>
> The accommodating mode can be problematic when one uses the mode to "keep a tally" or to be a martyr. For example, if you keep a list of the number of times you have accommodated someone and then you expect that person to realize, without your communicating to the person, that she/he should now accommodate you.

The *compromising* mode is moderate assertiveness and moderate cooperation. Some people define compromise as "giving up more than you want," while others see compromise as both parties winning.

Times when the compromising mode is appropriate are when you are dealing with issues of moderate importance, when you have equal power status, or when you have a strong commitment for resolution. Compromising mode can also be used as a temporary solution when there are time constraints.

The *collaborating* mode is high assertiveness and high cooperation. Collaboration has been described as "putting an idea on top of an idea on top of an idea…in order to achieve the best solution to a conflict." The best solution is defined as a creative solution to the conflict that would not have been generated by a single individual. With such a positive outcome for collaboration, some people will profess that the collaboration mode is always the best conflict mode to use. However, collaborating takes a great deal of time and energy. Therefore, the collaborating mode should be used when the conflict warrants the time and energy. For example, if your team is establishing initial parameters for how to work effectively together, then using the collaborating mode could be quite useful. On the other hand, if your team is in conflict about where to go to lunch today, the time and energy necessary to collaboratively resolve the conflict is probably not beneficial.

Times when the collaborative mode is appropriate are when the conflict is important to the people who are constructing an integrative solution, when the issues are too important to compromise, when merging perspectives, when gaining commitment, when improving relationships, or when learning." (Floyd, 2018)

In *Appendix A* the diagram's vertical axis represents assertiveness, with the lowest level at the bottom and the highest at the top. The horizontal axis represents cooperativeness, with the lowest level on the left and highest on the right. Each of the labels represents a conflict-handling style. It's interesting and useful to learn about your own individual conflict style. "The TKI was developed by Ken Thomas, PhD and Ralph Kilmann, PhD, both professors of management at the University of Pittsburgh. Inspired by the Managerial Grid Model of Blake and Mouton, the two researchers developed a neat, accessible model that people at any level in an organization could use to deal with conflict quickly and effectively. Since their early work, their model has become the leading measure of conflict-handling modes, backed up by hundreds of research studies and selling over four million copies." (Kilmann, 2018),

Knowing your conflict style helps to improve communication when in disagreement in the workplace. Work performance depends heavily on how well managers and employees work with each other. Once communication breaks down, work performance drops along with workplace morale. When constructive conflict is enforced positive working relationships increase, work will be rewarding and the organization flourishes. "Discerning how we manage our conflict, why we manage conflict the way we do, and thinking about the value of engaging in conflict with others are important. With better understanding we can make informed choices about how we engage in conflict and when we will engage in conflict. It is important to have control when determining if we will enter into a conflict situation or not." (Floyd, 2018)

Having a complete understanding of the advantages and disadvantages of each conflict style prepares employees in the workforce to operate in conflict constructively with choices and alternatives that creates confidence and problem solving skills. Being self-aware and empowered with the proper training increases the odds of a positive outcome when faced with conflict in the workplace. Figure 1 below provides a list of how each style could be used to for the best potential outcomes.

TKI Conflict Style Advantages and Disadvantages

Conflict Style	Advantages	Disadvantages
Competing (High Concern for self/Low concern for others)	• Instrumental goals is above all others • Allows for rapid decision making	• Can hurt relational and self-preserving goals • Quick conflict escalation • Avoid others
Collaborating (High Concern for self/ High concern for others)	• Mutual satisfactions/creative solutions • High Commitment/Good for long term relationship • Enhances instrumental & relational goals	• Can be fake • Requires a lot of energy • Frustrating if not reciprocated
Compromising (Moderate concern for self and others)	• Both parties accomplish some goals • Efficient • Reasonable • Maintains relational goals	• Easy but can be counter productive • Requires sacrifice • Limits creativity
Accommodating (Low concern for self,/Low concern for others)	• Reasonable • Avoids harm to self • Improves Relationships	• Communicates a lack of power • Ignores personal goals • Sacrifices instrumental goals
Avoiding (Low concern for self,/Low concern for others)	• Can't get goals met • Protects against harm • Appropriate for short term relationships	• Seen as weak and uncaring • Abandons goals • Reinforces ideas that conflict is unnatural/damaging

Figure 1

Causes of Conflict in the workplace and how to recognize them

Conflict in the workplace is inevitable and should never be ignored. Working relationships can become very complicated when unresolved conflict festered in the work environment. When conflict is unresolved, over time, petty grievances can become long-standing antagonisms that affect other team members, the overall morale in the department and even customer satisfaction. Supervisors and managers should be trained to recognize conflict

before it gets out of hand. Employees should also be aware of the signs of conflict and address them quickly before the supervisor or manager needs to bring workers together to discuss, and resolve, areas of disagreement. When employees have the skills to recognize the conflict and which conflict style to use they can be proactive in addressing the problem. A few of the key reasons workplace conflicts occur stem from the list below:

"Poor Communication

Poor communication is one of the main causes of conflict between employees in the workplace. This can result in a difference in communication styles or a failure to communicate. For example, a manager reassigned an employee's task to the employee's co-worker but failed to communicate the reassignment to the employee. This may cause the employee to feel slighted, which can transform into animosity among the two employees and the manager. Failing to communicate in the workplace may cause employees to make incorrect assumptions and believe workplace gossip. Poor communication in the workplace not only causes conflict but decreases productivity and employee morale.

Difference in Personalities

A difference in personalities among employees is another cause of workplace conflict. Employees come from different backgrounds and experiences, which play a role in shaping their personalities. When employees fail to understand or accept the differences in each other's personalities, problems arise in the workplace. For example, an employee may possess a straightforward personality that results in him speaking whatever is on his mind, even if the timing is inappropriate. The employee with the straightforward personality may offend a co-worker that does not possess the same type of personality. The co-worker may feel as if the employee is rude or lacks the authority to deal with her in such a straightforward manner.

Different Values

Similar to personalities, the values of employees differ within the workplace. A difference in values is seen clearly when a generational gap is present. Young workers may possess different workplace values than older workers. The difference in values is not necessarily the cause of employee conflict in the workplace, but the failure to accept the differences is. When employees fail to accept the differences, co-workers may insult each other's character and experiences. When insults occur, the conflict intensifies until the right solution is offered and accepted.

Competition

Unhealthy workplace competition is a cause of employee conflict. Some industries foster competitive environments more than others. When salary is linked to employee production, a workplace may experience strong competition between employees. Competition that is not properly managed can result in employees sabotaging or insulting one another, which creates a hostile work environment. Unhealthy workplace competition discourages teamwork and promotes individualism." (Green, 2018)

Signs of bulling, mobbing and harassment in the workplace

The Workplace Bullying Institute (WBI) defines bullying as repeated mistreatment of an employee, abusive conduct that can be threatening, humiliating, or intimidating of an employee, or sabotage and verbal abuse. (WBI, 2018)

Managers are positioned to prevent bullying. To do so, they must promote a culture of respect and professionalism, and model expected behaviors. They must also promote civility, kindness and decency by encouraging and rewarding employees who behave professionally. Managers who become aware of bullying must address negative behaviors immediately and discuss expectations. A focus on the behavior, not the person, is essential. Bullying should never be rewarded. A zero-tolerance policy must be enforced, and any undesirable behaviors should be addressed with human resources.

What steps should a federal employee take when directly confronting a bully?

- Protect your self-esteem.
- Assert yourself by identifying the offending behavior and insisting it stop.
- If the behavior is directed at your work or work ethic, ask to see the specific metrics you're failing to meet and for a detailed explanation of how you're falling shy of that mark.

What further steps can you take to defend yourself against a bully?

- Factually record all incidents and gather any other evidence or witnesses.
- Take your complaint to a higher authority, either in management Civil Rights office or in your Human Resources Department.
- Remain open, honest, and forthright in all of your relationships.

It's important to be able to recognize bullying, because it can have serious consequences for individuals and for the organization as a whole. Federal employees must be well informed about actions that constitute bullying to help counteract bad behaviors and to promote a healthy and supportive work environment.

Examples of bullying behavior:

Bullying can involve several types of behavior:

- taunting
- blackmail
- intimidation
- social exclusion
- physical injury
- unfair treatment
- unwelcome sexual advances
- spreading malicious rumors

- blocking training opportunities
- making threats about job security
- leaking personal or sensitive information
- unwarranted criticism or undermining the target's work

Who gets targeted by bullies at work?

"In some cases employees are targeted for reasons the instigator may or may not even know or understand. In some cases it is because you posed a "threat" to him or her. The perception of threat is entirely in his/her mind, but it is what he/she feels and believes. WBI research findings from their year 2000 study of conversations with thousands of targets have confirmed that targets appear to be the veteran and most skilled person in the workgroup. Targets are independent. They refuse to be subservient. Bullies seek to enslave targets. When targets take steps to preserve their dignity, their right to be treated with respect, bullies escalate their campaigns of hatred and intimidation to wrest control of the target's work from the target." (WBI, 2018)

Targets are sometimes more technically skilled than their bullies. They are the "go-to" veteran workers to whom new employees turn for guidance. Insecure bosses and co-workers can't stand to share credit for the recognition of talent. Bully bosses steal credit from skilled targets. Targets are better liked, they have more social skills, and quite likely possess greater emotional intelligence. They have empathy even for their bullies. Colleagues, customers, and management with exception to the bullies and their sponsors appreciate the warmth that the targets bring to the workplace. Targets are ethical and honest. Some targets are whistleblowers who expose fraudulent practices. Every whistleblower is bullied. Targets are not schemers or slimy con artists. They tend to be guileless. The most easily exploited targets are people with personalities founded on a prosocial orientation a desire to help, heal, teach, develop, nurture others.

Targets are non-confrontative. They do not respond to aggression with aggression. They are thus morally superior. But the price paid for apparent submissiveness is that the bully can act with impunity as long as the employer also does nothing.

Signs and effects of bullying:

Targets of bullying in the workplace may experience a range of symptoms:

- stress
- anxiety
- depression
- job resignation
- physical illness
- low self-esteem
- poor job performance
- sudden changes in behavior and work habits
- absence and diminished productivity

Signs and experiences at work when being bullied:

- You attempt the obviously impossible task of doing a new job without training or time to learn new skills, but that work is never good enough for the boss
- Surprise meetings are called by your boss with no results other than further humiliation
- Everything your tormenter does to you is arbitrary and capricious, working a personal agenda that undermines the employer's legitimate business interests
- Others at work have been told to stop working, talking, or socializing with you
- You are constantly feeling agitated and anxious, experiencing a sense of doom, waiting for bad things to happen
- No matter what you do, you are never left alone to do your job without interference
- You are shocked when accused of incompetence, despite a history of objective excellence, typically by someone who cannot do your job
- Your request to transfer to an open position under another boss is mysteriously denied

Signs of Mobbing in the Workplace:

Mobbing is "bullying on steroids," a horrifying new trend whereby a bully enlists co-workers to collude in a relentless campaign of psychological terror against a hapless target. "Targets are usually anyone who is "different" from the organizational norm. Usually victims are competent, educated, resilient, outspoken, challenge the status quo, are more empathic or attractive and tend to be women, aged 32 to 55. Targets also can be racially different or part of a minority group." (WBI, 2018)

The target receives ridicule, humiliation, and eventually, removal from the workplace. It leaves the victim reeling with no idea what happened or why. It takes away a person's safety in the world, dignity, identity and belonging and damages his or her mental and physical health. The effects also radiate outward toward the target's partner, family, friends and even community. Mobbing is more likely to occur when a number of workplace factors are present. Understanding what they are can help to protect yourself from staying in, or taking a job in a toxic organization. For example, certain industries facing increased financial pressure because market demand is on the wane are more mobbing-prone. These organizations are driven by the dollar and accountable only to shareholders and directors. This creates toxic environments where managers turn a blind eye to bullying and mobbing and may even encourage it.

Organizations that are driven by bureaucracy, e.g., government departments, are arguably the most toxic. They appear to have policies and procedures to ensure a safe workplace, but they will redefine bullying as a "personality conflict" and end up offering no real protection. In essence, bad behavior is tolerated and left to escalate. The 2012 film, "Murder by Proxy: How America Went Postal" is a fascinating portrayal of the ultimate in toxic workplaces. In contrast, healthy organizations are accountable to a wider range of shareholders including customers, staff and community. They also have values that are centered on caring for others.

"The best way to deal with workplace mobbing is to increase resilience, practice self-care and get out as soon as possible. It is often impossible to win against organizations that tacitly support mobbing. Five steps that you must take to ensure recovery are:

1. Document everything in detail
2. Give yourself space and time to figure things out
3. Get a good recovery team to stop the isolation
4. Make self-care a priority
5. Engage in meaningful life activities" (WBI, 2018)

Non-Sexual and Sexual Worksite Harassment:

Subtle forms of jobsite intolerance such as belittling comments, persistent criticism of work and withholding resources, appears to inflict more harm on employees than sexual harassment. This finding was presented at the Seventh International Conference on Work, Stress and Health, co-sponsored by the American Psychological Association, the National Institute of Occupational Safety and Health and the Society for Occupational Health Psychology. Hershcovis and co-author Julian Barling, PhD, of Queen's University in Ontario, Canada, reviewed 110 studies conducted over 21 years that compared the consequences of employees' experience of sexual harassment and workplace aggression. "As sexual harassment becomes less acceptable in society, organizations may be more attuned to helping victims, who may therefore find it easier to cope," said lead author M. Sandy Hershcovis, PhD, of the University of Manitoba. "In contrast, non-violent forms of workplace aggression such as incivility and bullying are not illegal, leaving victims to fend for themselves." (WBI, 2018)

Incivility included rudeness and discourteous verbal and non-verbal behaviors. Bullying included persistently criticizing employees' work; yelling; repeatedly reminding employees of mistakes; spreading gossip or lies; ignoring or excluding workers; and insulting employees' habits, attitudes or private life. Interpersonal conflict included behaviors that involved hostility, verbal aggression and angry exchanges. "Bullying is often more subtle, and may include behaviors that do not appear obvious to others," said Hershcovis. "For instance, how does an employee report to their boss that they have been excluded from lunch? Or that they are being ignored by a coworker? The insidious nature of these behaviors makes them difficult to deal with and sanction." (WBI, 2018)

The WBI has a great deal of information about signs of being bullied and how you can protect yourself, know your rights and recognize what you are experiencing. The site also provides survey results about what employees are experiencing in the workplace and legal support to answer questions about how to handle situations. Knowing how to keep yourself safe when in this type of situation is most important.

Federal Government Conflict Resolution Best Practices

Office of Personnel Management (OPM) issues Government-wide guidance on documentation of Federal employment. In addition, OPM issues guidance on reporting human resources, payroll and training data which are based on instructions of government-wide data element standardization and system edits. OPM provides policy guidance and advice to agencies government-wide on such topics as taking performance-based actions and adverse actions. OPM develops, implements, and communicates policies and regulations. In addition, OPM provides guidance on other topics such as alternative dispute resolution, reasonable accommodations, and appeal rights to include employee coverage and affirmative defenses. OPM also advises the Director on exercising OPM's statutory authority to intervene or seek reconsideration for erroneous third-party decisions.

Adverse Actions

Most Federal agencies are authorized under 5 U.S.C. chapter 75 to suspend, demote, furlough, or remove employees for "such cause as will promote the efficiency of the service." Actions taken under 5 U.S.C. chapter 75 are "adverse actions" and are based upon misconduct, unacceptable performance, or a combination of both. They may also be based upon non-disciplinary reasons such as medical inability to perform or furlough. OPM issues government-wide regulations at 5 CFR part 752 which implement the law. (OPM, 2018)

Performance Based Actions

Most Federal agencies are authorized under 5 U.S.C. chapter 43 to demote, or remove employees for "unacceptable performance." Such actions are commonly referred to as performance-based actions. We issue government-wide regulations at 5 CFR part 432 which implement the law. Actions based on unacceptable performance may also be taken under 5 U.S.C chapter 75 and are regulated at 5 CFR part 752. (OPM, 2018)

Alternative Dispute Resolution

Alternative Dispute Resolution (ADR) is a procedure for settling disputes by means other than litigation. Often times, a third-party neutral assists in reaching an amicable resolution through the use of various techniques. ADR contributes to effective management by controlling the costs of conflict, producing quicker and more durable results, and preserving resources for the mission of the agency.

The alternative methods to traditional, formal dispute resolution include mediation, fact-finding, ombudsing, interest-based negotiation, arbitration, and alternative discipline. Alternative methods involve the use of alternatives to traditional disciplinary procedures and penalties. Through the effective use of ADR, agencies resolve employee-employer disputes in a way that is more efficient and more effective than traditional, adversarial methods of dispute resolution. Office of Personnel Management (OPM) promotes the use of ADR by Federal agencies.

Appeals

Federal employees have a variety of appeal and grievance rights. Depending on the issues involved, they may pursue the matter within their agency, appeal to the Merit Systems Protection Board (MSPB) or file a complaint with the Equal Employment Opportunity Commission (EEOC) or the Office of Special Counsel (OSC). Employees generally have the right to appeal a suspension, demotion, or removal to the MSPB or to grieve the action through the agency's negotiated grievance procedure. Employees can choose between these two methods of appeal, but cannot pursue both avenues. Allegations of discrimination, reprisal for whistleblowing, and other prohibited personnel practices can be raised as part of an employee's appeal or grievance. Such allegations can also be filed directly with the agency's Equal Employment Office or the OSC.

Employees working during their probationary/trial periods generally are not covered under 5 CFR parts 432 or 752 of the Code of Federal Regulations. Except for certain circumstances, if an action is warranted against a probationer, he or she can appeal the termination to the MSPB only if the action is based on marital status or partisan political affiliation. This is due, in part, to the very nature of the probationary/trial period which provides supervisors the opportunity to determine whether a new employee will be an asset rather than a liability to the organization. (OPM, 2018)

Office of Personnel Management (OPM) Core Competency Guidance

The Office of Personnel Management (OPM) has been conducting Government-wide occupational studies using its *Multipurpose Occupational Systems Analysis Inventory* (MOSAIC) methodology for more than two decades. MOSAIC is a multipurpose, survey-based occupational analysis approach. OPM uses this tool to collect information from incumbents and supervisors on many occupations for a wide range of human resource management functions. (OPM, 2018)

Through these studies, OPM has identified the critical competencies and tasks employees need to perform successfully in nearly 200 Federal occupations. In *Appendix B* and C there is an example of the core competencies for supervisors and the leadership competencies that have been identified to support the core competencies skills. When filling supervisory positions agencies may consider using additional competencies beyond the ten (10) recommended competencies listed in *Appendix B*. Agencies may choose from among any of the leadership competencies listed in *Appendix B* based on job analysis. Agencies may also develop their own competencies/Knowledge, Skills, Abilities (KSAs) to meet the job criteria.

"The foundation of the MOSAIC approach is the common language or tasks and competencies used to describe all occupations included in the study. Furthermore, it provides agencies with a basis for building integrated human resource management systems that use a common set of tasks and competencies to structure job design, recruitment, selection, performance management, training, and career development so that employees receive a consistent message about the factors on which they are selected, trained, and evaluated." (OPM, 2018)

All Federal employees need to understand that a competency is a measurable pattern of knowledge, skills, abilities, behaviors, and other characteristics that an individual needs to perform work roles or occupational functions successfully. Competencies specify the "how" of performing job tasks, or what the person needs to do the job successfully. Competencies are used for:

- assessing and selecting candidates for a job;
- assessing and managing employee performance;
- workforce planning; and
- employee training and development

Federal employees are encouraged to use an Independent Development Plan (IDP) to help them maintain or develop core competencies to perform their job effectively. Managers normally work with employees to help guide professional development for improved work performance. When there is conflict between managers and employees professional development can be delayed or even denied. It is important to take the initiative to invest in your own professional development when working in a toxic work environment. When you are not supported by your manager your career development will not be a priority. Suggested ways to invest in your own professional development is to:

- Volunteer to support a conference in your field of work
- Volunteer for an advisory committee that supports your field of work
- Look for free online classes to expand your skill set
- Request rotations, details or special assignments to work outside of your office

OPM will not enforce any regulatory requirement for an Independent Development Plan (IDP). However, they do suggest that it is a good management practice, and many agencies already require their employees to have an IDP. In addition, many employee development programs require participants complete IDPs as part of a program such as the President Management Fellow (PMF) program and the Senior Executive Service Candidate Development Program (SES CDP). "OPM also offers an IDP wiki page on the OPM Training and Development wiki as a resources for how to complete the IDP. The wiki page provides examples of agencies IDP policies and templates. All Senior Executives are required in 5 CFR 412.401 to have an Executive Development Plan (EDP). OPM advises all federal agencies to include guidance on the use of IDPs in their agency training policy manual." (OPM, 2018)

Career development planning benefits the individual employee as well as the organization by aligning employee training and development efforts with the organization's mission, goals, and objectives. An individual development plan (IDP) is a tool to assist employees in achieving their personal and professional development goals. IDPs help employees and supervisors set expectations for specific learning objectives and competencies. While an IDP is not a performance evaluation tool or a one-time activity, IDPs allow supervisors to clarify performance expectations. IDPs should be viewed as a partnership between an employee and their supervisor, and involves preparation and continuous feedback. Many agencies require IDPs for new and current employees, and encourage employees to update them annually.

When using an IDP, supervisors develop a better understanding of their employees' professional goals, strengths, and development needs. Employees take personal responsibility and accountability for their career development, acquiring or enhancing the skills they need to stay current in their roles. Some of the benefits of an IDP are:

- Provide an administrative mechanism for identifying and tracking development needs and plans
- Assist in planning for the agency's training and development requirements
- Align employee training and development efforts with its mission, goals, and objectives.

The Chief Human Capital Officers Council (CHCOC) was established by the Chief Human Capital Officers Act of 2002 (CHCO Act) to advise and coordinate the activities of its member agencies. CHCOC gave advice to its member agencies on matters such as the modernization of human resources systems, improved quality of human resources information, and legislation affecting human resources operations and organizations. CHCOC is composed of the Director of the Office of Personnel Management (OPM), who serves as chairman, the Deputy Director for Management of the Office of Management and Budget (OMB), who acts as vice chairman, the CHCOs of the 15 Executive departments, and the CHCOs of 8 additional agencies designated by the OPM Director. In addition, the Council has an Executive Director who coordinates and oversees the activities of the Council. The council represents a positive communication channel between the federal human resource leaders who manage the federal governments capital planning and investment efforts. The council also recognize the importance of collaboration and the federal government's need to prepare for transformational change in the federal workforce for the 21st century. There are currently 27 CHCO's serving on the council that support conflict management training for their agency employees listed in *Appendix F.* The Chief Human Capital Officers Council serves the nation by advising and collaborating with the U.S. Office of Personnel Management and other stakeholders to create human capital management strategies that attract, develop and retain a high performing, engaged and diverse federal workforce.

Alternative Dispute Resolution Programs in the Federal Sector

According to EEOC "All agencies are required to have an alternative dispute resolution (ADR) program. Equal Employment Opportunity Commission (EEOC) has certain requirements that all agencies must follow when developing ADR programs." (EEOC, 2018) The most important ADR program requirement is fairness. Generally, an ADR program is fair if it is voluntary, confidential, enforceable by the parties (if an agreement is reached), and led by a neutral person, like a mediator, who has no personal interest in the dispute. Most agencies use mediation in their ADR Programs. "Mediation is an informal meeting between the parties that is conducted by a neutral mediator. A mediator is trained to help people who have disagreements talk to each other. The mediator does not decide who is right or wrong or issue a decision. Instead, the mediator helps the parties work out their own solutions to their dispute." (ADR, 2018)

There are real advantages to participating in ADR. ADR offers both you and the agency the opportunity for a fast and informal settlement of the dispute. Rather than leaving the decision to a third party, such as an Administrative Judge. ADR gives you the opportunity to reach an agreement that works for both you and the agency. ADR consists of a variety of approaches to early intervention and dispute resolution. Many of these approaches include the use of a neutral individual such as a mediator who can assist disputing parties in resolving their disagreements.

"ADR increases the parties' opportunities to resolve disputes prior to or during the use of formal administrative procedures and litigation, which can be very costly and time-consuming. It typically is not intended to replace the more traditional approaches and it can provide long-term solutions to employee-employer conflicts through stakeholders' participation and buy-in. In contrast, traditional dispute resolution procedures often impose a solution handed down by a third party, where neither party walks away satisfied, and the disputing parties' conflict continues or increases." (ADR, 2018)

In employee and labor relations and equal employment opportunity disputes, ADR has most commonly taken the form of mediation. However, there are many other options available including conciliation, cooperative problem solving, dispute panels, facilitation, fact-finding, interest-based problem solving and bargaining, settlement conferences, ombudsing, peer review, and alternative discipline. Alternative discipline as an ADR technique involves taking some type of action in lieu of traditional discipline to correct misconduct without resorting to more costly formal procedures and litigation.

Parties can use any of these ADR techniques, combinations of them, or others.
A number of recent initiatives by Congress and the agencies engaged in resolving disputes in the federal workplace have encouraged the use of ADR methods. The EEOC is the federal agency responsible for enforcing employment discrimination laws. "The EEOC created a Training Institute portal which provides a wide variety of training programs to help federal employers understand, prevent, and correct discrimination in the workplace. Federal employees who work in this capacity also gain experience and learn from the authorities on EEO law. The EEOC Training Institute (EECOTI) portal offers specialized training for Federal Sector Programs and is directed to federal supervisors and employees, EEO counselors and investigators, agency representatives, and attorneys to help these professionals meet yearly training requirements." (EEOCTI, 2018)

"EEOC enforces the federal laws prohibiting job discrimination in both the private and federal sectors--Title VII of the Civil Rights Act of 1964, as amended, the Age Discrimination in Employment Act of 1967, the Equal Pay Act of 1963, Title I and Title V of the Americans with Disabilities Act 0f 1990, as amended, Section 501 and 505 of the Rehabilitation Act of 1973, the Civil Rights Act of 1991, Title II of the Genetic Information Nondiscrimination Act, and the Lilly Ledbetter Fair Pay Act of 2009. EEOC also provides oversight and coordination of all federal equal employment opportunity regulations, practices and policies." (EEOC, 2018)

The EEOC Training Institute offers seminars, courses and on-site customer-specific training programs presented by the EEOC experts in enforcing the law. The EEOC believe that

discrimination can be prevented if companies, federal agencies and individuals know their legal rights and responsibilities. The EEOC trainers are subject-matter experts and have substantial experience in both enforcing the laws and providing high-quality training. The Institute's educational products contain the technical and legal guidance prepared by EEOC's attorneys, administrative judges, investigators, managers and policy experts.

"Programs provided by the EEOC Training Institute and the various manuals, workbooks and materials associated with these programs are made available under the auspices of the EEOC Education, Technical Assistance and Training Revolving Fund Act of 1992. This law authorizes the US Equal Employment Opportunity Commission to charge reasonable fees to cover the costs of providing specialized, in-depth education, technical assistance and training on EEO laws. These fees offset the costs of the training programs to enable us to keep our products and services very reasonably priced." (EEOCTI, 2018)

The Federal Sector has gone to great length to support and manage workplace conflict by ensuring there is proper training available to apply best practices when faced with workplace conflicts. The EEOC Training Institute portal is an innovative method the federal government has created to leverage training costs and meet core competency requirements for professionals who support and apply conflict management strategies in their positions on a daily basis. The EEOC resources are beneficial when discrimination cases fall within the guidelines and criteria they have identified. The criteria they provide resources to fight against falls under the category of age, race, religion, sex, disability, sexual orientation and religion. Personality conflicts, rudeness, incivility and exclusion among peers and management in the work place are not listed as an EEOC discrimination category. Conflict management skills would come into play when faced with destructive conflict management behaviors in the workplace. Knowing how to stay safe and to control emotional triggers are personal responsibilities that every employee is responsible for managing throughout their working profession.

HR University Conflict Management Training designed for the federal workforce

The Federal government believes that building the skills, competencies, and knowledge of our Federal Human Resource (HR) workforce has been a priority for the Chief Human Capital Officers (CHCO) and the broader HR community for several years. In 2009, the CHCO Council HR workforce subcommittee worked with Office of Personnel Management (OPM) to develop an HR assessment tool. "In early 2010, building on this accomplishment and collaboration, the CHCOs expressed an interest to continue efforts to professionalize the HR community, and concluded that the creation of an HR University (HRU) was the next critical step in advancing those efforts. In May, 2010, with unanimous support from the Council, a working group was convened to move forward with the HRU project, a Government wide resource for HR training and development. The HRU is not only intended to address competency and skill gaps within the HR community, it is an effort to achieve Government wide savings through shared resources and economies of scale identifying the best HR training across Government, and establishing a means of sharing with all agencies." (HRU, 2018)

The HRU is the Federal Government's single "one stop" training resource center for the HR professional throughout the Federal Government. Although there are many agency-specific training programs dedicated to training the HR professional, those training programs and their curriculum vary. Though these training programs may be very effective, there is still a need to develop HR courses and curriculum that are applicable across the Federal Government. To help bridge the gap of those course offerings and to improve the economies of scale, the HRU offers courses that have been evaluated and approved by OPM as courses designed to meet established competencies for the HR Profession.

In the 21st Century, the roles of a typical Federal HR professional have drastically changed from being "transaction operational" base to evolving into Strategic Business Partners. While the foundation for understanding Federal HR principles are still critical for the HR professional, new skills are also required to close the gap between technical versus strategic HR skills. The curriculum outlined on the website for the HR professional's correlates to established HR competencies and skill requirements. Therefore, HRU is designed to guide, train, and mentor Federal HR professionals as they maneuver through their career.

"The CHCO Council launched HRU in 2011. Since its launch, it has taken off and now offers 130 courses as well as many tools and resources to more than 50,000 registered users across government. Through its innovative method of leveraging existing resources throughout government, HRU has helped train thousands of employees and saved the government more than $100 million." (HRU, 2018)

The courses that are offered through HRU are a combination of classroom, online, and web-based courses. The majority of courses are free, but some are fee based. The CHCOC members, who consist of representatives from 27 Federal agencies and the Small Agency Council, also use this portal to address the need for conflict management training because the portal contains an extensive number of courses that are designed to improve the federal workforce conflict management skills gap. Through the HRU Ambassadors and other CHCOC committees, HRU supports the Federal HR professional development and also the development of the entire federal workforce. HRU in now available to the entire federal workforce. The conflict management courses currently available on the HRU portal is listed in *Appendix E*.

Project Management PMBOK Conflict Management Best Practices

The Project Management Body of Knowledge (PMBOK) provides guidelines for managing individual projects and defining project management related concepts. A project is a temporary endeavor undertaken to create unique product, service or result. The temporary nature of a project indicate that a project has a definite beginning and end. Every project creates a unique product, service or results. Project management is the application of knowledge, skills, tools and techniques to project activity to meet project requirements. Project Management is accomplished through the appropriate application and integration of the 47 logically grouped Project Management process which are categorized into five process groups. The five process groups are: Initiating; Planning; Executing; Monitoring and Controlling; and Closing. (PMBOK, 2018)

Project management professional training is ongoing for practitioners in this field. Project Management practices are usually partnered with other disciplines which require professionals to keep up with other work disciplines areas in addition to the project management methodology. For example, a database manager may also operate as a project manager and need to maintain certifications in Oracle, SQL and project management. A procurement contract manager may need to be certified as a contracting officer to manage a certain dollar threshold but also maintain the project management certification to manage the contract procurement process effectively.

The Project Management Institute (PMI) provides extensive training opportunities for professionals who are members of the organization. PMI also provides journal publications authored by Project Management professionals who share their personal experiences and lessons learned dealing with conflict management strategies used to complete projects on time and on budget. PMI sponsors conferences for various disciplines to bring together leaders in the every industry who manage conflict on projects on a regular basis. Project Management professionals are excited to share how they overcame project obstacles or how they accepted defeat to prepare for the next battle for a successful project outcome. PMI also offers networking opportunities through PMI chapters that meet monthly in several geographical locations at a minimal cost to members.

The federal sector have embraced the Project Management methodology and have incorporated these concepts into several disciplines operating in the workplace. The information technology and procurement project efforts fully utilize the project management methodologies. Many federal agencies have Project Management Offices (PMO) to manage project performance and to prevent duplicative efforts within the agency. The federal sector also provides training for federal employees to obtain and maintain the Project Management certification.

The Project Management methodology uses processes that support proper communication in projects, proper documentation of project tasks and scheduled deliverables, proper procedures to forecast processes needed to prepare for mitigating possible risks that would negatively impact the project and access to the proper tools to resolve conflicts that would negatively impact the project deadlines. The objective in the Project Management process is to organize, plan, monitor, control and correct the project activities. Project management relies on proven and repeatable processes and techniques.

The PMBOK guide provides insight about conflict management techniques to be used when managing projects in section 9.4.2 Manage Project Team Tools and Techniques guidance. This section identifies 5 techniques to use when managing conflict on a project. The word conflict is printed 75 times in the PMBOK 5th Edition. The PMBOK conflict techniques mimic the TKI and DiSC concepts in relation to the conflict style types. Listed below are the PMBOKS recommended conflict resolution techniques that can be used in a team dynamic:

1. *"Withdraw/Avoid* – Retreating from an actual or potential conflict situation, postponing the issue to be better prepared or to be resolved by others

2. *Smooth/Accommodate* – Emphasizing areas of agreement rather than areas of differences conceding one's position to the needs of others to maintain harmony and relationships.

3. *Compromise/Reconcile* – Searching for solution that brings some degree of satisfaction to all parties in order to temporary or partially resolve conflict.

4. *Force Direct* – Pushing ones viewpoint at the expense of others; offering only win-lose solutions usually enforced through a power position to resolve an emergency.

5. *Collaborate/Problem Solve* – Incorporating multiple viewpoints and insights from differing perspectives." (PMBOK, 2018)

The PMBOK states that "Conflict is inevitable in a project environment. Sources of conflict include resource schedule priorities, and personal work styles. Team ground rules, group norms and solid project management practices like communication planning and role definition reduce the amount of conflict. The PMBOK focuses on conflict from the team members or stakeholder interaction with the Project Managers and guidelines that help to keep the project on task until completion. This can be a difficult task for Project Managers because they are not always the direct line supervisor which requires other means of influence or negotiations skills to get project tasks completed." (PMBOK, 2018)

Project managers who encounter a great deal of conflict on their projects would have to find additional conflict resolution resources to help navigate their project to completion. The content provided in the PMBOK is limited to only address conflict within the team. The range of conflict that could exist with each individual team member, team leader and stakeholders should also be explored for project success.

Conclusion

Workplace conflict is one of the greatest causes of employee stress in the private and public sector. Taking simple steps to resolve conflict immediately can prevent many workplace conflicts from escalating. Employee stress, and many related health complaints, as well as workers' compensation and bullying claims, can be prevented by managers acting quickly to resolve issues between co-workers, or between themselves and co-workers. The information provided in this research has identified the level of effort the Federal sector has made to provide conflict management training for employees whose positions require that they take training yearly. The EEOC Training Institute is designed for those professionals who need to understand the laws that support the way conflict in managed in the workforce. HR University was initially developed to help HR professionals maintain their core competencies and now can be used by the entire federal workforce. This decision will transform the human capital planning mission to prepare the federal workforce to manage technical advancements and conflict management literacy for the 21st century.

In my opinion, conflict management training imposed on the federal workforce will create a healthy work environment and reduce workplace bullying that is not considered a category for civil rights grievance. To meet the needs of every generation and culture who authentically strives to build a successful career in the federal workforce, training and coaching in conflict management musts be made mandatory. Conscious and unconscious biases that cause conflict in the workplace will be address with conflict management training because employees will be able to recognize this mindset and address the issues before it escalates to a grievance or legal battle. The practical knowledge of how to apply conflict management strategies in our daily lives will be critical to successfully building healthy working relationships. The changes in technology and the financial deficits the Unites States is experiencing will continue to impact future needs of society.

Leadership can function as a means for conflict resolution. Articulating the leadership style employed by a business in advance can prime staff expectations. If you tell staffers they can expect a lot of freedom or limited freedom in their work, it should not come as a shock when that occurs. Leadership can also minimize conflict by setting and enforcing clear, formal procedures and processes to eliminate ambiguity. A genuine commitment to conflict resolution must come from the top. Staff members will prove unlikely to embrace conflict resolution if the business owner or management only pay it lip service. Leadership can demonstrate a commitment to conflict resolution through active participation in the process by, for example, serving as an arbiter or bringing in an expert

Based on the information provided in this research the next step will be to request for the CHCO Council and OPM to implement mandatory conflict management training for the federal workforce. I would also like to have a dialog with the PMI Board of Directors about incorporating a chapter in the PMBOK dedicated to conflict resolution best practices. These best practices would include conflict resolution strategies that support project team leaders and members. The chapter would also address conflict that may be encountered in a matrix environment with stakeholders, functional mangers, vendors as well as internal biases. Now is the time to impose a change that will empower employees to manage conflict constructive to preserve relationships in the workplace. Proper training and coaching will help in the process changing minds and behaviors. Developing metrics and tracking progress with surveys, interviews and case studies yearly or bi-annually will help to show the benefits of the training and the impact made in the federal workplace. Having the knowledge and the practical application is the key. A workforce that collaborates and solves problems respectfully will create a healthy workforce. Addressing poor performance with a win-win scenario in mind will be transformational because it will encourage an employee's success when problems are identified early to modify behavior. Actively managing conflict in a constructive manner will foster innovation. Technology changes the federal workforce will be enforcing on a continuous bases needs a workforce that constructively manages conflict to meet the needs of 21st century job requirements.

References

Alternative Dispute Resolution Working Group. (2018). *About*. Retrieved on March 5, 2018 from https://www.adr.gov/fai.html

Crossman, Ashley (2017). Understanding Conflict Theory. *ThoughtCO*. Retrieved on January 10, 2018 from https://www.thoughtco.com/conflict-theory-3026622.

Equal Employment Opportunity Commission (2018). *Alternative Dispute Resolution.* Retrieved on February 12, 2018 from https://www.eeoc.gov/federal/fed_employees/adr.cfm

Equal Employment Office Commission Training Institute (2018). *Resolution*. Retrieved on March 5, 2018 from https://eeotraining.eeoc.gov/profile/web/index.cfm?PKwebID=0x2547d970&varPage=agenda

Froyd, Jeffrey (2011). Understanding Conflict and Conflict Management. *Coalition Foundation.* Retrieved March 20, 2018 from http://fc.civil.tamu.edu/publications/brochures/conflict.pdf

Green, Charles (2017). *Examples of 4 Types of Conflict*. Chron Publication. Retrieved March 10, 2018 from http://smallbusiness.chron.com/examples-4-types-conflict-1207.html

Haun, Lim Jin and Yazdanifard, Rashad (2012) *Business & Entrepreneurship Journal, vol.1, no.1, 2012, 141-155 ISSN: 2241-3022, 2241-312X* Scienpress Ltd, 2012. *The Difference in Conflict Management Styles and Conflict Resolution in the Workplace.* Retrieved March 10, 2018 from http://www.scienpress.com/Upload/BEJ/Vol%201_1_9.pdf

Henshaw, S. (2014). Bullying at Work: Workplace Mobbing is on the Rise. *Psych Central*. Retrieved on March 29, 2018, from https://psychcentral.com/blog/bullying-at-work-workplace-mobbing-is-on-the-rise/

HR University (2018) Course Catalog. Retrieved on March 1, 2018 from https://hru.gov/Course_Catalog.aspx

Killmann, Ralph. (2018) *A Brief History of the Thomas-Kilmann Conflict Mode Instrument.* Retrieved March 1, 2018 from http://www.kilmanndiagnostics.com

Kreisberg, Louis (2009). *History of Conflict Resolution.* Retrieved on March 10, 2018 https://www.maxwell.syr.edu/uploadedFiles/parcc/Publications/2009%20Evolution-ConflictResolution.pdf

Nauert PhD, R. (2015). Non-Sexual Worksite Harassment Is More Harmful. *Psych Central*. Retrieved on March 31, 2018, from https://psychcentral.com/news/2008/03/10/non-sexual-worksite-harassment-is-more-harmful/2020.html

Office of the Chief Human Capital Office Council (OCHCOC). *Members*. Retrieved on March 10, 2018 from https://chcoc.gov/members/chcos

Office of Personnel Management (2018) *Federally Mandated Training*. Retrieved on March 2, 2018 from https://www.opm.gov/wiki/training/Federally-Mandated-Training/Print.aspx

Project Management Body of Knowledge (2018). Chapter 9.4.2: Retrieved March 1, 2018 from http://marketplace.pmi.org/Pages/ProductDetail.aspx?GMProduct=00101388701

Reece, Roger (2017). Conflict Management Competencies. Roger Reece Seminars. Retrieved on January 15, 2018 from http://conflictmanagementworkshops.com/conflict-management-article.htm

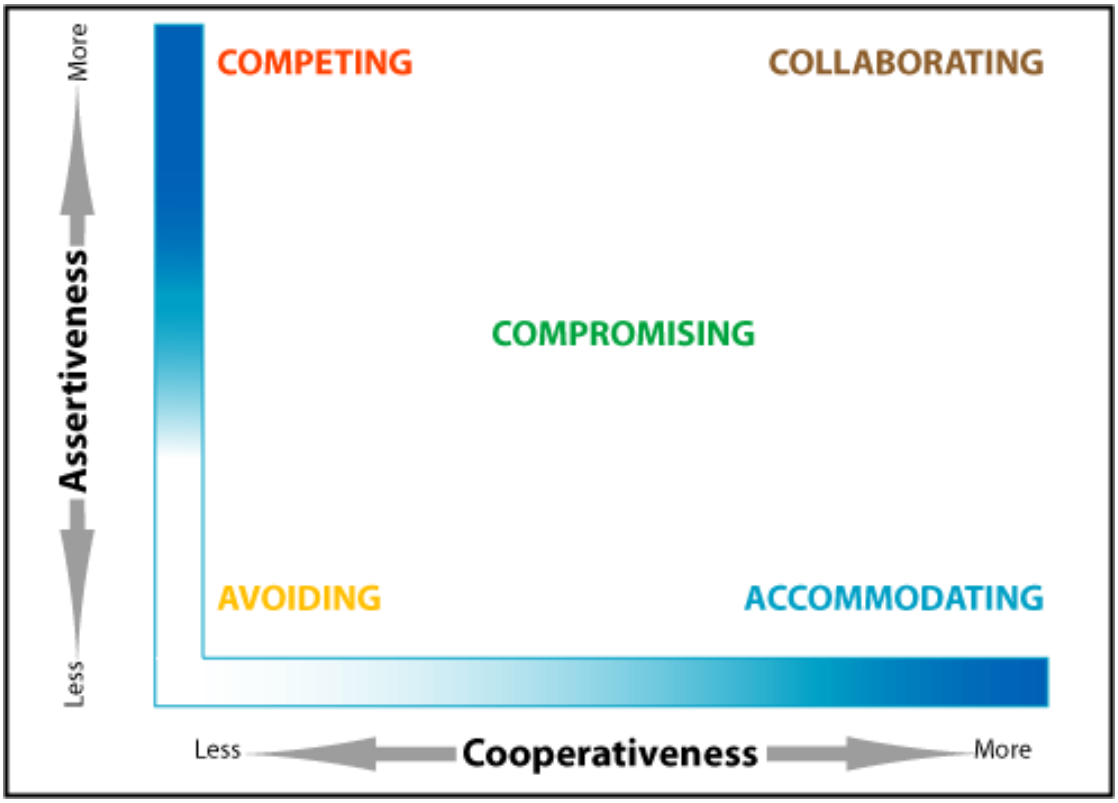
Thomas, K.W., & Kilman, R.H. 1974. *A Brief History of the Conflict Mode Instrument.* Tuxedo, New York. Retrieved on Feb 2, 2018 from http://www.kilmanndiagnostics.com/brief-history-thomas-kilmann-conflict-mode-instrument

Workplace Bully Institute (2018). *Who Gets Targeted?* Retrieved on March 10, 2018 from http://www.workplacebullying.org/individuals/problem/who-gets-targeted/

Workplace Bully Institute (2018). *How Bullying Happens?* Retrieved on March 10, 2018 from http://www.workplacebullying.org/individuals/problem/how-bullying-happens/

Workplace Bully Institute (2018). *3-Step Target Action Plan?* Retrieved on March 10, 2018 from http://www.workplacebullying.org/individuals/solutions/wbi-action-plan/

Appendix A


More
Assertiveness
Less
COMPETING
COLLABORATING
COMPROMISING
AVOIDING
ACCOMMODATING
Less
Cooperativeness
More

Appendix B

Characteristics of bullying	
Characteristic	**Description**
Imbalance of power between the bully and target	**Bullying can involve an abuse or misuse of power such as blocking opportunities for promotion or deliberately undermining the work of a coworker.**
Directed at a person, rather than a characteristic	**Bullying behaviors may have some basis in prejudice, but ultimately they are directed at the person as an individual rather than a specific trait.**
Intimidation of coworkers	**Sometimes coworkers can become fearful of being targeted by bullying behavior, so they hesitate to support the target and report the bullying.**
Psychological manipulation	**Employees who are targets of bullying behavior might be psychologically manipulated to believe that they are overreacting to the bullying and that the behavior is normal workplace interaction.**

Appendix C

Supervisory Core Competency for the Federal Sector

Supervisory Work	**Supervisory Guide:** The *Supervisory Qualification Guide* prescribes general guidance when determining requirements for supervisory positions in the General Schedule (GS) or equivalent at grades 15 and below. While not mandatory, use of this *Guide* is strongly recommended.
Accountability	Holds self and others accountable for measurable high-quality, timely, and cost-effective results. Determines objectives, sets priorities, and delegates work. Accepts responsibility for mistakes. Complies with established control systems and rules.
Customer Service	Anticipates and meets the needs of both internal and external customers. Delivers high-quality products and services; is committed to continuous improvement.
Decisiveness	Makes well-informed, effective, and timely decisions, even when data are limited or solutions produce unpleasant consequences; perceives the impact and implications of decisions.
Flexibility	Is open to change and new information; rapidly adapts to new information, changing conditions, or unexpected obstacles.
Integrity/Honesty	Behaves in an honest, fair, and ethical manner. Shows consistency in words and actions. Models high standards of ethics.
Interpersonal Skills	Treats others with courtesy, sensitivity, and respect. Considers and responds appropriately to the needs and feelings of different people in different situations.
Oral Communication	Makes clear and convincing oral presentations. Listens effectively; clarifies information as needed.
Problem Solving	Identifies and analyzes problems; weighs relevance and accuracy of information; generates and evaluates alternative solutions; makes recommendations.
Resilience	Deals effectively with pressure; remains optimistic and persistent, even under adversity. Recovers quickly from setbacks.
Written Communication	Writes in a clear, concise, organized, and convincing manner for the intended audience.

NOTE: Ten (10) competencies listed in this document reflect those considered as most important for successful performance of Federal supervisory work. Candidates should possess proficiency or the potential to develop proficiency in these competencies prior to entry into a supervisory position. The specific level of proficiency identified for each competency depends on the specific requirements of the position being filled and must be determined by the employing agency.

Appendix D

Leadership Competencies: Many supervisory positions have specific subject-matter knowledge and skill requirements (i.e., technical requirements) candidates must meet. **When the supervisory position has technical requirements, the employing agency must use an occupation-specific qualification standard. The *Supervisory Qualification Guide* should be used in conjunction with the occupation-specific qualification standard.**

Conflict Management	Encourages creative tension and differences of opinions. Anticipates and takes steps to prevent counter-productive confrontations. Manages and resolves conflicts and disagreements in a constructive manner.
Continual Learning	Assesses and recognizes own strengths and weaknesses; pursues self-development.
Creativity and Innovation	Develops new insights into situations; questions conventional approaches; encourages new ideas and innovations; designs and implements new or cutting edge programs/processes.
Developing Others	Develops the ability of others to perform and contribute to the organization by providing ongoing feedback and by providing opportunities to learn through formal and informal methods.
Entrepreneurship	Positions the organization for future success by identifying new opportunities; builds the organization by developing or improving products or services. Takes calculated risks to accomplish organizational objectives.
External Awareness	Understands and keeps up-to-date on local, national, and international policies and trends that affect the organization and shape stakeholders' views; is aware of the organization's impact on the external environment.
Financial Management	Understands the organization's financial processes. Prepares, justifies, and administers the program budget. Oversees procurement and contracting to achieve desired results. Monitors expenditures and uses cost-benefit thinking to set priorities.
Human Capital Management	Builds and manages workforce based on organizational goals, budget considerations, and staffing needs. Ensures that employees are appropriately recruited, selected, appraised, and rewarded; takes action to address performance problems. Manages a multi-sector work force and a variety of work situations.
Influencing/Negotiating	Persuades others; builds consensus through give and take; gains cooperation from others to obtain information and accomplish goals.
Leveraging Diversity	Fosters an inclusive workplace where diversity and individual differences are valued and leveraged to achieve the vision and mission of the organization.
Partnering	Develops networks and builds alliances; collaborates across boundaries to build strategic relationships and achieve common goals.
Political Savvy	Identifies the internal and external politics that impact the work of the organization. Perceives organizational and political reality and acts accordingly.
Public Service Motivation	Shows a commitment to serve the public. Ensures that actions meet public needs; aligns organizational objectives and practices with public interests.
Strategic Thinking	Formulates objectives and priorities, and implements plans consistent with the long-term interest of the organization in a global environment. Capitalizes on opportunities and manages risks.
Teambuilding	Inspires and fosters team commitment, spirit, pride, and trust. Facilitates cooperation and motivates team members to accomplish group goals.
Technical Credibility	Understands and appropriately applies principles, procedures, requirements, regulations, and policies related to specialized expertise.
Technology Management	Keeps up-to-date on technological developments. Makes effective use of technology to achieve results. Ensures access to and security of technology systems.
Vision	Takes a long-term view and builds a shared vision with others; acts as a catalyst for organizational change. Influences others to translate vision into action.

Appendix E

HR University Conflict Management Core Competency Courses Offered	
Course Title:	**Location/Hours/Cost**
Leading a Generationally Diverse Workforce	**Online/1.5 Hours/Free**
Putting yourself in the other persons shoes	**Online/1 Hour /Free**
Addressing and resolving poor performance	**Online/3 Hours/Free**
Basic Employee Relations: Your Accountability as a Supervisor or Manager	**Online/3 Hours/Free**
Coach for Success: How to Hold Performance Conversations like a Pro	**Online/.75 Hours/Free**
Difficult Conversations	**Online/.75 Hours/Free**
Domestic Violence, Sexual Assault and Stalking in the Workplace	**Online/1.5 Hours/Free**
FLRA Comprehension Arbitration Training	**Online/2 Hours/Free**
Supervisory Development Seminar I: Fundamentals	**Online/1.Week/ $3,350**
Supervisory Development Seminars II: Learning to Lead	**Online/1 week/ $3,350**
Emotional Intelligence Leadership	**Online/45 minutes /Free**
Maximizing Employee Engagement	**Online/1 Hour/ Free**

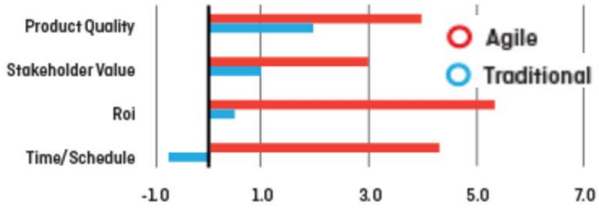
Appendix F

Chief Human Capital Officer Agencies Represented on the Council	
Web Site Address for the CHCOC Info:	**https://chcoc.gov**
Department of Agriculture	**Environmental Protection Agency**
Department of Commerce	**General Services Administration**
Department of Education	**National Aeronautics and Space Administration**
Department of Defense	**National Science Foundation**
Department of Energy	**Nuclear Regulatory Commission**
Department of Health and Human Services	**Office of Management and Budget**
Department of Homeland Security	**Office of Personnel Management**
Department of Housing and Urban Development	**Office of the Directors National Intelligence**
Department of Interior	**Small Agency Council**
Department of Justice	**Small Business Administration**
Department of Labor	**Social Security Administration**
Department of State	**Agency for International Development**
Department of Treasury	
Department of Transportation	
Department of Veterans Affairs	

Earned Capabilities Management

I. ***Agile Governance Challenge****: Managing Uncertainty Doesn't Eliminate Uncertainty*

Agile offers many benefits to organizations for software portfolio management. The greatest benefit is the increase in project success rates. Projects that leverage hybrid or scrum-agile processes are successful more often, and deliver much higher value to business stakeholders. Ambysoft's 2013 survey data from 173 respondents across industries showed that Agile was successful 64% of the time, while Traditional project management was only 49% successful. Even more impressive was the difference in project value, as shown here based on respondents ranking methods from -10 to 10 (image source: http://clearcode.cc/2014/12/agile-vs-waterfall-method/).



Agile accomplishes this by enabling projects to learn and adapt scope to achieve the higher-level vision for the project. Often the best solution cannot be pre-determined without building, testing, and rebuilding the software. This allows for exploration of technical solutions, but more importantly it engages users with working software to validate scope. Learning what actually works and is needed for business users is far more crucial than the learning that comes from technical exploration of a problem space – ***since the best built software is valueless if no one uses it***. However, by being both incremental and iterative, Agile provides a structure to test both technical solution feasibility and end user adoption.

While these benefits are great for project execution, Agile introduces a significant challenge in knowing what scope or actual software will be delivered. Even more so, how does one know that the project is being efficient in spending and delivering value to the organization?

Traditional project management uses earned value management (EVM) to track scope using integrated master schedules, comparing estimates and actuals. This works when the scope does not change often or quickly. With scope certainty, project baselines remain constant long enough for tracking variance and identifying potential issues when they are small and manageable. However, even these measurements are only as useful as the accuracy of the estimates and the reported project progress. And in all cases, EVM does not measure the impact of the project deliverables to the business, but instead reports the percentage of baselined scope completed. Just as Agile fails to track efficiency, there is no mechanism in EVM to validate if the project deliverables will be useful to the end users.

Summary of the Agile Governance Challenge:

- Agile is a better way to deliver software projects with high uncertainty
- Agile appears to fix schedule (timeboxes) and budget (whole teams), while varying scope (features)
- Agile currently offers no meaningful way to track efficiency or effectiveness
- Traditional project management estimates project efficiency with EVM, but cannot verify it
- Traditional project management fails to validate that scope delivered is valuable to end users

No popular methods exist to effectively track projects in terms of the return on investment (dollars earned per dollar spent) for projects with high levels of uncertainty.

II. *Earned Capabilities Management:* *A Simple Solution for Controlling Value*

The heart of the Agile Governance Challenge is the lack of connection between project management and a project's purpose: to deliver benefits to the organization. Every project's goal is not the completion of scope, but to improve the organization. This is true whether the project is to increase the skill of the employees, install new IT systems for efficiency, or add a new business line that delivers novel services. The project itself is purely the cost, but the new capabilities delivered by the project add value to the organization.

$$Capability - an\ ability\ to\ perform\ work\ of\ a\ certain\ quality, capacity, and\ efficiency$$

Only the delivery of *needed capabilities at a reasonable cost* should be considered value when tracking and managing a project. Value can be redefined then as a return on investment, or "ROI." Using this ROI metric, leaders can make strategic decisions on initiating, continuing, changing, intervening, or stopping projects at a portfolio level.

To determine the ROI of capabilities delivered by projects within a portfolio, an organization must perform the following:

1) *Set Objectives* – Establish value in fungible terms (e.g. money or units) for business processes
2) *Baseline Original Performance* – Measure initial business process costs and throughputs
3) *Measure Performance with Capability* – Determine new business process costs and throughputs

For each capability delivered, the *Capability ROI* can be determined as the net profit to the business normalized by the cost; where net profit is the gain in performance minus the cost investment:

$$Capability\ ROI = \frac{(New\ Throughput - Initial\ Throuhput) + (Initial\ Cost - \ New\ Cost)}{Amortized\ Capability\ Investment}$$

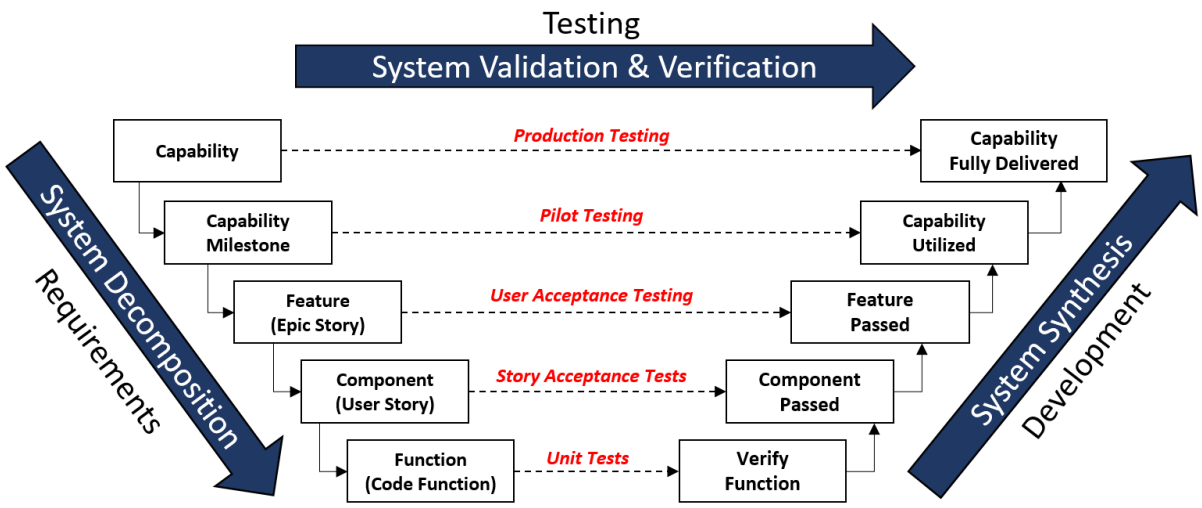
Notes: "New Cost" includes the Amortized Capability Investment (planning, development, O&M) as well as the total resources needed to operate the business with the new capability installed. This ensures the topline is net profit, or gains (higher throughputs and lower costs) minus the investment. All values should be amortized (e.g. annual) to normalize across differences in economic life and rates of return. Reference: http://www.investopedia.com/terms/r/returnoninvestment.asp.

Agile offers a unique ability to validate and verify the Capability ROI equation during execution. By delivering early versions of working software, leadership can continuously learn the following answers:

- Is this software useful? If not, will it be? Why?
- Will this lower our costs? If not, can we afford it?
- Will this increase our throughput (or at least capacity for now)? What are the constraints?
- Does this new system have a positive ROI now? Will it in the future?
- What are the barriers to success on this project? Can they be removed?

Answering these questions provides leadership the information needed to decide whether to exercise the next option year of investment or stop the project and recover the remaining funds.

Addressing Long Release Trains. For long release cycles, Agile projects should use the V-Model of product verification and validation (V&V). This process requires that each capability in the project is defined by what tests will be used to *measure performance with the capability* at every build level. The V-Model aligns with Agile's extreme programming (XP) roots with test-driven development, where every function has a test defined prior to development that must be passed before it's considered "done:"



The V-Model offers an on-demand method for starting and tracking the completion of capability, while not requiring a complete and integrated master plan. During project initiation or early planning, each capability should be decomposed into planned milestones based on business, technical, and testing dependences. Then the Agile team can select an available capability milestone to begin work on. The team must decompose the work by describing at minimum the Epics and User Stories that are "must-have" requirements to deliver the capability. Tests are defined at each level before work begins, and when work is complete testing is performed by the appropriate stakeholders (Dev Team, IV&V, and/or End Users) bottom-up.

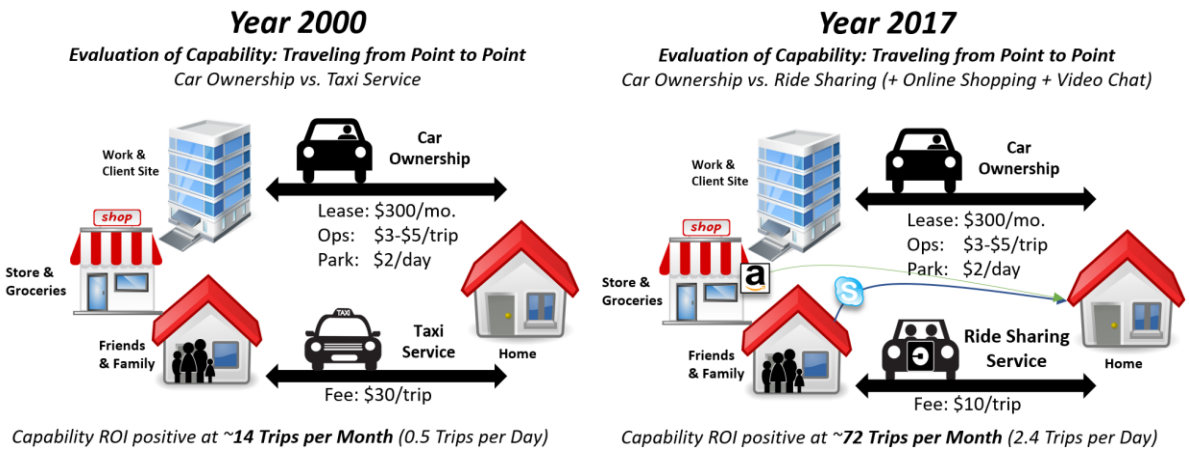
Before any new Capability is started there must be a business case for beginning development. This includes setting the objective function and baselining the performance of the business. Based upon expected capability improvements and the planned must-have Epics and User Stories, the Capability ROI can be estimated and managed during development prior to end user validation (Pilot and Production Testing).

These approaches constitute a new process, called 'Earned Capabilities Management." At a project level, it is a radical change from "Earned Value Management" used to track and manage large procurements. Instead of actively managing proposed cost against actual cost (both budget and schedule), the new controlling function is to manage the ROI of a project. The focus becomes on delivering timely capabilities that are the true "value" a project provides an organization.

> ***Earned Capabilities Management focuses leadership's attention on changes in a project's timely delivery of capabilities with positive ROI, independent of a project's original scope***.

III. *Example of Timing Impacts on Capability ROI:* *Buying a Car in the Age of Uber*

Consider a car as a personal example of this separation of cost and value. It costs money and time to buy, drive, store, and maintain a car. However, for years it has been worth the costs to have the capability to transport oneself from point-to-point quickly. Going to work, picking up groceries, and seeing family all required this capability. However, today those same activities can be delivered by Uber (ride sharing), Amazon.com (online shopping), and Skype (video chat). Many more people are going "carless" today as the activities are completed in new ways as services, while being much cheaper.



Does this change the value of the car? If someone employs these new alternative services, then yes it does change how much value the car can provide that person. This is because the car provides little to no additionally *needed capability*. ***The marginal gain of a car became less than the marginal cost***, and the Capability ROI becomes zero or even negative.

Summary: The ROI of a capability is always changing as the business process changes. As discussed when defining the Agile Governance Challenge, if no one uses the best built software then the software is useless. Or building on our car example in this section, a project started in the year 2000 to build and sell a better car to millennials in the year 2020 may just waste resources because of ride sharing (e.g. Uber). However, if that car is delivered with half the performance improvements by 2005 then it will provide great value even without meeting all desired specifications.

Earned Capabilities Management emphasizes fast delivery of capabilities while they are still useful to the enterprise to ensure positive Capability ROI.

IV. *Example of Scope and Capability Independence*: *Lighting Projects in Modern Facilities*

Take for example a project to reduce energy costs of facility lighting as an example of scope and capability independence. The original project scope is to replace old incandescent bulbs with light emitting diodes (LEDS) that last twenty years and consume a fraction of the energy. The result is the same light level (if properly designed), and the project takes time, money, and management focus to execute. On the day of completion, the project has used resources of the organization and is now over with no immediate benefit to the organization *except* that the organization now has a new capability of "economical lighting." After about six months to a year, the total cost and time savings of installing the "economic lighting" capability (LEDs) are earned back when baselined against the "original lighting" capability (incandescent bulbs). The remaining 19 years before replacement are pure net profits.

The light replacement example is a simple means of showing how even the most agreeable projects are pure cost until the new capabilities (economical lighting) are delivered. This new capability adds value to the organization when compared to the baseline of doing nothing to change the organization. Based on these *marginal gains* and the *amortized project cost* (installation, operations, and maintenance) the project is either beneficial or not.

However, here are three alternative scenarios that illustrate achieving the same objective capability, "economic lighting," but with real-world adjustments to scope:

Cheaper Alternative: Small halogens or compact fluorescent lightbulbs (CFLs) could be cheaper, given the right market conditions, and offer the same economic benefits as LEDs. LED shortages have spiked prices before, and there is no shortage of analogies to other re-world sourcing scenarios (steel, oil, people, etc.). Here, the project team uses the best available resources to complete the project.

Competing Objectives: What if in some areas LEDs are installed and in other areas with poor lighting conditions halogens are used (because halogens are brighter)? Making many employees who earn hundreds of thousands of dollars more productive must be worth the extra costs of using a different light fixture. Here, the project team knows the constraints are to ensure proper lighting to employees which maximizes the ROI of the project, by reducing negative impacts to business process throughput.

Novel Solutions: What if, upon inspection, it was clear the whole organization was working in facilities with twice the lighting needed, and the goal was to reduce light energy consumption in half? "De-lamping" (removing bulbs) could be done by one person per building and the goal could probably be met in a day or two. The organization would even gain piles of bulbs ready for spot replacements. Once achieved the organization could choose whether to replace the remaining lights with LEDs. Here the project team keeps the goal in mind, and learns quickly by doing (a significant benefit of Agile).

In all scenarios, the capability "economic lighting" is delivered. In the first case, a change is made due to resourcing uncertainty (CFLs being cheaper than LEDs in lifecycle cost). In the second case, scope is adjusted due to higher priority goals (employee productivity is higher priority over energy savings). In the third case, a completely novel and cheaper solution is identified that can be completed quickly at a fraction of the cost.

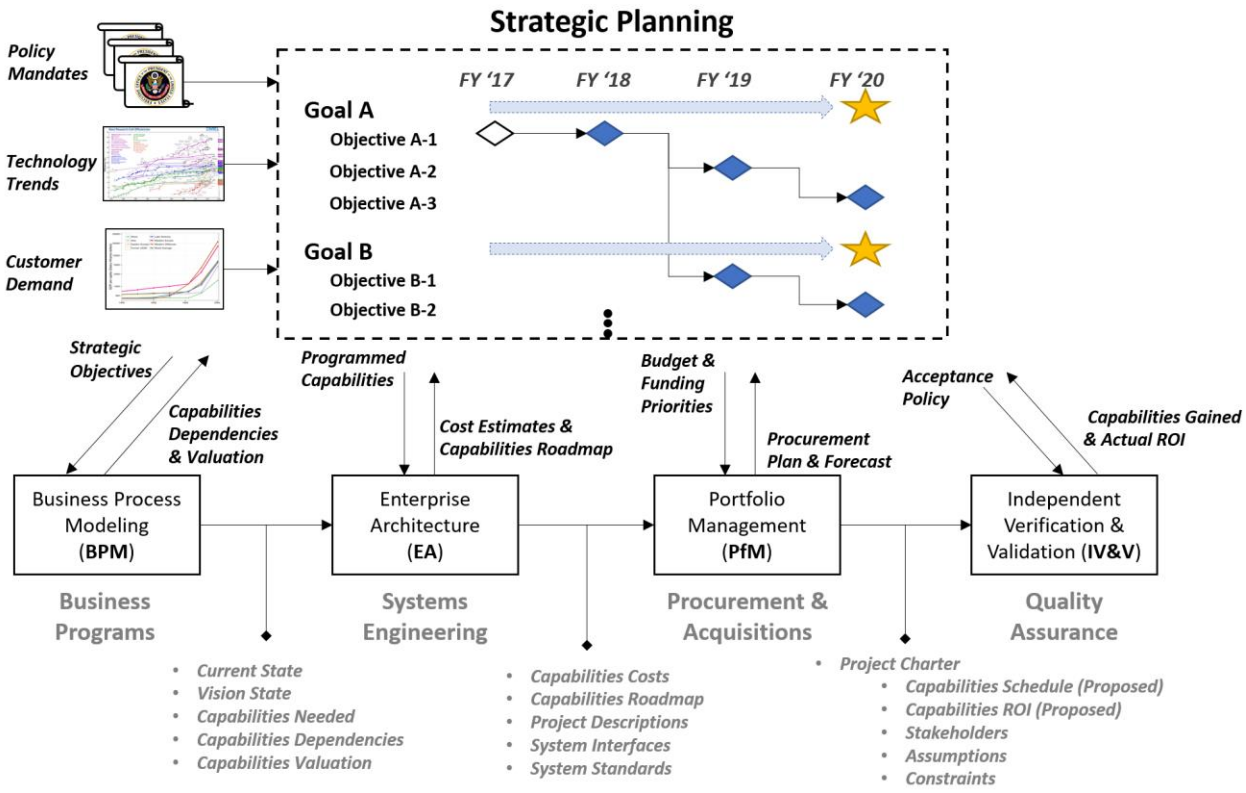
Summary: Capabilities can be delivered in many ways, meaning that scope does not constitute capability. However, the Capability ROI is sensitive to the final scope delivered, just as shown in the three alternative solutions to the LED project (CFLs, Halogens, and de-lamping). The decisions to achieve the Capability and maximize the Capability ROI is almost always best left to the project teams with ground-level knowledge. However, management should track and intervene when large, negative changes are proposed or when scope deviates from the project constraints and standards needed for enterprise integration.

Earned Capabilities Management encourages rethinking the original scope to deliver cheaper alternatives, adjust for competing objectives, and discover novel solutions.

V. *Enterprise Capabilities Management:* *Controlling the Capability Lifecycle*

Agile and Earned Capabilities Management alone doesn't plan and manage capabilities across the organization. To manage projects effectively together, organizations should use "Enterprise Capabilities Management," which consists of:

1) *Strategic Planning* – elaborates mission and vision as goals with a series of strategic objectives
2) *Business Process Modeling (BPM)* – identifies capabilities needed to reach strategic objectives
3) *Enterprise Architecture (EA)* – estimates costs of capabilities and manages system interfaces
4) *Project Portfolio Management (PPM)* – programs and controls projects to achieve objectives
5) *Independent Verification & Validation (IV&V)* – provides actionable feedback to PPM processes



The five processes of Capabilities Management work together to move the organization forward with valuable (high ROI) capabilities. Each can be owned by different departments or whole business lines within the organization.

Strategic Planning – usually owned by the executive leadership, this process involves identifying a clear actionable path to accomplish the mission of the organization, while transforming it to become the vision at a set point in the future. Leadership evaluates the market and mandates to establish goals that elaborate the vision state. These goals are then broken down across a timeline as objectives which state the expectations of what will be needed at what time to achieve these goals. Then the objectives are iteratively assessed to determine what business capabilities are needed, the dependencies and costs of those capabilities, and finally potential projects that could deliver those capabilities. The result is a Project Roadmap that must be monitored, controlled, and updated to achieve the strategic vision.

Business Process Modeling (BPM) – usually owned by the business program, this process involves evaluating the critical path of work through an organization. This path of work is then assessed for pain points (places of high resource use) and gain points (where internal work can become externalized value). These pain and gain points can then provide a basis for a prioritized and phased set of capabilities needed to achieve higher levels of performance (e.g. strategic planning objectives). The outputs are a Process Model (Current & Vision State), and Needed Capabilities (Dependencies & Valuation).

Enterprise Architecture (EA) – usually owned by the systems engineering team, this process takes in the Process Model and Needed Capabilities, and evaluates the technical feasibility and requirements. By evaluating existing systems and available technology, the EA team can estimate costs, define interfaces, and establish required standards for managing the delivery of the Capabilities over time. This can also

involve defining new "Enabling Capabilities" needed for technical or shared requirements across business lines. The output is a Capabilities Roadmap and Cost Estimates. These outputs can be captured in a Concept of Operations (CONOPS) that includes system interfaces and standards; as well as a series of recommended Project Descriptions to deliver the capabilities.

Portfolio Management (PfM) – usually owned by Procurement & Acquisitions with support business programs and systems engineering, this process takes in the project descriptions, budget, and funding priorities to generate a series of funded projects. The projects are described by their Project Charter, which captures the proposed Capabilities Schedule, expected Capability ROIs at each delivery milestone, and the essential project information (Stakeholders, Assumptions, and Constraints). This level of detail sets clear expectations of what capabilities the project must deliver, to who, and when they are needed. However, it does not specify scope or "how" the project will be delivered. Any type of project management methodology can be used; from Waterfall with Stage-Gate controls and EVM, to fast Scrum-Agile with regular end user validation of earned capabilities, or even Scaled Agile Frameworks (SAFe) methods that use the V-Model for earned capability management across long release cycles (i.e. release trains).

Independent Verification & Validation (IV&V) – usually owned by Quality Assurance, this process takes in the Project Charter and coordinates the measurement of Capability ROI throughout the project lifecycle. Measuring Capability ROI includes testing of lower-level components (e.g. User Stories), as well as coordinating the End User Testing, Pilot Testing, and Production Testing for validation of new capabilities. To reduce the risk of low or no-ROI projects, IV&V must continue to validate the Capability is needed by the business line using simulation, automation, and performance testing.

It is important to note that the Enterprise Capabilities Management is very similar to but much lighter than the government's planning, programming, budgeting, and execution processes (PPBE). This is because the same principles apply in terms of focusing long-range business planning on the future needs, while adding detail and cost trade-off considerations at the programming and budgeting points of the process. Too often the PPBE process is mired by a fixation on scope, the one constant in traditional project management. Now that Agile approaches are helping to illuminate the disconnection between capability and scope, enterprises can reduce the effort required to form comprehensive strategies and project roadmaps. Instead a lighter, more true Capability Roadmap can guide investments and ensure projects always deliver value (or are terminated early enough to minimize waste).

Together, these five processes manage the capability lifecycle to ensure that executive leadership can identify, defend, and maximize the return on the organization's investment to meet strategic goals. At each level and each stage of the planning pipeline there is a clear separation of concerns that focuses on the priorities. First and foremost are the mission and vision that set the direction for planning transformational change. Then through deliberate planning to meet objectives, projects can be defined not by scope, but by the needed capabilities they deliver to the organization.

Earned Capabilities Management defends and maximizes the return on organization budgets, by always tying the capability lifecycle back to achieving the mission and vision

About Softek

Softek is a Minority-Owned Small Business providing technology solutions to government clients since 2007. We specialize in evolving business systems using Agile, DevOps, and Cloud technologies to deliver working solutions faster for your most critical IT challenges.

Softek has a proven track record of delivering these cutting-edge technologies at scale. Key past performance includes building DevOps solutions for CMS (Medicare & Medicaid), a Google-like discovery platform for NARA (National Archives), and migrating mainframe batch jobs to use Big Data technologies for SSA (Social Security).

Services – Softek uses a unique technical approach to adapting government business systems through service-oriented architecture (SOA), DevOps, and Cloud technologies:

- **SOA –** Innovative Service-Oriented Architectures (SOA) maximize reuse of existing systems.
- **DevOps** – Continuous delivery drives technical validation and end-user engagement.
- **Cloud** – Virtualization minimizes infrastructure requirements and maximizes processing power.

Staffing – Softek also supports government and prime vendors with technical leaders and experienced professionals who are highly valued for providing quality services:

- **Validated** – Architects are screened for experience, innovation, and delivery excellence.
- **Leadership** – Softek's Architects take responsibility for delivery and ensuring project success.
- **Reach-Back** – Architects also provide reach-back expertise across Softek engagements.

With Softek you get better value by reusing your existing working business systems and applying the technical expertise to leverage Cloud and DevOps technologies. This leads to more project success and lower total procurement costs as you build, test, and manage new transformational technologies.

Contact Us:

Imran Memon
Chief Executive Officer
SOFTEK ENTERPRISES
Imran.memon@softekenterprises.com
443.824.7922 (c) | 443.741.8715 (o)

John Johnson, PMP
Chief Technology Officer
SOFTEK ENTERPRISES
john.johnson@softekenterprises.com
412.608.2654 (c) | 443.741.8715 (o)

About ClearPlan

ClearPlan is a federally recognized small business that provides Earned Value Management (EVM) and program planning & control services to large federal and other Fortune 100/500 companies nationwide. ClearPlan is committed to the federal industry as an active member of the National Defense Industrial Association (NDIA); Department of Energy Facility Contractors Group (EFCOG); and sponsor of the College of Performance Management (CPM), the world leader in supporting federal EVM policy and industry to government communication.

ClearPlan brings a systems engineering approach to our projects, focusing on the program and business requirements to drive a systematic process to bring the highest value, individually customized solution to each of our clients.

- **Designs** based upon specific requirements and compliance
- **Develops** world class integrated management systems
- **Deploys** in the most challenging, high profile environments
- **Runs** large, complex management systems
- **Leads** in the Project Management Industry

ClearPlan's team is comprised of industry experts in designing, building, integrating, and running efficient, compliant Federal Earned Value, program planning, and other Management and Control Systems. ClearPlan is an established industry leader in emerging project management techniques. In 2015 ClearPlan presented the well regarded "The Art of Planning" presentation, which describes strategies for utilizing program planning as a problem-solving management tool. ClearPlan utilized its industry leading expertise in creating integrated cost and schedule models of complex development engineering projects. This presentation was showcased at EVM World and other locally-hosted nationwide events. ClearPlan has also been leading an effort to document the keys to successfully integrating agile software development processes into a compliant EVM System.

Contact Us:

Josh Garvey
President
ClearPlan
joshgarvey@clearplanconsulting.com
727-543-2116 (c) | 888-249-7990 (o)

Robin Pulverenti
Consultant
ClearPlan
robinpulverenti@clearplanconsulting.com
315-572-1415 (c)

House of Waste and its Implication for Project Management

Charles Igwe[1], Alireza Mohammadi[2] , Fuzhan Nasiri[3,] and Amin Hammad[4]

[1]Phd Student, Department of Building, Civil & Environmental Engineering, Concordia University, H3G 2W1 Montreal, Quebec; c_igwe@encs.concordia.ca

[2]Phd Student, Department of Building, Civil & Environmental Engineering, Concordia University, H3G 2W1 Montreal, Quebec; areza.moh@gmail.com

[3]Assitant Professor, Department of Building, Civil & Environmental Engineering, Concordia University, H3G 2W1 Montreal, Quebec; fuzhan.nasiri@concordia.ca

[4]Professor, Concordia Institute for Information Systems Engineering, Concordia University, H3G 2W1 Montreal, Quebec; hammad@ciise.concordia.ca

ABSTRACT

The ability of construction projects in satisfying the key performance indicators of time, quality and cost have long been the subject of concern to industry practitioners and the academia over the years. Many project management tools, techniques, and processes have been suggested as means of managing projects to ensure that they better meet the expectations of stakeholders, but these have not been entirely successful in improving value due primarily to the prevalence of waste. The underlying principle of lean thinking in construction is to enhance value through the elimination of waste. This study focuses on categorizing the lean wastes based on the transformation-flow-value theory and prioritizing them using the analytical hierarchy process (AHP). A new concept called the house of wastes was introduced to elucidate the interconnection of the lean waste. The goal of this research is to identify and rank the parameters required to facilitate waste reduction to improve the management of construction projects.

Keywords: Lean construction, waste, project management, AHP

INTRODUCTION

The ability of construction projects in satisfying the key performance indicators of time, quality and cost have for long been the subject of concern to industry practitioners and the academia over the years. The manufacturing industry, when compared to the construction industry, has recorded better performance in terms of productivity, flow, quality control, waste elimination and value generation by adopting a new production philosophy tagged “Lean Manufacturing” which was adapted from the Toyota production system (TPS) made famous by the Japanese auto industry. The focus of the lean enterprise is to ensure that the project delivers value to the project stakeholders by making certain that wastes are eliminated through a systematic approach based on transparent information flow and collaboration. Aziz and Hafez (2013), however, asserted that

the presence of waste has negatively affected the performance and overall productivity in the construction industry. To increase the productivity of the industry, it was suggested to transfer some lean manufacturing principles, tools, and techniques to construction.

The attempt to transfer the principles of lean manufacturing to construction was first proposed by Koskela (1992). It is based on the philosophy that rejects all kind of wastes (Waste in this instance is regarded as any non-value activity). According to Howell and Ballard (1997), lean thinking lays emphasis on value generation, Fewings (2013) asserted that lean thinking goes beyond seeking to eliminate waste but also extends its focus on value delivery to the client starting from the design through to the handover of a project. Lean thinking creates a means for specifying value and differentiates value adding from non-value adding activities and helps in the sequential arrangement of value-adding activities (Womack and Jones 2010). The main thrust behind lean thinking is the reduction, and eventual elimination of waste. Although there has been considerable number of research with respect to waste in the construction industry, there has been little attempt to prioritize these wastes in terms of its association with transformation activities, flow aspect of production and the role management activities play in the generation and elimination of waste.

The classification and prioritization of waste are important factors in its identification and elimination as this helps us to aggregate and rank the wastes in order of importance to be able to properly focus intervention measures. The objectives of this research are to classify and prioritize wastes based on the transformation-flow-value principle and highlight the interdependence of the lean waste using "the house of waste", to better understand its implication for project management.

LITERATURE REVIEW

Lean construction was first discussed by Koskela (1992) who investigated what he referred to "the new production philosophy and its application to construction" and he went further to claim that the attempt to improve the construction processes will continue to fall short of the desired results due to the absence of a general theory of production. He posited that three fundamental elements (transformation, flow, and value) need to be added to a production theory for the gains of the lean production system in manufacturing to have any meaning for construction (Koskela 2000).

Lean construction has continued to evolve over the years and the lean construction literature is characterized by a lack of commonly used definitions to aptly capture its meaning. According to Emmitt (2014), lean construction has far-reaching interpretations that range from definitions which include design and construction activities to very limited interpretations related to precise functions and/or applications. Emmitt (2014) proposed a simple definition of lean and asserted that lean construction is a production system designed in a way to reduce waste of materials, time and effort to facilitate the creation of maximum value. Lean construction refers to the application and adaptation of the concepts and principles of the TPS to construction (Sacks et al. 2010) and places emphasis on reduction of non-value activities otherwise referred to as waste as a means of value improvement. Green and May (2005) asserted that lean construction can be regarded as consisting of a set of techniques, a social-technical paradigm or a cultural commodity that can be directly applied to construction while Koskela

et al. (2002) claimed that lean construction represents a way to design production systems to discourage, minimize and eventual eliminate waste of materials, time and effort to facilitate the generation of maximum value. Aziz and Hafez (2013) contended that lean construction has altered the traditional view of a project by embracing the concepts of flow and value generation. Regardless of the different definitions of "lean" there exist two common features in all the school of thoughts on lean and these are: reduction/elimination of waste and focus on value as defined by the client.

The concept and application of lean thinking

The reduction and eventual elimination of waste is the main idea behind lean thinking. It is based on the philosophy that rejects all kind of wastes. According to Howell and Ballard (1997), lean thinking lays emphasis on value generation, Fewings (2013) asserted that lean thinking goes beyond seeking to eliminate waste but also extends its focus on value delivery to the client starting from the design through to the handover of a project. Lean thinking creates a means for specifying value and differentiates value adding from non-value adding activities and helps in the sequential arrangement of value-adding activities (Womack and Jones 2010). The principles of lean thinking in production are based on different management philosophies like Just-In-Time (e.g. lot size reduction, cellular manufacture, continuous flow, etc.) Total Preventive Maintenance (preventive maintenance, maintenance optimization, corrective maintenance, maintenance scheduling, and strategies), Total Quality Management (benchmarking, quality management, continuous improvement, process measurement) and Human Resource Management (workforce diversity and flexibility). According to Koskela (2000), the principles of lean thinking are based on (i) reduction in the share of non-value activities; (ii) reduction in the lead time and variability and (iii) increased flexibility, transparency, and simplicity of operations. The five main principles of lean thinking as highlighted by Womack and Jones (2010) includes (i) value, (ii) value stream, (iii) flow, (iv) pull and (iv) continuous improvement. The application of the lean principles is geared towards creating value for the project stakeholders by ensuring that the share of non-value adding activities is reduced.

Transformation-Flow-Value model of production

Koskela (1992) proposed a means for adapting lean production concepts into construction and suggested three ways through which this can be attempted, namely: (1) **T**ransformation; (2) **F**low; and (3) **V**alue generation (TFV) theory of production. This three-way view of production subsumes the transformation dominated construction management (Bertelsen and Koskela 2002; Koskela et al. 2002) and is one of the basic criteria for the implementation of lean construction. There are three basic features involved in production. The first has to do with the transformation of input into output. This input may be in the form of labor, equipment, and materials needed to convert raw materials into the finished product. The second feature is "flow" and concerns activities along the value chain such as transportation, storage, waiting and inspection. The third feature of production involves meeting the customer's expectation by ensuring that the final product conforms to the client requirements. These three features of production are encapsulated in the TFV model which regards construction as a transformation process.

A closer review of the TFV model shows the relationships between a projects key performance indicators (KPI's) of cost, quality and time. The transformation process of the model facilitates the reduction of project costs by ensuring the minimization of the cost of subprocesses. The flow view process reduces the time to completion of a project through the elimination and/or reduction of non-value adding activities while the value generation view aims at ensuring that the project quality requirements are achieved using the least functional cost ratio. The TFV model provides an important criterion for lean construction. Tezel (2011), however, warns that using the TFV approach requires that the interaction between flows and the construction processes be closely monitored to ensure the reduction of waste and process variability and Koskela (2000) argued that the peculiarities of the construction sector make it very challenging in creating continuous flows.

Construction Wastes

Waste in the construction industry has generated a lot of interest and research over the years. However, Aziz and Hafez (2013) claimed that the subject of these researches has been focused on material waste. Formoso et al. (2002) claimed that this is perhaps because material waste is tangible and therefore easy to see and measure. In lean thinking, however, waste is associated not just with tangible wastes but also intangible wastes and therein lies the problem as it is difficult to measure the intangible aspects of waste. Identification and elimination of waste are crucial to the success of lean. One of the most important definitions of waste was put forward by Womack and Jones (1996) when they asserted that waste is any activity that makes use of resources without creating value. However, Aziz and Hafez (2013) asserted that it is quite difficult to measure waste when it s is being measured in terms of the efficiency of the process, equipment or personnel because the optimal efficiency is not always known.

Attempts have been made to classify construction wastes into controllable and non-controllable wastes. Controllable wastes, as the name suggests, are wastes that can be controlled. Alarcon (1997) separated these into three different activities:

A. *Controllable wastes associated with flows*: resources (material, equipment, labor), information (lack of information, poor information quality, timing and delivery of information);
B. *Controllable wastes associated with transformation*: planning (lack of workspace, poor work conditions, scheduling), quality (poor execution of work, damages to already finished work);
C. *Controllable wastes associated with management activities*: Decision making (poor allocation of work to labor, poor distribution of personnel), poor supervision/control.

Uncontrollable wastes, on the other hand, are wastes caused by unforeseen circumstances such as force majeure.

Lean Wastes

Ohno (1988) identified seven wastes associated with the lean philosophy and this was expanded to eight by Liker (2004). These wastes are responsible for downtime experienced in construction projects (Table 1) which is directly reflected in the loss of productivity.

Table 1: Lean wastes (Adapted from Terry and Smith 2011)

	Type	Examples
D	Defects	• Incorrect information on drawings • Rework • Inspections to reduce/remove defects, • Production of defective work, not meeting specifications
O	Over-production	• Producing items earlier than needed or beyond specification • Producing more than is required • Generating waste through over-staffing
W	Waiting	• Equipment downtime • Documents awaiting approval, updating or processing • Workers unable to do value creating work • Waiting time between processes or for capacity to take the next step
N	Non-utilized talent	• People working one or two levels below their true capability • Lack of knowledge learned from one project transferred to another • Losing time and ideas, skills improvement and learning opportunities
T	Transportation	• Moving work in progress from one place to another • Moving temporary site facilities from one location to another • Delivering equipment, incomplete orders • Moving material to and from storage
I	Inventory	• Excess raw material, WIP or finished goods causing longer lead times, damaged goods, transportation/storage costs and delays • Too much material compromising the workspace • Large site storage of materials
M	Motion	• Unnecessary movement of people and equipment that does not add value • Walking between workplace and welfare facilities, manual paperwork processing • Unnecessary movement of personnel and equipment at site
E	Extra-processing	• Taking unnecessary steps • Providing higher quality products than necessary and produced to standards beyond specifications • Inefficient processing, especially due to poor design or work planning causing something unnecessary

RESEARCH METHODOLOGY

The Design science research methodology was adopted. Aken (2004) asserted that that design science is not concerned with action itself but with knowledge to be used in designing solutions. According to Lukka (20013 and Saunders et. Al, (2009), the design science involves the creation of new knowledge through design of novel things or processes and analyzing what has been created through reflection and/or abstraction. The methodology flowchart is shown in Fig. 2.

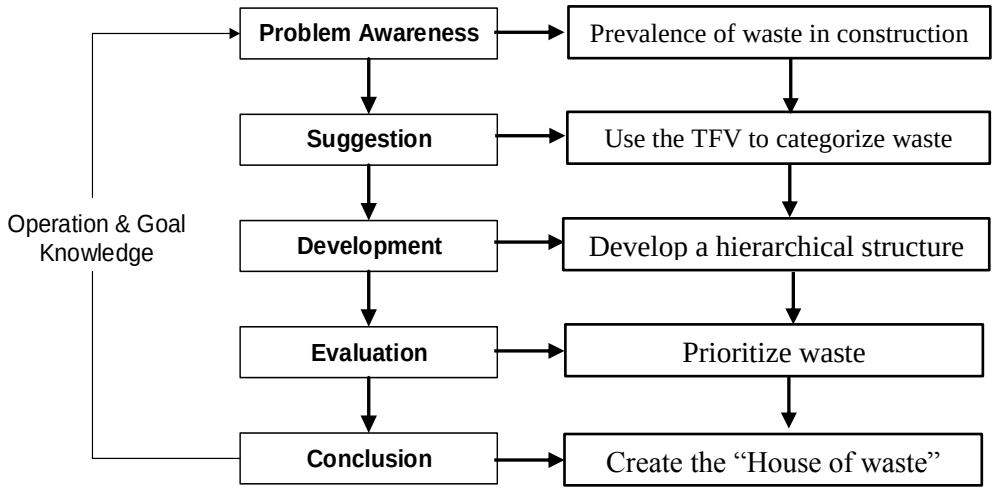


Figure 2: Methodology Flowchart

The research objectives were achieved starting from a theoretical approach that formed the basis of classifying the lean wastes into three categories using the classification by Alarcon (1997) as a starting point and modifying it to suit the TFV theory. The wastes were grouped into (i) wastes associated with transformation activities, (ii) wastes associated with flows and (iii) wastes associated with management activities shown in Fig. 3.

A decision hierarchy was constructed to derive priorities for the criteria based on a pilot questionnaire survey conducted on industry practitioners and the results were analyzed using the AHP. The AHP is a decision-making strategy used to compare alternatives on given criteria based on assigning priority weighing to the alternatives (Saaty 1980). The goal of the AHP in this research is to obtain priority weights for the sub-criteria (Level 2) of the developed framework and elucidate its implication for project management.

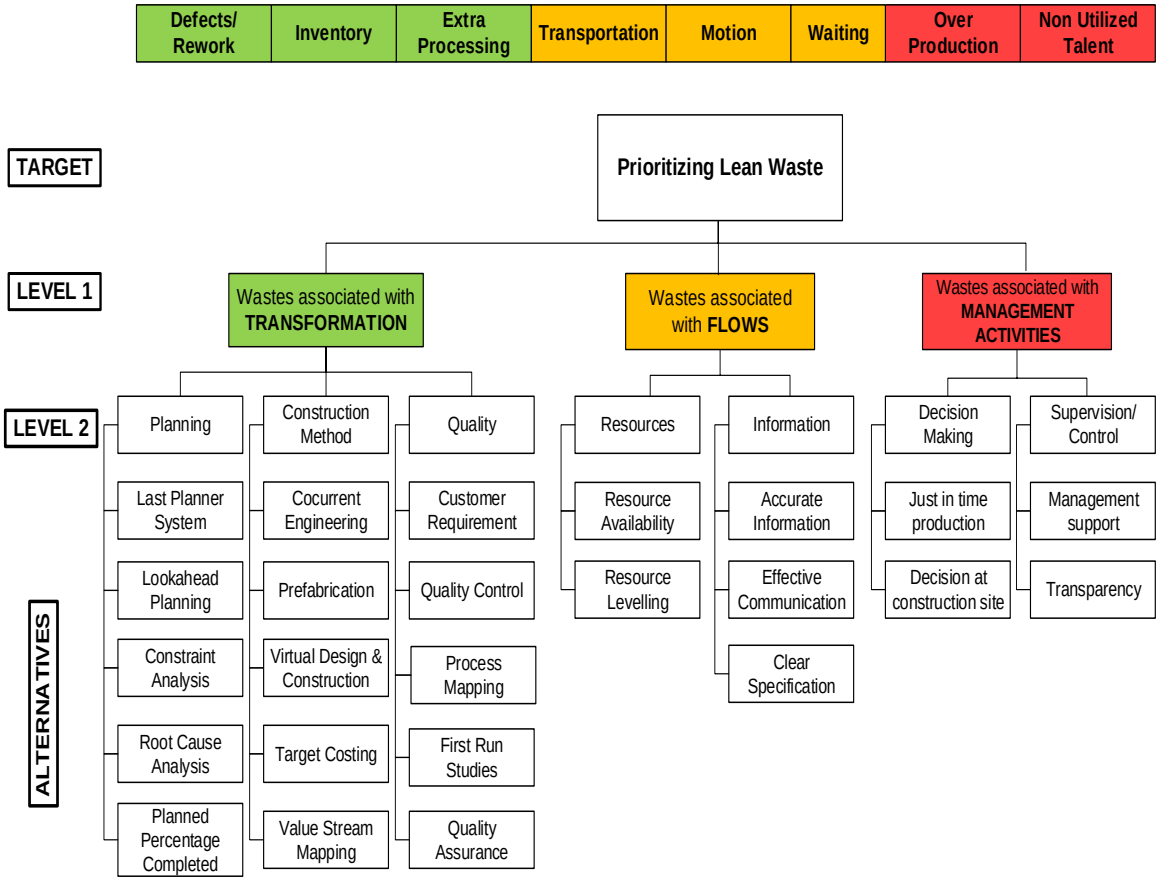


Figure 2: AHP for prioritizing lean wastes

The procedure required for the AHP as proposed by Saaty (1980, 1987) includes the following steps:

1. Pairwise comparison is determined for each level of the AHP by constructing a matrix for the pairwise elements.
2. The values in each column of the pairwise matrix are summed, thereafter, each element of the matrix is divided by its column total to generate a normalized pairwise matrix.
3. When all the normalized pairwise comparison is made, the priority vectors are calculated by finding the row averages, the consistency of comparison is determined by using the eigenvalue (λ_{max}) to calculate the consistency index (CI), [CI= (λ_{max}-n)/(n-1)] where n = No of criteria.
4. The consistency ratio (CR) is then calculated by dividing the CI with the appropriate value of the random index (RI), shown in Table 3. If CR does not exceed 0.10, it is acceptable but if it does, the judgment matrix is inconsistent and should be reviewed and improved (Saaty 1980; Al-Harbi 2001).

Table 2: AHP scales (Saaty 1987)

Weight	Definition
9	Extremely Important
8	
7	Strongly more important
6	
5	More important
4	
3	Slightly more important
2	
1	Equally important

Table 3: Random index (RI) values ((Alonso and Lamata 2004)

Size of matrix (n)	1	2	3	4	5	6	7	8	9	10
Random consistency	0	0	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49

Data Analysis

Data were collected from 6 respondents each being a leader in the field of lean construction and analyzed using the AHP steps, scales and random index value explained above. A sample calculation for one of the respondents is shown in Table 4 and the overall analysis of the results with the relative weights is presented in Table 5'

Table 4: Example of Judgement matrix

					Transformation Matrix				
		Planning	Construction Method	Quality	Planning	Construction Method	Quality	w	cv
Level 2 (Transformation)	Planning	1.00	1.00	5.00	0.45	0.45	0.45	**0.45**	3.08
	Construction Method	1.00	1.00	5.00	0.45	0.45	0.45	**0.45**	3.08
	Quality	0.20	0.20	1.00	0.09	0.09	0.09	**0.09**	3.08
		2.20	2.20	11.00				λmax	3.08
								ci	0.04
								cr	**0.069**

Wastes due to management activities had the highest overall weights and this is consistent with the demands of the lean construction paradigm which places great importance on management commitment and participation in the lean journey of any organization. Priority was given more to wastes associated with flows than wastes associated with transformation. This is again consistent with research on lean construction as flows typically drive transformation.

Table 5: Summary of Results

Level 1	Level 2	Relative Weights
Transformation	Planning	0.21
	Construction method	0.04
	Quality	0.04
	Total	**0.29**
Flows	Resources	0.19
	Information	0.16
	Total	**0.35**
Management Activities	Decision making	0.24
	Supervision/control	0.12
	Total	**0.36**

DISCUSSION

The identification and elimination of waste is the driver to adding value as both waste and value are at different ends of the spectrum of what project stakeholder's desire. However, although there is a significant amount of non-physical wastes in the construction industry, the drive towards the identification and elimination of waste has been mainly focused on tangible wastes (such as material waste). It is important to put into perspective how the lean wastes contribute to the physical construction wastes through a concept we name "the house of wastes". Wastes that cannot be identified, cannot be seen. Thus, waste identification is a precursor to its elimination.

House of wastes

The idea for the house of wastes was adopted from the house of quality. The house of quality is a diagram resembling a house used for representing and defining the relationship between customer desires and an organization capability for meeting those desires either through its products or services. Representing the lean wastes as a "house" presents a holistic way of viewing and understanding the relationship and interconnection between them with the aim of elucidating how one waste can serve as a driver for the others and how the reduction and elimination of the "driver" waste can lead to the creation of more value for stakeholders.

Non-physical wastes play an important part in the discussion of wastes, but they have typically not been given the same attention as physical wastes. It is important to consider the interrelationship between these non-physical wastes and how they affect the management of projects.

Wastes associated with overproduction is considered the tipping point of all other wastes associated with the lean construction paradigm. This waste includes any resources more than what is required to perform an activity whether they are people, equipment, material or facilities. Overproduction increases cash outlay without an attendant increase in value. A typical example of this can be found in construction projects where excessive workforce leads to increased overhead cost, and excess equipment and facility increases the cost of depreciation. Overproduction has a strong impact on the cost aspect of project management and typically is the precursor to other forms of waste in the "house of wastes". Overproduction requires the "transportation" or transfer of the overproduced components to a storage facility where they will be stored till needed, leading to the waste of motion and inventory. During the process of trans-

ferring the overproduced material, storing or retrieving it, the waste of defect may occur. All these give birth to the waste of extra processing (the process of trying to restore the defect). At the center of these wastes is the waste of non-utilized talent/ employee creativity. These wastes have the effect of reducing productivity, reducing value for the stakeholders through an increase in cost and generally affect project management.

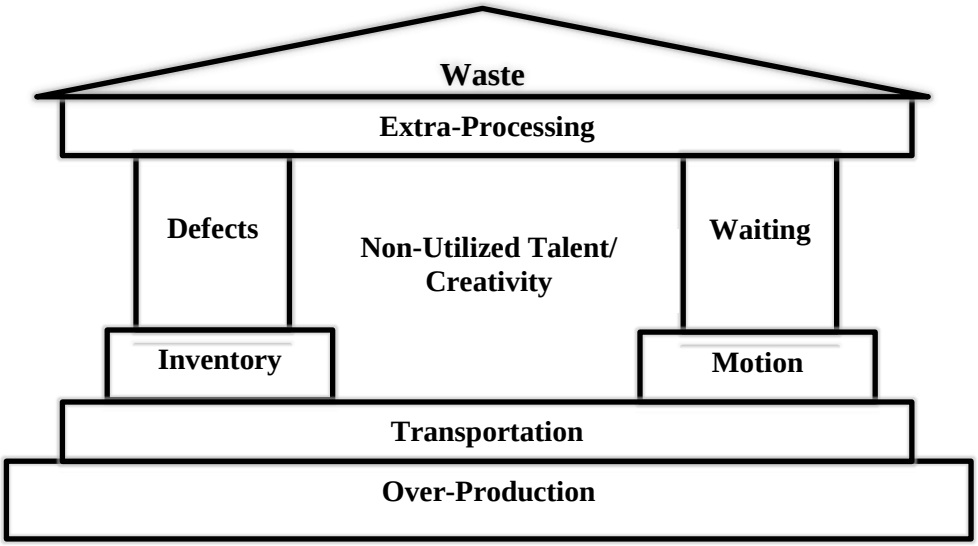


Figure 2: House of waste (adapted from house of lean)

CONCLUSION

Lean thinking in construction provides an excellent opportunity for reducing wastes. Regardless of the extensive body of literature, few works have been dedicated to classifying and prioritizing the lean wastes. This study focused on prioritizing the lean wastes based on a categorization system adapted from the TFV theory of production. The essence of this prioritization is to better understand where to focus intervention measures to help reduce the effect of these wastes to improve value. The "house of wastes" was also introduced to explain the interdependency of the lean wastes and its implication for project management. However, the research has some limitations and one of the limitations is that the main consideration of the AHP was in prioritizing the wastes associated with transformation, flow, and management activities and their criteria. Prioritizing the alternatives was not considered as part of this research. The research also did not to provide solutions on how to reduce the effect of the waste through the selection and use of an appropriate lean tool/technique.

Future works would include combining the analytical network process (ANP) to show the decision relationship between the wastes associated with transformation, flow, and management activities, the AHP to show the relative weights of the sub-criteria relating to the wastes of transformation, flow and management activities and the choosing-by-advantage (CBA) method to select the appropriate lean tool/technique to optimize waste reduction with specific focus on highway projects.

REFERENCES

Aken. J. E. (2004). "Management research based on the paradigm of the design sciences: The quest for field tested and grounded technological rules." *Journal of management studies 41, 219-246*

Alarcon, L. F. (1997). "Tools for the identification and reduction of waste in construction projects." *Lean Construction,* L. Alarcon, ed., Balkema, Rotterdam, Netherlands, Netherlands, 365-377.

Al-Harbi, K. M. A. (2001). "Application of the AHP in project management." *Int.J.Project Manage.,* 19(1), 19-27.

Alonso, J., and Lamata, M. (2004). "Estimation of the random index in the analytic hierarchy process." *Proceedings of information processing and management of uncertainty in knowledge-based systems,* 317-322.

Aziz, R. F., and Hafez, S. M. (2013). "Applying lean thinking in construction and performance improvement." *Alexandria Engineering Journal,* 52(4), 679-695.

Bertelsen, S., and Koskela, L. (2002). "Managing the Three Aspects of Production in Construction." 13-22.

Emmitt, S. (2014). *Design management for architects.* Wiley Blackwell, New Jersey.

Fewings, P. (2013). *Construction project management: an integrated approach.* Routledge, New York.

Formoso, C. T., Soibelman, L., De Cesare, C., and Isatto, E. L. (2002). "Material waste in building industry: main causes and prevention." *J.Constr.Eng.Manage.,* 128(4), 316-325.

Green, S. D., and May, S. C. (2005). "Lean construction: arenas of enactment, models of diffusion and the meaning of leanness." *Build.Res.Inf.,* 33(6), 498-511.

Howell, G., and Ballard, G. (1997). "Lean production theory: Moving beyond "Can-Do"." *Lean Construction,* 17-23.

Koskela, L. (2000). *An exploration towards a production theory and its application to construction.* VTT Technical Research Centre of Finland.

Koskela, L., Huovila, P., and Leinonen, J. (2002). "Design management in building construction: from theory to practice." *Journal of Construction Research,* 3(01), 1-16.

Koskela, L. (1992). "Application of the new production philosophy to construction." *Rep. No. 72,* Center for Integrated Facility Engineering, Stanford.

Liker, J. (2004). *The Toyota way: 14 management principles from the world's greatest manufacturer.[Electronic version]*. McGraw-Hill, New York.

Lukka, K. (2003). "The constructive research approach". Case study research in logistics. Publication of the Turku School of Economics and Business Administration, Series B (1), 83-101

Ohno, T. (1988). *Toyota production system: beyond large-scale production.* Productivity, Inc., Portland, Oregon.

Saaty, R. W. (1987). "The analytic hierarchy process—what it is and how it is used." *Mathematical Modelling,* 9(3-5), 161-176.

Sacks, R., Koskela, L., Dave, B., and Owen, R. (2010). "Interaction of Lean and Building Information Modeling in Construction." *J.Constr.Eng.Manage.,* 136(9), 968-980.

Saunders, M., Lewis, P. & ThornhiL, A. (2009). Research methods for business students, Essex, England, Prentice Hall.

Terry, A., and Smith, S. (2011). "Build Lean: Transforming construction using lean thinking." *Rep. No. 696,* CIRIA, London.

Tezel, B. A. (2011). "Visual Management: An exploration of the concept and its implementation in construction". Doctor of Philosophy. Salford: University of Salford,

Thomas L. Saaty. (1980). *The analytic hierarchy process: planning, priority setting, resource allocation.* McGraw-Hill International Book Company.

Womack, J. P., and Jones, D. T. (2010). *Lean thinking: banish waste and create wealth in your corporation.* Free Press, New York.

Womack, J., and Jones, D. (1996). *Banish Waste and Create Wealth in Your Corporation.* Simon & Schuster.

INFORMATION MATTERS

Revolutionizing the Construction Industry through the Adoption of Technology

Mark Brian Bodner

Founder & CEO, Foresee Consulting

&

Gregory Lance Coburn, Esq.

Partner, Procopio, LLP

FORESEE CONSULTING
Creating Collaboration to Contain Costs

Table of Contents

Executive Summary

Project delays and cost over-runs are a fact of life for many construction projects around the world. In recognition of these challenges, the Project Management Institute (PMI) created a construction extension of the Project Management Body of Knowledge guide in 2003, in order to forestall the shortcomings that plague project management in the construction industry.[1] Unfortunately, such guidance has failed to reduce construction inefficiencies. Study after study shows that not only are delays and budget overruns rife, but productivity in the industry is lacking greatly. As a result, there is a growing cry for the construction industry to do better.

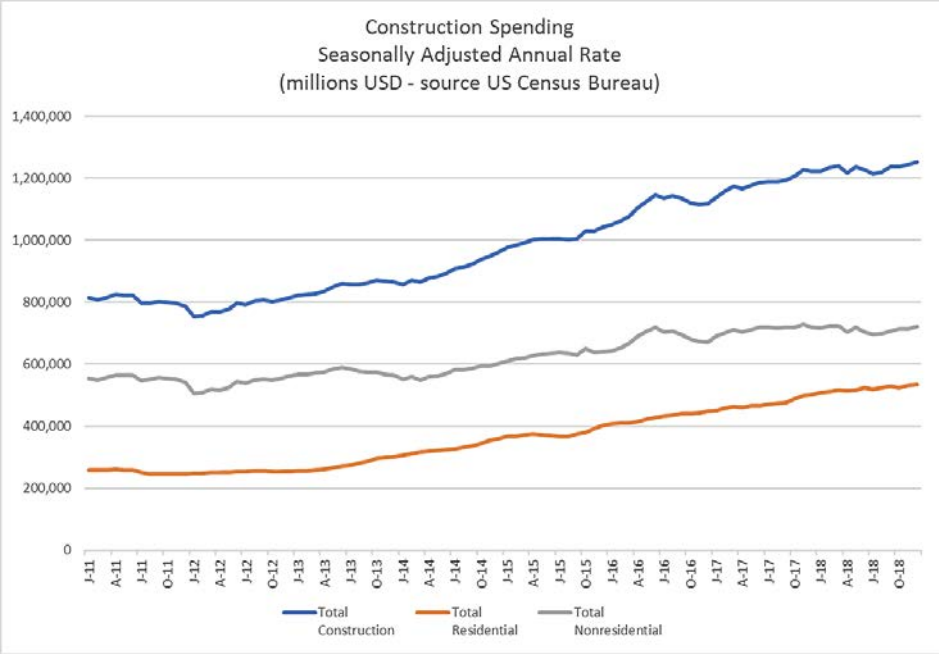
Asymmetry of information – a situation in which one party is better informed than the other party and exercises control over the flow of information – is one of the most critical (but often over-looked) factors responsible for this state of affairs. Inconsistency of access to information and control over such information is hindering efficiency in the sector and causing delays and cost over-runs.

Because Owners often do not get the information they need from Contractors (or do not have the necessary expertise to interpret the information), they essentially lose control over their projects while the Contractors exercise a monopoly over information and the project itself. This paper examines four key elements required to avoid this problem. In particular, it focuses on the role that the adoption of technology can play in revolutionizing the industry by reducing the phenomenon of asymmetric information.

[1] Pmi.org. (2017). Construction Extension to the PMBOK Guide | PMI. Available at: https://www.pmi.org/pmbok-guide-standards/foundational/pmbok/construction-extension

Introduction

The construction industry represents an interesting dichotomy of growth and inefficiency, of progress and stagnation. On one hand, buoyed by rapid expansion in major cities and unprecedented economic growth in emerging economies, the global construction industry has enjoyed a boom in the last decade. Not only is there an increase in the number of construction projects worldwide, those projects are increasingly larger, more complex, and having significant impacts on national economies. In September 2017, for example, the United States' construction spending for that month alone was $1,219.5 billion[2]. Annualized construction spending for 2017 is forecast to top $1.5 trillion. With that level of spending, it should not come as a surprise that the industry is perceived to be robust and healthy.

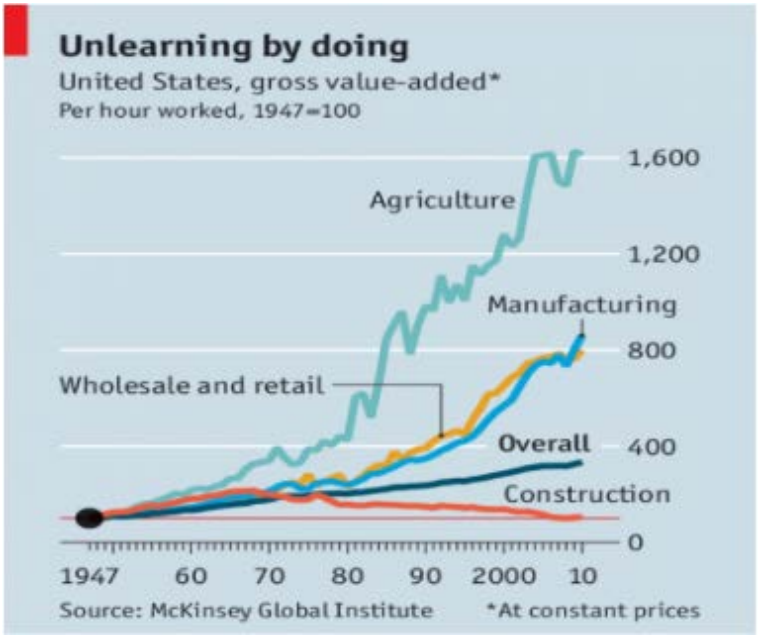


And yet, on the other hand, the industry has a dismal record when it comes to efficiency in the management and execution of projects. That contradiction can be something of a shock to those outside the industry. Surely, an industry whose very essence is in the execution of projects would be the poster child for efficiency and best practices in project management? Sadly, the data suggests that the opposite is often the case. Construction projects are fraught with delays, inefficiencies, and cost over-runs.

[2] United Sates Census Bureau Monthly Construction Spending, September 2017, Available at: https://www.census.gov/construction/c30/pdf/release.pdf

According to The Economist, 90% of all construction projects are either late or over-budget; frequently both.[3] McKinsey, the global consultancy firm, reports that construction has the lowest productivity gains of any industry in the U.S. – an abysmal 1% per annum![4] Value added per hour has been shrinking since the 1960s. Only 31% of projects are completed within 10% of the projected budget, and only 25% are completed within 10% of the set deadline.[5]

Is this malaise perhaps attributable to the complexity and size of today's projects? Not according to the data. This has been the trend for several decades now. In the U.S., the trend for productivity in the construction industry has dropped and/or remained flat for decades, and it is now half of what it was in 1960.



Naturally, this state of affairs has significant implications for the U.S. economy. The issue is expanded upon by author and lawyer, Barry LePatner, in his excellent book, *Broken Buildings, Busted Budgets*. LePatner observes that inefficiency and waste cost the U.S. over $120 billion annually, including $1.2 billion in lost productivity for Architect/Engineering firms working on capital facilities.

[3] Economist.com. (2017). *Efficiency eludes the construction industry*. Available at: https://www.economist.com/news/business/21726714-american-builders-productivity-has-plunged-half-late-1960s-efficiency-eludes

[4] McKinsey, The construction productivity imperative https://www.mckinsey.com/industries/capital-projects-and-infrastructure/our-insights/the-construction-productivity-imperative. 2015.

[5]KPMG (2015). Global Construction Survey. Climbing the curve. KPMG International, p.6. Available at: https://assets.kpmg.com/content/dam/kpmg/pdf/2015/04/global-construction-survey-2015.pdf.

What that means for the U.S. economy is lost opportunity and income that could potentially be put to good use:

> *By January 2007, construction was a $1.23 trillion a year industry in the United States. A one-time improvement in construction productivity of 10 percent would boost America's GDP by $123 billion. That sum, compounded annually at 3 percent for thirty years, would mean a real per capita income over $273 billion higher in 2037 than if the construction industry remains unreformed. Put another way, reform of the construction industry could generate enough economic growth to save Social Security as it is currently constituted.*[6]

In addition to direct costs and lost productivity, project inefficiency also comes with legal costs, as projects often become the subject of litigation. The dollar value of construction claims can be as much as 5% - 10% of project cost, which translates to up to $150 billion per annum; extended litigation costs could add as much as the equivalent value of the claim.

Interestingly enough, these challenges are not a uniquely U.S. problem. Around the world, the story is often the same. Even countries such as Germany and Japan, which are looked upon as bastions of efficiency, battle the same challenges. The Berlin Brandenburg Airport is a good example. Originally projected to cost $2.44 billion dollars with a completion date in 2012, that project has morphed into a national embarrassment for Germany, with costs currently sitting at $6.9 billion dollars, and completion expected in 2020.[7]

Predictably, such cost overruns and project delays are often portrayed in the media as scandals of incompetence and/or corruption by entities – individual and corporate – involved in the projects. However, research suggests there is often more to it than that.

[6] LePatner, Barry B. Broken Buildings, Busted Budgets: How to Fix America's Trillion-Dollar Construction Industry. The University of Chicago Press. 2007.
[7] Brook, B. (2017). *Berlin's massive new $8bn airport was supposed to open in 2012. Some say it may never*. Available at: http://www.news.com.au/travel/world-travel/europe/the-ongoing-multibillion-dollar-disaster-of-berlins-new-international-airport/news-story/ff684d8f7bee04c3776c381258d92f3a

The Primary Factor Driving Inefficiency

There are multiple factors responsible for inefficiency in the industry – poor management, ineffective supervision and insufficient investments in technology, to name a few.[8] However, one of the biggest drivers of inefficiency is the very nature of the construction business and the standard methods and procedures used industry-wide. From the immediate outset, there is often an asymmetry of information, which is driven by the power dynamics inherent in a project, which in turn changes with the stages of the project. It is a power dynamic that revolves around the control of information between Owners and Contractors.

At the outset, project owners find themselves in a rather complicated position in which they have to balance power, responsibility and control in three different contexts:

- As the Owner, they are in a position of power because of the competitive nature of the bidding phase, and because they have control over the project budget. Additionally, Owners have control over the actual information collected from both the bidding and budget phases of a project.
- At the same time, Owners are accountable to their organization's Board and have ultimate responsibility for the project's success or failure, with the potential personal financial and professional reputational costs.
- Once the execution phase of a project begins, however, the power dynamic changes significantly. Owners have very little control during project execution, because they must yield control over the project to the Contractors who have the requisite expertise.

With the first two aspects, control of information primarily lies with the Owner. With the third aspect, however, the balance of power shifts to the Contractor. Once awarded the project, the Contractor quickly establishes a monopoly over the project and associated information. The Contractor attempts to recoup any profits it may have sacrificed during the bidding process, when it may have submitted a lower bid in order to win the contract. To accomplish this, the Contractor resorts to Change Orders. Once the project is under way, Owners have very little recourse but to yield to the Contractor's demands for more funds and time extensions, otherwise they risk

[8] LePatner, B. Broken Buildings, Busted Budgets: How to Fix America's Trillion-Dollar Construction Industry. The University of Chicago Press. 2007.

incurring even greater delays and costs. At this stage, the management of the construction project is a mystery to most Owners because information is held (and hoarded) by the Contractor.

The situation in which one party (usually the Contractor) is better informed than the other party is described as "asymmetric information". When asymmetric information occurs, it can have significant economic repercussions for the other party, as well as inefficient execution of the project.

How Asymmetric Information Affects Projects

- Asymmetric information puts pressure on Owners to make hasty payments without necessary due diligence. In a bid to ensure timely completion, Owners are usually quick to make payments, sometimes without a thorough understanding of what work the payment is for. Owners are often unable to track expenses, making contractor accountability difficult.
- Oftentimes, payments are made for changed work that is in progress without the Owner having proper insight or knowledge about the specific "extra" work being performed out-of-contract. The Owner may even be unknowingly paying for "changes" that are attributable to some misstep on the part of the Contractor that the Owner shouldn't be paying for at all!
- Dealing with non-conforming work and quality assurance becomes difficult. Without access to accurate information, the Owner pays for work performed before realizing it is not up to specifications. Conversely, the Owner may be forced to withhold payment when it becomes aware there is a gap between the specifications and the final product, a step that could lead to work stoppages and even litigation.
- Acceleration cost becomes a source of major dispute between Owners and Contractors[9] when there is asymmetry of information. When delay happens (due to a number of reasons), the Contractor asks for an extension of time (EoT). Ideally, the Owner's first point of action should be to establish if the delay was self-inflicted or caused by unforeseen circumstances beyond the Contractor's control. Without adequate information, it is impossible for the Owner to determine where faults lie within their attendant contractual implications.

[9] Maritz, T. (2017). The calculation of acceleration costs on construction projects: review article. Available at: https://www.academia.edu/800911/The_calculation_of_acceleration_costs_on_construction_projects_review_article?auto=download

The fact is that too many Owners fail or refuse to devote adequate resources to key aspects of the project during the contract development phase. Often, they lack adequate project management skills. Research shows that many Owners do not have confidence in their ability to hit project schedule, budget and quality targets. According to a study by the International Project Management Association (IPMA), nearly three quarters (72%) of CEOs/COOs and Project Managers surveyed identify the ability to manage projects efficiently as critical or absolutely critical to the future growth of their businesses. And yet, only 11% of those CEOs/COOs and Project Managers were very confident in their ability to manage business critical projects in the most efficient way.[10]

This gap in the Owner's project management skills, ability or knowledge raises the need for a third party – an effective intermediary – with the right sets of skills and expertise to fill the gap. That role was traditionally filled by architects who acted on behalf of Owners, but this has since changed. Instead, construction managers (who are often viewed by many industry insiders as simply contractors with suits and ties)[11] fill that position without much advantage to the Owner. Without a knowledgeable intermediary contracted to serve the Owner's interests, the Owners find themselves in a predicament in which the Contractor is both the final determinant of cost and also in charge of construction.

Ultimately, asymmetry of information, together with the absence of effective intermediaries to offset the knowledge gap of the Owner, leads to serious project complications such as predatory contractor behavior, mutable contract cost, and probable litigation. Effectively, the Owner "drops the ball," and is at the mercy of the Contractor, who has greater monopolistic power in negotiations.[12] The ideal situation, therefore, would be for all parties to have proper, adequate, timely, and equal access to information so they can make informed decisions.

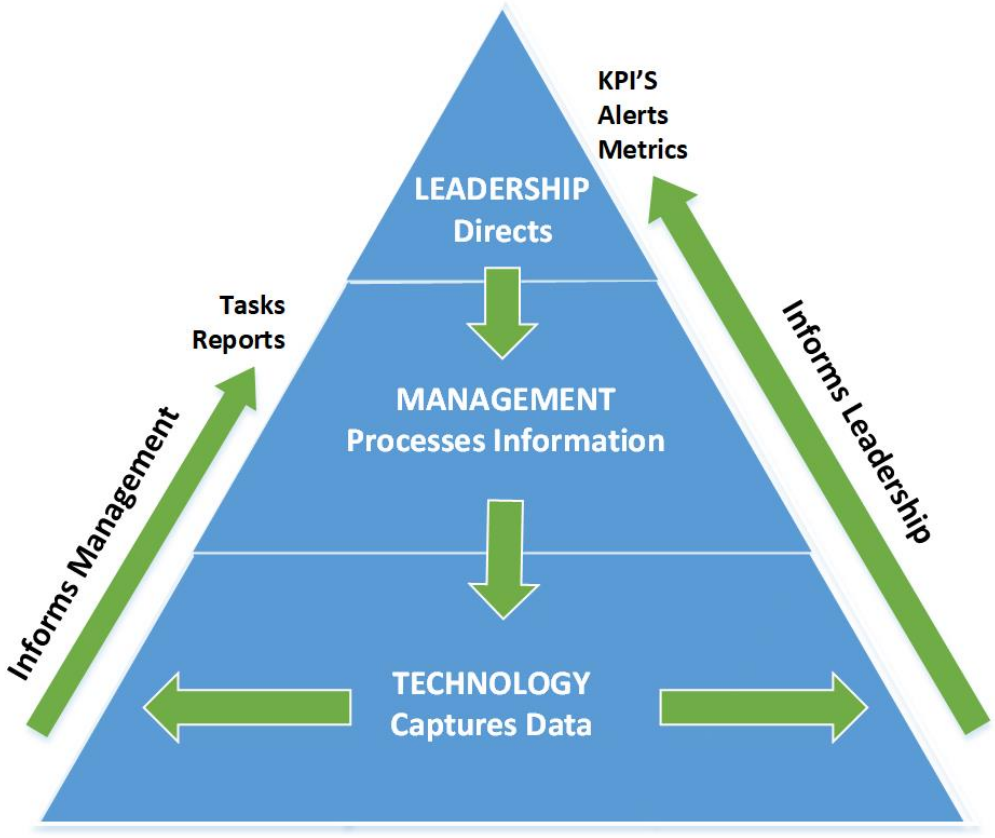
[10] International Project Management Association Study, September 2010
[11] LePatner, B. Broken Buildings, Busted Budgets: How to Fix America's Trillion-Dollar Construction Industry. The University of Chicago Press. 2007.
[12] Hillebrandt, P., Hughes, W., Greenwood, D. and Kwawu, W. (2006). Procurement in the Construction Industry. 1st ed. Hoboken: Taylor & Francis Ltd., p.11.

Achieving Low Levels of Asymmetric Information

In order to avoid the problems discussed above and achieve true cost containment, projects need to strive for low levels of asymmetric information between Owners and Contractors. The key to achieving low asymmetric information is aligning the project team around three key elements that serve to inform all constituents and executing those elements with a four-pronged approach. These elements include:

Three Key Elements

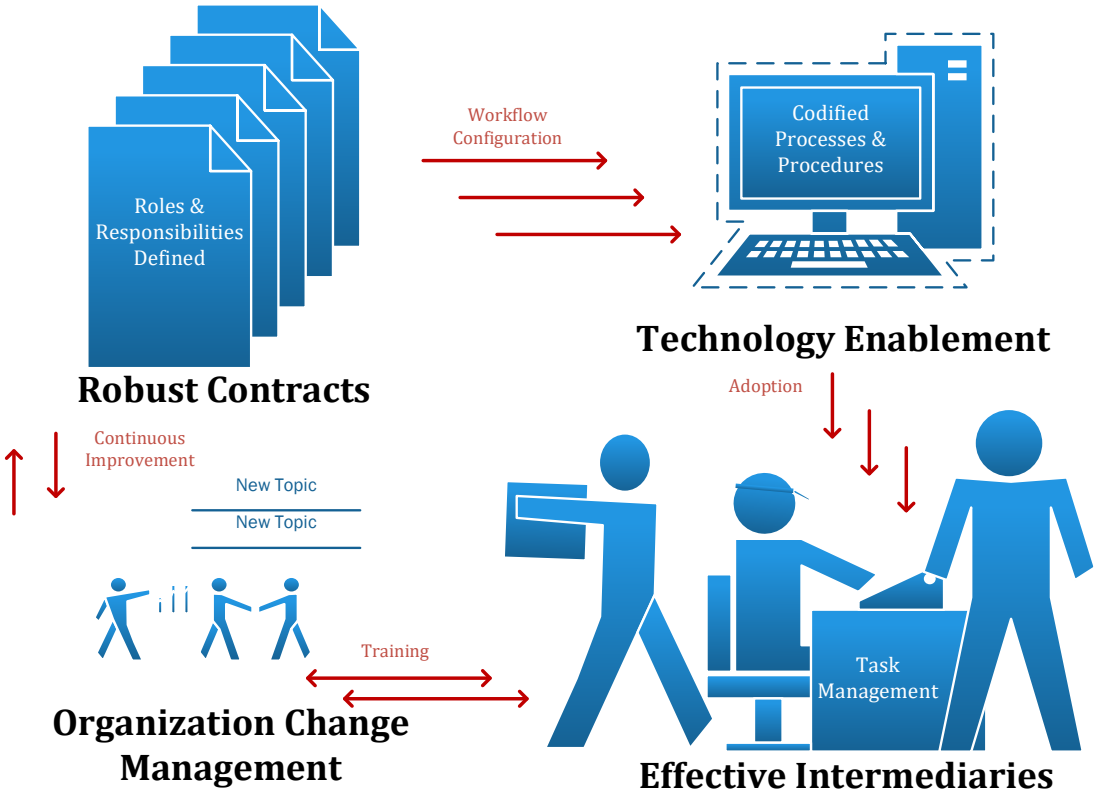
- **Leadership** that directs the delivery approach, organizational strategy and contractual methodology. This paper will further expound upon the imperative for Leadership to be fully engaged in the project delivery adoption strategies, as well as;
- **Management** that implements the strategy by managing information and processing tasks in alignment with the strategic direction of leadership; and
- **Technology** that captures the project record, facilitates communication, affords visibility of compliance and ensures the veracity of project information and reporting.



Four-Pronged Approach

The four-pronged approach to execution of the above three elements demands the following tactical components:

- **Robust contracts -** rule-based contractual requirements crafted into clear and strong contract language that mandates compliance to adopted processes, agreed terms and conditions;
- **Technology enablement** - leveraging technology (including cloud-based collaborative technologies with database functionality) to codify adopted processes, systems and responsibilities outlined in the contract;
- **Effective intermediaries** who know their roles and responsibilities and have enough expertise to understand information and prioritize action;[13] and
- **Organization Change Management** to ensure deployment of the acquired tools to monitor compliance at every stage of the project.



[13] LePatner, B. Broken Buildings, Busted Budgets: How to Fix America's Trillion-Dollar Construction Industry. The University of Chicago Press. 2007.

1. ROBUST CONTRACTS

Even without the problem of information asymmetry, the complex nature of today's construction projects, makes it imperative to have sophisticated agreements with strong provisions that address all the key elements. With the additional challenges associated with inadequate information, however, contractual requirements must be robust enough to prevent the project Owner from incurring untold delays and cost overruns.

A robust contract addresses every key element of the project. Generally, the *Agreement* identifies the legal arrangement between the parties by addressing the entities, the term, the compensation, etc. The *General Conditions* identify the specific legal arrangement between the parties. The *Drawings & Specifications* identify what is to be constructed by the contracted entity and the technical requirements of the project that are to be delivered.

The most crucial component for a successful project is the often overlooked *General Requirements* (more commonly referred to as Division 1 of the Specifications). It is in the *General Requirements* that the day-to-day processes, procedures, and individual responsibilities by job function are delineated. It contains provisions pertaining to keeping costs in check, maintaining the project schedule, and upholding quality standards. The *General Requirements* typically covers the following: project life-cycle, execution and close-out requirements, quality, price and payments, administrative requirements, product requirements and much more.[14] In short, it informs the day-to-day processes, procedures, and individual responsibilities by job function of all stakeholders in the project. For the contract to be effective, it must clearly state the specific penalties for failing to comply with outlined requirements.

However, it takes expertise to iron out the details of the document such that the Owner is well-protected. Most Owners do not have such expertise and need help. Owners need to involve credible and reputable law firms that specialize in construction, as well as construction management firms with a proven track record of aligning with the Owner's objectives to oversee the project. With the Owner actively participating (or helped by intermediaries), it assures that the Contractor is not 'blind-siding' the Owner with information or a lack there-of.

[14] England, M. (2016). Construction Estimating - Accounting Software | The Jobsite. Jobsite.procore.com. Available at: https://jobsite.procore.com/6-general-requirements-that-can-bust-your-estimate

Benefits of Robust Contractual Requirements

1. Having agreed upon requirements ensures expectations on performance and delivery are detailed enough to enforce the kind of quality the Owner requires.
2. A robust contract ensures cost is kept to a minimum because estimates are made according to specifications agreed upon by both parties before the project commences.
3. It minimizes dispute and risks of legal action for the Owner.
4. It saves everyone time and money and helps the Contractor avoid disruptions, safeguarding the project's schedule.

There are numerous law firms that specialize in construction, and working in conjunction with a reputable construction management firm is one way to achieve these objectives. As contracts are neither self-enforcing nor self-monitoring, it is important to have mechanisms for achieving these goals.

2. TECHNOLOGY ENABLEMENT

In today's technology-driven world, there is no reason why technology cannot be leveraged to sustain minimal levels of asymmetric information. Construction projects can be so complex that they become cumbersome to track and monitor. They generate a massive amount of information and involve a large number of moving parts. Owners need to track this information in real-time in order to make decisions and monitor all the moving parts to ensure they are meeting the project's objectives.

In order to get the most out of the robust contractual requirements previously discussed, the contracts need to be effectively monitored. The provisions of the *General Requirements* can be codified in a SaaS workflow application that ensures real-time visibility into the Owner's processes and procedures. Management is then afforded the ability to hold all parties accountable to their respective responsibilities.

Leveraging technology in the management of construction projects, according to Gareth Harley, Director of Engineering and Construction at Oracle, is all about "moving something from a manual process to seeing that information in real-time,"[15] where potential problems are nipped in the bud before they materialize into full-blown money-sapping and time-consuming mistakes.

[15] Peiffer, E. (2017). 10 construction industry trends to watch in 2017. Construction Dive. Available at: https://www.constructiondive.com/news/construction-industry-trends-2017/433151/

"Technology" in this context is multi-faceted and could include a wide range of options including Software as a Service (SaaS), Platform as a Service (PaaS), block-chain technology, analytics, and drones.

However, the construction industry's slowness in adopting technology is well documented. Only 8% of construction firms can be classified as "cutting-edge visionary" when it comes to technology adoption, while a whopping 69% are lagging behind.[16] Compliance is still usually tracked using spreadsheets such as Excel. There are many limitations to using Excel for construction projects, including the fact that:

1. Being accessible by multiple people makes the data susceptible to human error;
2. Changes cannot be tracked in real time, and even if the spreadsheet is designed to track changes, the data cannot be trusted;
3. The spreadsheets are not suitable for collaborative work involving multiple departments – in this case, accounts, contractors, owners, quality assurance, etc. - as only one person can access the file at a time[17]; and
4. They are cumbersome for large scale projects as time is wasted reconciling data from different departments.

What construction projects need is software that the *General Requirements* and all other project responsibilities can be codified (collected, arranged and ordered) into such that the process and procedural data are available in real-time. The traditional mode of deploying software is quite expensive and requires a steep learning curve for the users.[18] This has prompted a new wave of Project Management and Information Systems (PMIS) such as Software as a Service (SaaS) cloud-based technologies that allow Owners to adopt technology at relatively lower costs. A PMIS is designed to improve project planning, scheduling, monitoring and controlling, in order to raise the quality of decision making in each phase of the project life-cycle. It enables engineers and project managers to communicate project status swiftly and accurately with functional departments, while also keeping senior management up to speed on all the projects in the organization's portfolio.[19]

[16] KPMG (2016). Global Construction Survey. Building a technology advantage. KPMG International, p.4. Available at: https://assets.kpmg.com/content/dam/kpmg/xx/pdf/2016/09/global-construction-survey-2016.pdf
[17] Denizon. (2012). Top 10 Disadvantages of Spreadsheets. Available at: https://www.denizon.com/spreadsheets/top-10-disadvantages-of-spreadsheets/
[18] Sylos, M. (2013). Top five advantages of software as a service (SaaS) - Cloud computing news. Cloud computing news. Available at: https://www.ibm.com/blogs/cloud-computing/2013/09/top-five-advantages-of-software-as-a-service-saas/
[19] KPMG (2015). Global Construction Survey. Climbing the curve. KPMG International, p.6. Available at: https://assets.kpmg.com/content/dam/kpmg/pdf/2015/04/global-construction-survey-2015.pdf

The result of configuring the contractual responsibilities of all parties in a system that reinforces those responsibilities via electronic workflows is that it serves to align all staff for a more effective and effcient delivery of the project.

It is worth noting that, in order to be effective, whatever technology is adopted must be enforced through its inclusion in the contract.

Benefits of Leveraging Technology

1. Owners can monitor progress and track project details in real-time, catching errors and issues before they get out of hand.
2. Data integrity is preserved as errors can be rolled back.
3. Its visibility makes it easier to hold all parties accountable for their assigned roles and responsibilities.
4. It facilitates collaboration and easy communication between participants ensuring timely feedback for work completed.
5. Ensures large amounts of data files are synchronized into one location, granting easy access to all with an internet-enabled device.

6. Saves tremendous costs, not only in applying value, but in the amount of errors and disputes it forestalls. A $6.5 million to $13 million investment in technology can result in cost savings of between $151 million and $171 million. [20]

Despite these advantages, however, only 50% of the industry uses PMIS workflow applications at present. And yet, their adoption offers tremendous value, epitomized by significant time and cost savings as the case study below shows.

CASE STUDY: UNIFIER SOLUTION FOR MGM/MIRAGE CITY CENTER PROJECT

In 2005, MGM/Mirage, the premier hospitality service providers operating in Las Vegas, Nevada, embarked upon the $6.9 billion development of City Center, a gigantic construction project in the heart of the Las Vegas strip. With only 48-months to bring the project from concept to fruition, the MGM Mirage Design Group selected two firms to augment their 25-member in-house team of architects and engineers to deliver this massive project. One of those firms was Tishman Construction Corporation.

At the height of construction, the project employed over 10,000 workers and constructed more than $250 million of work-in-place per month. MGM Mirage Design Group recognized that the undertaking of such an enormous project in an unusually short period of time would necessitate a comprehensive approach to solidifying the diverse individuals that needed to come together to achieve such an ambitious task.

In order to organize the project around a single delivery strategy, MGM/Mirage tasked Tishman with the responsibility of establishing standard project protocols, systems and procedures that would solidify the 500-member management team into a cohesive unit. The Tishman organization brought in Mark Bodner to lead Tishman's work on the project and assume responsibility for delivering on the specified objectives. Prior to an 18-year stint with a competitor, Mark had served as the Vice President of Advanced Systems for Tishman. Following his extensive work on the City Center project, Mark successfully founded Foresee Consulting.

Tishman needed to determine the best approach to creating a unique culture for the project by identifying and utilizing the best-practices of each of the four main entities involved in the project, namely the Owner, Architect/Engineer, Construction Manager and General Contractor.

[20] Guy, S. (2012). Shaping Urban Infrastructures. Hoboken: Taylor and Francis, p.167.

This could only have been done with an "off-the-shelf" SaaS business process workflow software platform that was easily and rapidly configurable. Such a software platform had to:

- Provide the ability to create consistency and clarity of individual roles and responsibilities across the delivery team organization;
- Break down silos of information that needed to be shared across job functions;
- Aggregate meaningful management information reporting from the reams of data the project's administrative activities produced;
- Afford the team visibility and accountability; and
- Establish itself as the single source of truth in a "real-time" objective "project record".

Additionally, the right software solution had to offer the following functional requirements:

- Flexibility in configuration to enable the team to "work" the way they chose to work (i.e. a workflow application);
- Easily configurable forms for custom definition and function of all information gathering "fields" on each step of the workflow;
- Conformance with written procedures (i.e. the project's codified *General Requirements* which defined the administrative requirements, roles and responsibilities of the individual entities and functional staff positions);
- Conformance with the project's cost accounting and reporting requirements; and
- The option to implement the system either in the "cloud" or 'self-hosted".

At the end of the solicitation, "Unifier" (an Oracle, previously Skire, PMIS solution) was selected, having stood out because of its ability to act as a self-sustaining entity. In other words, the software was configurable without custom development that would have necessitated going back to the vendor for modification of program code. It also offered the option to self-host, was competitively priced, and could be implemented in phases.

Because the project was on a fast track schedule (i.e., design and construction were proceeding simultaneously), the project administration would have been disjointed, chaotic and essentially a free-for-all with members of each of the four main entities doing things differently, if the Unifier solution had not been found and implemented in a timely manner.

Implementation of the Solution

The Unifier solution provided the tool that leveraged expert project and portfolio management knowledge with innovative state-of-the-art technology that went well beyond the original intended scope of strictly budget and cost control. Initially conceived as a tool to support 50 users performing work in 13 Business Processes on budget and cost control tasks, the application grew to over 1,300 users performing all sorts of project management tasks in over 150 Business Processes. Despite this growth throughout the project, the technical team supporting the application stayed steady with only one Technical Specialist and an Assistant Trainee. Once configured, implemented and adopted, the Unifier solution promoted MGM/Mirage's ability to be self-sufficient in many other information requirements of the project team.

Unifier brought real world benefits to the MGM/Mirage City Center project, including Cost Management, Schedule Management and Document Management. A variety of additional Business Process designs were implemented. Some of the other capabilities it provided were:

- Centralized, accurate and real-time project data in a trusted system of record;
- Streamlined and improved processes and communications;
- Owner-defined business rules for Field Reporting and Quality Control;
- Easily created and configured workflow processes via workflow designer tools for tracking retention release requests; and
- Standardized and structured approvals for subcontractors to work on the project across the entire program.

When Owners require the following project management qualities, they would be well served to consider using Unifier:

- Accessibility, accountability, and auditability;
- A highly flexible, configurable platform that facilitates team collaboration;
- A robust web-based information system with an intuitive user interface; and
- Established values and techniques that enable visibility, standardization, measurement and process improvement.

Unifier's Impact on the Project Outcome

During the contract close-out phase of City Center, Unifier provided a clearing-house of information required to close-out contracts (it was the irrefutable system of record). Unifier also

presented the ability to access project-related documentation in real-time with an impeccable audit trail. This proved to be invaluable, as it allowed MGM/Mirage to always be minutes away from finding what was needed in a database of millions of documents.

The MGM/Mirage project manager's perspective was that the Unifier system provided information to track payments to subcontractors (as the trusted source of information) to enable the Owner to establish a range of values (by Subcontractor) to accurately forecast the final cost of the project.

Unifier also provided the tool that allowed the Owner to hold the Contractor accountable for fact-based failures, because it provided the required documentation to support or refute the Contractor's Change Order requests. The Ball-in-Court (BIC) and audit features of Unifier were vital. Unifier's workflow functionality provided an irrefutable record of actions taken by the project participants. In other words, the system kept an audit trail of who initiated each record (e.g. an RFI or Change Order request), its content, and when it was initiated, reviewed, edited, and acted upon (e.g. rejected or approved). This information was extremely effective in defeating arguments floated by any of the parties that were not based upon the factual project record.

Post-construction claims resolution was supported by the Unifier system. The Unifier system provided the basis of facts for the Owner's project management and legal teams to evaluate the scope and value of the work performed by each Subcontractor.

The Unifier system was efficient in gathering information for the attorney's argument because all project information was in one place. The system eased access to project record information for disclosures during discovery. Unifier also enabled MGM/Mirage's legal counsel the ability to place the opposing counsel into the position of accepting the veracity of the system as the system of record. During the litigation discovery phase, the system was accepted as the official communication platform amongst the Owner, design team and construction team and was relied upon by all parties. As an example, it allowed a simple query of the database that enabled the Owner's counsel to easily determine, without question, that an RFI over a disputed item of work was never raised.

The legal team's perspective was that the project records were very well-organized. The Unifier system allowed the information required for litigation to be prepared in "packets" of confidential communications, which was critical to the resolution of problems. It also resulted in over $1.7 million in cost savings, saving up to 12 man-days of effort for document organization, review and

compilation and deposition preparation, because the data was already organized and retrievable. This enabled MGM/Mirage and their legal counsel to focus on strategies and tactics months earlier than what would have been possible without the Unifier system's effective, efficient, and highly-advanced organization of the City Center project's data.

Applying Contractual and Technology Solutions to Key Challenges

Contracting and technology solutions can make a practical difference in the key areas in which information asymmetry leads to inefficiency. These solutions can impact the following:

a. Payment

Whereas traditional contracts obligate the Owner to pay on-time and pressure them to resolve changes and disputes in a timely manner to keep the project progressing, robust contractual requirements will define a standard form of a Change Order Request with information required by the Owner for a quick analysis and an efficient process, while the right project control technology will provide visibility into Contractor compliance to ensure accountability and enable pro-active and timely resolution of non-compliance.

b. Changes and non-conforming work

More often than not, payments are made for changed work that is in progress, while knowledge of specific "extra" work being performed out-of-contract-scope stays exclusively with the Contractor. Similarly, when it comes to non-conforming work, it is often the case that such work is already paid for before the non-conformance status is identified. When the non-conformance is identified prior to payment, the only recourse for an Owner is to withhold payment for the Contractor's work that does not meet specifications. This leads to work delays, litigation and other problems.

Robust contract terms combat such situations by making payments to the Contractor conditional upon identifying the specific work for which the payment is requested. The contract will also obligate the Contractor to submit as built documentation with their application for payment for "extra" work performed. Use of project control technology provides a further safeguard by ensuring that the project accounting record correlates to the general accounting records.

c. Acceleration costs

Tracking acceleration costs and the "slow down to speed up" process is another area with a heightened potential for disputes and delays. Ensuring coordination between the legal requirements in the contract (e.g. by stipulating that costs are to be "reasonably, necessarily and actually incurred") will bring about a tighter connection between the general accounting system and the project record.

The use of drones as part of the tracking controls on a project will make monitoring more effective, because their integration into project monitoring brings more "eyes" into the field, ensuring better oversight.

d. Quality Assurance

Sometimes non-conforming or substandard work is not a deliberate act on the Contractor's part. The Contractor's management may have no idea that the work in the field is non-conforming until it is too late. With robust contract requirements that clearly set forth the expectations of inspection responsibilities of all parties, Quality Assurance and Quality Control ("QA/QC") can be more closely monitored. The contract will require QA/QC roles to be filled and the policies strictly adhered to. The project control technology can then be used to monitor compliance to those contractual requirements.

3. EFFECTIVE INTERMEDIARIES

Unfortunately, Owners often fail to recognize the value of effective intermediaries – those who are independent and knowledgeable and can engage effectively with both the Owner and the Contractor throughout the duration of the project. An intermediary is "an in-between agent working deliberately towards achieving a goal."[21] Their expertise could be in any number of project areas, from funding management to design management. It could also include cost management, schedule management, contract management, quality management and scope management. Ideally, such intermediaries would be Owner staff with expertise to know what is important and can process project-critical information. In other words, the Owner should have access to such expertise within its own workforce.

In over forty (40) years of supporting high-value, high-impact projects, however, it has been our experience that Owners often do not have sufficient levels of staff that possess the required expertise. As a result, Owners either go into projects without effective intermediaries or establish a partnership with an organization that can play that role. Because it often takes a large amount of resources and time to first identify and select partners, and then coordinate their activities together,[22] project

[21] Thomas, E., Balestrin, A. and Howells, J. (2014). The Role of Intermediaries in Open Innovation: Developing a Model for Collaborative R&D. Academy of Management Proceedings, 2014(1).
[22] McKinsey & Company (1997). A revolution in interaction. Available at: https://www.mckinsey.com/business-functions/strategy-and-corporate-finance/our-insights/a-revolution-in-interaction.

Owners often stick to already established relationships for all projects and carry the same partnership into multiple projects, regardless of fit (or lack thereof).

At face value, this approach might seem useful for saving time and resources. For some projects, however, these established partnerships do not have the expertise to deal with the project requirements. In other words, different projects most likely require different sets of intermediaries depending on the type of expertise required.

Intermediaries process information during various stages of the project, ensuring that all stakeholders have the information required and that no party has a monopoly of the data.

To be successful in their role however, intermediaries need four critical elements:

a. Understanding the project's objective

Intermediaries – may they be architects, engineers, quantity surveyors, contractors, or other professionals – need to be clear regarding what they are working towards and their role in the overall picture. This will require a series of meetings to settle on measurable objectives premised on key performance indicators attached to all parties. When setting objectives and goals, it is important that everyone knows the why, who, what, and when of each outlined objective. These objectives should be documented and shared with all parties for the sake of accountability.

b. Healthy and collaborative interaction

Investing time and resources in facilitating collaboration and interaction between intermediaries can reduce time spent working by half. This is because ideas from one party help another party solve a pressing problem that could have otherwise held up the project. For the aforementioned to happen, the intermediaries need to have a connection – a vibe, so to speak. Such a connection needs to be intentionally nurtured. This involves integrating regular mandatory review meetings into the job function of all key stakeholders.

c. Provision of adequate resources

In addition to the contract provisions that guide the performance of all entities involved in the delivery of the project, most large projects will benefit from a fully developed project *Procedures Manual* that addresses the roles and responsibilities of all entities supporting the Owner's mission during the pre-construction, construction and post-construction phases of the project. A comprehensive project *Procedures Manual* must address, at a minimum, certain key subjects in explicit detail [See sidebar].

As the extensive list of subjects in the project *Procedures Manual* and the contractual *General Requirements* shows, a variety of disciplines are required to not only engineer the processes to suit the Owner's requirements, but also to implement the execution of the project throughout delivery. Because it is highly likely that individuals with the skills and experience to enforce the specific provisions delineated in these documents may not exist within the Owner's organization, they can be seconded from a variety of professional firms with the right expertise and business model.

Content of Procedures Manual

1. Project Administration
2. Architectural Facility Program
3. Design Phase Management and Scope Control
   - A/E Selection
   - A/E Contractual Responsibilities
   - A/E Management
   - Contract Work
   - Design Phase Budgeting
   - Planning & Scheduling
4. Constructor Procurement
   - Scope of Construction Work
   - Project Controls
     - Estimating
     - Scope Control
     - Cost Management
     - Planning & Scheduling
   - Bid Process
     - Contractor pre-qualification
     - Solicitation
     - Negotiation
     - Award
5. Project Execution
   - Cost Management
     - Project Estimating
     - Value Engineering
     - Change Order Estimating
     - Cost Reporting
   - Schedule Management
     - Master Schedule
     - Progress Reporting
   - Construction Execution
     - Field Supervision
     - Management Reporting
6. Technical Support
   - Standards
   - Quality Management Goals
   - Project Team's Responsibilities

d. Effective management

Effective management is critical for three key reasons: conflict resolution, keeping Contractors in check against deviant behavior, and keeping everyone focused on the task at hand. According to Transparency International, "Third parties used as intermediaries are one of the most common channels through which bribes are made."[23] This is why Owners should not only put a strong focus on creating systems

[23] PwC, *Corruption prevention in the Engineering & Construction industry*. Available at: https://www.pwc.com/gx/en/engineering-construction/fraud-economic-crime/pdf/corruption-prevention.pdf

and processes that prevent nefarious acts, but also ensure that the intermediaries brought on-board are independent, tested, and maintain a strong track record.

Benefits of Having Effective Intermediaries

1. There is equitable sharing of risk and fair incentives for intermediaries, which favors everyone including the Owner and the major Contractors.[24]
2. It promotes collaboration that has its gain in profitability and efficiency.
3. Conflicts are resolved quickly.
4. The goals and objectives of the project are disseminated to all parties - making it easy to demand accountability for execution that fails to meet requirements.

4. ORGANIZATION CHANGE MANAGEMENT

The construction industry is notorious for its apathy towards embracing change, especially when it concerns technology. For this reason, when introducing new technology and tools, as well as systems and processes that are new or uncommon, it is important to manage the disruption properly.

The fourth and final component in avoiding information asymmetry is implementing an Organizational Change Management (OCM) process. This refers to aligning the organization to utilize the technological tools which are introduced to ensure visibility into processes and monitor compliance with the rules.

The Owner must set expectations and communicate what is required of each individual. It is necessary to identify and articulate "why things are done this way" and provide feedback mechanisms in order to learn and deal with problem issues as they arise. Conducting training in required skills is paramount.[25]

[24] Out-law.com. (2017). *Construction industry must embrace collaborative working quickly or miss out on benefits.* Available at: https://www.out-law.com/en/articles/2017/october/construction-industry-must-embrace-collaborative-working-quickly-or-miss-out-on-benefits/

[25] Search CIO. (n.d.). What is organizational change management (OCM)? Available at: http://searchcio.techtarget.com/definition/organizational-change-management-OCM

Training

The best technology products accomplish nothing if users do not use or understand how to use them or what their true benefits are. A successful training program is about more than just going through the motions; it is about self-sufficiency and user adoption. It is about giving the project team the confidence that a well-designed PMIS will empower them to do more with less. A comprehensive training program can put clients who wish to become self-sufficient on a path to supporting the change themselves. With a fully comprehensive, well-designed and professionally delivered training program, stakeholders will buy into the vision and stay true to it, in spite of the obvious challenges brought on by change.

Adoption

New technology, tools and processes are important elements of any enterprise project, but workforce adoption is the most critical component. Misalignment between the technology team and business leaders, or lack of organizational readiness within the workforce, can dramatically extend adoption, invite process work arounds and jeopardize overall project success.[26]

The main vehicle for communicating and coaching the project team throughout the phases of change is a change agent that works with the organization to create a structured, intentional program made up of multiple levels of leadership hierarchy that are responsible for cascading communications, coaching the level beneath them and gathering feedback. Initially, the purpose of messaging is awareness — "what" changes are being implemented and "why" these changes are crucial for business success. Then the team is ready to move on to more granular, role-specific information — the "when" and "how" of training.[26]

Ready: People need to understand the rationale for changes taking place in their organization. Direction must be provided from the "C-Suite". Efficiency and effectiveness comes from improvement in understanding the variety and subtle differences in agendas of silo(ed) individuals that are inter-dependent but performing discrete job functions.

Successful projects require open and unvarnished communications by utilizing a top-down, bottom-

[26] The Mosaic Company, Preparing Your Workforce for Transformative Organizational Change; available at www.themosaiccompany.com

up, middle-out communication strategy[26] that:

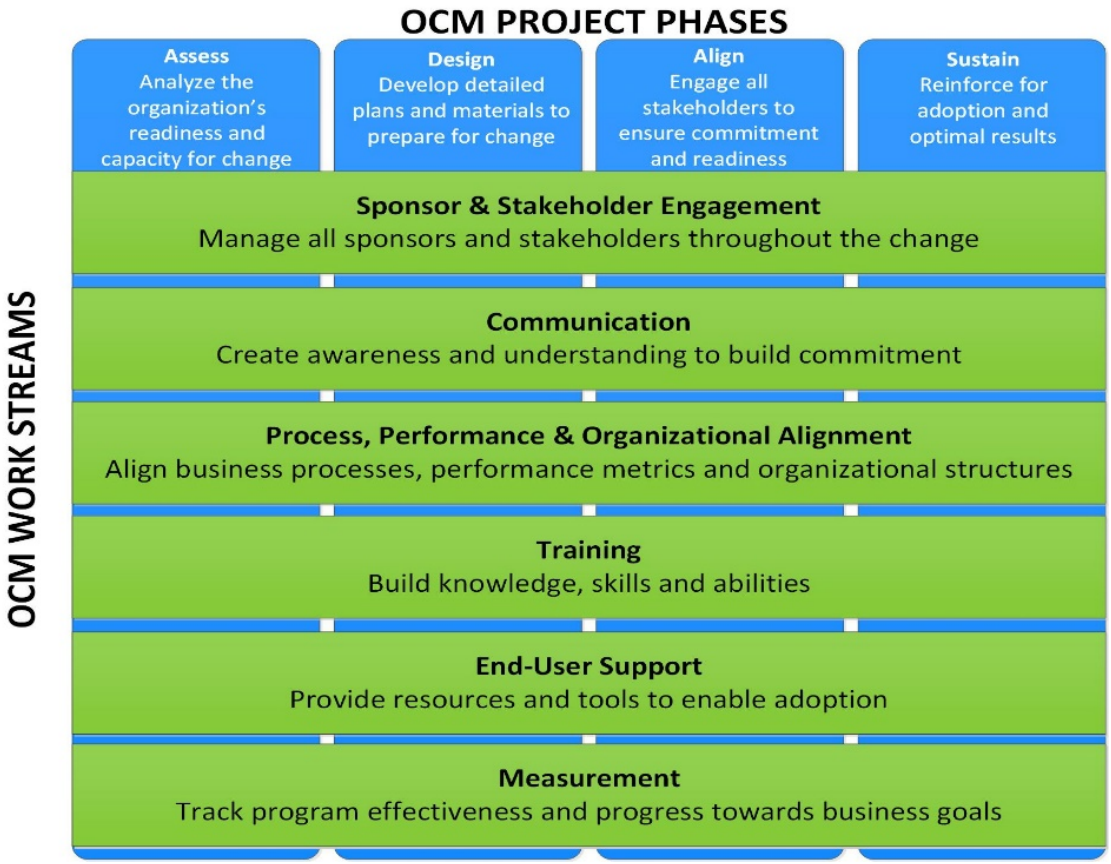
- Helps users understand the "big picture"
- Promotes awareness of process-related integrations/changes
- Clearly identifies where users fit in the process
- Provides context for process focused training
- Reinforces alignment with project vision[26]

Willing: Leadership must allow staff some "space" in their everyday "job" to accomplish the additional work required to make the necessary changes in the way they communicate, work, monitor progress and collaborate with each other.

Able: To be embraced by all team members, including contractors, training must encompass processes, procedures and systems in a variety of settings, (i.e. team based-training, individualized role-based training as well as cross-functional training). Since all individuals have different learning preferences and styles, training must also be offered through a variety of media (e.g. streamed video, off-line recorded video, on-demand and self-directed instructional videos, conventional classroom instruction, etc.). In addition, self-help guides and user-productivity kits and quick reference guides will promote user adoption.

OCM Phases & Work streams

The following infographic identifies the phases and work streams for a successful OCM program.[27]



Benefits of Change Management

- Increased speed of adoption, better utilization, and a higher degree of efficiency;
- Key business impacts identified and mitigated;
- Invites engagement between leaders and individual contributors and creates alignment for the business;
- Sustained support beyond go-live embeds to change and creates a more responsive organization[28];
- Greater ROI for investments made in the changes being implemented; and

[27] The Mosaic Company, 2015. Available at www.themosaiccompany.com
[28] The Mosaic Company 2015, available at www.themosaiccompany.com

- Reduced stress and a greater sense of control.

Change management can be a complex task. It is important that organizations have the requisite expertise to lead the process. These services can be secured from a variety of specialized professional service firms.

Conclusion

Inefficiency and its symptoms – low productivity, delays and going over budget – are a blot on the construction industry. Although widespread, the problem is not incurable. As this paper has shown, the root cause and driver of these problems is not one without a solution: by simply embracing systems and processes that prevent asymmetric information, project owners and stakeholders can keep projects within their estimated budget and time frame.

Developing robust contract requirements, leveraging technology, bringing on board effective intermediaries, and adopting organizational change management are all critical steps that Owners need to take in order to enhance the productivity and efficiency of their projects.

About the Authors

Mark Brian Bodner is the Founder & CEO of Foresee Consulting. He has been involved in the delivery of mega-projects as an Owner Representative for more than 45 years, having worked in a variety of roles including Chief Scheduler, Auditor of Budgets and Controls, Project Manager and Project Executive on a number of high-profile projects since the 1970's, such as: EPCOT Center, Canary Wharf, MetroTech, the 1996 Atlanta Olympic Games, the Ben Gurion 2000 Airport Project and, most recently, the MGM/Mirage City Center project. Foresee Consulting, in operation since 2011, is headquartered in Las Vegas with clients across North America.

Gregory "Lance" Coburn is an expert construction attorney with more than 20 years of experience. He represents clients in domestic and international business litigation and is a member of Procopio's Construction team. He provides representation throughout the construction project process, from preconstruction strategy and contract drafting to lien and defect litigation on multi-billion dollar developments. In particular, he has extensive experience representing developers of resort hotels and casinos on the Las Vegas strip in complex construction law, intellectual property rights, and lien litigation. Lance also has counseled clients on a wide range of media law matters. His practice is based in Las Vegas.

Together, Mark and Lance were instrumental in the delivery and post project resolution of claims on the $6.9 billion City Center project.

About Foresee Consulting

Foresee Consulting is a Nevada-based construction consultancy company specializing in the deployment of Oracle Cloud Solutions. Founded in 2011 by Mark Bodner, a project executive with over forty years' international project portfolio experience, Foresee Consulting has grown to become the foremost provider of project control solutions to a wide range of projects.

As a Certified Oracle Primavera Platinum and Cloud Select Partner, Foresee specializes in the implementation, integration, support, and training for Oracle Primavera Unifier. Our team of 36 professionals comprises construction and technology professionals who have a combined 200 years of project oversight experience. The team boasts more than 100 years of combined Unifier experience, making Foresee the world's most experienced Unifier solutions provider.

By applying high performance methodologies, innovative technologies and best practices for superior and sustainable project results, Foresee has successfully defined and executed Project Controls strategies for several high-impact, high-value projects across North America. Foresee consistently deploys best-in-class industry knowledge and expertise in project control technology to help clients establish standard project protocols, systems and procedures that eliminate inefficiency and delays from projects. Foresee partners with clients from the initial planning stages of a project, through training and on-going support. Some of Foresee's current and past clients and projects include:

Energy	Higher Education	Manufacturing	Commercial	Transportation
NextEra Energy	UC Berkeley	International Paper	IKEA	MWAA
Consumers Energy	USC	Ingersoll Rand/Trane	Rudolph Libbe	SLCDA
Williams Energy	McGill		Goldman Sachs	Metrolinx
Citizens Energy	University			Sound Transit

About Procopio

Attorneys practicing construction and infrastructure law at Procopio represent all segments of the construction industry including owners, developers, public entities, general contractors, subcontractors, sureties and financial institutions. They provide guidance to clients on the legal issues that arise at all stages of public and private construction projects. In addition to speaking engagements, their construction attorneys are active with the International Bar Association – International Construction Projects Committee, the American Bar Association (ABA) Forum on the Construction Industry, the Associated General Contractors of America and other construction-related organizations. Procopio also partners with Meritas and Law Exchange International working with clients around the world.

Services

Clients trust Procopio's construction law team to solve their most complex problems. Procopio focuses their deep legal and technical knowledge in the following practice areas:

- Bid protests
- Consulting during construction
- Construction contract formation and performance
- Contractual claims
- Environmental and Land Use issues
- Mechanic's lien and Stop Notice claims
- OSHA investigations and citations
- State and federal false claims act claims
- Surety bond claims

References

1. Pmi.org. (2017). Construction Extension to the PMBOK Guide | PMI. Available at: https://www.pmi.org/pmbok-guide-standards/foundational/pmbok/construction-extension
2. United States Census Bureau Monthly Construction Spending, September 2017, Available at: https://www.census.gov/construction/c30/pdf/release.pdf
3. Economist.com. (2017). Efficiency eludes the construction industry. Available at: https://www.economist.com/news/business/21726714-american-builders-productivity-has-plunged-half-late-1960s-efficiency-eludes
4. McKinsey, The construction productivity imperative https://www.mckinsey.com/industries/capital-projects-and-infrastructure/our-insights/the-construction-productivity-imperative. 2015.
5. KPMG (2015). Global Construction Survey. Climbing the curve. KPMG International, p.6. Available at: https://assets.kpmg.com/content/dam/kpmg/pdf/2015/04/global-construction-survey-2015.pdf
6. LePatner, B. Broken Buildings, Busted Budgets: How to Fix America's Trillion-Dollar Construction Industry. The University of Chicago Press. 2007.
7. Brook, B. (2017). Berlin's massive new $8bn airport was supposed to open in 2012. Some say it may never. Available at: http://www.news.com.au/travel/world-travel/europe/the-ongoing-multibillion-dollar-disaster-of-berlins-new-international-airport/news-story/ff684d8f7bee04c3776c381258d92f3a
8. LePatner, B. Broken Buildings, Busted Budgets: How to Fix America's Trillion-Dollar Construction Industry. The University of Chicago Press. 2007.
9. Maritz, T. (2017). The calculation of acceleration costs on construction projects: review article. Available at: https://www.academia.edu/800911/The_calculation_of_acceleration_costs_on_construction_projects_review_article?auto=download
10. International Project Management Association Study, September 2010
11. LePatner, B. Broken Buildings, Busted Budgets: How to Fix America's Trillion-Dollar Construction Industry. The University of Chicago Press. 2007.
12. Hillebrandt, P., Hughes, W., Greenwood, D. and Kwawu, W. (2006). Procurement in the Construction Industry. 1st ed. Hoboken: Taylor & Francis Ltd.
13. LePatner, B. Broken Buildings, Busted Budgets: How to Fix America's Trillion-Dollar Construction Industry. The University of Chicago Press. 2007.
14. England, M. (2016). Construction Estimating - Accounting Software | The Jobsite. Jobsite.procore.com. Available at: https://jobsite.procore.com/6-general-requirements-that-can-bust-your-estimate

15. Peiffer, E. (2017). 10 construction industry trends to watch in 2017. Construction Dive. Available at: https://www.constructiondive.com/news/construction-industry-trends-2017/433151/
16. KPMG (2016). Global Construction Survey. Building a technology advantage. KPMG International, p.4. Available at: https://assets.kpmg.com/content/dam/kpmg/xx/pdf/2016/09/global-construction-survey-2016.pdf
17. Denizon. (2012). Top 10 Disadvantages of Spreadsheets Available at: https://www.denizon.com/spreadsheets/top-10-disadvantages-of-spreadsheets/
18. Sylos, M. (2013). Top five advantages of software as a service (SaaS) - Cloud computing news. Cloud computing news. Available at: https://www.ibm.com/blogs/cloud-computing/2013/09/top-five-advantages-of-software-as-a-service-saas/
19. KPMG (2015). Global Construction Survey. Climbing the curve. KPMG International, p.6. Available at: https://assets.kpmg.com/content/dam/kpmg/pdf/2015/04/global-construction-survey-2015.pdf.
20. Guy, S. (2012). Shaping Urban Infrastructures. Hoboken: Taylor and Francis, p.167.
21. Thomas, E., Balestrin, A. and Howells, J. (2014). The Role of Intermediaries in Open Innovation: Developing a Model for Collaborative R&D. Academy of Management Proceedings, 2014(1).
22. McKinsey & Company (1997). A revolution in interaction. Available at: https://www.mckinsey.com/business-functions/strategy-and-corporate-finance/our-insights/a-revolution-in-interaction.
23. PwC, Corruption prevention in the Engineering & Construction industry. Available at: https://www.pwc.com/gx/en/engineering-construction/fraud-economic-crime/pdf/corruption-prevention.pdf
24. Out-law.com. (2017). Construction industry must embrace collaborative working quickly or miss out on benefits. Available at: https://www.out-law.com/en/articles/2017/october/construction-industry-must-embrace-collaborative-working-quickly-or-miss-out-on-benefits/
25. Search CIO. (n.d.). What is organizational change management (OCM)? Available at: http://searchcio.techtarget.com/definition/organizational-change-management-OCM
26. The Mosaic Company 2015, available at www.themosaiccompany.com
27. The Mosaic Company 2015, available at www.themosaiccompany.com
28. The Mosaic Company, Preparing Your Workforce for Transformative Organizational Change; available at www.themosaiccompany.com

Interdisciplinary Competence: The Key to Exceptional Project Performance

Abstract: This paper describes the benefits for integrating knowledge across project teams. Research in interdisciplinary demonstrates that better integration of knowledge is achieved through individuals attaining cross disciplinary learning. Integrated teams of interdisciplinary members achieve better problem solving through leveraging common knowledge. This common knowledge or common ground is the overlap between disciplines. Interdisciplinary project managers facilitate problem resolution across the team; leveraging common ground to produce better integration of team knowledge and ideas.

Results, from academic institutions and a 3M study, support the development of depth and breadth in disciplines to achieve exceptional performance. Traditional individual development focus on specialists and generalists. Academia has established interdisciplinary curriculums and research centers to facilitate greater advances of knowledge and technology. For complex projects, interdisciplinary project managers facilitate the integration of knowledge across the team. Developing interdisciplinary project managers require changes to organizational personnel practices to leverage the combination of depth and breadth for key positions.

As stated by John Sterman of the Sloan School of Management at Massachusetts Institute of Technology (MIT), "large scale projects belong to the class of complex dynamic systems…these systems are extremely complex, consisting of multiple interdependent components; are highly dynamic; involve multiple feedback processes; involve nonlinear relationships; and involve both hard and soft data (Sterman, 5).

Complex problems require balancing multiple conflicting and competing objectives and constraints to determine a solution. A problem limited to a single disciplinary field is solvable by experts of that disciplinary field. Complex problems cross disciplinary fields requiring multiple disciplines for a solution. Integrated Product Teams (IPTs) are multidisciplinary, comprising specialists from several functional areas; however, an IPT is challenged fusing knowledge across disciplines. Solving complex problems requires different thinking than solving simple problems.

An interdisciplinary perspective bridges knowledge between disciplines to identify solutions to complex problems. Successful teams integrate multiple disciplines to frame a problem, agree on a methodological approach, and analyze data using collaboration (Stock, 7). Exceptional teams better fuse the integration of knowledge, seeing connections and intersections that a single discipline would not. An interdisciplinary project manager facilitates the knowledge across team members, establishing an environment for good problem solving. Greater integration of disciplinary knowledge creates more effective critical thinking and innovative ideas.

Typically, the pursuit of further knowledge and exploration deals with depth within one field to gain further understanding. The concept of interdisciplinary studies requires not only depth but breadth across more than one discipline to understand the integration of knowledge between the studied disciplines.

Individuals educated in multiple disciplines are better able to design and apply a process based on conditions and constraints. This produces flexibility in thinking that challenges trained specialists; competence bias inhibits one to think past that single view. Common ground is the linkage between the disciplines creating insight and ability to gain multiple perspectives. Using a multidisciplinary approach through a team of disciplinary or functional specialists does not achieve integration or synthesis of knowledge due to lack of common ground.

Teams of specialists produce a multidisciplinary approach, viewing a problem from their own discipline and recommending solutions based on their area of expertise (figure 1). A project manager either selects one solution or needs to merge the multiple solutions into a single fused solution. This requires an interdisciplinary approach and accompanying knowledge of the various functional areas of expertise to develop a single, comprehensive solution. This fused solution is different from any single, functional solution.

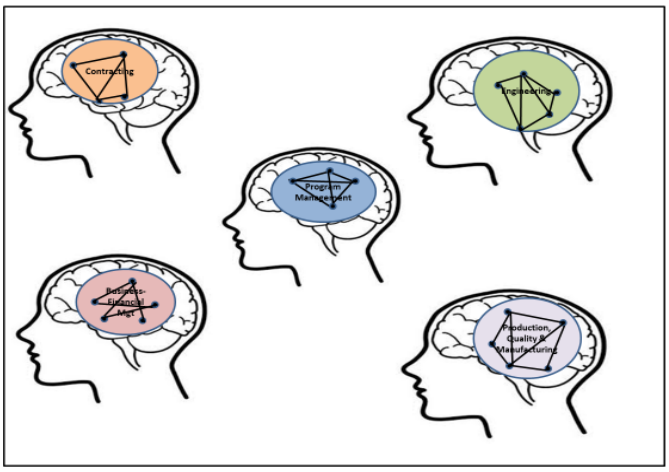


Figure 1. Multi-disciplinary Knowledge of a Team

Jay Forrester of MIT developed the system dynamic concept as a theory for understanding complex systems. He initially developed the tool in the engineering domain but then applied it to the business world. The system dynamics paradigm concludes results of decisions are disappointing because important casual relationships are overlooked or misread usually by assuming a linear or unidirectional relationship versus a nonlinear and multidirectional relationship (Martin, 152). Applying a systems perspective from engineering to business operations is an interdisciplinary approach. Specialist dominated organizations often simplify problems to linear, unidirectional casual relationships, even if the problem is more complex and multidirectional. Simplifying a problem can lead to solving the wrong problem. Interdisciplinary research laboratories, such as the Rockefeller University, recognize the need to solve complex problems with integrated, complex solutions. The university is recognized for more major discoveries in biomedicine than anywhere else in the world. The success is attributed to a laboratory environment deemed 'without walls' to promote cross-knowledge utilization of scientists on research projects.

The need to acquire breadth even when pursuing advanced degrees is recognized in the recommendations for a new vision for academic institutions. Although the findings focus on academic application for universities, institutes, and laboratories, they are easily transferable to government organizations and industry for solving problems and improving effectiveness in managing projects or programs. A workforce skilled in single disciplines challenges integration of complex technology development. An interdisciplinary workforce positions enhanced technology development through individual knowledge integration and then team knowledge integration. Common vocabulary can enhance understanding across team members.

> "A matrix structure in a university might include many joint faculty appointments and PhDs granted in more than one department which would enable participants to address cross-cutting questions more easily. It might create numerous interdisciplinary courses for undergraduates, provide mentors who bridge the pertinent disciplines, and equally important, offer faculty numerous opportunities for continuing education whereby they could add both depth and breadth of knowledge throughout their careers" (National Academy of Science, 172-173).

In the innovation process, existing brain connections (neurons) significantly change to cross a

wider number of areas of the brain dealing with different types of knowledge and problems to assimilate very different concepts and challenge long held assumptions. The strengthening of neurons in the brain creates competence bias and limits problem solving. Competence bias limits recognizing multiple solutions, reverting to one's current knowledge base without pursuing further information.

Innovation relies on an individual's expertise to generate new knowledge or create new ideas through combining ideas to create innovative applications. The researchers' state:

> "Even though many inventions are created when individuals work in teams, studies allude to the observation that individuals are effective in combining existing knowledge to generate new knowledge and innovations. Innovative ideas and insights first occur to individuals, before such ideas are subsequently shared at the group levels and institutionalized at the organizational level. Fundamentally, this highlights that individuals are the basic unit in which knowledge integration and knowledge creation takes place, regardless of whether individuals work alone or in teams" (Boh, 349).

If innovative ideas are not created at the unit level, they are not created at the team level. A study conducted on how inventors' breadth and depth of expertise influence innovation at 3M Corporation exceeded previous research focused on a single indicator, technical success achieved by the inventor. The 3M study examined three indicators: (1) the number of inventions generated, (2) the extent to which the inventor has a significant impact on the technical domain, and the inventor's career success, in terms of commercial value they have brought by converting their inventions into products that generate sales for commercial organizations (Boh, 349).

The study concluded that generalists (breadth) create many inventions but are not technically influential; specialists (depth) create fewer inventions but are technically influential. The combination of breadth and depth (polymath) of expertise create the most valuable inventors based on their record for effectively converting inventions into commercially successful products. In other words, the polymath earned the most money for 3M Corporation by producing the most marketable inventions.

A specialist is defined as one who achieves great depth in knowledge through learning and experience. The study concluded that specialists acquire ability for detail and accurate analysis of a problem leading to solutions for difficult technical problems in their area of expertise. Specialists also make difficult trade-offs and through their depth of knowledge can better predict what will go wrong. They create groundbreaking innovations through persistence of exploring deeper into an area.

Generalists have knowledge in a broad range of areas but do not acquire expertise in any one area. Generalists tend to enjoy new work and become bored when confined to one area; this inhibits their ability to develop the specialist's depth of analysis. Generalists focus on application of technologies into useful products and integration of multiple technologies into a product, creating innovation through a broader focus.

Polymaths acquired interdisciplinary competence through obtaining significant depth and breadth, first becoming an expert in one area and then expanding their expertise into other areas. One polymath inventor at 3M Corporation described the benefits of both: "his depth of expertise plays a key role in identifying the technical contributions of an idea, while he draws upon a breadth of expertise to evaluate the potential ways the invention can impact different industries" (Boh, 355). By balancing the combination of depth and breadth, polymath inventors become astute at applying, integrating, and recombining technology of their domain across other

technologies and applications. Generalist inventors focus on applying a developed technology in other applications but lack the depth to develop the technology. Generalists acquire an interdisciplinary perspective but without depth of knowledge are challenged to exploit the overlap between disciplines. Specialists develop the technology but lack breadth to apply in various applications.

How are polymaths developed? Acquiring depth probably precedes acquiring breadth. Once depth is acquired, the polymath can use that "learning how to be an expert" to develop depth in other areas faster. First acquire the ability to go deep and then apply that ability to go broad. Once the path of breadth is established without acquiring depth first, depth is probably never attained.

The study concluded that organizations need specialists, generalists, and polymaths but "both breadth and depth of expertise are required to effectively convert inventions into commercially successful products that bring sales and value to the organization. The polymaths contributed not only by generating inventions but applying those inventions widely to multiple parts of the organization, integrating with multiple technologies, thus becoming the most valued scientists of 3M" (Boh, 364).

This combination is created through starting careers developing significant depth in one area. Over time, significant knowledge and experience outside that domain is acquired. By leveraging an understanding for how to become an expert, one develops an expertise more quickly in other areas. A polymath develops an interdisciplinary perspective through attaining depth and breadth across multiple disciplines, leveraging the knowledge interface between functional areas to develop the interdisciplinary perspective faster. For example, Jay Forrester of MIT acquired expertise in system dynamics for engineering and then applied the concept of system dynamics to business and management.

For teams to be effective, team members need common ground to develop fused ideas. Each discipline develops greater depth of their discipline through linkages of the knowledge nodes. The results of the team will likely evaluate solutions based on a single, functional approach when little common ground (linkages) exists between the functions (figure 2).

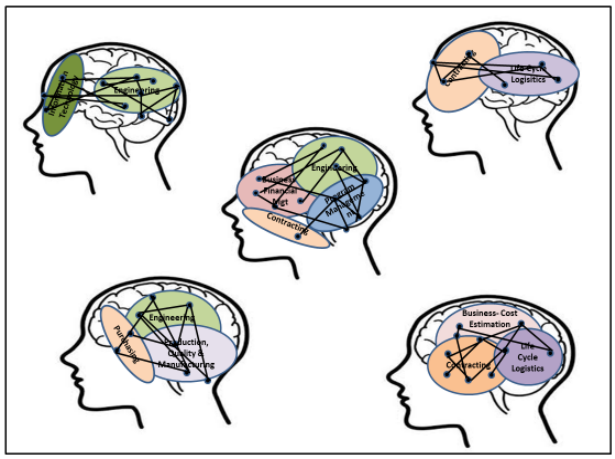


Figure 2. Lack of Linkage between Integrated Functions

Typically, project managers may lack interdisciplinary knowledge, selecting the one disciplinary solution that appears to have the most advantages with fewer disadvantages for other

areas. This is not an integrated solution. An integrated project manager has an interdisciplinary background with knowledge and experience across pertinent disciplinary areas facilitating knowledge integration through a common ground for the team. The greater the complexity of the project, the greater the need for an integrated project manager.

The common ground between the project manager and a team member can share knowledge from one team member to another team member, basically creating a network transfer of knowledge through common ground (figure 3). Common vocabulary is the most basic aspect of common ground. Interdisciplinary project managers develop expertise in a discipline and then build upon that expertise acquiring competence in other areas. This capability then facilitates knowledge across the team members. Project management career path development should cross multiple disciplinary areas while ensuring depth of knowledge within those disciplines. Experience through challenging assignments strengthens the learning and produces adaptable, resilient problem solvers.

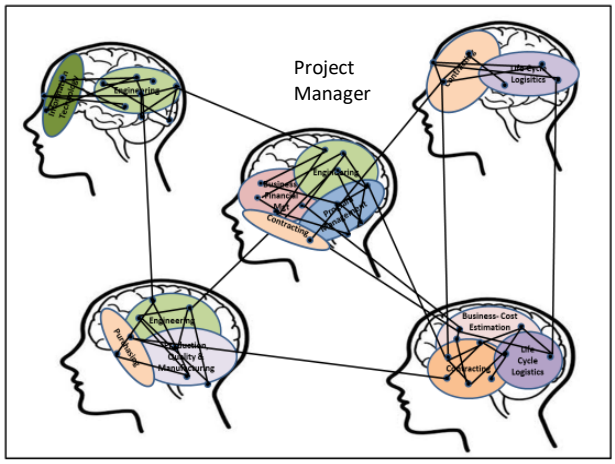


Figure 3. Knowledge Integration Maximized through Project Manager

An interdisciplinary team merges knowledge across multiple disciplines; each team member's knowledge crosses at least two disciplines (figure 3). For solving complex problems, greater insight is needed through crossing disciplines. Having the workforce develop an initial primary field establishes expertise and then secondary field certifications develop breadth. Integrated interdisciplinary teams leverage the connections of knowledge and provide a means for "seeing the space between nodes of knowledge". Common ground connects two different areas sharing modeling or statistical tools; analytical tools should complement training curriculums and position assignments. Interdisciplinary individuals resolve complex problems across multiple disciplines through the internal fusion of knowledge and understanding.

In summary, individuals create ideas. Teams improve upon those ideas. Interdisciplinary teams are more capable to synthesize ideas by leveraging common ground. Interdisciplinary project managers facilitate better team knowledge integration and therefore develop comprehensive ideas or problem resolutions.

References

1. Boh, Wai Fong, Roberto Evaristo, and Andrew Ouderkirk. *Balancing breadth and depth of expertise for innovation: A 3M story*. Elsevier Research Policy 43. 2014. http://www.elsevier.com/locate/respol.

2. Martin, Roger. The Opposable Mind: Winning through Integrative Thinking. Harvard Business School Publishing, Boston, MA 2009.

3. Academy of Sciences, National Academy of Engineering, and Institute of Medicine of the National Academies. *Facilitating Interdisciplinary Research*. The National Academies Press. Washington, DC. 2005.

4. Sterman, John. *System Dynamics Modeling for Project Management*. Sloan School of Management, Massachusetts Institute of Technology, Cambridge, MA 1994.

5. Stock, Paul and Rob J.F. Burton. *Defining Terms for Integrated (Multi-Inter-Trans-Disciplinary) Sustainability Research*. Sustainability. ISSN 2071-1050. July 26, 2011. http://mdpi.com/journal/sustainability .

Life Cycle Cost Optimization Within Decision Making on Alternative Designs

Shiven Jiten Sompura[1], Aakash Goyal[1] and Hakob Avetisyan, Ph.D. [2]

[1]Graduate Research Assistant at the Department of Civil and Environmental Engineering, 800 N. State College Blvd, California State University Fullerton, CA 92834, U.S.A, shivensompura09@gmail.com

[1]Graduate Research Assistant at the Department of Civil and Environmental Engineering, 800 N. State College Blvd, California State University Fullerton, CA 92834, U.S.A, aakashg17@csu.fullerton.edu

[2]Assistant Professor at the Department of Civil and Environmental Engineering, E-209, 800 N. State College Blvd, California State University Fullerton, CA 92834, U.S.A, havetisyan@fullerton.edu

ABSTRACT

This paper is to feature the importance of the life cycle cost criteria in decision making on the proposals of construction projects. Life cycle costing is a method for financial analyzing of all costs associated with initial construction, operations over its lifespan, and maintaining a construction project over a defined period. Obtaining the costs and savings, we can then directly compare these areas and be fully informed when decisions will be made. The most significant advantage of life cycle costing can be obtained in the initial phase of the construction projects. Construction cost and equipment cost is vital for a complicated decision-making process in the optimization of the life-cycle cost of a project. In this paper, a probabilistic life cycle analysis will be performed to compare precast concrete pavement over traditional onsite casting. With this solution, the minimal value of the life-cycle cost of pavement alternative can be selected. This paper will also discuss the issues of life cycle costing and difficulties analyzing it. The study will also help to clarify the necessary data, and a suitable process of life cycle costing will be proposed. Decision-making using the probabilistic life cycle cost optimization will be demonstrated in this paper using GAMS.

INTRODUCTION

The lowest cost is often the only absolute priority in the process of preparation of the budget in a construction project. If we consider a pavement lifespan as tens of years, assessing project alternatives with only investment costs occurs as shortsighted and insufficient. Running costs (operation costs, maintenance, and renovation costs) are an essential section of investment during the life cycle. Life cycle costing (LCC) should be an integral part of the decision making on financially high stake projects. Calculation of life cycle costs provides an entirely new economic view on pavement design. This study helps in understanding the implementation and incorporation of the LCC criterion in the decision making.

LCC is a technique to estimate the total cost of ownership (OGC, 2003). The technique can assist decision-making for investment projects (Flanagan et al., 1989). LCC is particularly useful for estimating the total cost in the early stage of a project (Bogenstatter, 2000). An LCC process usually includes the following steps: planning of the LCC analysis (e.g.definition of objectives), selection and development of the LCC model (e.g., cost breakdown structure, identifying data sources and contingencies), application of LCC model, and documentation and review of LCC results (NSW Treasury, 2004). Nevertheless, LCC is not usually adopted in The United States of America.

According to ISO/DIS 15686-5 (2006), Life Cycle Costing is both a tool and technique, which enables comparative cost assessments to be made over a specified period of time, taking into account all relevant economic factors both in terms of initial capital cost, future operational costs and asset replacement costs, through to end of its life. Also, LCC will take into consideration any other non-construction costs and income. LCC represents the overall costs spent in the course of the pavement's whole life cycle.

IMPLEMENTATION OF LCC IN DECISION MAKING

The LCC calculation should be used as a tool for effective selection of project alternatives in every phase of the project's life cycle, its effective use is in the design phase. Literature refers that 80 to 90 per cent of operation, maintenance are determined just by design. Implementing the LCC criteria in the decision making during the design will allow a more effective selection of competitive alternatives (design, detail, structure, equipment).

The value of the LCC criteria is set up based on LCC calculation. LCC may be a preliminary calculation or a detail calculation of LCC in the later investment phase (design phase). The detail LCC calculation is based on more specific project documents and data. For the decision-making process refer Table 2.

1	Defining the purpose and scope of decision
2	Defining of the range and key parameters
3	Summarizing data to the evaluated alternatives
4	Economic evaluation of alternatives
5	Selection of the optimum alternative

Table 2. Decision-making process based on LCC criteria

Total LCC are calculated in the frame of the economic evaluation. For example, either as the Net Present Value or the Annual Equivalent Cost.

GAMS CODE FOR LCC

```
Positive variable
I, N, n, M, O, U, S, i;
Variable
z;
equations
eq1
```

eq2

eq3

eq4

eq5

eq6

obj;

eq1..I=g=2741715.57;

**initial construction cost*

eq2..M=l=189746.995;

**maintenance*

eq3..O=l=116452.65;

**operational cost*

eq4..U=g=1037382.55;

**User cost*

eq5..i=g=0.04;

**discount rate range*

eq6..n=e=5;

**year of analysis*

*obj..z=e=I+{[(M+O+U)/(1+i)**n]-[s/(1+i)**n]}*

model LCCA /all/;

solve LCCA minimizing z using nlp;

CASE STUDY

The implementation of the concept for decision making in alternative design using LCC in this paper is applied in a small example which can be implemented to the enitre project with a similar approach. The example is basically carrying a LCC cost optimization of Precast Prestressed Concrete Pavement (PPCP) by optimizing a way to reduce the cost of pavement over its life. For this model, hypothetical dimensions were considered for a mile length road to

calculate the life cycle parameters. The costs were taken as constraint and the total Life Cycle Cost was considered as objective to be optimized. By bound the objective function to be a higher value and the operational cost, maintenace cost and user cost to be lower values the code was run. The equation of NPV (objective function) is stated as below.

$$NPV = I + \sum M+O+U/ (1+i)^n - S/ (1+i)^n \qquad (1)$$

Where, C O = Initial construction cost; n= specific year of expenditure; i= discount rate; Mn= maintenance cost in year n; On= operating cost in year n; Un= user cost in year n; S= Salvage value (Scheving, A. G., 2011).

Constraints	**Costs in US Dollar**
Initial Construction Cost	2,741,715.57
Maintenance Cost	189,746.995
Operational Cost	116,452.65
User Cost	1,037,382.55

By giving these equations as inputs the code was run and solution was found to be as follows: -

```
COMPILATION TIME     =        0.000 SECONDS      2 MB  25.0.3 r65947 WEX-WEI
GAMS 25.0.3  r65947 Released Mar 21, 2018 WEX-WEI x86 64bit/MS Windows 05/02/18 23:56:12 Page 2
G e n e r a l   A l g e b r a i c   M o d e l i n g   S y s t e m
Equation Listing    SOLVE LCCA Using NLP From line 27


---- eq1  =G=

eq1..  I =G= 2741715.57 ; (LHS = 0, INFES = 2741715.57 ****)


---- eq2  =L=

eq2..  M =L= 189746.995 ; (LHS = 0)


---- eq3  =L=

eq3..  O =L= 116452.65 ; (LHS = 0)


---- eq4  =G=

eq4..  U =G= 1037382.55 ; (LHS = 0, INFES = 1037382.55 ****)


---- eq5  =G=

eq5..  I =G= 0.04 ; (LHS = 0, INFES = 0.04 ****)


---- eq6  =E=

eq6..  N =E= 5 ; (LHS = 0, INFES = 5 ****)


---- obj  =E=

obj..  - (1)*I + (0)*N - (1)*M - (1)*O - (1)*U + (1)*S + z =E= 0 ; (LHS = 0)

GAMS 25.0.3  r65947 Released Mar 21, 2018 WEX-WEI x86 64bit/MS Windows 05/02/18 23:56:12 Page 3
G e n e r a l   A l g e b r a i c   M o d e l i n g   S y s t e m
Column Listing      SOLVE LCCA Using NLP From line 27


---- I
```

```
MODEL STATISTICS

BLOCKS OF EQUATIONS           7     SINGLE EQUATIONS            7
BLOCKS OF VARIABLES           7     SINGLE VARIABLES            7
NON ZERO ELEMENTS            13     NON LINEAR N-Z              6
DERIVATIVE POOL              20     CONSTANT POOL              16
CODE LENGTH                  20


GENERATION TIME      =        0.000 SECONDS      3 MB  25.0.3 r65947 WEX-WEI


EXECUTION TIME       =        0.000 SECONDS      3 MB  25.0.3 r65947 WEX-WEI
GAMS 25.0.3  r65947 Released Mar 21, 2018 WEX-WEI x86 64bit/MS Windows 05/02/18 23:56:12 Page 5
G e n e r a l   A l g e b r a i c   M o d e l i n g   S y s t e m
Solution Report     SOLVE LCCA Using NLP From line 27


              S O L V E      S U M M A R Y

     MODEL   LCCA                OBJECTIVE  z
     TYPE    NLP                 DIRECTION  MINIMIZE
     SOLVER  CONOPT              FROM LINE  27

**** SOLVER STATUS     1 Normal Completion
**** MODEL STATUS      2 Locally Optimal
**** OBJECTIVE VALUE          2741715.5700

 RESOURCE USAGE, LIMIT          0.000      1000.000
 ITERATION COUNT, LIMIT         4    2000000000
 EVALUATION ERRORS              0             0
CONOPT 3         25.0.3 r65947 Released Mar 21, 2018 WEI x86 64bit/MS Windows
```

SUMMARY AND CONCLUSION

It can be concluded with the below code that Precast concrete pavement is more economical than Cast-in-place concrete. Also, from the GAMS code it can be analyzed that higher initial construction cost will lower the maintenance cost and entire Life cycle cost of the project. As per the results obtained in GAMS code it can be concluded that the objective value is 2,741,715.57 for the analysis of fifth year after the construction of pavement which is an optimal solution. Hence this is a feasible approach.

```
               S O L V E      S U M M A R Y

     MODEL   LCCA                OBJECTIVE  z
     TYPE    NLP                 DIRECTION  MINIMIZE
     SOLVER  CONOPT              FROM LINE  27

**** SOLVER STATUS     1 Normal Completion
**** MODEL STATUS      2 Locally Optimal
**** OBJECTIVE VALUE           2741715.5700

 RESOURCE USAGE, LIMIT          0.000      1000.000
 ITERATION COUNT, LIMIT         4    2000000000
 EVALUATION ERRORS              0             0
CONOPT 3         25.0.3 r65947 Released Mar 21, 2018 WEI x86 64bit/MS Windows


    C O N O P T 3   version 3.17G
    Copyright (C)   ARKI Consulting and Development A/S
                    Bagsvaerdvej 246 A
                    DK-2880 Bagsvaerd, Denmark


    The model has 7 variables and 7 constraints
    with 13 Jacobian elements, 6 of which are nonlinear.
    The Hessian of the Lagrangian has 2 elements on the diagonal,
    9 elements below the diagonal, and 6 nonlinear variables.

                    Pre-triangular equations:   1
                    Post-triangular equations:  2
```

REFERENCE

Edwards S., Bartlett E. and Dickie I. (2000) Whole life costing and life-cycle assessment for sustainable building design, BRE Digest 452, CRC, London

CPN (2000) Whole life costing: the new BS-ISO standard, Members' report E01444, CIRIA

Task Group 4 (TG4) (2003) Report of Task Group 4: Life Cycle Costs in Construction, the European Commission, http://ec.europa.eu/enterprise/construction/suscon/tgs/tg4/lccreport.pdf.

Davis Langdon (2007) A common European methodology for Life Cycle Costing, European Commission, Davis Langdon Management Consulting.Office of Government Commerce (OGC) (2003) Achieving Excellence Guide 7: Whole-life costing, http://www.ogc.gov.uk/SDToolkit/reference/ogc_library/achievingexcellence/ae7.pdf

Flanagan, R., Norman, G., Meadows, J. and Robinson, G. (1989) Life Cycle Costing: Theory and Practice, BSP Professional Books, Oxford. Bogenstatter, U. (2000) Prediction and optimisation of life-cycle costs in early design. Building Research & Information, 28(5/6), 376-386. New South Wales Treasury, (2004) Total Asset Management, Life Cycle Costing Guideline 13, NSW Treasury, Sydney, Australia. http://www.treasury.nsw.gov.au/tam/pdf/life_cycle_costings.pdf.

Flanagan, R., Kendell, A., Norman, G.,Robinson, G.: (1987) Life cycle costing and risk management, Construction Management and Economics, 5: 53-71

Ashworth, A.(1996): Estimating the life expectancies of building components in life cycle costing calculations, Structural Survey, 14 (2): 4-8 Kishk, M., Al-Hajj, A., Pollock, R., Aouad, G., Bakis, N., Sun, M. (2003): Whole life costing in construction. A state of the art review. RICS Foundation Papers, 4(18).

Boussabaine, A., Kirkham, R.(2004): Whole Life-cycle Costing, Risk and risk responses, Blackwell Publishing Ltd., Oxford, UKSchneiderová Heralová, R. (2013) Life Cycle Cost Analysis in Public Procurement In: Central Europe towards Sustainable Building 2013.Prague: Grada, 2013, p. 781-784.

Macek, D. (2010) Building Maintenance and Renovation. In Central Europe towards Sustainable Building. Prague: Czech Technical University, 2010, p. 669-672

Schneiderová R. (2007) The Building's Value Assesment using the Utility and the LCC In: Central Europe towards Suistainable Bulding 07 Prague. Prague: CTU, Faculty of Civil Engineering, vol. 1, p. 126-131.

Hromada, E., Beran, V., Dlask, P., Eaton, D., Zindulka, O. (2011) Mapping of synchronous activities through virtual management momentum simulation In: Construction Innovation. Vol. 2011, no. 11, p. 190-211.

Interdisciplinary Competence: The Key to Exceptional Project Performance

Abstract: This paper describes the benefits for integrating knowledge across project teams. Research in interdisciplinary demonstrates that better integration of knowledge is achieved through individuals attaining cross disciplinary learning. Integrated teams of interdisciplinary members achieve better problem solving through leveraging common knowledge. This common knowledge or common ground is the overlap between disciplines. Interdisciplinary project managers facilitate problem resolution across the team; leveraging common ground to produce better integration of team knowledge and ideas.

Results, from academic institutions and a 3M study, support the development of depth and breadth in disciplines to achieve exceptional performance. Traditional individual development focus on specialists and generalists. Academia has established interdisciplinary curriculums and research centers to facilitate greater advances of knowledge and technology. For complex projects, interdisciplinary project managers facilitate the integration of knowledge across the team. Developing interdisciplinary project managers require changes to organizational personnel practices to leverage the combination of depth and breadth for key positions.

As stated by John Sterman of the Sloan School of Management at Massachusetts Institute of Technology (MIT), "large scale projects belong to the class of complex dynamic systems…these systems are extremely complex, consisting of multiple interdependent components; are highly dynamic; involve multiple feedback processes; involve nonlinear relationships; and involve both hard and soft data (Sterman, 5).

Complex problems require balancing multiple conflicting and competing objectives and constraints to determine a solution. A problem limited to a single disciplinary field is solvable by experts of that disciplinary field. Complex problems cross disciplinary fields requiring multiple disciplines for a solution. Integrated Product Teams (IPTs) are multidisciplinary, comprising specialists from several functional areas; however, an IPT is challenged fusing knowledge across disciplines. Solving complex problems requires different thinking than solving simple problems.

An interdisciplinary perspective bridges knowledge between disciplines to identify solutions to complex problems. Successful teams integrate multiple disciplines to frame a problem, agree on a methodological approach, and analyze data using collaboration (Stock, 7). Exceptional teams better fuse the integration of knowledge, seeing connections and intersections that a single discipline would not. An interdisciplinary project manager facilitates the knowledge across team members, establishing an environment for good problem solving. Greater integration of disciplinary knowledge creates more effective critical thinking and innovative ideas.

Typically, the pursuit of further knowledge and exploration deals with depth within one field to gain further understanding. The concept of interdisciplinary studies requires not only depth but breadth across more than one discipline to understand the integration of knowledge between the studied disciplines.

Individuals educated in multiple disciplines are better able to design and apply a process based on conditions and constraints. This produces flexibility in thinking that challenges trained specialists; competence bias inhibits one to think past that single view. Common ground is the linkage between the disciplines creating insight and ability to gain multiple perspectives. Using a multidisciplinary approach through a team of disciplinary or functional specialists does not achieve integration or synthesis of knowledge due to lack of common ground.

Teams of specialists produce a multidisciplinary approach, viewing a problem from their own discipline and recommending solutions based on their area of expertise (figure 1). A project manager either selects one solution or needs to merge the multiple solutions into a single fused solution. This requires an interdisciplinary approach and accompanying knowledge of the various functional areas of expertise to develop a single, comprehensive solution. This fused solution is different from any single, functional solution.

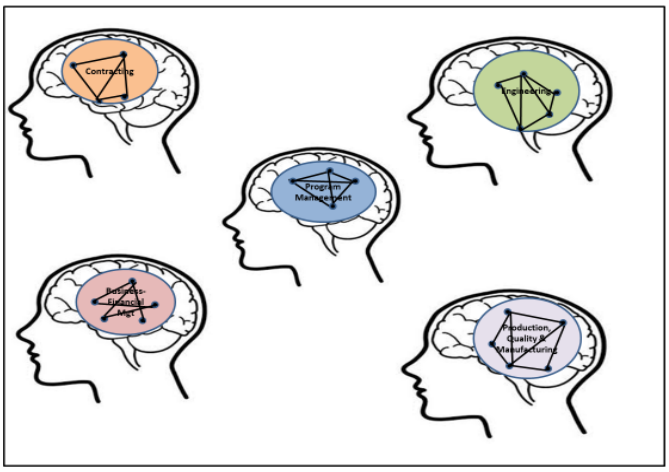


Figure 1. Multi-disciplinary Knowledge of a Team

Jay Forrester of MIT developed the system dynamic concept as a theory for understanding complex systems. He initially developed the tool in the engineering domain but then applied it to the business world. The system dynamics paradigm concludes results of decisions are disappointing because important casual relationships are overlooked or misread usually by assuming a linear or unidirectional relationship versus a nonlinear and multidirectional relationship (Martin, 152). Applying a systems perspective from engineering to business operations is an interdisciplinary approach. Specialist dominated organizations often simplify problems to linear, unidirectional casual relationships, even if the problem is more complex and multidirectional. Simplifying a problem can lead to solving the wrong problem. Interdisciplinary research laboratories, such as the Rockefeller University, recognize the need to solve complex problems with integrated, complex solutions. The university is recognized for more major discoveries in biomedicine than anywhere else in the world. The success is attributed to a laboratory environment deemed 'without walls' to promote cross-knowledge utilization of scientists on research projects.

The need to acquire breadth even when pursuing advanced degrees is recognized in the recommendations for a new vision for academic institutions. Although the findings focus on academic application for universities, institutes, and laboratories, they are easily transferable to government organizations and industry for solving problems and improving effectiveness in managing projects or programs. A workforce skilled in single disciplines challenges integration of complex technology development. An interdisciplinary workforce positions enhanced technology development through individual knowledge integration and then team knowledge integration. Common vocabulary can enhance understanding across team members.

> "A matrix structure in a university might include many joint faculty appointments and PhDs granted in more than one department which would enable participants to address cross-cutting questions more easily. It might create numerous interdisciplinary courses for undergraduates, provide mentors who bridge the pertinent disciplines, and equally important, offer faculty numerous opportunities for continuing education whereby they could add both depth and breadth of knowledge throughout their careers" (National Academy of Science, 172-173).

In the innovation process, existing brain connections (neurons) significantly change to cross a

wider number of areas of the brain dealing with different types of knowledge and problems to assimilate very different concepts and challenge long held assumptions. The strengthening of neurons in the brain creates competence bias and limits problem solving. Competence bias limits recognizing multiple solutions, reverting to one's current knowledge base without pursuing further information.

Innovation relies on an individual's expertise to generate new knowledge or create new ideas through combining ideas to create innovative applications. The researchers' state:

> "Even though many inventions are created when individuals work in teams, studies allude to the observation that individuals are effective in combining existing knowledge to generate new knowledge and innovations. Innovative ideas and insights first occur to individuals, before such ideas are subsequently shared at the group levels and institutionalized at the organizational level. Fundamentally, this highlights that individuals are the basic unit in which knowledge integration and knowledge creation takes place, regardless of whether individuals work alone or in teams" (Boh, 349).

If innovative ideas are not created at the unit level, they are not created at the team level. A study conducted on how inventors' breadth and depth of expertise influence innovation at 3M Corporation exceeded previous research focused on a single indicator, technical success achieved by the inventor. The 3M study examined three indicators: (1) the number of inventions generated, (2) the extent to which the inventor has a significant impact on the technical domain, and the inventor's career success, in terms of commercial value they have brought by converting their inventions into products that generate sales for commercial organizations (Boh, 349).

The study concluded that generalists (breadth) create many inventions but are not technically influential; specialists (depth) create fewer inventions but are technically influential. The combination of breadth and depth (polymath) of expertise create the most valuable inventors based on their record for effectively converting inventions into commercially successful products. In other words, the polymath earned the most money for 3M Corporation by producing the most marketable inventions.

A specialist is defined as one who achieves great depth in knowledge through learning and experience. The study concluded that specialists acquire ability for detail and accurate analysis of a problem leading to solutions for difficult technical problems in their area of expertise. Specialists also make difficult trade-offs and through their depth of knowledge can better predict what will go wrong. They create groundbreaking innovations through persistence of exploring deeper into an area.

Generalists have knowledge in a broad range of areas but do not acquire expertise in any one area. Generalists tend to enjoy new work and become bored when confined to one area; this inhibits their ability to develop the specialist's depth of analysis. Generalists focus on application of technologies into useful products and integration of multiple technologies into a product, creating innovation through a broader focus.

Polymaths acquired interdisciplinary competence through obtaining significant depth and breadth, first becoming an expert in one area and then expanding their expertise into other areas. One polymath inventor at 3M Corporation described the benefits of both: "his depth of expertise plays a key role in identifying the technical contributions of an idea, while he draws upon a breadth of expertise to evaluate the potential ways the invention can impact different industries" (Boh, 355). By balancing the combination of depth and breadth, polymath inventors become astute at applying, integrating, and recombining technology of their domain across other

technologies and applications. Generalist inventors focus on applying a developed technology in other applications but lack the depth to develop the technology. Generalists acquire an interdisciplinary perspective but without depth of knowledge are challenged to exploit the overlap between disciplines. Specialists develop the technology but lack breadth to apply in various applications.

How are polymaths developed? Acquiring depth probably precedes acquiring breadth. Once depth is acquired, the polymath can use that "learning how to be an expert" to develop depth in other areas faster. First acquire the ability to go deep and then apply that ability to go broad. Once the path of breadth is established without acquiring depth first, depth is probably never attained.

The study concluded that organizations need specialists, generalists, and polymaths but "both breadth and depth of expertise are required to effectively convert inventions into commercially successful products that bring sales and value to the organization. The polymaths contributed not only by generating inventions but applying those inventions widely to multiple parts of the organization, integrating with multiple technologies, thus becoming the most valued scientists of 3M" (Boh, 364).

This combination is created through starting careers developing significant depth in one area. Over time, significant knowledge and experience outside that domain is acquired. By leveraging an understanding for how to become an expert, one develops an expertise more quickly in other areas. A polymath develops an interdisciplinary perspective through attaining depth and breadth across multiple disciplines, leveraging the knowledge interface between functional areas to develop the interdisciplinary perspective faster. For example, Jay Forrester of MIT acquired expertise in system dynamics for engineering and then applied the concept of system dynamics to business and management.

For teams to be effective, team members need common ground to develop fused ideas. Each discipline develops greater depth of their discipline through linkages of the knowledge nodes. The results of the team will likely evaluate solutions based on a single, functional approach when little common ground (linkages) exists between the functions (figure 2).

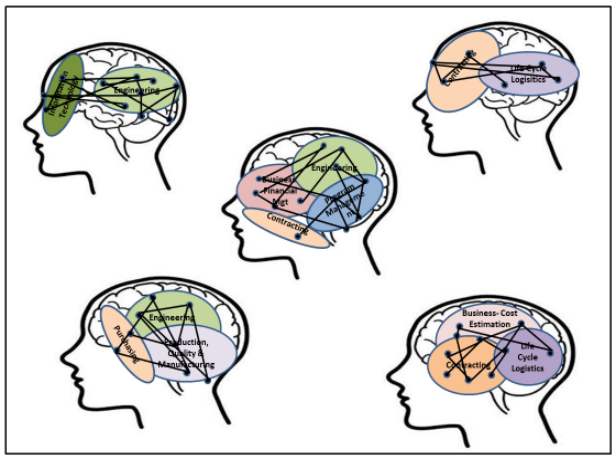


Figure 2. Lack of Linkage between Integrated Functions

Typically, project managers may lack interdisciplinary knowledge, selecting the one disciplinary solution that appears to have the most advantages with fewer disadvantages for other

areas. This is not an integrated solution. An integrated project manager has an interdisciplinary background with knowledge and experience across pertinent disciplinary areas facilitating knowledge integration through a common ground for the team. The greater the complexity of the project, the greater the need for an integrated project manager.

The common ground between the project manager and a team member can share knowledge from one team member to another team member, basically creating a network transfer of knowledge through common ground (figure 3). Common vocabulary is the most basic aspect of common ground. Interdisciplinary project managers develop expertise in a discipline and then build upon that expertise acquiring competence in other areas. This capability then facilitates knowledge across the team members. Project management career path development should cross multiple disciplinary areas while ensuring depth of knowledge within those disciplines. Experience through challenging assignments strengthens the learning and produces adaptable, resilient problem solvers.

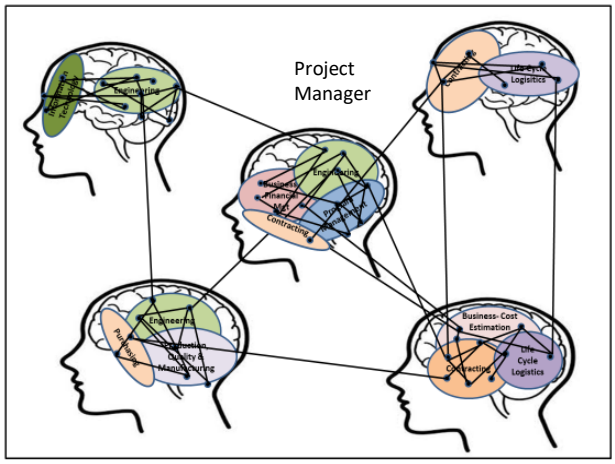


Figure 3. Knowledge Integration Maximized through Project Manager

An interdisciplinary team merges knowledge across multiple disciplines; each team member's knowledge crosses at least two disciplines (figure 3). For solving complex problems, greater insight is needed through crossing disciplines. Having the workforce develop an initial primary field establishes expertise and then secondary field certifications develop breadth. Integrated interdisciplinary teams leverage the connections of knowledge and provide a means for "seeing the space between nodes of knowledge". Common ground connects two different areas sharing modeling or statistical tools; analytical tools should complement training curriculums and position assignments. Interdisciplinary individuals resolve complex problems across multiple disciplines through the internal fusion of knowledge and understanding.

In summary, individuals create ideas. Teams improve upon those ideas. Interdisciplinary teams are more capable to synthesize ideas by leveraging common ground. Interdisciplinary project managers facilitate better team knowledge integration and therefore develop comprehensive ideas or problem resolutions.

References

1. Boh, Wai Fong, Roberto Evaristo, and Andrew Ouderkirk. *Balancing breadth and depth of expertise for innovation: A 3M story*. Elsevier Research Policy 43. 2014. http://www.elsevier.com/locate/respol.

2. Martin, Roger. The Opposable Mind: Winning through Integrative Thinking. Harvard Business School Publishing, Boston, MA 2009.

3. Academy of Sciences, National Academy of Engineering, and Institute of Medicine of the National Academies. *Facilitating Interdisciplinary Research*. The National Academies Press. Washington, DC. 2005.

4. Sterman, John. *System Dynamics Modeling for Project Management*. Sloan School of Management, Massachusetts Institute of Technology, Cambridge, MA 1994.

5. Stock, Paul and Rob J.F. Burton. *Defining Terms for Integrated (Multi-Inter-Trans-Disciplinary) Sustainability Research*. Sustainability. ISSN 2071-1050. July 26, 2011. http://mdpi.com/journal/sustainability .

UMD Project Management Symposium
Mindful Leadership – What is it?
How can I apply it to my programs and projects?

Sandra Menzies, MS, ASQ-CQA, ASQ-CQM/OE, PMI-PMP

Food and Drug Administration, Center for Biologics Evaluation and Research, 10903 New Hampshire Avenue, Bldg. 71-Rm 6218, Silver Spring, MD 20993; SANDRA.MENZIES@FDA.HHS.GOV

ABSTRACT

It's a typical day. You get-up, read the news, listen to the TV or radio, rush to get out of the house for your busy day at work. Traffic is a snarl all the way into work. As you travel, you are listening to the radio or a book to try and relax before work. Once you get into work, there are emails awaiting your review and response, people are stopping at your door to ask questions or just wanting to chat, you have more meetings than work hours, and multiple tasks that need to be completed right now. You do not have time to think or prepare. All you want to do is, STOP! Have you felt this way? What can you do?

This paper reviews the benefits of being a mindful leader. It discusses how mindfulness helps you focus, cultivate being present (an external awareness) and the ability to pause (an internal awareness). Being focused helps leaders minimize multitasking and pay attention to what is important. Being present allows leaders to observe what is going on around them and actively listen to what is being said, so they can separate our self from a situation and reflect, thus allowing our inner knowledge to emerge. When we pause we create space, so we can learn to respond and reframe a story instead of reacting in stressful situations. In addition, managers who demonstrate and encourage the practice of mindfulness create an engaging and interactive team environment.

MINDFUL LEADERSHIP

Have you found yourself focusing on a meeting you had yesterday and what you could have done better or how the team could have reached a better solution? Or maybe you find yourself worrying about tomorrow and what could go wrong even when you have planned for various contingencies. This reflection is often not about learning and growing but about judging yourself and your abilities as a leader. Mindfulness is defined as the practice of being present or being aware of your current situation, your emotions, and how you are feeling at any given time and in any given situation without judgement. Mindfulness helps you focus on the tasks you need to accomplish right now so you can manage your project through all phases from

initiation through closure. Mindfulness also helps you be present and aware of what you can accomplish in this moment and acknowledge what is within your limits and current control.

Forbes defines leadership as "a process of social influence, which maximizes the efforts of others towards the achievement of a goal[i]." Great leaders exhibit characteristics such as: being focused, direct, clear in how they respond, creative, trustworthy, engaging, reliable, humble, understanding, self-aware, grounded, etc. A mindful leader is "someone who embodies a leadership presence by cultivating focus, clarity, creativity, and compassion in the service of others.[ii]" Great leaders are mindful leaders.

Having a mindfulness practice helps you focus, cultivate presence (an external awareness) and the ability to pause (an internal awareness). Frequently our minds wander; we tune-out when we need to **focus**. How many times have we reached the end of an hour and wondered, "What have I spent my time on?", "What have I accomplished?" Maybe you get distracted by emails, news bulletins, comments from others, or pop-ups on your phone. Many consider these activities multitasking. Multitasking is defined as the ability to perform multiple tasks at the same time. Earl Miller, a professor of neuroscience at MIT, shows that people appear to handle more than one task at a time, yet he or she actually switches between the tasks very rapidly. This rapid-fire switching is a distraction that decreases productivity, causes mistakes, and limits creativity[iii]. The lack of attention to a given task results in the task taking longer to complete and being more prone to errors[iv]. Dr. Miller recommends the following steps to counter multitasking and help you focus: block out periods of time to focus and eliminate as many distractions as possible such as putting away your smartphone, turning off extra screens, and shutting down your email. If all else fails, take short breaks and move around. Through a practice of mindfulness, you begin to learn how to let those distractions go and decide how you want to focus your time and attention to detail, so you can cultivate presence and the ability to pause.

Presence is the ability to observe what is around us, so we can separate our self from a situation to contemplate and reflect, thus allowing our inner knowledge to emerge[v]. This awareness includes our understanding of the current situation, our frames, and our emotions and feelings. Frames are defined as mental models that we use to help make sense of the world around us[vi]. Presence helps a leader become aware of her core assumptions, so she can delay offering her understanding of a situation and not limit her team in contributing advice, ideas, and solutions. Presence also takes us from having a binary frame of reference or "believing we know what is going on" to an open frame of reference that actively seeks other possibilities thus observing and questioning a situation to challenge our core assumptions. A leader who has a binary frame of reference or is closed-minded only sees or contemplates two outcomes: a

situation is either black or white, she is either right or wrong, or the answer is either this or that. Whereas, an **open-mind leader** can see many solutions to a situation, many options to an issue, and many answers to a question. As a productive project manager, you may be called upon to help mediate disputes or help a group come to reasonable next steps in your project. By cultivating an open-mind and being aware of our frames, we allow our self the space to acknowledge our biases and positions, so we can actively observe what is happening around us.

Observation is the noticing of details without judgment. When we actively observe a situation, we notice what people are saying, their body language, and the emotional current of the room. We observe the body language of our team to see if it matches the words being stated. We notice which team members have open postures – or are taking up a lot of physical space, which shows that they are actively involved in the process. Typically, open postures are when the torso is leaning toward others, their arms are at or away from their side, and their chest, abdomen, and lower extremities are easily seen. Whereas, in a closed posture the person is taking up as little space as possible to protect their most vulnerable body parts. Their shoulders may be rounded and elevated by their ears, their arms may cover their chest, and their legs may be crossed. A person showing a closed posture may be demonstrating that he or she is feeling threatened, so upon noticing this the project manager could make the environment safe so that the person can contribute to the project. Having an open-mind also allows a project manager to set-aside his position or current understanding, and **actively listen** and consider what is being said. Active listening is when the listener fully concentrates, understands, responds, and remembers what is being said so he can repeat the intent of what the speaker said, instead of listening to prepare counter arguments. Active observation and listening allows a leader to evaluate the mood of the team and understand the discussions, which leads to identifying a common ground, which then enables the team to come up with solutions that are best for the project and the sponsor. In addition to using mindfulness to understand your team and the situation, it helps you become more self-aware.

By adding a **pause** or silence to being present, a leader gets space to learn more about herself, so she can embrace curiosity and become open to hearing other points-of-view and accepting other solutions. The pause allows her to check-in with herself and identify her reactions, so she can choose how to respond. The pause also allows her to reframe her stories. Let's look at these concepts more.

Mindfulness helps you become a better leader by giving you space to decide how to respond to a situation instead of reacting to it [vii]. Using a physical act, such as focusing on your breath, the sensation of your toe pressing into the floor, or physically moving yourself away from the table, can give you space and time to separate yourself from a situation. When a leader is not aware of his feelings and he

experiences stress, his fight-or-flight instincts take over and he reacts to the stressful situation. By using the pause to **check-in** with himself and acknowledge his feelings and emotions, physical reactions, and maybe identifying what triggered his emotions, he gets space to break that fight-or-flight reaction so he can choose how to respond. By cultivating space, a leader gains the ability to consider his response and the possible outcomes and consequence of his response. By pausing, he also becomes more grounded as a leader, so he can choose how to respond. This act of self-awareness gives him time to consider what is the best response. For example, if a person is yelling at you, her face may be red and arms flailing. If you do not realize that you are feeling threatened and attacked, you would probably react by yelling back and escalating the interaction. However, by pausing to check-in and assess your feelings and your physical reactions, you gain the space and insight to decide what is the best way to respond. By acknowledging your emotional state, you can ask questions to get a better understanding of why she is yelling and maybe the use of this space will lead to a better outcome.

Another benefit of a mindfulness practice that helps you be a better leader is the ability to **reframe a story**. Take a moment and think back on an unfavorable interaction you've had, mindfulness helps you consider both the facts and the context of the story related to that interaction. For example, let's consider what it means to reframe the following story, where Sally is a fictitious project manager.

> *When Sally was assigned as a project manager to facilitate the standardization of a business process among five different working groups within her organization, Sally faced many challenges to get these groups to come to consensus on a new standardized business process.*
>
> *For over 20 years, each group had developed their own way of performing this process. The multiple ways of performing the process caused conflicts between the groups and did not support the organization's goal of automating its business processes. Over several meetings the team interactively mapped the old process and discussed how to improve the process to make it consistent. They documented the new process and even piloted the new process to show its functionality and feasibility. Yet once the new process was issued for implementation, the working groups did not follow the new business process.*

As you read this story, you may be adding context to this story such as: telling yourself what you would have done differently, or additional steps Sally could have performed in standardizing this business process. You also might be judging Sally,

saying she failed as a project manager since she was unable to implement the business process. Maybe you are reliving a similar experience and noticing how you felt during your project, the interactions you had with colleagues and management, and what you were able to achieve. Maybe you said things like "The other groups were very difficult to work with.", "They did not like me." or "Harold, a key member of my project team, was distracted during most of this project since he was having health issues, so I gave him leeway to not participate as much as he should have." As you consider the facts, it is natural to start to build context around those facts that can be supportive or judgmental. Through a mindfulness practice we start to learn how to separate the facts from the context, so we can reframe the story to empower and refocus our time and attention.

When you take a situation and break the facts from the context – or your story about the facts – you can focus on the components that empower you to grow as a project manager, instead of wallowing in what you could have done better. For example, Sally could focus that the project failed, or she could state that the project was able to get five different working groups time to meet and discuss the existing and future process. It was a huge accomplishment to start to change culture. Maybe she could reframe the context to say, "Sally was able to establish a baseline for getting the working groups to discuss inconsistent business processes so future standardization projects would function smoother." By reframing the story, you can empower yourself to grow as a project manager and learn how to improve for your next project. Also, by reframing a story to identify the empowering aspects or to see another person's perspective, you get to see more than one perspective and support your growth as a project manager. Now that we discussed mindfulness, let's explore what current research has to say about mindfulness.

REVIEW CURRENT RESEARCH ASSOCIATED WITH BEING MINDFUL

As of February 19, 2018, ClinicalTrials.gov[viii], included 64 ongoing or completed studies and PubMed, listed 4,992 research publications related to mindfulness. These studies assessed whether mindfulness affects conditions such as: attention, stress, sleep, pain, rheumatoid arthritis, hypertension, cancer, diabetes, medication adherence, and migraines. One of the challenges with these studies is that there is not a commonly agreed upon definition for mindfulness. In addition, many of the published studies do not have sufficient number of study subjects to be able to make statistically sound conclusions. Since there is not a consistent definition and use different methods of applying mindfulness, it is difficult to combine the results from the variety of different studies. The data tends to show trends, possibilities, and possible correlations between mindfulness and physical and mental changes. Below are a couple studies to show the types of data being obtained and how mindfulness is being studied.

A study, sponsored by the National Center for Complementary and Integrative Health (NCCIH), a Center of the National Institutes of Health (NIH), found through the practice of mindfulness meditation, there were measurable changes in the regions of the brain involved in memory, learning, and emotion[ix]. This study used magnetic resonance images (MRI) of the brains of 16 participants 2 weeks before and after they joined a meditation program and a control group of 17 non-meditators over similar time periods. The brain images in the meditation group revealed increases in gray matter concentration in the left hippocampus and four other brain regions involved in learning, memory, and emotional control.

In another study, Jha et. al[x] found that mindfulness training helped improve the focus and attention of soldiers during high-demand intervals of pre-deployment training. Three groups were studied, groups 1 and 2 received 8-hours of training for 8-weeks. Group 1 received Mindfulness-based Mind Fitness Training (MMFT) with 50% of time spent practicing and 50% on lecture and content discussion; group 2 received didactic (or instructional) focused variant with 12.5% of time spent on practice and 87.5% of time on lecture and content discussions; and group 3 served as controls and did not receive any training. The MMFT group had better retention of material so the mindfulness exercises seemed to protect the study subjects against memory lapses resulting from the mind wandering.

In addition to the research studies, companies have started to implement mindful leadership programs within their organizations. Companies such as General Mills, Google, and Target have established mindfulness programs. Google's program is described in "Search Inside Yourself, The Unexpected Path to Achieving Success, Happiness (And World Peace)[xi]" by Chade-Meng Tan. These companies claim that they are offering these mindfulness programs due to the positive impact on employees and improved bottom line[xii] of the organization.

A SIMPLE MINDFULNESS EXERCISE

To become a Mindful Leader requires perseverance and practice. In Angela Duckworth's recent book "Grit: The Power of Passion and Perseverance[xiii]", she shares her research on grit. Grit has two main components: passion and perseverance. If you want to become more mindful, effort is more important than having an innate talent. By combining talent with effort, you gain skill and by combining skill with effort you get achievement. Dr. Duckworth noted that effort counts twice. The more effort we put into learning to become mindful the more likely you are to achieve it. Also, you must consistently practice to maintain the ability, otherwise you may lose the skill.

You might already have a mindful exercise you practice regularly. For example, Tai Chi, martial arts, yoga, meditation and prayer are examples of mindful exercises you may already be practicing. You also may have an app on your smartphone or watch that tells you "It's time to breathe." If so, these are great ways to begin to develop a mindfulness practice. Just keep in mind that simply because a pop-up says it is time to practice, it may not be the best time for you to practice. Be mindful of what is best for you and your situation.

The following is an example of a mindfulness exercise you can practice through-out your day. This practice consists of three steps: preparation, awareness, and closing.

> *Begin by coming to a comfortable seated position. Maybe placing your feet flat on the floor and allowing your back to be supported, yet not slumped. You may feel more comfortable closing your eyes or looking toward the floor. Prepare yourself by taking three deep breaths in and releasing them.*
>
> *Start by pressing a toe into the floor as you bring focus your attention to your breath. Feel your breath move in and out of your body.*
>
> *Notice the quality of your breath*
>
> - *Is your breath shallow or deep?*
> - *Are you breathing from your chest or your belly?*
>
> *If your mind starts to wander, bring your attention back to your breath.*
>
> *When you are ready, remove the pressure of your toe and take a deep breath and as you let your breath out bring your awareness back to your surroundings.*

SUMMARY

When we are mindful, we carefully observe our thoughts and feelings without judging them as good or bad. Instead of letting go and letting life pass us by, mindfulness embraces living in the moment and awakening to our current experience, rather than dwelling on the past or anticipating the future[xiv]. Being mindful allows us to focus our attention on what is happening right now in a curious and open manner. We explore what we are feeling and maybe why, so we can decide how we want to respond to a situation. Yes, we will make mistakes and not make every decision perfectly, and that is okay. Through a mindfulness practice, we learn that it is okay to begin again – whether bringing our mind back to the breath, apologizing to someone for our behavior, or just acknowledging the situation and how we contributed to it. If you think about

your project, mindfulness can help you focus your attention and awareness on what is important right now.

Being a mindful leader can help you be a better project or program manager through cultivating a practice that helps you be more focused and cultivating presence and the ability to pause. Thus, allowing you to focus on a single task, observe what is going on around you and actively listening to what is being said. When you pause you get space, so you can learn to respond instead of reacting in stressful situations and you can reframe a story.

---

[i] Kruse, K. "What is Leadership?" *Forbes*. April 9, 2013 @ 10:06 AM. ET. https://www.forbes.com/sites/kevinkruse/2013/04/09/what-is-leadership/2/#67e3f6f141f0

[ii] Marturano, J.L. "Welcome to the New Mindful Leadership Page on HuffPost." *The Blog*. August 5, 2013 @ 9:06 AM ET. https://www.huffingtonpost.com/janice-l-marturano/welcome-institue-for-mindful-leadership_b_3698126.html

[iii] Miller, E. "Here's Why You Shouldn't Multitask, According to an MIT Neuroscientist" *Fortune*. December 8, 2016. http://fortune.com/2016/12/07/why-you-shouldnt-multitask/

[iv] Hamilton, J. "Think You're Multitasking? Think Again". *Morning Edition*. October 2, 2008. @ 1:47 PM ET. https://www.npr.org/templates/story/story.php?storyId=95256794

[v] P. Senge, et.al. (2005) *Presence - An Exploration of Profound Change in People, Organizations, and Society*. DOUBLEDAY, New York. 88-89.

[vi] Roberto, M.A., (2013) *The Art of Critical Decision Making*, The Great Courses, Chapter 4 – Decision Making: Framing Risk and Opportunity. Released July 8, 2013

[vii] Hozel, BK, et.al. "How does mindful Meditation Work? Proposing Mechanisms of Action from a Conceptual and Neural Perspective". *Perspectives on Psychological Science*, 2011: 6(6). Issue published: November 1, 2011. https://doi.org/10.1177/1745691611419671

[viii] ClinicalTrails.gov is a database of privately and publicly funded clinical studies conducted around the world. It is a resource provided by the U.S. National Library of Medicine. https://clinicaltrials.gov.

[ix] Hölzel BK, Carmody J, Vangel M, et al. "Mindfulness practice leads to increases in regional brain gray matter density". *Psychiatry Research: Neuroimaging.* 2011; 191(1):36–43. http://www.ncbi.nlm.nih.gov/pubmed/21071182

[x] Jha, A.P (2015) *Minds "At Attention": Mindfulness Training Curbs Attentional Lapses in Military Cohorts*. PLoS One. 10(2): e0116889.

[xi] Tan, C.M. (2012) *Search Inside Yourself, The Unexpected Path to Achieving Success Happiness (and World Peace)* HarperCollins, New York.

[xii] https://hbr.org/2015/12/why-google-target-and-general-mills-are-investing-in-mindfulness

[xiii] Duckworth, A. (2016) *Grit: The Power of Passion and Perseverance*. Scribner, New York, 35-54.

[xiv] "Mindfulness Present Moment Awareness," *Psychology Today*. Accessed: January 2018. https://www.psychologytoday.com/basics/mindfulness

Practical Methods for Successful Change Adoption

Aimee Baxter, PMP
Macalester College, Business Services, 1600 Grand Avenue, St. Paul, MN 55105
abaxter@macalester.edu

Most of us know that change adoption is a key to project success. But what are the elements that can insure a successful project adoption? What are some basic tactics that can be used to help make sure that stakeholders and in-the-trenches users have the best attitude possible to make the change and spread the news to their colleagues?

How Complex?

First, determine how large the change is. How much of an impact will the project have on the culture of the organization? Are you asking your organization to take on a change they are ready to make? Then the planning, communication, and time spent on selling the project can be scaled back. If this is a change that will impact the entire organization, and the project has been attempted before and failed—but it still must go forward and many are against it—then you have a much more challenging task of selling the idea and keeping stakeholders and end users updated (and positive) throughout the project. Plan for extra communication at a lot of levels, roundtables to talk about their requirements, forums to have users test drive the solution, and more stakeholders—and even bring on some that may not be in favor of the project.

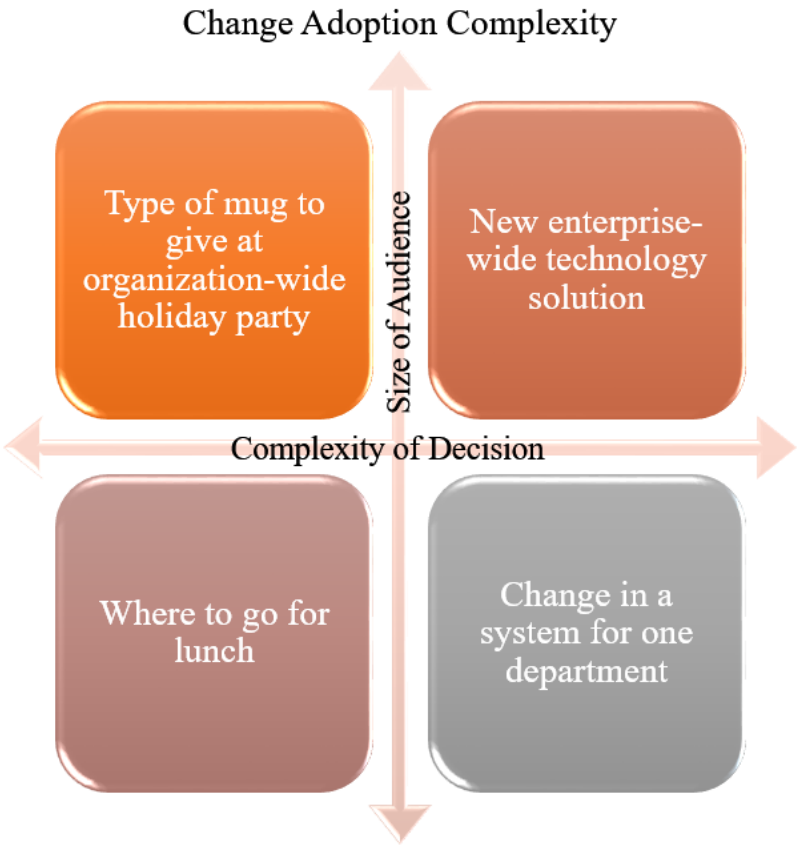


Figure 1: Change adoption complexity.

Listen to the Users, It Will Be Worth It

Everyone wants to be heard. That is no different when you are in charge of changing something. As an agent of change, and someone who is invested in the change being successful, the first step is to gather requirements.

- What did users like about the old system?
- What didn't they like?
- If this is a new system, what are they hoping to automate that they haven't been able to do previously?
- Do they want to simplify or make a business process more solid or secure? Have them step through what they do.
- Ask how they interact with their customers—internal and external.
- What are their frustrations?

Prepare your questions ahead of time, but then be willing to add questions to your interview template as you talk to your users. Be the best listener possible and don't jump to solutions! Show you are truly interested in their needs, but make no promises. Let them know you are taking in everything they are telling you, documenting it, and will bring this information back to be evaluated. Users will understand that with the maturity of business technology, not every feature will be addressed and answered. Requirements interviews are invaluable in finding key supporters and detractors. Often, the most important features in the solution are identified as mandatory from the end users' point of view are determined during the initial requirements gathering.

You may consider gathering requirements from multiple user groups, using alternate methods. For example, you may conduct in-person interviews for the stakeholders you have identified, and create a survey for the wider community. The survey for the wider community can help you to identify a need that you may not have known otherwise, and the survey helps to start the communication about the upcoming project.

This requirements gathering method can help identify risks. Some examples include:

- Risk(s) if these feature(s) are not implemented
- Risk(s) if this business process is not addressed
- Risk(s) if this group is not able to interface with the internal or external team

It is important to meet with all of the key end users; you will gain so much insight, even if you can't deliver on every aspect.

Communicate, Plan, and Then Communicate Some More

I wholeheartedly agree with PMI's *A Guide to the Project Management Body pf Knowledge (PMBOK® Guide)* – Fifth Edition (PMI, 2013) about communication plans—and I put them to practice. I have developed a template that has all of my ideas of communication and publicity ideas. I refer to the template each time I am working on a project and use this as a jumping-off point whenever I am developing a communications plan. I never assume that any one method of communication would be enough. I always add a date for when the communication should occur; this way, the communication happens on a schedule and the team does not rely on remembering to communicate ad hoc in the heat of a busy project or at the end—once everyone is moving on. That is why a plan is so important—it helps us remember the what and the when. I review the plan with the team regularly so we can adapt the communications as the project evolves during roll out.

There are some basic thoughts about communication that everyone knows, but there are some disciplines and structures that might be helpful to think about before and during a project to make communication more thoughtful and planned.

PLAN

- Make a plan—from something formal to just a few notes—either way, this will give you the clarity you want so you can launch certain communications on certain dates and perhaps make changes in your plan based on what you hear back from the communication.

AUDIENCE

- Who is your audience? Consider all of the possible audiences your project may impact and make a list.

TIMING

- Time communications throughout a project or initiative: before (here is what is coming), during (here it is), and after (how did it go?).

- Think carefully about the timing of your communication. You may not want to give some initiatives too much of a lead-time because this may allow time to worry or speculate about what is coming.

CHANNELS

- Use a variety of communication channels; no one group of people will respond to the same method. This is your best chance of getting the message through to everyone. How do you like to receive your communication? Does it depend on the message? Via email? In the electronic newspaper? Via phone? At a staff meeting? One-on-one meetings? Training sessions?

- A couple of methods may be needed if it is a large initiative because people may not hear you the first time. Brainstorm a list of communication methods and keep it for next time; it will make it that much easier.

- Communicate in a method that your audience is comfortable understanding. For example, when communicating a new process is a flowchart the best method or a narrative of the steps – or both?

STAKEHOLDERS

- Have a couple of people review your communication; and ideally, involve stakeholders that are in different roles who will bring a fresh perspective.

DOCUMENT

- Plan for a lessons learned review when the project is completed to reflect on what went well and what you would do differently next time. Document your findings so you can refer to the notes, and change any of your key documents that you rely on so they are ready to go for the next project.

Ambassadors as a Secret Weapon – Trusted Advisors Who Were Champions, Advocates, and Critics

With such a diverse organization of interests and concerns, I have found that carefully selecting a group of ambassadors who are invested in the change in technology is a boost to the success of any project. I have used this strategy multiple times and found it useful every time.

First, I make a list of those constituents who are either the best champions of the existing system or the loudest critics. We work to gather representatives from the various parts of the organization—in our case, a college, not only the academic departments, but the administrators as well. I always look for ambassadors who are *not* shy and who are willing to speak openly about the project/system or software enhancement. Second, I ask the ambassadors to help us with the requirements, testing, and early training. Lastly, I always ask the ambassadors to spread the word about the project. If the message with the ambassadors has been open and honest, then the word about the projects is passed along, even if the message is that everything isn't perfect.

Take the Leap, Use Live Data to Gain Speedy Project Adoption

During the recent implementation of a time clock system, there were a number of challenges. The time clock system would be "turned on" and two weeks later—using the new system—the time cards would be approved for the first time. Over 1,400 employees would be using the system with overtime approvers reviewing their time clock in a new system. The time approvers would need to be confident of the new system in order to complete their approvals on time and with a high rate of accuracy. It was decided to have training once the time clock system was live and the employees were clocking time so that the time approvers would see real data were key to the adoption of the new system.

Training was delivered by:

- Lecture with static screen shots
- Hands-on exercises with live data
- Open labs available on payroll approval days (two days only)

Use of the live data:

- Captured the time approvers' attention – it was their employees time that they were trained on as examples
- The time approvers encountered some circumstances during hands-on training they may not have encountered in "canned training" scenarios
- Earned their trust in the new system as they had a chance to navigate the system in the training room with the support of the payroll staff and trainer
- Further testing on the live system by users uncovered technical issues early in the adoption of the system
- Developing a robust set of training scenarios would have been very difficult and would not have been complete; live data was best and had unusual examples

Conclusion

In all, successful change adoption can be tricky. Perhaps implementing one or more of these techniques can help your stakeholders to get engaged in all stages of the project in the change, and be a part of the promotion of the good the change will bring.

Reference

Project Management Institute. (2013). *A guide to the project management body of knowledge (PMBOK® guide)* – Fifth edition. Newtown Square, PA: Author.

About the Author

Aimee Richcreek Baxter has worked in the technology industry for over 25 years as a project manager and technology trainer. She has been a Project Management Professional (PMP)® certification holder since 2000. Currently, Ms. Baxter works at Macalester College, as a financial system specialist bringing technology solutions to the Business Services Office and the Macalester community it serves. She utilizes her PMP skills every day from small tasks to larger, campus-wide projects.

Managing Teams with Servant Leadership

Joseph D. Launi, PMP

Project Management Experts, LLC
18373 Fairway Oaks Sq. Leesburg, VA 20176
703-777-1689, jdlauni@projectmanagementexperts.com

Abstract

Servant Leadership is an ethical perspective toward leadership that was originally developed by Robert K. Greenleaf during the 1960's and 1970's and further defined by Larry Spears in 1998. It is a set of practices that enrich the lives of individuals, builds better organizations and ultimately creates a more just and caring world. Discussion will include the "*Seven (7) Pillars of Servant Leadership"* as published by James W. Sipe and Don M. Frick while incorporating Spears' ten (10) characteristics that all leaders must aspire to obtain: listening, empathy, healing, awareness, persuasion, conceptualism, foresight, stewardship, commitment to the growth of people, and the building of community.

The objective of this presentation is to first understand what truly motivates the average team member and then justify and demonstrate the application of servant leadership principles. This unique leadership perspective considers the needs of the whole community, customers, and employees while incorporating the corporate strategy and culture.

Paper

Years ago, as a young project manager, I attended a technical conference in Washington, DC. I decided to attend a talk presented by Hall of Fame coach, Joe Gibbs, the former head coach of the Washington Redskins. He began his presentation by stating that professional football, like many professions, was a people-oriented business and how he learned how important it was to properly motivate his players. You would think that with the big money players were making that motivating them would be relatively easy, but he found just the opposite to be true. One year he decided to purchase two, large La-Z-Boy® recliners and placed them right in the middle of the locker room at Redskins Park, located at the time in Reston, Virginia. He proclaimed that every week, following Sunday's game, the coaching staff would proclaim the offensive and defensive players of the week. The reward for obtaining this honor was that only the winning players would be allowed to sit in the recliner before and after practice for the entire week. This set off a flurry of competition between the players, especially on game days. Dexter Manley, for example, would come running off the field after sacking the quarterback, screaming: "That chair is

mine this week!" Darrell Green, the Hall of Fame cornerback, would come to the sideline after an interception, challenging Dexter that **HE** would be the one owning the chair that week! These were well-paid, highly skilled athletic machines who, even among fanatical fans at RFK stadium, were mostly interested in where they would be sitting that week! Coach Gibbs taught me that human behavior was rarely predictable and always fascinating. He also taught me that taking a personal interest in your team members and searching for what they truly need to be successful is a servant's tool to leadership.

Motivation, worker behavior, and efficiency studies have been conducted since the industrial revolution. Management scientists like Abraham Maslow, Frederick Herzberg, and David McClelland all conducted studies to better understand what truly motivates the average worker. This paper attempts to build on the works of these scientists and expand on their findings to further understand how to tap into the human psyche and position our project team members to be increasingly focused and productive. Additional studies from the Massachusetts Institute of Technology (MIT) and even my own informal survey of project managers and team members will be discussed. By first understanding what motivates your team can you serve and support them to meet common project goals. Finally, we'll the principles of Servant Leadership and how they must be applied consistently across the project and the work environment.

Traditional Theories

As managers we often find ourselves delegating work as a standard operating procedure. Our expectation is that our team is getting paid, so of course they will accept and execute the work we assign to them. As professionals, we expect this work to be done in the highest quality manner, yet we're often disappointed when the result does not meet our expectations. Why is this? Steven Covey, in his book *The 7 Habits of Highly Successful People*®, states, "One must seek to first understand and then to be understood." For my own purpose, I've turned this around to state, "to be understood we must seek to understand." How can we possibly understand this missed expectation unless we can understand the person who performed the work? Once we can understand the worker, then we can properly motivate the worker. "To motivate, we must seek to appreciate."

Abraham Maslow developed his famed "Hierarchy of Needs." As depicted in Figure 1, he stated that everyone exists somewhere on the pyramid of needs. To meet our most basic needs, we must have food, water, safety, and our health. It's only when these minimum needs have been met can we even begin to search for more sophisticated needs such as love, relationships, and a solid, well-formed sense of self-

respect and self-esteem. Finally, we all hope to reach the point of total self-actualization — the "nirvana" of living life, for at this point we are in complete harmony with ourselves and the world around us. We have a well-developed moral compass and the confidence in our abilities to solve problems and positively influence others. We are committed to our work and our lifestyle without the need to be judgmental of others. Obtaining and maintaining self-actualization is difficult and often fleeting. Rarely do we enter and stay in complete self-actualization, because life throws us curve balls that can send us down the pyramid for the subsequent climb back up to the top. Most of us are fortunate if we can maintain the self-esteem level within the pyramid; it is at this level we hope to find all of our team members. For example, professional athletes find a positive correlation between their level of confidence and their performance in their sport; that said, this confidence can only be maintained when the lower levels of the pyramid are strong and sturdy.

Figure 1: Maslow's Hierarchy of Needs

Frederick Herzberg developed his theory on motivation and hygiene in 1959 and was one of the first theorists to state that money **was not** a motivating factor. He stated that workers needed and were often forced to tolerate "hygiene" factors, such as company policy, supervision, and working conditions but what truly excited and motivated workers were the opportunities to achieve, excel, and be recognized for these achievements on the job. Subsequently, these opportunities would lead to increased job satisfaction, responsibilities, and organizational advancement.

David McClelland also addressed the need for achievement but also found that workers found increasing job satisfaction when they were positioned to actually influence the way a job was performed. This need for power and the enjoyment that

workers obtained when they could affiliate with like-minded workers also led to increased job satisfaction and improved job performance.

More recent studies, performed by MIT on behalf of the Federal Reserve Board, have made some fascinating, albeit, not so surprising findings. These studies showed that performance decreases when paying sizable financial incentives for complicated tasks requiring conceptual creative thinking. Financial incentives are quite effective, though, for relatively simple tasks that have a clear cause and effect, such as completing administrative or routine activities. These studies demonstrated that when workers feel they are paid fairly, they are then free to concentrate on accomplishing the work to the highest standard possible. Daniel Pink, former speech writer for former Vice President Al Gore and now noted author on motivation, noted that team members feel the most comfortable and perform better when positioned under the following three criteria:

- **Autonomy:** the opportunity to self-direct their work. This allows team members to exercise their creativity and problem-solving skills.

- **Mastery:** the opportunity to get better and become subject matter experts in a chosen area of expertise.

- **Purpose:** the opportunity to make a contribution to the betterment of the common good. This sense of purpose supports McGregor's Theory Y management approach, which states that team members want to impact the mission of the organization and provide recognizable value to that mission.

PME's Motivation and Morale Survey Results

To this point, little has been said about the role of rewards and recognition programs. Historically, there is simply little correlation between financial rewards, such as salary and bonus programs, and a real noticeable increase in performance. I decided to undertake my own informal study and take these findings to the next level by asking the question: What do managers and executives need to do to reward team members and encourage the right behaviors that will lead to improved performance, better results, and greater morale? I sent surveys to over 1000 managers and team members to address this question and received 118 responses. In addition, I addressed and discussed similar questions to over 300 project managers attending my numerous project management training classes, and the results are very consistent. Let's take a look at the questions, answers, and my conclusions below.

1. I feel considerable excitement when I receive:				
	Don't Agree	Somewhat Agree	Totally Agree	No Answer
My regular salary pay	44%	45%	8%	3%
My bonus pay	6%	34%	48%	12%
A compliment for a job well done.	2%	19%	79%	1%

Conclusion: Receiving our compensation clearly DOES NOT generate the same excitement as that which comes from recognizable success in performing the job. This reaffirms Herzberg's theory that the opportunity to achieve outweighs the financial incentives. Project managers and team members that I speak with consider their compensation, including bonuses, an "entitlement" rather than a reward. If the objective is to build morale and improve performance, financial rewards are clearly not the answer.

2. I tend to perform better on the job when:				
	Don't Agree	Somewhat Agree	Totally Agree	N/A
My work related confidence is high.	1%	19%	80%	0%
I'm passionate about my work.	2%	8%	90%	0%
My personal life is going well.	2%	36%	62%	0%
I'm compensated what I feel I'm worth.	6%	42%	52%	0%

Conclusion: Performance is higher when:

(1) We are confident and passionate about our work
(2) Our personal life is going well
(3) We are paid fairly

Again, there is little correlation between higher pay and increased performance. Like Daniel Pink in his book *Drive* stated, "team members simply want to be paid fairly" but to increase performance, they must be confident and passionate about their assignments.

3. Which type of bonus program excites YOU most?	
Bonus paid against YOUR success.	58%
Bonus paid against TEAM success.	42%

Conclusion: In project management we stress the importance of the team and the value the team has to effectively deliver the project's product. This importance goes out the window when it comes to our personal compensation. We would prefer to be compensated against our own performance rather than against the performance of our colleagues on our team. This may be due to our entrepreneurial spirit, which encourages us to be rewarded against our own efforts rather than those of our competitors.

4. Which type of reward/bonus would best help you feel GREAT about yourself and the organization in which you work?	
Total monetary reward.	44%
A personally customized reward/bonus package to include gifts, vacations, college scholarships for your family members, etc.	56%

5. Given the choice, which type of reward/bonus option would you choose?	
Total monetary reward.	53%
A personally customized reward/bonus package to include gifts, vacations, college scholarships for your family members, etc.	47%

Conclusion: Over 50% of those who responded to this study admitted that a personally customized reward/bonus package would help them feel great about themselves and the organizations they work for. Again, financial rewards do not consistently lead to higher morale and improved performance; that said, given the choice, we would prefer the cash so we can exercise our independence and choose what **we** would like to do with our reward. Although cash rewards may increase our choices, it may not improve our morale or provide enough incremental motivation to increase performance.

Servant Leadership

Now that we better understand our team, we can apply the servant leadership mindset to support them as we work together to meet our customer's expectations. If we're to succeed consistently and efficiently, we as leaders must work to create a healthy team environment filled with "happy carpenters" as depicted below:

As defined by the Robert Greenleaf Center for Servant Leadership, "Servant Leadership is a philosophy and set of practices that enriches the lives of individuals, builds better organizations and ultimately creates a more just and caring world". Robert Greenleaf, its founder, spent 38 years with AT&T and felt that "Good leaders must first become good servants". He felt that great leaders of great organizations must be committed to employees, customers and to the community as a whole. To obtain this we as leaders must have a servant's mindset, committed to enhance the life and well-being of all three of these entities. This leadership style can only exist when it is supported by a strategy and a management culture that embraces this concept. In summary, servant leadership consists of 7 basic pillars that state a servant leader is:

1. A Person of Character
2. Puts people first
3. A Skilled Communicator
4. A Compassionate Collaborator
5. Has Foresight
6. A Systems Thinker
7. Leads with Moral Authority

A servant leader flips the organizational chart and supports his/her team and customer first. A servant leader embraces that he/she doesn't own the entire perspective but listens, collaborates, and communicates in search of truth. A servant leader has vision and see's consequences to all choices. A servant leader isn't afraid to say no, that is just plain unethical. It is this mindset that is in the forefront of the servant leader's brain. When we manage this way, we work to understand the "happy carpenter" and position him/her to achieve their goals and subsequently the goals of the customer. Servant leaders believe that this approach, coupled with good business sense, will lead to fair and reasonable profitability.

Recommendations

Now that we understand what motivates the team and that a moralistically simplistic approach works well, here are some recommendations moving forward.

1. Start recognizing and rewarding passion, commitment, teamwork, customer service…. not just project success.

2. Look to hire (or acquire) team members that have demonstrated "great team member traits". Recruit team members with positive attitudes first and technical skills second.

3. Seek to understand the whole person not just the "worker." Get to know your team members on a personal level and work to respect their personal situations.

4. Excessive financial incentive programs do not deliver exceptional performance. Pay workers fairly and consider other ways to motivate them, such as independent work, training, recognition of expertise, and the opportunity to share in the project's success.

5. Consider customizing rewards and bonus programs to each individual to include a balance of emotional, materialistic, and financial rewards.

6. Practice Servant Leadership

References

Covey, S. (1989). The 7 Habits of Highly Successful People. Free Press.

Brady, M (2017). "Maslow's Hierarchy of Needs for Caregivers" https://mariasplace.com/creative-activities/marias-journal/maslows-hierarchy-needs-caregivers/ Edwards, CO 81632

Pink, Daniel H. (2011). "Drive: The Surprising Truth About What Motivates Us" Riverhead Books, New York, New York.

Launi, Joseph D. (2016). "Motivation and Morale in Project Managers" Leesburg, VA

Sipe, J., and Frick, D. (2015). "*Seven Pillars of Servant Leadership; Practicing the Wisdom of Leading by Serving"*,Paulist Press, Mahwah, New Jersey.

About the Author

For over 30 years, Joseph (Joe) D. Launi, PMP, President and CEO of Project Management Experts, 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 progressive experience, which encompasses 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.

Mr. Launi has published numerous works in areas such as software implementation and project planning. Project Management Experts specializes in providing organizations with the skills, knowledge, and experience needed to improve their project management competency.

Project Stakeholder Management and Engagement: An Analysis of the Drivers of an Evolving Subject Discipline

Aurangzeb Z. Khan[1], Miroslaw Skibniewski[2], John H. Cable[3]

1. Department of Management Sciences, COMSATS Institute of Information Technology, Islamabad, Pakistan;
2. Project Management Center for Excellence, A. James A. Clark School of Engineering, University of Maryland, College Park, MD, USA;
3. Project Management Center for Excellence, A. James Clark School of Engineering, University of Maryland, College Park, MD, USA

Project stakeholder management and engagement is now acknowledged as a critical success factor on virtually every project. Its importance and thematic popularity is self-evident from the voluminous body of literature which has been written on the subject, especially since the advent of the new millennium. Also by the increasing attention and consideration projects are according to their stakeholders, both primary and secondary, whose support is seen as critical for enhancing the performance of projects as well as for reducing threats, existential and other, to them. However, little to nothing appears to be known about the key underlying factors – or 'drivers' - which over time in academic and especially in practitioner circles have precipitated this tremendous surge in interest in project stakeholders and in seeking out ways and means of managing and engaging them in the best possible way.

This research attempts to bridge this knowledge vacuum. Based on a comprehensive analysis of the project stakeholder literature from academic and other sources, through several discussions and interviews with project managers and staffers, and drawing on their own years-long experience with projects, the authors have identified nine distinct fundamental 'drivers'. These drivers collectively are the reason why stakeholders have emerged as the prime force to be reckoned with on projects in the past few decades, especially in large and complex projects as in construction and civil infrastructure development. Though this research offers little in terms of practical guidance for project decision-makers and is actually more of historical interest it nevertheless clearly and convincingly shows why stakeholders have gradually become so crucial for projects and hence the need and justification for their effective management and engagement.

* * * * *

Stakeholders lie at the core of each and every project regardless of category, complexity, location and time. Projects are conceived and conceptualized, defined, initiated, planned and designed, and executed, monitored, evaluated and controlled by stakeholders for stakeholders. At the same time, projects may affect as well as be affected by stakeholders who are not involved in performing any of their managerial or technical functions but whose interests, misgivings, expectations and so forth must nevertheless be carefully addressed. Shortcomings in the management or engagement of stakeholders may entail serious negative consequences and possibly existential danger for projects. Hence, a clear and thorough understanding of the importance of stakeholders on projects is essential for practitioners so that they can deal with them in a prudent, appropriate and fair manner and in doing so advance the interests of their projects.

This paper identifies and examines the key factors or 'drivers' which in recent decades have resulted in the subject of stakeholder management and engagement acquiring the universal

interest it presently evidently commands amongst project practitioners. The ideas presented in this paper are based on the authors' extensive years-long research on project stakeholders as well as their own practical insights stemming from their direct and indirect involvement in projects in diverse fields over time, especially in construction and civil infrastructure (CCID) projects under which transportation, dams, energy, mining, building and facility construction and development, and other schemes of economic significance normally fall. Several books and research articles, project performance surveys, project management websites and other informational sources available in the public domain were also reviewed specifically for this paper and discussions were conducted with practitioners with decades of managerial experience on projects. Though this paper has little to offer project owners, planners and executors in terms of practical guidance about how to, or how not to, manage and engage their stakeholders, it shows why stakeholders have over time become such a critically important factor on projects and from which the need for effective stakeholder management and engagement as a means for ensuring a higher likelihood of success of projects in the field of CCID as well as throughout the entire project category spectrum should be obvious.

The authors' research has identified nine subject 'drivers' whose salient aspects in terms of their relationship with project stakeholders are briefly discussed separately below. Their order of appearance does not necessarily reflect their degree of importance:

Awareness: Probably the most important subject driver identified through this research is awareness. Project practitioners have become universally cognizant over time of the enormous influence project stakeholders, both primary (i.e. those stakeholders who have a contractual obligation or legal responsibility towards the project and are directly involved in it) and secondary (those stakeholders who do not have contractual obligations or legal responsibilities towards the project but are affected by it in some way), can wield on projects. This is especially true in the case of large and complex CCID-projects whose stakeholders, especially secondary ones, typically are characterized by a great diversity, inter alia, of interests, needs, desires, concerns and so forth, making the task of engaging them effectively in favor of the project immensely challenging, difficult and costly to achieve. Research clearly indicates now that stakeholders are a paramount critical success factor on projects and several published project performance surveys undertaken across the globe from time to time in various project categories by and large indicate that stakeholder-related issues, challenges and complications, more so than technical ones, are the prime cause of project failure. A survey of high-performing and experienced project managers also backs this finding up as do the results of an interesting research study undertaken in 2008 by a consortium of organizations in the European Union called NETLIPSE (Network for Knowledge Dissemination on the Management and Organization of Large Infrastructure Projects in Europe*)*. The NETLIPSE study of 15 large European transportation projects revealed the criticality of stakeholder management and engagement and claimed that "sustaining the relationships and measuring the effectiveness of communication with stakeholders can yield strong benefits for a disproportionately low amount of time and expenditure ... the essential lesson learnt in the NETLIPSE project is that dialogue, communication and cooperation are as useful as focusing on technique, contracts and other internal concerns … When comparing the NETLIPSE projects, it seems that those projects which dealt with stakeholders on an ad hoc basis experienced far more problems with their stakeholders than those projects which developed a stakeholder strategy early on in the project". Formal interviews as well as informal discussions conducted by the authors with many project managers, owners, consultants and other key stakeholders for this paper and as part of their overall research into project stakeholder management and engagement clearly echo this conclusion. Long is the list of large projects

across the globe which were prematurely terminated or which failed to achieve the intended results mainly because they failed to deal effectively with their stakeholders.

Awareness about the importance of project stakeholders can moreover be found in numerous written mediums as the authors discovered, prominent of which are, inter alia, books, book chapters, articles published in research and non-scientific journals, master and doctoral theses, articles in newspapers and magazines and project management websites and blogs, the publications of development financing institutions and international development agencies, transnational organizations, research institutes, government bodies and consultants and, off course, current as well as past project documentation and archives.

Awareness of stakeholder management and engagement is increasingly finding its way into the curricula of project management degree programs across the globe and many short-term subject-specific courses are being offered on the subject in addition to frequent hosting of conferences, seminars, workshops, trainings and other such events. Field experience is a direct and personal source of awareness about the importance of stakeholders and the need for carefully and prudently managing and engaging them on projects. Tacit knowledge too is an important source of awareness and one which can be particularly useful when exchanged between project practitioners. The broadcasting media has also contributed towards increased awareness about stakeholders. Long-running popular television programs such as Megastructures, Extreme Engineering, and Modern Marvels, whose episodes usually feature very large and complex CCID-projects undertaken across the globe, often include content about the projects' stakeholder aspects. And importantly, major professional project management associations responsible for developing and popularizing project management standards and benchmarks, such as the Project Management Institute's Project Management Body of Knowledge (PMBOK), the International Project Management Association's IPMA Competence Baseline (ICB) and the Association of Project Management's Body of Knowledge (APMOK) all – and in addition to the many standards and benchmarks developed separately by national project management associations in several countries – increasingly acknowledge the crucial importance of stakeholders for projects and the need for their effective management and engagement.

Complexification: That projects in our contemporary age tend to be characterized by a far higher degree of 'complexity' than projects undertaken in the past is an undeniable fact. This has become especially evident with the advent of globalization since the 1970s. The notion of complexification as it applies to projects encompasses in the view of the authors at least four distinct dimensions - environmental, transformational, associational, and project-specific complexity - all of which have come about largely because of stakeholder influence.

Environmental Complexity relates primarily to the external environment in which projects are undertaken. Many factors have contributed towards the growing level of complexity encountered here. In the context of commercial projects for instance these include the opening up of domestic markets to foreign competition through elimination of the barriers to trade and investment. Consequently, competition to provide consumers with goods and services has grown considerably and consumers have generally come to expect access to higher-quality offerings at lower cost. Rapidly changing consumer preferences and increasing demand for customized and superior products has also resulted in products becoming obsolete more rapidly than in the past, necessitating significant performance, functional, aesthetic and other product improvements which are effected through modification or new product development projects undertaken with increasing frequency and over shorter time horizons. For organizations this can be quite challenging and failure to satisfy their stakeholders' (i.e. existing &

prospective consumers') needs, wants and expectations can cost them their competitive edge and possibly endanger their survival as the high number of firm liquidations and insolvencies in recent years appears to indicate.

Transformational Complexity differs from environmental complexity in that while the latter considers external factors and forces influencing projects, the former focusses on intra-organizational ones which significantly influence projects. Both complexity forms are related; environmental complexity stems in large measure from increasingly empowered and demanding stakeholders and competition and is mainly responsible for precipitating transformational complexity. Transformational complexity manifests itself in many ways for projects, inter alia, by attempting to reduce project cost and duration, increasing project adaptability, value and efficiency, focusing on quality, diversifying product and/or service offerings, and by effecting improvements in the organizations technological, process and institutional support infrastructure and frameworks for its projects. This in turn demands effective management of stakeholders by organizations in order to sensitize them to the need for such changes.

For its part, *Associational Complexity* relates to projects undertaken with substantive and sustained participation by two or more organizations. Projects under this category include (international) joint ventures, mergers and acquisitions, strategic alliance initiatives, public-private-partnerships, and full or partial outsourcing of projects or project phases, activities or functions. Globally the investment in such undertakings has grown at an exponential level in the past few decades and annually runs into hundreds of billions of Dollars. Such projects pose numerous and significant challenges which makes the task of effectively managing and engaging their stakeholders especially hard to undertake. In particular, the difficulty of communication, trust and relationship-building between stakeholders across national borders, which necessarily involves dealing with multiple legal, public administrative and political systems, as well as handling the often significant differences in national, organizational and group cultures, mentality, attitude to work and time, business and social etiquettes, standards of professionalism, ethics and red-tape among many other stakeholder-salient considerations, constitute major hurdles. Empirically such undertakings have also been proven to be at a higher risk of project failure.

The fourth complexity dimension - *Project-specific Complexity* - relates to individual projects. It applies especially for CCID-projects being undertaken across the globe, which in our era of megaprojects and superlatives, are characterized increasingly by astronomical investment, long project durations, enormous technical complexities, quest for innovativeness, and specialized human, technological, material, knowledge and other resources and inputs provided by numerous stakeholders which often are based in several countries. Dealing with many and diverse primary (and secondary) stakeholders presents an enormous challenge and risk for projects and constitutes a compelling factor for practitioners to be more cognizant of the importance of their stakeholders and the need for managing and engaging them effectively.

Information & Communication Technology (ICT): Advances in ICT over the past twenty to thirty years have revolutionized the way we live, work and interact with each other. ICT has also immensely changed the way stakeholders interact with projects as well as the way stakeholders interact with each other. For projects this presents both opportunities and challenges. ICT has brought with it multifarious and very substantive benefits for projects

and, in particular, the way it manages its (primary) stakeholders. Project Management Information Systems, for example, enable storage of and simultaneous access by project stakeholders located in multiple project offices and sites everywhere to mammoth amounts of data and information in any digital format to an extent that was unimaginable when manual systems were previously used for this purpose. Project management software have evolved into highly sophisticated tools which are now indispensable on large and complex projects for project designing, planning, scheduling and monitoring as well as for performing other key functions, including program and project portfolio management. Groupware software allows non-collocated project teams to closely collaborate in performing complex design and other activities. CAD-software enables 3D visualizations of project facilities to be developed upfront giving project owners and clients a realistic feel of how their facilities will look on completion and the opportunity to push through design changes before construction commences. Virtual meetings conducted through video- und web-conferencing technologies have eliminated the need for personal meetings between project stakeholders and avoidance of the consequent high cost, hassle and time spent on travelling sometimes far distances for this purpose. And through ICT, projects can quickly and cheaply reach out to and inform stakeholders – both primary and secondary – about the projects in a favorable way.

At the same time, the application of ICT presents is accompanied by some major risks which can pose severe challenges for projects. Notably, these are the potential danger to the integrity of stored and shared information and exposure of confidential information, data loss in the event of inadequate or lacking system data backups, and an often observed tendency by users towards overreliance on such technology. The stakeholder communication process itself may be flawed resulting in the occurrence of communicational deficiencies, such as, over-, under- or miscommunication and an excess of or absence of communication on occasions. And even the best available ICT cannot guarantee the quality of information it contains and on which the efficiency, effectiveness and sometimes even the survivability of projects often hinges.

For stakeholders opposed to projects, which typically fall in the category of the secondary stakeholders, ICT presents them with an excellent opportunity to express their hostility towards projects easily, quickly and cheaply to a large, sometimes even global, audience. Negative information about many projects, especially CCID-projects, often finds its way onto internet websites specifically set up to warn the public about the demerits of projects and galvanize resistance to them. ICT is often used by advocacy groups forming ‘coalition alliances’ to leverage their respective resources to actively oppose large projects. Social media websites such as Facebook, Twitter and YouTube are being used increasingly to quickly spread hostile information - and sometimes even gross disinformation - about projects which may subsequently be quite hard or impossible for the projects to dispel.

Advocacy Groups: In recent decades advocacy groups have emerged as a potent force with global outreach to be reckoned with. For projects involving spatial development, which is typical of CCID-projects, particularly large, complex and high-profile ones, advocacy groups may and in practice often do pose a direct and immense challenge. Advocacy groups’ vehement and persisting opposition to these projects stems from what they expect or perceive to be often substantive and permanent damage inflicted on entities (i.e. stakeholders) whose involvement in the projects in question is often involuntary and who often lack the means or resources to resist them themselves. Stakeholders typically deemed at risk by CCID projects and thus protection-worthy by advocacy groups include the natural environment, especially rivers, forests and wetlands, the fauna and flora which exist in the natural environment, and indigenous or marginalized people who often tend to inhabit land or areas coinciding with

identified project locations. Presently numbering several thousand across the globe, some advocacy groups have a thematic focus, such as the environmentalists 'Greenpeace' and 'Friends of the Earth', the indigenous people defender 'Survival International' and the anti-mining group 'MAC: Mines and Communities'; others were formed to oppose certain specific projects (e.g. oil tar sands) or companies (protestbarrick.net). A small number operate globally and possess a significant resource base; most advocacy groups however are small and active only at the national or, more usually, at the local level. Advocacy groups often pool their resources, knowledge, experience and influence to form networks or coalitions to oppose specific projects. From project perspective their often much publicized intervention is usually viewed as negative and invasive and many large projects across the globe have been severely affected, some significantly delayed or even prematurely terminated, by advocacy group intervention over time. Hence, acknowledging the role of advocacy groups on projects and understanding the reasons for their opposition and properly engaging them and the entities whose interests they seek to protect – all of whom are (secondary) stakeholders - is imperative for these projects if they wish to avoid public controversy and all the negative ramifications which this may subsequently entail for the projects.

The Media: In its printed, broadcast and online variants, the media is an extremely powerful shaper of opinions - and project stakeholder. It is through the conventional media – and with the advent of the internet increasingly through social media - that people usually first get to know about the existence of a project and the media exposure a project gets over time largely determines how it is perceived by them. Often the media may have a commercial interest in projects, for instance, when newspapers allocate page space to inform readers about project employment and business opportunities. More often though the media constitutes a detailed source of information over time about projects and their activities and the public mood and sentiment displayed towards them. Controversial schemes – which many CCID projects frequently come to be seen as – usually pique public interest and often receive extensive and prolonged media coverage. The media, however, is not homogenous; it represents a possibly wide spectrum of political ideologies and reporting by individual media entities normally demonstrates their respective ideological or journalistic slant. For CCID projects this may sometimes result in quite disfavorable and obviously unwanted publicity which may or may not be warranted. Negative publicity courts critical attention towards projects and may breed suspicion of and hostility towards them on a large scale which possibly may result in the intervention by other entities who in the absence of adverse reporting may have been unaware of the project or its developments or who would be disinclined to act against it. The media, therefore, can be considered to be a very important project stakeholder and it essential for projects to understand its importance as a reputation maker or breaker and engage it prudently. Practice shows that CCID-Projects have increasingly come to realize the media's role as a powerful stakeholder and force to be reckoned with, and are becoming more amenable towards developing specific media engagement policies, strategies and plans and adopting proactive measures to safeguard the interests of their projects.

Corporate Social Responsibility (CSR): In recent decades the theme of CSR has attracted much interest and attention among organizations. CSR epitomizes the principle of reciprocity, namely, that organizations, usually commercial ones, must give something back to the society in which they are existing, operating and financially benefitting. The 3P's (Profit-People-Planet) concept, which appeared in the development literature in the 1980s, is increasingly being acknowledged and followed by commercial organizations and reflected in their respective CSR programs whose collective value globally runs into tens of billions of Dollars every year. Organizations are expected to focus not only on commercial gain or profit (i.e.

what they take from society), but also to give something back to it in terms of investment and spending on people and the environment, the latter two of which are universally considered important secondary stakeholders. The people or social component encompasses persons outside the organization who may or may not be affected, directly or indirectly, by its operational activities and/or by its programs/projects while the environmental component typically relates to the natural environment and its fauna and flora. Organizations undertaking CCID-projects in particular can reasonably be expected to invest relatively more in people and environment-focused CSR program activities because these projects usually tend to have a more invasive and negative social and environmental impact than projects undertaken in other categories by organizations.

CSR has been the subject of extensive research and most commercial organizations and corporations now have well-established CSR programs in place. CSR offers immense space for creative possibilities and the spectrum of CSR program measures implemented by organizations in practice has been observed in practice to be very broad. As CSR is essentially a stakeholder-focused scheme, its emergence and rapid growth and near universal acceptance over time lucidly indicates the recognition and importance which organizations, some more enthusiastically and vigorously than others, are according their stakeholders.

International Development: Tens of billions of Dollars are directly invested by regional and international development financing institutions every year in sponsoring 'development interventions' - mainly programs and projects intended primarily to expand or improve the civil and social infrastructure of poorer, less developed nations. Key players financing development interventions include the World Bank, the Asian, African, Caribbean, Inter-American, Islamic and North American Development Banks and the European Bank for Reconstruction & Development. Good stakeholder management and engagement policies and practices by funding recipients has become an increasingly important prerequisite for institutional borrowing over time and this importance is reflected in many forms, for instance, in the mandatory requirement for undertaking thorough environmental and social impact assessments on proposed programs and projects, on whose outcomes of which often the decision to grant or deny funding to the program or project in question hinges.

In addition to the development financing institutions, many other organizations were established in developed states to sponsor development interventions and provide technical and other specialized forms of assistance to developing states. At the global level this assistance too amounts to tens of billions of Dollars every year. Major international development agencies include USAID (USA), CIDA (Canada), UKAID (United Kingdom), GIZ (Germany), AUSAID (Australia), JICA (Japan), in addition to the European Union, and the United Nations system. As with development financing institutions, stakeholders – or 'beneficiaries' - have assumed significant importance in projects and programs sponsored by these organizations. Stakeholder acceptance of development-oriented programs and projects is viewed as increasingly crucial because it ensures a more efficient use of available resources, satisfies needs more effectively, and achieves results which are more sustainable. Consequently, such organizations are placing greater emphasis on measures aimed at involving stakeholders in the programs and projects which target them, notably stakeholder dialogue and consultation, and stakeholder participation in project or program need assessments, design and planning, execution, and monitoring and appraisal.

Empowerment: The ability of the public to influence CCID-projects has grown noticeably over time in both developed and developing countries. This increased influence is attributable

to several factors, in particular, democraticization and legislative and public administrative changes at the national or subnational level intended to enable citizens to have a greater say in schemes which affect them, and general reluctance at the political level to support projects which court and sustain a visibly high degree of public controversy and opposition. From project perspective, more community and citizen empowerment implies additional pressure on project owners, designers, planners and executors to take into consideration and adequately address the concerns and expectations of their secondary stakeholders. Failure to do so may possibly expose their projects to a higher risk of external intervention by other powerful stakeholders (public administration, courts, politicians) resulting in potential cost and schedule overruns, unwanted changes to the project scope, loss of image, or even existential threats in the event that permits, licenses or concessions granted are suspended, revoked or cancelled in the face of strong public hostility. The means through which secondary stakeholders can have their say in projects vary, depending on location. Oftentimes official permission for CCID-projects to go ahead goes hand in hand with the fulfillment of a gamut of conditions intended to compensate or benefit their secondary stakeholders financially, materially or in other ways. Mandatory Public hearings, for instance, give stakeholders the opportunity to air their general and specific concerns which the projects are expected or required to consider. In some places stakeholders can petition the public administration in support of or against projects and, when the number of petitions attains or exceeds a threshold level, even force unpopular projects to a halt or revision. Public referendums are a means which have in the recent past been used with success by local communities opposed to some major mining projects by large foreign corporations in Central and Latin America and, in the case of Switzerland, to prohibit the construction of mosque minarets. Legislation across the globe aimed in particular at protecting the environment has evolved substantially since the 1970s in response to universal concern at the environmental damage caused largely by CCID-projects. Independent Environmental and Social Impact Assessments are now virtually everywhere a prerequisite for launching CCID-projects. Other forms of assessment such as Cultural Impact Assessments, Health and Human Rights Impact Assessments, and Archeological Impact Assessments, which are being increasingly undertaken voluntarily or involuntarily in the feasibility phase of CCID-projects, also clearly reflect the growing importance and empowerment of the secondary stakeholders in relation to projects.

Stakeholder Theory: The term ‘stakeholder’ is relatively modern; it reportedly dates back to the early 1960s. As a body of academic knowledge Stakeholder Theory it even younger, having evolved extensively after the publication of Professor R. Edwards Freeman’s landmark book *Strategic Management: A Stakeholder Approach* in 1984. Stakeholder theory commands much interest in the academic sphere. Many of the now numerous research articles discussing stakeholder theory are found in prestigious academic journals, such as, the *Journal of Business Ethics*. Though stakeholder theory is focused primarily on the corporate organizational context, its principles are equally relevant for managing as well as engaging stakeholders across the project category spectrum. Stakeholder theory encompasses three distinct dimensions: descriptive, instrumental, and normative. Descriptive stakeholder theory is basically concerned with identifying and analyzing an organization’s (or their projects/programs) stakeholders. Before formal identification can take place a definition of the term stakeholder is needed and in practice this is not a straightforward exercise because the definition chosen by a project can range from being very narrow to extremely broad and anything in between, with each variant having its respective advantages and limitations. Instrumental stakeholder theory views stakeholders as an ‘instrument’ which organizations (or their projects/programs) must attempt to effectively manage and engage, failing which negative

consequences may ensue such as reduced project efficiency and/or higher risk of project failure. Normative stakeholder theory constitutes the ethical and philosophical foundation of stakeholder theory. At focus here is why and to what extent organizations (or their projects/-programs) should manage and engage their stakeholders and whether there is justification in broadening the stakeholder concept to encompass non-human (such as fauna & flora) and inanimate entities (the natural environment). All three stakeholder theoretical dimensions are important because they make a solid case based on sound and logical reasoning and empirical observation for organizations (or their projects/programs) to deal with their stakeholders and which they convincingly show is not only an ethically desirable course of action but also brings practical and possibly quite substantive benefits to organizations (and their programs/projects) and helps pave the way for pursuit of win-win situations for organizations, their projects as well as their stakeholders.

Concluding Remarks

As the authors' research has shown, nine fundamental forces – or 'drivers' – collectively account for the phenomenal growth of interest which the subject of project stakeholder management and engagement has witnessed, in particular amongst project practitioners, over the past few decades. Though knowledge of these drivers per se offers little in terms of developing practical and robust strategies, solutions and measures essential for undertaking the highly complex and challenging task of effectively managing and engaging project stakeholders, educating practitioners about these drivers is nevertheless desirable in order to show them how critically important stakeholders have become over time as *the* main force to be reckoned with on projects, a fact which at the very least should ensure and sustain their interest in pursuing the best possible stakeholder management and engagement on their projects.

Recommended Reading

Lynda Bourne. *Stakeholder Relationship Management: A Maturity Model for Organisational Management*, Gower Publishing Ltd., UK, 2009.

R. Edward Freeman, Jeffrey S. Harrison, Andrew C. Wicks, Bidhan L. Parmar & Simone de Colle. *Stakeholder Theory. The State of the Art*, Cambridge University Press, UK, 2010.

Andrew L. Friedman & Samantha Miles. *Stakeholders. Theory and Practice*, Oxford University Press, UK, 2006.

Marcel Hertogh, Stuart Baker, Pau Lian Staal-Ong & Eddy Westerveld. *Managing Large Infrastructure Projects: Research on Best Practices and Lessons Learnt in Large Infrastructure Projects in Europe*, AT Osborne BV, Netherlands, 2008.

Malcolm Orkar. *Stakeholder Engagement as Practiced in the UK Construction Industry: Investigating the Possibility for a Contingency Theory of Stakeholder Engagement in Construction*, VDM Verlag Dr. Mueller, Germany, 2009.

Risk Management Made Easy

I. S. Parente[1]

[1]Susan Parente, MS Engineering Management, PMP, CISSP, PMI-RMP, PMI-ACP, CSM, CSPO, PSM I, ITIL, RESILIA, CRISC, MS Eng. Mgmt.;

S3 Technologies, LLC, Principal Consultant; parente@s3-tec.com

ABSTRACT

Many people know and understand risk management but are struggling to integrated it into your project management processes. How do seamlessly incorporate project risk management in an effective way for your projects?

The focus of this session is effective and efficient implementation of risk management within your project teams. This paper will discuss how to implement an effective risk management program. Successful strategies will be discussed to address common problems and challenges encountered while implementing project risk management within their organization.

OVERVIEW

The objectives of this paper on Risk Management Made Easy are to define and provide an overview of risk management, discuss the risk management process (including identification, assessment, response planning, execution, monitoring, documentation and communication), and lastly focus on how risk management directly applies to projects.

The goal of this paper is to provide you with a framework on risk management for implementing for projects.

RISK MANAGEMENT DEFINED

The Triple Constraint. The project management triple constraint (iron triangle) consists of: scope, time and cost (denoting the management of these project aspects).

Often quality is show in the middle of this triangle and Risk may be show as a cloud around the triangle, or in the background, as it is shown in figure 1 below.

Figure 1. The Triple Constraint.

Fundamentally, only 2 of the 3 aspects of the triad can be selected (or detailed). The third is then determined by the aspects which are selected. This is particular critical when changes occur to the project. The project performance baseline includes the baselines for these 3 project objectives: the scope baseline, the schedule baseline and the cost baseline. If any aspect of the approved project performance baseline is modified (through a change request, or otherwise), then at least one of the other 2 baselines will be effected. For example, if the project schedule is reduced by a month, either the budget must be increased or the scope of work schedule must be adjusted or the scope of the work must be decreased to meet the project objectives.

The other project objective of quality (also known as customer satisfaction) must be met but as a best practice is never changed to accommodate a change to time, scope or cost. What a customer requires to be satisfied is what they require. A customer will not generally agree to less than their interpretation of good project quality, even if the budget or schedule is reduced, or the project scope is increased.

Risk Defined. A Risk is an uncertain event or condition, which if it occurs, has a positive or negative effect on at least one objective. A risk is denoted using the properties of probability and impact. Probability is the likelihood of a risk occurring. It is the possibility of a project objective not being met using the current project plan. Impact is the consequence of a risk occurring. It details the penalty incurred, if the project objective, associated with the risk, is not obtained.

Risk exposure is calculated by multiplying a risk's probability of occurring times the impact (usually denoted in days or dollars).

Probability x Impact = Risk Exposure

As shown in figure 2 below, increased probability and/ or impact increase the exposure of a risk.

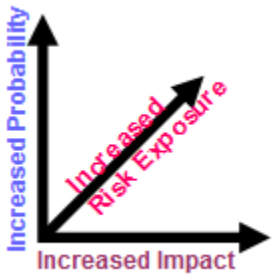


Figure 2. Probability and Impact.

It is important to understand the distinction between a risk and a problem/ issue. A Risk is an event that may occur in the future. A Problem or Issue is something which has already occurred and is being dealt with or has been resolved.

Project Risk Management Defined. Risk Management is an organized, systematic decision-making process that efficiently plans, assesses, handles, monitors, and documents risk to increase the likelihood of achieving project goals and decrease the likelihood that a risk would become a future problem

Project Risk Management has one inquire in uncertainty within their project: What are our project unknowns; what are the project's known unknowns; or what are the project's unknown unknowns? Risk Management provides a capability to quickly and effectively communicate risk information up and down the management chain.

The Risk Management Process. The risk management process includes the following: identification, assessment, response planning, execution, and planning, monitoring, documentation and communication. See figure 3 below for how these work together.

Figure 3. The Risk Management Processes

The focus of risk identification is the discovery of potential risks to the project. In particular, in includes distinguishing any uncertain event which may positively or negatively affect the obtainment of project objectives. The process of risk assessment includes the review, analysis, and prioritization of project risks. This may include qualitative and/ or quantitative risk analysis. Qualitative Risk Analysis uses a subjective assessment; while quantitative risk analysis uses values for risk impacts, usually days or dollars.

After identified risks are prioritized, response planning can be developed for risks. As a best practice this is completed for higher exposure risks first. Since there are generally limited resources for risk management, it is important to focus on risks which are most urgent (could potential occur sooner) and highest (due to a high level of probability and/ or impact). Threat risk response strategies include: mitigate, avoid, transfer or accept. Opportunity risk response strategies include: enhance, exploit, share, and accept. After these response strategies have been planned, they are executed, while continuing to monitor and control these risks and identify an emergent risks (new risks which have appeared which were not initially identified. Throughout the project risk management process, planning, monitoring, documentation and communication of risk also occur. These are foundational to the risk management process and are essential to repeat iteratively throughout the project. They are also part of continuous process improvement for the project's Risk Management Plan.

Why Manage Risk. Risk Management is what we have been doing for years as successful PMs, but in a structured and rigorous manner. It has us inquire in uncertainty: what are our project unknowns? known unknowns (identified risks)? Unknown

unknowns (unidentified risks). Risk management provides a capability to quickly and effectively communicate risk information up and down the management chain.

Benefits of Risk Management. Risk management assists us in identifying existing, as well as, potential project problems. (Existing problems are issues and must be handled through the issue management process. Potential problems are risks and must be handled through the risk management process.) Risk management also assists us in describing and classifying risks, which helps us to decrease threat risks and increase opportunity risks for projects. We are also able to prioritize risks, through the risk assessment processes (qualitative and quantitative risk analysis), so resources may be effectively applied. Here are some additional benefits of risk management:

- Identifies strategies to reduce threat risks
- Minimizes safety risk to personnel
- Provides a structure and systematic review of the processes to manage risk
- Provides an ongoing structure for project improvements
- Provides continuous risk communication

Risk Management facilitates communication by offering processes, mechanisms, and a common language for stakeholders to identify, define, evaluate and control risks.

THE RISK MANAGEMENT PROCESS

Risk Identification. The discovery of a potential risk

Risk Assessment. The review, analysis and prioritization of identified risks. They may include both qualitative and quantitative risk assessment.

Risk Response Planning. Planning actions to reduce threat risks and increase the likelihood of opportunity risks. Threat risk response strategies include: mitigate, avoid, transfer, accept, or escalate. Opportunity risk response strategies include: enhance, exploit, share, accept, or escalate.

Execution. This is also known as Implementing Risk Response Planning,

Planning, Monitoring, Documentation, and Communication. These continue throughout the project. These are foundational for project management and are essential to all processes of risk management. This is part of continuous process improvement for the risk management plan.

RISK IDENTIFICATION

Who? Any and all personnel on a project are responsible for identifying risks – it's an everyday part of the job.

At this point, it is not necessary to resolve the risk, simple capture the potential problem.

Identification Methods. Tools and techniques for risk identification include the following:

- Brainstorming
- Checklists
- Cost/ Schedule Analysis
- Functional/ Failure Analysis
- Interviewing
- Subject Matter Expertise

When? When is it appropriate to identify a risk?

- If the risk poses threats to meeting success criteria, mission objectives, critical milestones, etc.
- If you need resources to resolve the risk
- If broader awareness is needed
- If the risk presents threats to completing tasks

Risk Statements. Risk statements are written in a structured manner. State the risk in the format of an "If…, then…" statements. Each risk statement includes the following:

- Condition ("If") statement: A short, succinct statement that describes the background information and/ or description of the problem.

- Consequence ('Then') statement: A short, succinct statement that describes the key possible outcome(s) of the current conditions.

Consequences should be directly traceable to the event. Here is an example of risk statement: "If I have a flat tire while commuting to work, then I may not get to work on time."

RISK ASSESSMENT

What is Risk Assessment? This includes both qualitative and quantitative risk analysis. Not all projects use both processes for risk assessment. Two questions that are answered in risk assessment are:

- What is the probability of the risk occurring?

- What is the impact if the risk occurs?

    - Qualitatively, the impact assessment is subjective. For example: "significant", "severe".

    - Quantitatively, the impact is assessed in days or dollars. For example: 2 days or $10,000.

Both Probability and Impact are determined for both qualitative and quantitative risk analysis.

These are used to evaluate the risk as follows:

- Qualitative Assessment - Ex.: Risk Score or using the Probability and Impact Matrix. Figure 4 below is an example probability and impact matrix. These may be 3 by 3 or 5 by 5 (as shown).

- Quantitative Assessment - Ex.: EMV (Expected Monetary Value) = Probability x Impact

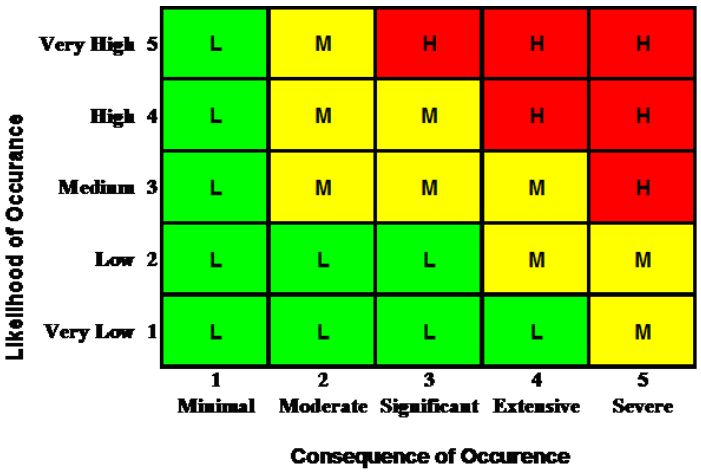


Figure 4. Probability and Impact Matrix

Quantitative Risk Analysis results in a quantitative value (dollar or day) for the risk, which is based on the probability and impact of the risk.

Methods Include:

- Monte Carlo Analysis (and Latin Hypercube)
- EMV (Expected Monetary Value)
- Decision Analysis

RISK RESPONSE PLANNING

Risk Response Strategies (for Threat Risks): These include:

- Mitigation: Pre-Event actions to reduce the probability or impact of a risk
- Avoidance: Eliminate the risk producing activity entirely by choosing an alternate approach.
- Transfer: Take actions that redistribute risk to another area. (This does not relieve the responsibility of tracking and closing the risk)
- Accept: Accept the risk as stated with no other action. Passive: Accept and do nothing
- Active: Accept and put a plan in place to minimize the impact of the threat, should it occur. Acceptance of a risk may be passive or active. In passive risk acceptance, the risk is accepted and nothing is done. In active risk acceptance, the risk is accepted and a plan is put in place to minimize the impact of the threat, should the risk event occur.

Risk Response Strategies (for Opportunity Risks): These include:

- Enhance: Increase the likelihood of the risk event occurring and/or increase the magnitude of its impact.
- Exploit: Pre-Event actions to increase the probability and/or impact of an opportunity risk, to ensure it occurs and is full realized.
- Share: Optimize probability and/or impact of an opportunity risk occurring.
- Accept: Accept the risk as stated with no other action. Acceptance of a risk may be passive or active. In passive risk acceptance, the risk is accepted and nothing is done. In active risk acceptance, the risk is accepted and a plan is put in place to take advantage of the opportunity, should it occur.

EXECUTION

PMI calls this Implement Risk Response. What is implemented is based on the actions detailed in the risk response plan for each risk. The responses executed include, for threats: mitigate, avoid, transfer, and accept, and for opportunities: enhance, exploit, share, and accept.

After a risk response plan is put in place, it may result in a secondary risk. A secondary risk is the "consequence" of implementing a risk response plan. In some cases, a risk response plan (for example avoid) might result in another (new) project risk. Another result of risk response planning is residual risk. Residual risk is the risk that remains after implementing the risk response for a risk. Another important risk management term is risk trigger. A risk trigger is an event which, when it occurs is a warming that the risk event will soon occur.

All risks should be recorded and tracked in the risk register. This includes the risk, fields associated with each risk, risk assessment, risk response plan, and status for each risk.

RISK PLANNING, MONITORING, DOCUMENTATION & COMMUICATION

Monitor, track, document, and communicate risk includes tracking the progress of mitigating the risk. This information is communicated to management and internal and external stakeholders. This also includes the integration of risk management processes with cost and schedule processes.

Part of monitoring, tracking, documenting, and communicating risk includes facilitating early mitigation and minimize project or program issues. This also includes escalation of risks to the management level where they can be resolved, or the elevation of critical risks to upper management can be expedited.

APPLICABILITY TO PROJECTS

Potential areas for implementing risk management include the areas of: project objectives (identifying and managing project uncertainty), project management processes, information security (for IT related projects) and product development (regardless of the type of product). Risk categories, which may be used to help identify and group project risks include the following: Integration (hardware/software), Logistics Support, Manufacturing, Schedule, Technology, Budget (funding), Capability of Developer, Management Strategies, Requirements, Test/Evaluation, Environment, Systems Engineering, Maintenance/ Supportability, Portfolio Management, Marketing, and other.

CONCLUSIONS/ LESSONS LEARNED

In conclusion, this paper on risk management made easy highlights the basics of project risk management and how the risk processes are used to manage risk for a project. The following topics were covered in this paper: definition of Risk Management, Risk Management overview, Risk Management processes (including: Identification, Assessment, Response Planning, Execution, Monitoring, Documentation and Communication), and lastly the applicability of risk management to projects.

In summary, Risk Management is an organized, systematic decision-making process that efficiently plans, assesses, handles, monitors, and documents risk to increase the likelihood of achieving project goals and decrease the likelihood that a risk would become a future problem. Risk Management adds structure and rigor to a fundamental process. To be successful completed, to support a successful project, risk management is everyone's job and that starts with each person on the project team!

REFERENCES

Byrne, John. Polaris- Lessons in Risk Management. Oshawa, ON, Canada: Multi-Media Publications Inc., 2011.

PMI. A Guide to the Project Management Body of Knowledge (PMBOK). Newtown Square, PA: Project Management Institute, Inc., Sixth Edition, 2017.

PMI. PMI Global Standard- Practice Standard for Project Risk Management. Newtown Square, PA: Project Management Institute, Inc., 2009.

Pritchard, Carl. Risk Management: Concepts and Guidance, Fourth Edition Arlington, VA: CRC Press, 4th Edition, 2010.

Standard Operating Procedures for Turning around Troubled Projects - A Structured Process

Pete Parnian

There are a number of articles, classes, and procedures addressing the recovery of troubled projects. The purpose of this article is to offer a set of structured, standard operating procedures with which to engage and execute a project recovery effort. In the author's opinion, a recovery project is just another project that needs a standard and structured approach. However, the project environment has changed. In fact, a troubled project is likely, a very complex, challenging, time-constrained, highly exposed, fast-paced, and highly charged situation.

Most project failures can be directly traced to poor project management practices. These often manifest themselves as:

- Scope creep – caused by ineffective Scope Change Control; I have gone into troubled projects well into the development phase of the project and found there was never a requirements specification approval in place; how does one implement change control if the requirements were never approved.
- Poor schedule performance – often lack of a schedule; lack of an accurate schedule, not using the schedule you have and holding team accountable for dates
- Poor communication – ineffective, ill defined, not implemented communication plan – They don't do what they say we are going to do
- Poor risk identification/mitigation – just ignoring the risks you know (or should know) are present. Things like inexperienced client PM but expecting this person to perform; no Steering Committee, no clearly defined escalation path, etc etc.

Who Is the One?

So, you've been selected to be the recovery project manager for the troubled project at ABC, Inc. Congratulations! Really? Veteran project managers know that the first reaction to such an appointment is not excitement, but instead, is probably closer to one of dread. Take a deep breath. While it may be a challenge, it's not impossible. The focus of this article is to offer you, the One, a practical, structured approach to project recovery.

Is It Too Late?

All projects have issues, but not all projects with issues are considered troubled. The spectrum of project difficulties may range from project challenges, project difficulties, project crises, and, finally, to project failures. As long as the project has not failed, it can be recovered. The sign of failure is that the client has stopped the project. The closer the project is to the point of failure, the more difficult the recovery. Consider variable *F,* defined as a trouble factor ranging from 0 to 1. A **1** means the project is considered by stakeholders as a complete failure. The author would suggest the probability of recovery (*R*) is **1** minus the trouble factor, or **R = 1 – F**.

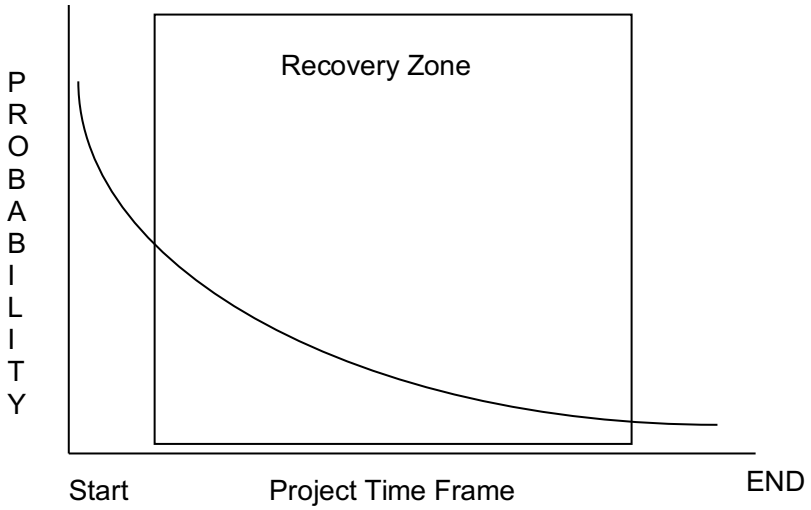


Figure 1. Probability of recovery success during the project life cycle

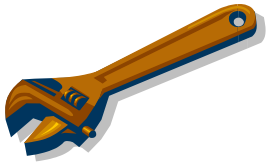
What Happened?

It is interesting to watch how project relationships change from the "honeymoon" period through various trials and tribulations to the "divorce" phase. Troubled projects typically involve unstable conditions, declining morale, high level of turnovers, stressed client relationships, internal conflicts, multiple accusations, and reduced or non-existent structure. Continuing the marriage analogy, it is also conceivable that some of the people involved really don't see the level of trouble or their own culpability because they are too close to the project. These folks are not at all objective. They are operating in their own comfort zone, with its convenient distractions, and have established relationships that may create a false sense of security.

To be honest, it is always important to look forward, independent of what has happened in the past. However, you also have to identify the cause of the issue or problem. As with any situation, there are always multiple takes on reality. It is the recovery project manager's job to cipher through the data resulting from documents, interviews, meetings, etc. in order to identify the root causes of the current situation. The assessment may range from a gut feeling to clear and concise evidence.

What Is Needed?

Projects require recovery for many different reasons—financial, performance, scope, quality, staff, client interaction, production, or a combination. The recovery project manager must clearly understand the reason for the trouble. Often, the initial reason given, turns out not to be the case at all. There are several factors for a successful project recovery:



- Qualification of the recovery manager
- Management support for the recovery effort
- Sufficient time to perform recovery activities
- A structured process for a successful recovery
- Clear objective, mission, support, and reporting structure of the recovery manager

Can I See the Forest Through the Trees?

As indicated before, the project team members are often too close to the situation. They can't "see the forest through the trees." Sometimes they are in denial. Some may blame the client for everything. In most cases, there is plenty of blame to go around. The recover process requires that you think "outside the box" by stepping away from finger-pointing and accusations, using sound judgment, following some basic steps, and looking at the big picture. It is important to understand the emotional investment of people involved on both sides, considering this as a factor that may impact a clear vision.

Problems with a project also are not always clear-cut or black and white. The recovery PM must start with a clean slate and make sound judgments based on experience and qualification. Time is of the essence so this must be done quickly and expeditiously.

What Are the Success Criteria?

In project recovery, it is also essential to clearly define what a recovery will mean as it may be different to others involved. A project is considered to be recovered ONLY if a timeline is met, or a budget objective is achieved. Without a specific recovery goal, it is difficult to define, and therefore achieve, success. With this in mind, the recovery goal may end up being any of the following or a combination:

- Achieve the original milestone objectives or an attempt to complete all deliveries as soon as possible
- Meet the original client requirements as stated in the RFP and the proposal

- Achieve project financial objectives, reduce overrun, improve margin, etc.
- Improve relationships and gain client satisfaction
- Improve delivery quality

As a professional project manager, this author actually enjoys doing project recovery. It is challenging, exciting, nerve-racking, and requires a lot of hard work. It also can be extremely rewarding. You must be methodical and disciplined to be successful. So, based on years of experience and the wisdom of colleagues and other professionals, a set of standard operating procedures are offered. Keep in mind that, just as no two projects are the same, no two recoveries are the same. Each one has its own nuances and special characteristics, but all share the same objective -- to turn around a troubled project.

What Is Next?

As in any project, a recovery project may be divided into phases. This is a four-phase approach to project recovery:

- Phase I: Recovery Transition, Assessment, and Strategy (PMI's Initiation)
- Phase II: Recovery Startup (PMI's Planning)
- Phase III: Recovery Execution and Control (PMI's Execution and Control)
- Phase IV: Recovery Closure (PMI's Closure)

The traditional PMI-recommended project phases—Initiating, Planning, Execution, Control, and Closure—are pretty much aligned with the phases outlined here. It is recommended that, at each phase, there are unique activities centered on recovery. Most often, as a recovery project manager, one does not enjoy the luxury of a clean project start up. Time is compressed, urgency is high, tensions are high, financial constraints have taken their toll, and relationships are damaged. These and numerous other factors will affect your role in the project.

The first is obviously is something that is gained by hands on experience, previous good and bad experiences as well as scares project managers have. Recovery management is something that is learned by a previous assignment as the first or second level management. Once is assigned recovery PM must ask for a formal charter, authority, reporting structure, escalation process, and sponsorship. Most often sponsor must be a different and even a higher level person that the previous project sponsor, simply because of the obvious culpability of the previous team.

What Tools Are Used?

The tools themselves are not as important as the structured process. As project manager, you need various automated or paper-based forms to gather data, ask questions, and assess the status. A PM needs spreadsheets, word-processing project management planning tools, email lists, collaboration tools, repositories, etc. A PM needs to have access to all of a project's historical material, deliverables, standards, and previous plans.

Who Are My Stakeholders?

Clearly, a key part of recovery is managing the project's stakeholders. It may be necessary to create a new stakeholder analysis and mapping. The traditional stakeholder analysis tools such as force field analysis, power/distance, power/influence, or even Infomentis tools maybe used to do so. Unfortunately, at this stage of the game it must be done quickly. Most likely, some of the data may have to be a "best guess." Typical stakeholders in an in-flight project are:

- Project and Corporate Leadership
- Quality management team
- PMs
- SMEs
- Execs
- IT staff

What Is My Role?

It is absolutely essential to get a clear definition of your role as you engage in a recovery operation. Whether or not a PM is assigned as the person who will take the project to conclusion or the PM is just performing the work on an interim basis, while looking for a permanent replacement. In either case PM role, authority, qualifications, and reporting structure must be communicated clearly to the client and the team. In this author's experience, although it may initially be uncomfortable, direct communication has the best long-term results. There may be possible scenarios regarding the assignment:

- Recovery PM, with full and complete takeover
- Interim Recovery Manager
- Recovery Advisor
- Recovery Evaluator

What Are the Recommended Standard Recovery Operating Procedures?

The Standard Operating Procedures for a recovery project are stated below and involve a structured set of tasks for each phase. After the initial couple of phases of this SOP, and as PM gets closer to steady state, recovery phases converge with standard project management phases and SOPs. During the next few paragraphs, we will step through the recommended recovery SOP phases and tasks (refined and detailed steps appear in Appendix A).

Phase I: Recovery Transition, Assessment and Strategy

- Recovery lead authority communication (week 1) -
- Mission Clarification – from management (week 1)
- Documentation repository review (week 1 &2)
- Root cause/map and gap analysis (week 2)
- Initial meetings and interviews (week 1,2)
- Assumptions, constraints, rule of engagement (week 1)
- Communication assessment (week 1)
- Organizational change management Assessment (week 2)
- Quality assessment (week 1 and 2)
- Recovery plan (week 2, 3)
- Recovery strategy approval (week 3)

Phase II: Recovery Project Start up (week 3, 4)

- Conduct formal stakeholder analysis
- Conduct introductions
- Re-establish scope management
- Re-establish quality management
- Re-establish work management
- Re-establish resource management
- Re-establish financial management
- Re-establish risk, issues and problem management
- Re-establish communication management
- Re-establish procurement management
- Re-establish configuration management
- Organizational change management
- Complete startup documentation

Phase III: Recovery Project Execution and Control (same as standard SOP)

Phase IV: Recovery Closure and Transition back

- Standard project closure if assigned to completion
- For interim recovery
- Document lessons learned

Program Benefits Management: an International Best Practice the U.S. Government Could Use

D. L. Pells[1], W. F. Abba[2], M. L. Shepherd[3]

[1]PM World Services, Inc., Addison, TX, USA; pells@pmworldinc.com
[2]Abba Consulting, Niceville, FL, USA; abbaconsulting@cox.net
[3]MS Projects Ltd, Salisbury, England, UK: miles.shepherd@msp-ltd.co.uk

ABSTRACT

Benefits Realization Management (BRM) has been incorporated into several international standards for program management, including The Standard for Program Management from the Project Management Institute (PMI) in the United States and Managing Successful Programmes (MSP) from the UK government (first published in 1999). MSP in the UK has been updated and replaced by Guidelines on Programme Management (2010) and Guide for Effective Benefits Management in Major Projects (Oct 2017). Policies and Guides related to BRM have also been issued by national and regional governments in Australia and New Zealand, as leaders have recognized the value of measuring program and project outcomes and benefits in addition to traditional measures such as scope, schedule and cost.

Professional bodies in the UK and Australia have focused attention on BRM in articles, blogs, conferences, papers and standards. While PMI devoted its entire suite of "Pulse of the Profession" and "Thought Leadership" papers to benefits realization in 2016, and has published some conference papers on the topic, there is little evidence of BRM being implemented in the United States. Among US federal agencies, almost nothing! Why is this? What is the purpose of a program or project? Why is a project launched, funded or performed? What is the purpose of all of the projects and programs in a portfolio? What benefits will be gained and for whom? What value will be created? BRM gets to the heart of these questions.

This paper will briefly explain BRM concepts and implementation issues, drawing on experience, guidance and documents in the UK and other countries. Its applicability for use in US government agencies will be explored. Effective BRM does not replace traditional project management processes and tools, but rather provides a basis for linking strategies, projects, programs, performance and outcomes. If anything, it can make earned value management and other proven project management methodologies more effective, while also promoting agility and stakeholder value.

A VERY SHORT INTRODUCTION TO BRM

According to PMI, program management includes the following five core domains: strategy alignment, benefits management, stakeholder management, governance and life cycle management. Program benefits management is the program management domain that defines, creates, maximizes and delivers the benefits provided by the program. The Purpose of Program Benefits Management is to focus program stakeholders (program sponsors, program manager, project managers, program steering committee and others) on the outcomes and benefits to be provided by the various activities conducted during the program. (PMI 2017)

The sixth edition of the APM Body of Knowledge lists benefits management as one of the core areas addressed under the heading of scope management, thus reflecting the assertion that the planned objectives of projects can 'be defined in terms of outputs, outcomes and benefits.' The APM Body of Knowledge asserts that delivering benefits is the primary reason for organisations to undertake change. (Dalcher 2017)

There is no other purpose in doing a programme than to deliver value and benefits. This is the true measure of a programme's success… research shows that for programmes to be more successful, they need to have a clear purpose, be strategically aligned with a recognized need and (have) a strong financial case. Programme[1] *benefits management is the practice that brings this together*. (Hudson 2017)

Some Definitions

Benefit – Gains and assets realized by the organization and stakeholders as the result of outcomes delivered by the program. (PMI 2017). The measurable improvement resulting from an outcome perceived as an advantage by one or more stakeholders; ex. Improved services (OGC 2007)

Benefit Management – The identification, definition, tracking, realisation and optimisation of benefits within and beyond a programme. (OGC 2007)

Benefits Realisation – A process to make benefits happen and also to make people fully aware of them throughout the entire process. (Serra 2016)

Outcome – The result of change, normally affecting real-world behaviour and/or circumstances; the manifestation of part or all of the new state conceived in a programme's blueprint. (OGC 2007)

Basic BRM Concepts

According to PMI, a benefit is an outcome of actions and behaviors that provide utility, value or positive change. Some benefits are relatively certain and easily quan-

[1] Both spellings, program and programme, are used in this paper to accurately reflect the references from other countries.

tifiable (for example, creation of physical products or services, achievement of financial goals, etc.). Other benefits may be less quantifiable, for example, improved employee morale, enhanced reputation, customer satisfaction, etc.) Benefits may not be realized until completion of a program, or may be realized in an iterative fashion as projects with the program produce incremental results. (PMI 2017)

Most books and papers dealing with BRM, for example Serra (2016), describe five phases or sets of activities involved in benefits management: benefits identification, benefits analysis and planning, benefits delivery, benefits transition and benefits sustainment. Figure 1 shows these steps aligned with the program lifecycle in the PMI standard.

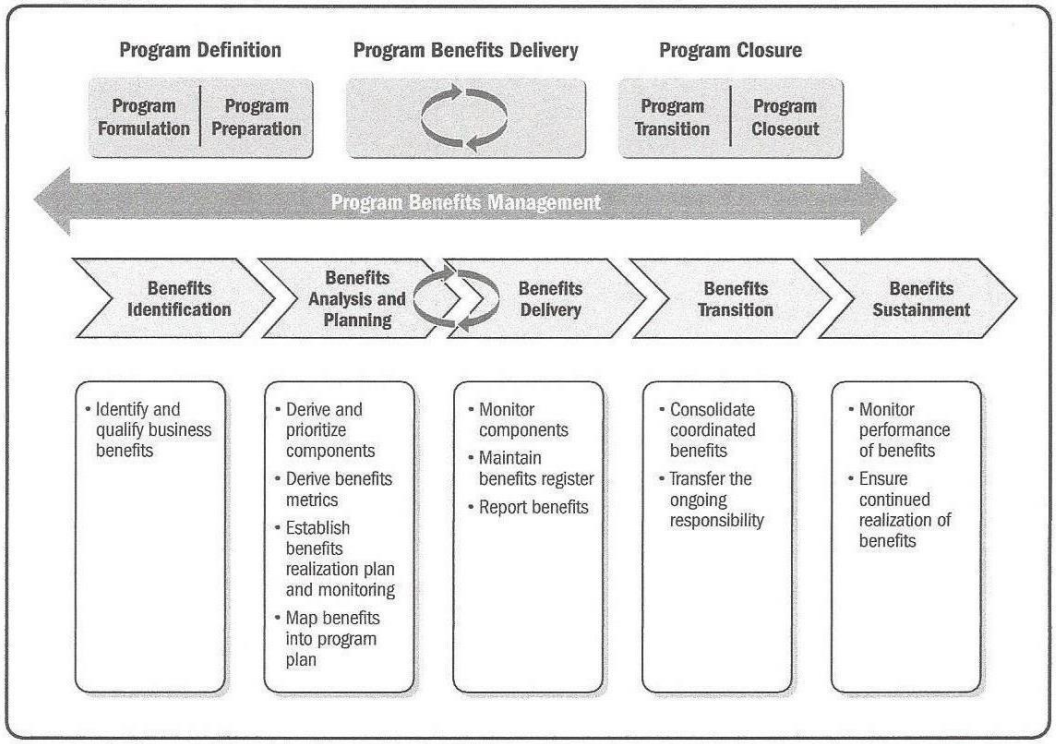


Figure 1: Program Lifecycle and Benefits Management
Adapted from the PMI Standard for Program Management (PMI 2017)

BRM links program and project outcomes to organizational strategies. Per the PMI standard and most books on the topic, benefits also link strategies directly to stakeholders. Historically, this linkage has been missing from the strategic planning process. Strategies in fact should flow from desired outcomes and benefits; programs and projects then flow from strategies to achieve those benefits. Programs and projects must deliver the desired benefits in order to be successful. Traditional project performance measures no longer suffice. (Pells 2017).

Piney says it more succinctly. *Benefits should drive programs, not vice versa, since programs are run in order to deliver benefits.* (Piney 2018, p. 33) Piney de-

scribes a modified, perhaps more mature model, including the following: Benefits Assessment, Business Case Development, Benefits Realization Planning, Benefits Realization, and Benefits Realization Completion. (Piney 2018, p. 35).

The primary point of these models is that BRM requires actions to identify and deliver benefits. Desired benefits must be defined and aligned to strategic objectives, which can then be the basis for sub-programs, projects and activities initiated to achieve those strategies and benefits. An important tool in the process is the Benefits Map, a simple example of which can be seen in Figure 2. For a more advanced model and approach to benefits mapping, see Piney (2018).

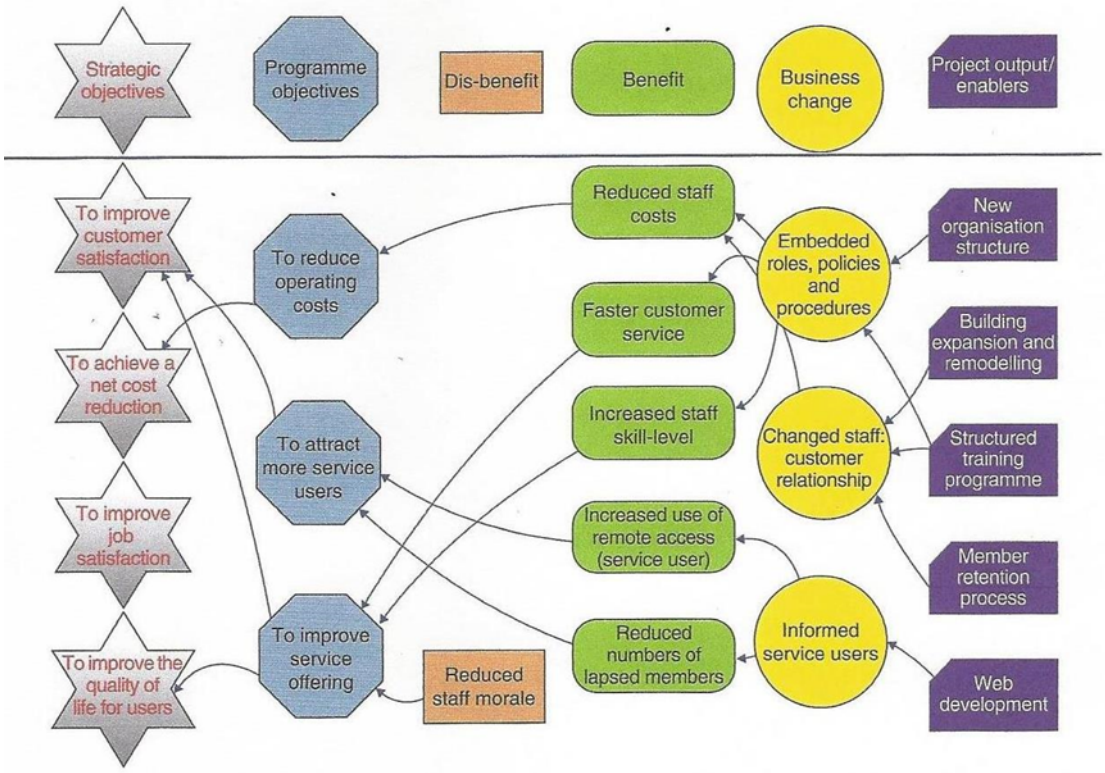


Figure 2: Example of Benefits Map
Adapted from the CIOB Code of Practice for Programme Management in the Built Environment (CIOB 2016)

According to Hudson, benefits need to be SMART – specific, measurable, agreed upon, realistic and time-bound. Benefit profiles (templates) are used to articulate benefits and include details such as description, ownership, measurement, risks and dependent benefits, enablers and capabilities. Measures are something you can put an amount, quantity, size, ratio or a percentage against. Measures are fundamental to benefits management since they tell you whether you have achieved a benefit or not. Benefit measures also tend to be the leading measures that drive performance improvement. (Hudson 2017).

Effective program benefits management or BRM requires planning, assignment of responsibilities and a variety of actions to identify, plan, influence, track, communi-

cate and realize benefits. One of the most effective ways to identify benefits is the categorization of stakeholders and benefits. An example is the five-point model shown in Figure 3.

Category	Benefit Type (examples)	Possible Measures
Financial	Revenue enhancement Capital expenditure	Increase revenue by 20% Reduce capex by 20%
Operational	Efficiency Effectiveness Quality Innovation	Increase profitability by 10%
Customer	Service Reputation Brand	Achieve 90% customer satisfaction Become market leader for programme management
People	Morale Capability	Reduce staff attrition by 20%
External stakeholder	Regulatory	Reduce CO_2 emission by xxx

Figure 3: Five Common Categories of Benefits with Examples
Adapted from the CIOB Code of Practice for Programme Management in the Built Environment (CIOB 2016)

Figure 4 shows an example of when benefits might be created and "harvested" during and after a program's life, as projects are completed.

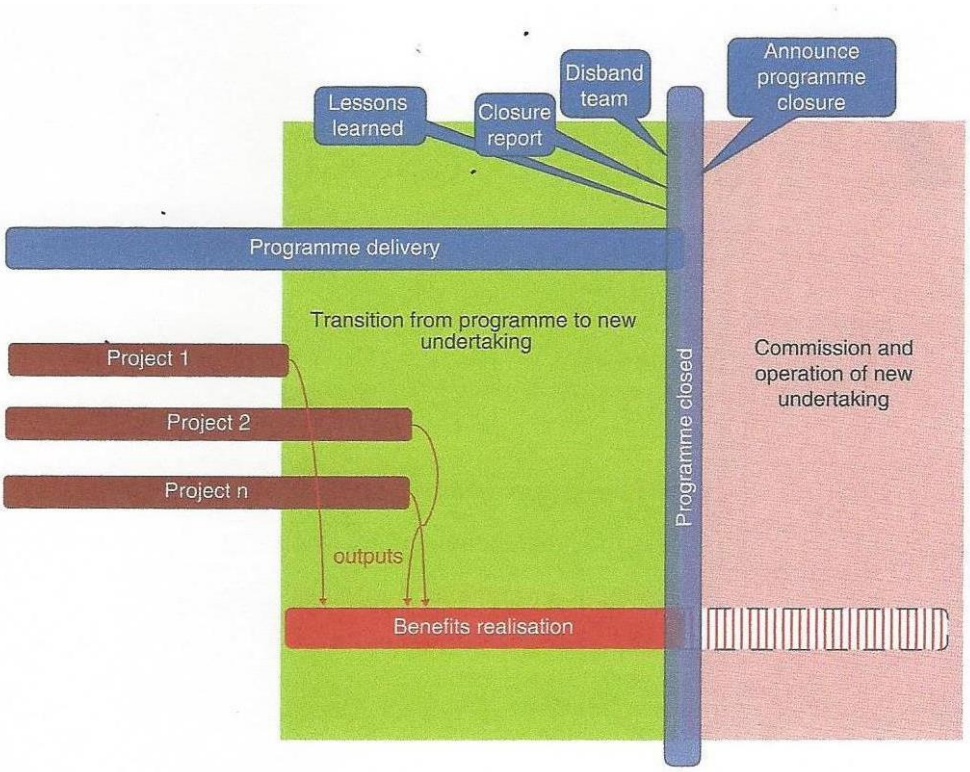


Figure 4: Program Transition and Benefits Realisation Example
Adapted from the CIOB Code of Practice for Programme Management in the Built Environment (CIOB 2016)

There is much more to be said about the benefits management process beyond the scope of this paper, especially including the resources required for successful BRM. In any case, BRM is now being widely used in the UK, Australia, New Zealand and other countries for managing public sector programs.

BRM IN THE UNITED KINGDOM

The UK is by far the leading source of information and guidance on program/project benefits management, per se, although one can argue that benefits realization has emerged from the broader value management discipline. (Morris 2013). Research on benefits realization began to appear in the 1980s and 1990s; primarily in information technology industries. (Dalcher 2017) The widespread attention on IT project failures led to the issuance in 1999 of the Managing Successful Programmes (MSP) guide/standard by the UK's Office of Government Commerce (OGC). MSP included major discussion of programme benefits, and required benefits to be identified and managed for all major UK government funded IT programs. MSP was updated several times through 2007 (Axelos 2007); it was replaced by Guidelines for Managing Programmes in 2010, now required for all major UK government funded programmes and requiring the same benefits realization management discipline as MSP. (UKG 2010)

The Association for Project Management (APM), the UK's chartered body for project management, has incorporated benefits realization into its "body of knowledge" (Dalcher 2017), has established a Benefits specific interest group (SIG), and has published many articles, papers and reports on the topic. The Government of Northern Ireland has published a very robust set of benefits realization guidelines, information and templates. (NIG 2007) The CIOB's Code of Practice for Programme Management in the Built Environment contains extensive coverage for UK architects, engineers, constructors and others involved with buildings programmes and projects. (CIOB 2016)

BRM IN AUSTRALIA

Australia has followed the lead of the UK with the following guides and requirements for benefits realisation:

- Benefits Management Guidelines, Australian Transportation Assessment and Planning (ATAP), Commonwealth Department of Infrastructure and Regional Development (ATAP 2016)
- Benefits Realisation Management Framework, New South Wales Government, (NSW 2015)
- Benefits Management Framework, Building Queensland, Government of Queensland, Australia (Queenland 2016)

According to the New South Wales' government's Benefits Realisation Management Framework website, "The purpose of the Benefits Realisation Management (BRM) Framework is to provide a framework of best practice principles and concepts

drawn from latest experiences and proven practice in setting up and managing programs that is transferable across NSW agencies." It is worth repeating here some of the principles outlined in their guidance:

- Benefits need to be first understood as outcomes. Benefits are the reason the investment is made.
- The benefits must be aligned to the organisation's strategic goals. The outcomes and benefits realisation delivered by the change help achieve strategic goals.
- Benefits Management is the cornerstone of a successful business case. Identification and understanding of benefits will provide evidence that the proposal will be effective and represents value for money.
- Benefits are not automatic. In addition to effective program management, delivery of desired benefits requires active monitoring of project/program progress and the outcomes and benefits realised.
- Benefits are both financial and non-financial. A benefit is the measurable improvement resulting from an outcome which is perceived as an advantage by a stakeholder. Benefits must be measurable and evidence based in order to demonstrate that an investment provides value.

BRM IN NEW ZEALAND

The Treasury Department, Government of New Zealand, has published the following policy documents and guidelines related to BRM:

- Benefits Guidance, The Treasury, New Zealand Government. (NZG 2017)
- Managing Benefits from Projects and Programs: Guide for Practitioners, The Treasury, New Zealand Government. (NZG 2016)
- Guide to Benefits Realisation Management, New Zealand Government. (NZG 2015)
- Better Business Cases: Managing Benefits from Projects and Programmes; Treasury's Infrastructure Unit, New Zealand Government. (NZG 2014)

BRM IN PMI STANDARDS & PUBLICATIONS

Benefits management is a key element (one of five primary domains) in the PMI Standard for Program Management. (PMI 2017). In 2016, PMI also focused on benefits in its three 'Pulse of the Profession' reports, titled as follows:

- Beyond the Project: Sustain Benefits to Optimize Business Value;
- Delivering Value: Focus on Benefits during Project Execution;
- Strategic Impact of Projects: Identify Benefits to Drive Business Results: (PMI 2016a).

PMI also focused its entire 2016 'Thought Leadership' series of articles on benefits realization, which had the following titles:

- Establishing Benefits Ownership and Accountability;
- Strengthening Benefits Awareness in the C-Suite;
- Connecting Business Strategy and Project Management;
- Benefits Realization Management Framework;
- Benefits Thinking Movement. (PMI 2016b)

Even with the significant emphasis on this topic by PMI, neither program benefits management nor BRM seem to have been widely adopted in the United States outside of a few information technology (IT) organizations. Little evidence was found of BRM being implemented in the U.S. federal government.

BRM IN COLLEGE OF PERFORMANCE MANAGEMENT

The College of Performance Management (CPM), based in Virginia, USA has incorporated benefits management into their Integrated Program Performance Management (IPPM) model and certification program.[2] According to William Mathis, CPM vice president, "*IPPM is designed to build on the foundation set by EVM (Earned Value Management) processes by adding several strategic elements:*

A. *Apply a common set of conventions to integrate processes for planning, measuring and communicating between the overall enterprise and the detailed work level to serve all management needs.*

B. *Formally integrate Schedule / Resource Management (SRM) processes involving dynamic schedule planning and management (e.g., Agile methodology and similar) to ensure that a common framework serves all types of activity present on the program.*

C. *Formally integrate Technical / Benefits Management (TBM) processes involving both BRM and systems engineering technical performance measurement to ensure a strong relationship between detailed level measures of progress with stakeholder values."…*

CPM's launch of the IPPM certification program continues to pursue a strategy based on improving the state of the profession through our professionals. The addition of BRM elements onto the foundation formed by 50 years of EVM experience and lessons learned improves the integration between disciplines and for the first time proactively addresses the need to align results with workscope. (Mathis 2018)

BRM IN USG FEDERAL PROGRAMS: NOT!

So why is BRM not being implemented on US government programs? Why has BRM been embraced by government agencies overseeing major projects and pro-

[2] Information about CPM's IPPM certification can be found at https://www.mycpm.org/professional-development-units/ippm-certification/

grammes in other countries but not in the USA? BRM may not be so easy to implement. According to Gerald Bradley, a BRM and MSP expert in the UK, here are some critical success factors for implementing BRM:

- Being clear about the business end goal;
- Keeping this end goal to mind throughout the change life-cycle;
- Engagement and involvement of stakeholders throughout;
- Quality mapping of objectives to determine the bounding objective;
- For each bounding objective, the creation of high quality robust Benefit Maps;
- Rigorous determination of enabler features and business changes using the Benefits Maps;
- Early identification of measures for most if not all the benefits;
- Early establishment of a benefits tracking and reporting system; and
- Effective transition into "business as usual". (Bradley 2014)

Put more simply, Carlos Serra identified the following common barriers to successful implementation:

- Culture of assessing success based on traditional project completion metrics, not on long-term processes;
- Lack of benefits realization strategies at the organizational level, leading to lack of BRM processes;
- Lack of integration between processes and organizational functions; and
- Lack of specific processes for managing benefits. (Serra 2016)

Hudson mentions BRM implementation problems associated with the following: *low organizational maturity, with poor governance; long lead times to benefits realization; programme complexity; misunderstanding of benefits management processes; poor forecasting; inadequate information; project/programme delivery pressures; stakeholder engagement and support; and lack of benefits accountability*. (Hudson 2017)

For successful BRM implementation, organizational culture often needs to change. For example, program and project managers must overcome the tendency to measure success according to traditional project performance measures (cost, schedule, quality, requirements, etc.). Effective program management including BRM however does require adequate performance metrics, which in turn requires adequate project management. Effective BRM goes hand-in-hand with effective program and project management. In any case, implementing BRM can involve serious organizational changes, which are certainly not always easy to effect in government agencies.

BRM IN USG FEDERAL PROGRAMS: WHY & WHEN?

United States Senate bill S.1550, the Program Management Improvement Accountability Act, was approved on 30 November 2016. The law was intended to reform federal program management policy in the United States to enhance accounta-

bility and best practices in project and program management throughout the federal government. The new law, co-sponsored by both Democratic and Republican Senators and heavily promoted by PMI, requires the following (among other things):

a. Government-wide standards, policies and guidelines for program and project management for executive agencies;
b. Implementation of program and project management for those standards, policies and guidelines;
c. Establishment of a Program Management Policy Council;
d. Establishment of standards and policies for executive agencies, consistent with widely accepted standards for program and project management planning and delivery;
e. Engagement with the private sector to identify best practices in program and project management that would improve Federal program and project management;
f. Portfolio reviews to address programs identified as high risk by GAO;
g. Not less than annually, portfolio reviews of agency programs;
h. A 5-year strategic plan for program and project management; and
i. Designation of a senior executive at each agency as Program Management Improvement Officer. (PMIAA 2016)

The act was to be fully implemented within one year. Clearly this did not happen under the Trump Administration. Nevertheless, the law was enacted and the PMI Standard for Program Management is the only widely recognized standard for program management in the United States (although the new IPPM standard and certification program from CPM may soon challenge that). It should therefore only be a matter of time before all U.S. federal agencies begin the process of implementing more formal program management policies and practices, including BRM.

CONCLUSION

BRM can successfully link program and project outcomes (and stakeholder benefits) to organizational strategies; BRM can be a key for managing program and project lifecycles. Strategies should be based on desired outcomes and benefits, programs and projects then flow from strategies to achieve those benefits. Programs and projects must deliver the desired benefits in order to be successful.

We've heard many times that successful outcomes depend on doing the 'right projects right', but doing the right projects depends on having the right strategies, and that in turn requires strategies aimed at achieving "benefits". Successful programs and projects are those that deliver full benefits (creating the desired 'value"); delivering projects on budget and schedule matter less if benefits are not delivered.

Program and project managers need to not only fully understand organizational strategies, they need to understand and embrace the desired outcomes and benefits to be achieved. Identifying, defining, tracking, implementing and measuring benefits

provide a link between organizational strategies, programs, projects, outcomes and value.

As Dalcher stated, *a benefits 'mindset' requires understanding that benefits don't just happen, actions are required; benefits rarely happen according to plan, progress must be monitored with plans and measures adjusted as needed; and benefits management is a continuous process of envisioning results, implementing, checking intermediate results and dynamically adjusting*. (Dalcher 2017)

So what is the purpose of your government program? Why is a program being launched or implemented? What is the purpose of all of the projects and programs in a federal agency's portfolio? BRM gets to the heart of these questions? And remember this simple equation: Value = benefits – investment! We think it's time for the US government to implement BRM as other governments have done, to recognize benefits management as an obvious way to increase value for program stakeholders.

REFERENCES

ATAP (2016). "Australian Transportation Assessment and Planning Guidelines: T6 Benefits Management," Commonwealth Department of Infrastructure and Regional Development, Commonwealth of Australia. https://atap.gov.au/tools-techniques/benefit-management/files/t6_benefits_management.pdf and https://atap.gov.au/tools-techniques/benefit-management/

Axelos (2007). Managing Successful Programmes (2007) https://www.axelos.com/best-practice-solutions/msp

Bradley, G. (2014). Benefits Realization Management; Chapter 8 in the Gower Handbook of Program Management, 5th Ed. Routledge, 2014. https://www.routledge.com/Gower-Handbook-of-Project-Management-5th-Edition/Turner/p/book/9781472422965

CIOB (2016). *Code of Practice for Programme Management: In the Built Environment*; Chartered Institute of Building, UK. Wiley, New York. http://www.wiley.com/WileyCDA/WileyTitle/productCd-1118717856.html

Dalcher, D. (2017). "So where do benefits come from?" *PM World Journal*, Feb 2017. https://pmworldlibrary.net/wp-content/uploads/2017/02/pmwj55-Feb2017-Dalcher-where-do-benefits-come-from-series-article-1.pdf

Hudson, A. (2017). "Managing Programme Benefits," *PM World Journal*, Feb 2017; https://pmworldlibrary.net/wp-content/uploads/2017/02/pmwj55-Feb2017-Hudson-managing-programme-benefits-series-article.pdf

Mathis, W. (2018). Benefits Realization and the US Federal Government, unpublished white paper by William Mathis, transmitted to authors on 28 April 2018.

Morris, P.W.G. (2013). *Reconstructing Project Management*, Wiley-Blackwell, 2013; pages 83-84, 189-190; http://www.wiley.com/WileyCDA/WileyTitle/productCd-0470659076.html

NIG (2007). Northern Ireland government guidance on Programme and Project Benefits Management: https://www.finance-ni.gov.uk/topics/programme-and-project-management-and-assurance/benefits-management-and-realisation-programmes

NSW (2015). "Benefits Realisation Management Framework," New South Wales government, Sydney, Australia. https://www.finance.nsw.gov.au/publication-and-resources/benefits-realisation-management-framework

NZG (2017). "Benefits Guidance." The Treasury, New Zealand Government. https://treasury.govt.nz/information-and-services/state-sector-leadership/investment-management/plan-investment-choices/benefits-guidance

NZG (2016). "Managing Benefits from Projects and Programmes: Guide for Practitioners," The Treasury, New Zealand Government. March, 2016. https://treasury.govt.nz/publications/guide/managing-benefits-projects-and-programmes-guide-practitioners

NZG (2015). Guide to Benefits Realisation Management, New Zealand Government, (2015): http://www.mbie.govt.nz/info-services/immigration/vision-2015-lessons-learned/artefact-52.pdf

NZG (2014). "Better Business Cases: Managing Benefits from Projects and Programmes", Treasury's Infrastructure Unit, New Zealand Government. https://treasury.govt.nz/information-and-services/state-sector-leadership/investment-management/better-business-cases-bbc.

Pells, D. (2017). "The Missing Link, Benefits Realization Management, and Welcome to the August 2017 PMWJ". *PM World Journal*, vol. 6, Issue 8; https://pmworldlibrary.net/article/the-missing-link-benefits-realization-management-and/

Piney, C. (2018). Earned Benefit Program Management: Aligning, Realizing and Sustaining Strategy. CRC Press/Taylor & Francis Group. Florida, USA; ©2018. https://www.crcpress.com/Earned-Benefits-Program-Management-Aligning-Realizing-and-Sustaining/Piney/p/book/9781138033122

PMI (2017). Standard for Program Management, 4th Edition, Project Management Institute. https://www.pmi.org/pmbok-guide-standards/foundational/program-management/fourth-edition

PMI (2016a). Pulse of the Profession, Benefits Realization Management: https://www.pmi.org/learning/thought-leadership/pulse

PMI (2016b). Thought Leadership papers on Benefits Realization; Project Management Institute, Upper Darby, PA, USA; https://www.pmi.org/learning/thought-leadership/series

PMIAA (2016). "Program Management Improvement and Accountability Act," Public Law 114-264, 114th Congress of the United States, Dec 14, 2016. https://www.congress.gov/bill/114th-congress/senate-bill/1550/text and http://pmworldlibrary.net/wp-content/uploads/2016/12/161130-Program-Management-Improvement-and-Accountability-Act-US-Senate.pdf

Queensland (2016). Benefits Management Framework, Building Queensland, Government of Queensland: http://buildingqueensland.qld.gov.au/wp-content/uploads/2016/12/Benefits-Management-Framework-1.pdf

Serra, C.E.M. (2016). *Benefits Realization Management: Strategic Value from Portfolios, Programs and Projects*, CRC Press, September 2016. https://www.crcpress.com/Benefits-Realization-Management-Strategic-Value-from-Portfolios-Programs/Serra/p/book/9781498739252

UKG (2010). "Guidelines for management programmes", Government of the United Kingdom; https://www.gov.uk/government/publications/guidelines-for-managing-programmes-understanding-programmes-and-programme-management

Strategic Decision-Making for Supply Chain Design and Expansion: the Case of Drinking Water and Irrigation Systems

Hakob Avetisyan[1], Mirosław J. Skibniewski[2],
Abhinandh Ramasami[1], Niranjan Mahamuni[1]

[1] Department of Civil and Environmental Engineering, E-209, 800 N. State College Blvd, California State University Fullerton, CA 92834, havetisyan@fullerton.edu

[2] Center of Excellence in Project Management, Department of Civil and Environmental Engineering, 1188 Glenn L. Martin Hall, University of Maryland, College Park, MD 20742, mirek@umd.edu

Abstract

Decision-making for supply chains in any industry providing products and services for profit is multi-dimensional. Traditionally, decisions made were based on the principle of meeting the demand. While meeting the demand is of highest priority, other important aspects include the cost, policy and regulatory compliance, and competition in the market. To arrive at an outcome that will satisfy all these aspects collectively and arrive at an equilibrium from which no participant in the market wants to deviate can be challenging. The problem becomes even more complex when there are more than one non-cooperative suppliers in the market and the decision-maker for a larger or lead supplier should decide the best strategic move supporting supply network expansion given the anticipated moves of other smaller or follower suppliers in the market. To aid decision-making in this process, a two-level leader-follower problem known as "Stackelberg game" is developed, in which the lower-level problem solves an equilibrium problem, which when combined with upper-level problem becomes a mathematical problem with equilibrium constraints (MPEC). Stackleberg games are commonly used by governments for analyzing regulations on the economy as a whole or on particular industry. Stackelberg game is regarded as a non-cooperative game where the follower makes its move by accepting the leader's choice and the leader, by anticipating that the follower makes its choice, solves for both the upper and lower-level problem variables in order to maximize its own profit or for any other chosen.

Introduction

A supply chain is one of the most important aspects for running any business successfully, and if done strategically and properly it can benefit the companies in a long-run. In order to be able to analyze the potential of improvements it is worth to define what is exactly the supply chain and how can one improve the processes of decision-making. There are many definitions in the literature for supply chain management (SCM). Since past few decades the supply chain management is growing rapidly and many researchers were targeting its different angles with a hope that the new findings will allow to serve the industries to be more stable and cost effective. It is about the

reliability and cost effectiveness when it comes to decision-making while meeting the expected quality. By expected quality it is referring to the acceptable and agreed conditions of anything that the client is looking for in any industry. In some cases the quality can be considered the least satisfactory level of functionality or specifications of delivered goods and products, while in other cases the level of the satisfaction will be exceeded to secure future business with the same client or others. In any case, the decision-making process is not straightforward and requires more advanced analysis that can allow evaluation of actions to be taken.

Definitions and the Problem

Supply chain management was defined over the last few decades, modified and improved along with technological advancement in the industry. Since the 1990's, one of the early definitions of SCM was by Novak and Simco (1991), which in particular defined it as the flow of goods from supplier that gets the goods from the manufacturer and distributor who is responsible for delivering the goods to the final user. Likewise, in 1993 Cooper and Ellram (1993) suggested that SCM is an integrative philosophy for managing the total flow of goods through distribution channel from the supplier to the final user. Yet, in 2001 Chopra and Meindl (2001) defined it as a chain that consists of all involved stages that are involved directly or indirectly in the process of fulfilling a customer request. In a similar approach, Mentzer et al. (2001) presented it as "The systemic, strategic coordination of the traditional business functions and the tactics across these business functions within a particular company and across businesses within the supply chain, for the purposes of improving the long-term performance of the individual companies and the supply chain as a whole." Given these definitions it can be acknowledged that over time indeed all researchers agree that this process is not straightforward and requires a careful and integrated analysis of the processes and steps involved.

One option to address the problem of making informed decisions is to look at many representatives in the market collectively yet each and each of them will have its own goals and perspective. Such understanding will help in forming the market structure in a game-theoretic setup where those who represent the market would be the players. In real life there will be larger players who will be treated as leaders as their decisions will drive the market movement while other may be seen as followers.

Traditionally, all the decisions-made by the suppliers were based on the principle of meeting the demand, while the profit was the target element for any company. Over time, due to the changing nature of the market policies, regulations and rules where suppliers operate and need to comply, the single goal of just meeting the demand while maximizing the profits is becoming more challenging. As such other equally important aspects include the cost reductions due to increasing worldwide competition, policy and regulation compliance. To find an outcome that will satisfy all these aspects together and arrive to an equilibrium from where no player in the market wants to deviate can be problematic. This market is not a cooperative setup and each player has its own objectives of surviving in the market and expanding its business by expanding its supply capacities. While for the follower companies it might be more challenging to invest in expansion

of their market the large companies can allow themselves to face such expenses and yet in the long-run be even more profitable.

To aid decision-makers in the process of SCM and strategic planning a mathematical game-theoretic bi-level leader-follower problem known as Stackelberg game is developed, in which the lower-level problem formulated for this research solves an equilibrium problem, which when combined with upper-level problem is known as mathematical problems with equilibrium constraints (MPEC). Stackleberg games are commonly used by governments for analyzing regulations on an economy or on a particular industry. Stackelberg game is thought to be a non-cooperative game where the follower makes its move by accepting leader's choice and the leader by anticipating that follower takes its choice solves its problem for both upper and lower-level problem variables for own profit maximization or for any other objective. The problem becomes even more challenging if the market consists of more than one leader in the upper level. For simplicity we will target the case when one large supplier acts as a leader on the top level problem for profit maximization. To illustrate the idea of a supply network, one can consider the water supply where the product is being delivered to the final user through the system where the water can be supplied from different wells or water treatment plants. It is considered that water treatment plants and others seek profit maximization and the more they produce and supply the better they will be. There is one specific difference in the water supply network, where the water is delivered to the final user through the pipelines and if the leader expands the capacities then the followers may use it, given the fees to be paid for operating it, which can be seen as an expense the followers may face in any other industry setup for utilizing any of other avenues for their business. To make the model more detailed and realistic it is also important to consider the environmental impact in terms of cost and controlled carbon market, which is done in the developed model below.

Formulation

The generalized formulation of bi-level problems is given as (Bard, 1998):

$$
\begin{aligned}
&\min_{x \in X} \; F(x,y) \\
&\quad \text{s.t.} \\
&\quad G(x,y) \le 0 \\
&\quad \min_{y \in Y} \; f(x,y) \\
&\qquad \text{s.t.} \\
&\qquad g(x,y) \le 0 \\
&\qquad x, y \ge 0
\end{aligned}
$$

From the structure of bi-level problem we notice that the upper-level player (the leader) solves the problem for x and the lower-level player (the follower) solves for y. In a case of game-theoretic approach this can be thought of as a Stackelberg game. If draw parallels between the Stackleberg game and zero-sum games we can state that in two-person zero-sum game the gain of one player is equal to the loss of the other player. In the Stackelberg game this condition does not hold, since

whatever is gained by one player is not equal to other player's loss. This idea should not be confused with the gain and loss of potential payoff from the market while players compete with each other. Also, in zero sum-game players move simultaneously while in the case of Stackelberg game leader makes the first move then gets information from the lower-level player behavior and adjusts its move accordingly. In both problems there are also similarities, which are perfect information about each other's strategy and resulting payoffs, and non-cooperativeness. This process continues as long as it takes to determine the most favorable solution for a leader (Fricke, 2003).

In the lower-level problem there is a Nash-Cournot competition, which means that an equilibrium problem needs to be solved. This problem is solved as complementarity problem by applying KKT conditions. Complementarity problem is defined as finding a vector ($z \in R^n$) which satisfies the following conditions or to show that the vector z does not exists (Cottle, Pang, & Stone, 2009):

$$\begin{aligned} & z \geq 0 \\ & q + Mz \geq 0 \\ & z^T \cdot (q + Mz) = 0 \end{aligned}$$

where vector $q \in R^n$ and M is a matrix $\in R^n$.

To illustrate the structure of KKT conditions the lower-level problem will be considered separately. Also, for completeness of KKT conditions, an equality constraint is added to the above presented lower-level problem. In bi-level problems the variable associated with upper-level problem is considered exogenous for the lower-level problem. This is due to the fact that leader makes its move first and the follower takes it as given, which in economic terms is a price taker. So, here in the lower-level problem all players are price takers. Hence, by considering x as given value (x') for a follower and converting the problem to maximization as in the developed model we get the following lower-level problem with its KKT conditions:

$$\begin{aligned} & \max_{y \in Y} f(x', y) \\ & \text{s.t.} \\ & g(x', y) \leq 0 \\ & h(x', y) = 0 \\ & y \geq 0 \end{aligned}$$

Corresponding first order KKT conditions for constrained maximization problem would be:

$$\begin{aligned} y: \quad & \frac{\partial f}{\partial y} - \lambda \frac{\partial h}{\partial y} - \mu \frac{\partial g}{\partial y} \leq 0; \qquad y \geq 0 \\ & y \cdot \left(\frac{\partial f}{\partial y} - \lambda \frac{\partial h}{\partial y} - \mu \frac{\partial g}{\partial y} \right) = 0 \\ \mu: \quad & g(x', y) \leq 0; \quad \mu \geq 0; \quad \mu \cdot g(x', y) = 0 \\ \lambda: \quad & h(x', y) = 0 \end{aligned}$$

Equation $\mu \cdot g(x', y) = 0$ is known as generalization of complementary slackness conditions for linear programs (Winston, 2009; Gabriel & Leuthold, 2010; Hobbs, 2001).

To be able to deal with nonlinearity terms in KKT conditions we need to write all inequality constraints in a followers' problem in the form (Fricke, 2003):

$$g_i(x', y) \geq 0$$

and in this case the complementary slackness condition would be:

$$\mu_i \cdot g_i(x', y) = 0$$

which when used with disjunctive programming technique will result to the following constraints:

$$\mu_i \leq M \cdot r_i$$
$$g(x', y) \leq M(1 - r_i)$$

where r_i is a binary variable for replacing complementarity by disjunctive constraint.

After these steps the followers' problem gets combined with the leader's problem and can be solved with known standard IP/MIP solvers, such as in GAMS or CPLEX. The schematic representation of the chain can be presented as the following Figure 1 below:

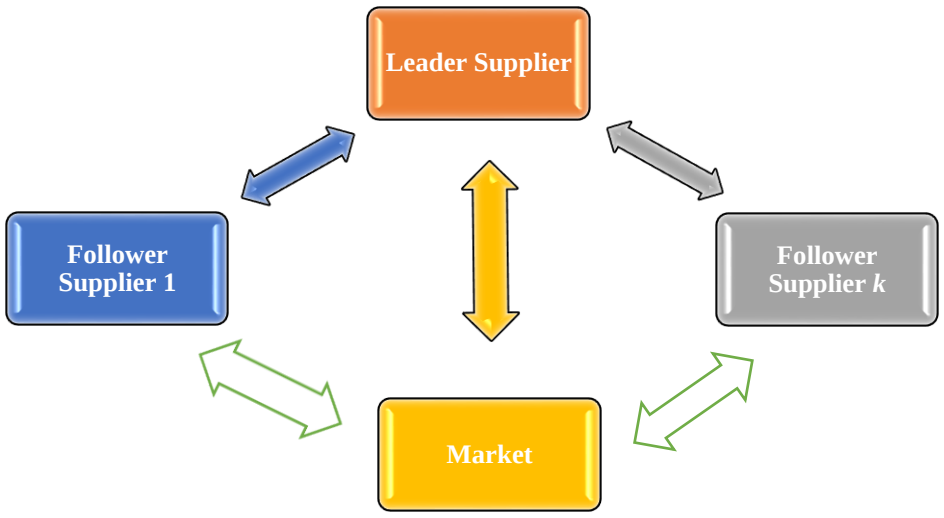


Figure1. Simplified Schematic representation of a SCM

Notation for the Model

This section presents the notation and sets used in the model formulation. Note that most of capitalized notation refers to the same parameter or variable for the leader's problem.

Indices:

f	indicates the followers
i	indicates the node of origin

j	indicates the node of destination
t	indicates discrete time period in 5 year increments for which optimized capacities need to be added

Sets:

F	set of all followers
N	set of all nodes
T	set of all time periods included in the model

Parameters:

A_{ijt}, B_{ijt}	Intercept, slope, respectively, of the linear demand functions for pipeline capacity expansion by leader between nodes $i \in N$ and $j \in N$ at time $t \in T$ and $i \neq j$
a_{fijt}, b_{fijt}	Intercept, slope, respectively, of the linear demand functions for water supplied through pipelines by followers $f \in F$ between nodes $i \in N$ and $j \in N$ at time $t \in T$ and $i \neq j$
U_{ijt}, W_{ijt}	Intercept, slope, respectively, of the linear demand functions for water supplied through pipelines by leader between nodes $i \in N$ and $j \in N$ at time $t \in T$ and $i \neq j$
KQ_{ijt}	Fixed cost term if capacity expansion by pipeline if selected by leader between nodes $i \in N$ and $j \in N$ at time $t \in T$ and $i \neq j$
$TechQ_{ijt}$	Expended pipeline operational capacities, between nodes $i \in N$ and $j \in N$ at time $t \in T$ and $i \neq j$
$techq_{fijt}$	Existing pipeline operational capacities for followers $f \in F$, between nodes $i \in N$ and $j \in N$ at time $t \in T$ and $i \neq j$
H_{it}	is the wellhead or plant capacity at node $i \in N$ over time $t \in T$
$CONS_{jt}$	Consumption at node at node $j \in N$ over time $t \in T$
DQ_{ijt}	Dependence factor for supplies through leader's pipeline expanded capacities between nodes $i \in N$ and $j \in N$ at time $t \in T$ and $i \neq j$
dq_{fijt}	Dependence factor for supplies through follower's $f \in F$ existing pipeline between nodes $i \in N$ and $j \in N$ at time $t \in T$ and $i \neq j$
ρ_{ijt}	Discounting factor, which may vary between nodes $i \in N$ and $j \in N$ at time $t \in T$ and $i \neq j$

Variables:

Q_{ijt}	The amount of pipeline capacity expansion (and supply) by leader between nodes $i \in N$ and $j \in N$ at time $t \in T$ and $i \neq j$
q_{fijt}	The amount of supplied water through pipeline by followers $f \in F$ between nodes $i \in N$ and $j \in N$ at time $t \in T$ and $i \neq j$
XP_{ijt}	Binary variable for pipeline fixed costs if expansion is selected between nodes $i \in N$ and $j \in N$ at time $t \in T$ and $i \neq j$
α_{fijt}	Shadow price of technical capacity constraint on pipelines for followers' $f \in F$ problem between nodes $i \in N$ and $j \in N$ at time $t \in T$ and $i \neq j$

Functions:

$CP_{ijt}(dd)$	Costs for pipeline capacity expansion as a function of distance and diameter between nodes $i \in N$ and $j \in N$ at time $t \in T$ and $i \neq j$
$CCP_{ijt}(dd)$	Carbon costs associated with pipeline capacity expansion as a function of distance and diameter between nodes $i \in N$ and $j \in N$ at time $t \in T$ and $i \neq j$
$CQP_{ijt}(dd)$	Costs for supplied water by leader through pipeline between nodes $i \in N$ and $j \in N$ at time $t \in T$ and $i \neq j$
$cqp_{fijt}(dd)$	Costs for supplied water by followers $f \in F$ through pipeline between nodes $i \in N$ and $j \in N$ at time $t \in T$ and $i \neq j$
$ccp_{fijt}(dd)$	Carbon costs associated with supplied water by followers $f \in F$ through pipeline between nodes $i \in N$ and $j \in N$ at time $t \in T$ and $i \neq j$

Leader in this problem is maximizing its own profits based on followers' market behavior. Its decision variables are capacity expansions as pipelines and accordingly the supply volumes. The objective function for leader's problem is given in (1):

$$\max_{Q_{ijt}} \sum_i \sum_j \sum_t \Bigg(\Bigg(A_{ijt} - B_{ijt} \Bigg(\sum_f q_{fijt} + \left(Q_{ijt} - Q_{ij(t-5)}\right) \Bigg) \Bigg) \left(Q_{ijt} - Q_{ij(t-5)}\right) + \Bigg(U_{ijt} - W_{ijt} \Bigg(\sum_f q_{fijt} + Q_{ijt} \Bigg) \Bigg) Q_{ijt} - \left(CP_{ijt}(dd)\left(Q_{ijt} - Q_{ij(t-5)}\right)\right) - \left(CQP_{ijt}(dd) Q_{ijt}\right) - \left(CCP_{ijt}(dd) Q_{ijt}\right) - \left(KQ_{ijt} \cdot XP_{ijt}\right) \Bigg) \rho_{ijt} \qquad (1)$$

Leader's Problem:

The leader's problem has the following constraints, which are formulated based on technological and natural conditions of production/supply and dependency preferences of a customer from a particular supplier:

$$0 \leq \left(Q_{ijt} - Q_{ij(t-5)}\right) \leq TechQ_{ijt} \cdot XP_{ijt}, \quad \forall i, j, t \qquad (2)$$

$$\sum_i \sum_j \left(\sum_f q_{fijt} + Q_{ijt} \right) \leq H_{it}, \quad \forall f, i, j, t \qquad (3)$$

$$CONS_{jt} - \sum_i \sum_j \left(\sum_f q_{fijt} + Q_{ijt} \right) = 0, \quad \forall f, i, j, t \tag{4}$$

$$Q_{ijt} \leq DQ_{ijt} \sum_i \sum_j \left(\sum_f q_{fijt} + Q_{ijt} \right), \quad \forall f, i, j, t \tag{5}$$

$$q_{fijt} \leq dq_{fijt} \sum_i \sum_j \left(\sum_f q_{fijt} + Q_{ijt} \right), \quad \forall f, i, j, t \tag{6}$$

$$Q_{ijt} = 0, \qquad \forall i, j, t \; when \; i = j \; and \; when \; defined \; by \; user \; (i.e. political \; obstacle) \tag{7}$$

$$XP_{ijt} \in \{0,1\}, \qquad \forall i, j, t \tag{8}$$

$$Q_{ijt} \geq 0, \qquad \forall i, j, t \tag{9}$$

In leader's problem the capacity expansion is subject to technical limitations for a given time interval between origin and destination nodes. Such limitation is enforced through constraint (2) that is limiting pipeline capacity expansion in a given time interval. In addition to technological constraints the capacity of expansion can be limited because of the wellhead capacity, which is expressed through constraint (3). In this constraint players from lower level problem are also included since the capacity of a particular underground basin or source can be used by few players and hence the total capacity of expansions and accordingly flow capacities cannot exceed the maximum capacity possible to extract from a particular location. Constraint (4) is the market clearing condition which in other terms ensures that the consumption is met and there is no excess amount of water pumped and left unused. Consumers are free in their preferences and may prefer to have more capacities from one supplier and less from another supplier. Having information about consumer's preferences leader can make more reasonable decision for its investments in getting market share. Constraints (6) are designed for accommodating consumer's preferences into decision making process. In other commodity cases due to constraints (6) the decision model is also useful for consumers, who may decide for preferable conditions and strategies for them or their company and consequently develop contracts based on suggestions of the model. Constraints (7) enforce zero capacities for nodes itself, since there is no need to have capacity starting and ending at the same location. Constraints (8) are requirements for certain variables integrality and constraint (9) is non-negativity requirements.

Followers' Problem:

Followers want to maximize their profits by maximizing their production at the same time taking leader's production quantities as fixed. Followers are included in this problem with fixed capacities, which means they do not solve the problem for capacity expansion. The reasoning behind this approach is that leader would use all its options to add the gap between demand and supply if it turns to be a profitable investment to make, otherwise the dual variables included in followers' problem will provide information about the needs for followers' capacity expansions. The objective function for followers' problem is given in (i):

$$\max_{q_{fijt}} \sum_i \sum_j \sum_t \left(\left(a_{fijt} - b_{fijt} \left(\sum_f q_{fijt} + Q_{ijt} \right) \right) q_{fijt} \right.$$
$$\left. - \left(\sum_f \left(\left(cqp_{fijt}(dd) q_{fijt} \right) + \left(ccp_{fijt}(dd) q_{fijt} \right) \right) \right) \rho_{ijt} \right) \qquad (i)$$

Followers have only technical limitations on their production capacities. Those are presented below:

$$0 \leq q_{fijt} \leq Techq_{fijt}, \quad \forall f,i,j,t \qquad (\alpha_{fijt}) \qquad (ii)$$

Constraint (ii) enforce capacity limitations, which are related to the upper levels of existing capacities in terms of pipelines.

KKT conditions for followers problem:

To formulate KKT conditions it is necessary to use derivation. To ease the situation we used a prime on the top of those terms that are associated with the term used for derivation. For instance $q_{f\acute{\imath}jt}$ is one of those followers in the lower level $\sum_f q_{fijt}$,

$$0 \leq \left(-a_{f\acute{\imath}jt} + 2b_{f\acute{\imath}jt} \cdot q_{f\acute{\imath}jt} + b_{f\acute{\imath}jt} \left(\sum_f q_{fijt} - q_{f\acute{\imath}jt} \right) + b_{f\acute{\imath}jt} \cdot Q_{ijt} + cql\acute{n}_{f\acute{\imath}jt}(dd) \right.$$
$$\left. + cc\acute{p}_{f\acute{\imath}jt}(dd) \right) \rho_{ijt} + \alpha_{f\acute{\imath}jt} \perp q_{f\acute{\imath}jt} \geq 0, \quad \forall f,i,j,t \qquad (I)$$

$$0 \leq -q\acute{}_{f\acute{\imath}jt} + Tec\acute{h}q_{f\acute{\imath}jt} \perp \alpha_{f\acute{\imath}jt} \geq 0 \qquad \forall f,i,j,t \qquad (II)$$

Dual variables for non-negativity constraints are omitted. For further discussion of KKT conditions and its modifications see (Cottle, Pang, & Stone, 2009; Winston, 2009). Following the steps discussed above the KKT conditions need to be formulated as disjunctive program (not shown here).

Disjunctive form of followers' problem:

Once disjunctive program is formulated it can be combined with upper level problem and solved for equilibrium point indicating the supply volumes by both the upper and lower level players that

slows to get the best outcome in the market and plan strategically. The combined problem and the case study are not presented in this paper due to space limitations.

Conclusions:

Application of bi-level problems were proven to provide non-intuitive findings that benefit both the upper-level and lower-level players in any industry. The preliminary results of this study indicate such instances in supply chain management area as well. In previous studies authors found the importance of Stackelberg problem setup for natural gas supply network expansion between Russia and China (Avetisyan, 2013). It is expected that finding of this case study will provide similar valuable information and can be expanded and adopted by any other sector or industry's supply chain management system. The formulation in this paper is simplified to consider just few constraints for illustration perspective, but the actual larger scale model considers more than one commodity type that can be supplied by the suppliers, which gives the model more flexibility for managing the entire set of supplies.

References:

Avetisyan, H. (2013). Sustainable Infrastructure Modeling and Policy Analyses: Construction, Energy and Transportation Industries. Collections: Civil & Environmental Engineering Theses and Dissertations – University of Maryland Theses and Dissertations. URI: http://hdl.handle.net/1903/14570

Bard, J. F. (1998). *Practical bilevel optimization: algorithms and applications.* Netherlands: Kluwer Academic Publishers.

Chopra S. and Meindl's (2001), Supply Chain Management: Strategy, Planning, and Operation, Prentice Hall of India.

Cooper M. C. and L. M. Ellram, (1993). "Characteristics of Supply Chain Management and the Implications for Purchasing and Logistics Strategy," International Journal of Logistics Management, (4: 2), pp. 13-24.

Cottle, R. W., Pang, J.-S., and Stone, R. E. (2009). *The Linear Complementarity Problem.* Boston: Academic Press.

Fricke, C. (2003). *An Introduction to Bilevel Programming.* University of Melbourne, Department of Mathematics and Statistics,. Melbourne: University of Melbourne.

Gabriel, S., and Leuthold, F. (2010). Solving Discretely-Constrained MPEC Problems with Applications in Electric Power Markets. *Energy Economics , 32* (1), 3-14.

Hobbs, B. F. (2001, May 1). Linear Complementarity Models of Nash–Cournot Competition in Bilateral and POOLCO Power Markets. *IEEE TRANSACTIONS ON POWER SYSTEMS , 16* (2), pp. 194-202.

Mentzer J. T. , DeWitt V, Keebler K. S., Min S., Nix N. W. and Smith. C. D (2001). "Defining Supply Chain Management, "Journal of Business Logistics, (22: 2).

Novack R. A. and Simco S. W., (1991). "The industrial procurement process: a supply chain perspective", Journal of Business Logistics, (12: 1), pp. 145-67.

Winston, W. L. (2009). *Operations Research: Applications and Algorithms* (4th Edition ed.). Canada: Curt Hinrichs.

The Project Stakeholder Management and Engagement Strategy Spectrum: An Empirical Exploration

Aurangzeb Z. Khan[1], Miroslaw Skibniewski[2], John H. Cable[3]

1. Department of Management Sciences, COMSATS Institute of Information Technology, Islamabad, Pakistan;
2. Project Management Center for Excellence, A. James A. Clark School of Engineering, University of Maryland, College Park, MD, USA;
3. Project Management Center for Excellence, A. James Clark School of Engineering, University of Maryland, College Park, MD, USA

Project stakeholders are now universally acknowledged as a prime critical success factor on every complex project. Consequently, and especially for projects key decision-makers, a profound knowledge of practical strategies and measures which can be applied to effectively and efficiently manage and engage their stakeholders, both primary and secondary, is essential. Doing so can reduce threats, in particular severe and existential ones, to their projects on the one hand while helping the projects benefit significantly from the sustained support, encouragement and goodwill of their stakeholders on the other.

The experience with large projects in the construction and civil infrastructure development field shows that in general much ignorance currently still prevails about how stakeholders should be managed and engaged appropriately. The numerous observed and often avoidable conflicts which arise and linger on over time between projects and their stakeholders and the frequent and surprising lack of proactive stakeholder management and engagement still witnessed on many projects is clearly indicative of this knowledge deficiency in practitioner circles. This deficiency appears to have been rarely addressed systematically and in-depth in the project stakeholder literature.

Through an analysis of extensive available documentation collected from diverse sources in the public domain on over fifty on-going and completed high-profile construction and civil infrastructure development projects across the globe, as well as on some selected projects in other fields, the authors have explored a broad spectrum of stakeholder management and engagement strategies applied in practice. In particular, the authors have focused their attention on innovative and effective strategies designed to maximize benefit for the projects and their stakeholders and to thus ensure attainment of a 'win-win' situation for them both. Through their research, the authors hope to motivate and assist key project decision-makers to significantly improve the quality of their interaction with their stakeholders through pursuit of sound and tested strategies which serve the interests of their projects while simultaneously ensuring that the legitimate interests of their stakeholders are duly taken into consideration.

*****

Introductory Comments

In their 2014 UMD project management symposium paper *A Governance Framework for Managing and Engaging Project Stakeholders* the authors proposed and discussed four pillars – i.e., the institutional, instrumental, technical and educational – on which they argued that professional management and engagement of project stakeholders by organizations can rest. For analytical clarity the authors reserved the term 'management' for the project's

dealings with its primary stakeholders and 'engagement' for its dealings with its secondary stakeholders – a distinction which is normally not applied in the project stakeholder literature. Both (primary) stakeholder management and (secondary) stakeholder engagement lie at the end of a complex process which commences with project contextualization in stakeholder perspective followed by stakeholder identification and a thorough stakeholder analysis, and finally culminating in design and execution of effective and efficient management and engagement strategies intended to influence stakeholders in favor of the project.

This paper's objectives are two-fold: First, to propose a practical strategy framework which can assist projects in managing their primary stakeholders and especially in engaging their secondary stakeholders more effectively. Since secondary stakeholders lie outside the project's formal control the task of engaging them is usually more difficult for the project to undertake than managing its primary stakeholders and this paper hopefully will contribute towards reducing some of the ignorance and uncertainty that still prevails among many project practitioners in this regard. Second, this paper seeks to acquaint readers with selected examples of good stakeholder management and engagement used on projects across the globe mainly in the field of Construction and Civil Infrastructure (CCID) as well as in other selected fields. CCID-projects were considered a logical choice for analytical focus because projects falling under this broad category, which include transportation, dams, energy, mining, building and industrial facility construction and development and many other important schemes of considerable economic significance, typically have complex stakeholder patterns which allow much space for application of creative stakeholder management and engagement. For this exploratory research several projects were reviewed using research journal articles and information freely available in the public domain and, additionally, interviews were conducted with several project practitioners. Numerous good examples of management and engagement came to light through this research but space constraints here restrict the discussion to just a handful of them. The examples selected for inclusion in this paper are inspirational and intended to show project owners, planners and executors how projects may benefit immensely from good stakeholder management and engagement practices, without excessively burdening the projects, financially or otherwise. It is hoped that this will not only educate them about the breadth and diversity of good stakeholder practices, but also encourage them to apply such practices where feasible and apply their minds creatively to develop and implement good practices on their own projects.

Well-designed and smoothly executed stakeholder management and engagement strategies fulfill two fundamental overriding objectives: to reduce, eliminate and especially to prevent actual and potential opposition (and the consequent danger this entails) to the project from its stakeholders, and at the same time, to enable the project to benefit as much as possible from its stakeholders through utilization of their goodwill, knowledge, experience, show of support, and all other forms of practical assistance that they are able and willing to apply for the project. Both stakeholder opposition and predisposition towards projects are not static; they can and usually do change with the passage of time and project circumstances. Stakeholders initially favoring a project may become opposed towards it and vice versa. Once opposition to the project emerges and consolidates itself, reducing or overcoming it may be costly, frustrating and challenging. If the project has effective stakeholder management and engagement strategies in place from the onset, serious opposition to it is less likely to evolve. Hence, it is important for projects to give careful thought and consideration to management and engagement of its stakeholders as early as possible, preferably even prior to the project's formal initiation and especially as the project subsequently advances into its planning phase and detailed information about the stakeholders, especially the secondary ones, becomes

available through the stakeholder analysis process, its management and engagement strategies must become more focused, inclusive and refined.

Big, complex CCID projects typically have a very large and heterogeneous community of stakeholders, especially secondary ones, with diverse interests, goals, roles and responsibilities, experiences, needs, wants, ambitions, apprehensions, mindsets, level of power and influence, and so forth. It is usually not possible to effectively manage or engage stakeholders with a single one-size-fits-all or even with a handful of off-the-shelf management or engagement strategies applied across the board. Just as all projects are unique in their context, so too are their stakeholders and to influence them to support a project often a bundle of innovative strategies, some focusing on individual stakeholders, others on specific groups of stakeholders, may be needed.

Project Primary Stakeholders: The Management Imperative

According to Cleland/Ireland, all primary stakeholders share one basic common feature, namely, they all have a contractual obligation and/or legal responsibility towards the project. In large and complex CCID especially, many entities, from individuals to large organizations, typically fall under this stakeholder category. They include, inter alia, the project owner or sponsor, steering committee, the project manager and team, senior executives, functional and resource managers, consultants, external financers, legal advisers, partners, contractors and subcontractors, vendors, and participating government agencies. All have their respective interests, roles and responsibilities in the project as well as shared and entity-specific motivation and concerns about the project, and develop their respective expectations and perceptions about it over time. Primary stakeholder involvement in the project is usually voluntary and through it these stakeholders seek to maximize their net gain which they may assess in monetary terms and/or also in terms of other considerations they may deem important, for instance, reputational, experiential, networking, capacity-building and so forth. For projects undertaken by public agencies and not-for-profit organizations, developmental or social considerations and objectives eclipse interest in commercial gains. Regardless of organizational or sectoral context, project success hinges mainly on the ability, willingness and determination of all its primary stakeholders to fulfill their agreed commitments to the project in a responsible, timely and professional manner and to collaborate closely in their common fundamental pursuit, namely, achievement of the project goal. Primary stakeholders normally are not expected to display adversity to the project per se (like some secondary stakeholders may do) but sometimes, for instance, when a realization sinks in that they have overestimated their net gain or underestimated the level of effort required or expected from them, demotivation and loss of interest in the project can result. Consequently, their performance or quality of work may decrease. Such situations obviously can be quite detrimental for the project. Disenchanted or disgruntled primary stakeholders are, moreover, more amenable to initiating or fueling conflicts on the project which if unaddressed or mismanaged can linger on or escalate into crises situations, resulting in cost and schedule overruns and potentially even endangering the project's existence or goal. Hence, the onus rests mainly with the project to prevent such situations from arising in the first place or to deal with them promptly and effectively in the event that they do arise. The best way to do so is to ensure that all its primary stakeholders' interests are comprehensively safeguarded over the project life-cycle and their motivation and concern, and expectations and perceptions - which collectively influence their attitude and, crucially in turn, their behavior towards the project - are carefully and continuously monitored and systematically addressed. This is where the project's stakeholder management strategies must focus on.

A now sizeable body of literature provides ample guidance on how primary stakeholders on CCID-projects, as well as on other types of projects, can be 'managed' effectively in practice. Well-formulated project plans also provide many useful insights in this regard. Both the authors' research and their personal experience indicate that stakeholder management strategies in practice basically revolve largely around information and communication, motivation, conflict prevention and management, monitoring and controlling, leadership, trust and relationship-building, situational adaptability, and facilitation within the project's given constraint framework, in addition to other considerations. Too comprehensive to present and discuss in detail in this paper, some major management highlights worthy of mention here include ensuring effective and continuous communication among all primary stakeholders to ensure good performance and coordination of their respective work tasks and activities, and to keep key stakeholders closely informed about project progress and developments and to retain their interest in the project throughout the project life-cycle. Information and communication appears to be a universal and is probably the most cost-effective stakeholder management strategy. Ensuring awareness, understanding and acceptance among stakeholders of the project goal, objectives and purpose, and clarifying their respective project roles, responsibilities and commitments (and ensuring that these commitments are fulfilled) are critical to avoid conflicts and misunderstandings. With the advent of globalization and consequent increasing cultural diversity encountered in CCID project environments, knowledge of the often widely different cultural backgrounds stakeholders bring along with them to the project is assuming greater relevance for avoiding preventable issues and conflicts and helping projects reap the benefits which cultural diversity brings with it. The importance of providing project human resources with a safe, clean and comfortable work environment, performance incentives and access to counselling and mentoring to keep them motivated and focused on their tasks is also widely acknowledged and accepted. Clear project scope delineation and early elucidation of requirements and specifications, thorough project planning, realistic cost and time estimates, a robust monitoring and controlling system, and emphasis on maintaining a high standard of professionalism and ethics throughout the project are also important considerations as are clear formulation of contracts, the selection of competent and experienced project managers and staff, consultants, contractors, sub-contractors and vendors, and creation of a strong and fair dispute and grievance settlement mechanism in order to ensure a smooth project workflow. And so forth.

Project Secondary Stakeholders: The Engagement Challenge

The project's secondary stakeholders, i.e. those entities which according to Cleland/Ireland do not have a contractual and/or legal obligation towards the project but which are affected, or who believe they are affected by it nonetheless, are the focus of the project's engagement strategies. On large and complex CCID projects the number of entities in question may be very large – numerically many times greater than the primary stakeholders. Typically they include local communities (and sometimes the general public), civic, professional, political and religious organizations and associations, advocacy groups, the media, academia, and government agencies not involved in the project. Broader notions extend the stakeholder definition over and above the many directly and indirectly affected individuals and organizations to include the non-human and inanimate entities, notably the natural environment, fauna and flora, and even places, objects and structures of major historical, archeological and cultural significance. Predictably the range of secondary stakeholder interests, motivation and concern, expectations and perceptions, may be commensurately large and engaging these stakeholders who, unlike the primary stakeholders, lie outside the project's formal control and to some extent are involved in it involuntarily can be, and frequently usually is, comparatively immensely more challenging and risky.

Attempting to engage and satisfy all project secondary stakeholders is a desirable undertaking but in practice is off course extremely difficult, if not downright impossible, to achieve within the project constraint framework. Projects may not be unwilling or unable to effectively engage all their secondary stakeholders due to non-recognition, disinterest or non-commitment, cost and time limitations, insufficient trained human resources, information and knowledge deficiencies, lack of experience and creativity, or non-existent or inadequate engagement policies, processes and tools. A more pragmatic engagement approach often adopted by projects is to prioritize and focus engagement by taking into consideration stakeholder power, influence and interest differentials. The larger the stakeholder's power, influence and interest, the more intense is the project's engagement with it, and vice versa. Though seemingly logical, it ignores the fact that good and ethically sound stakeholder engagement must also seek to ensure that all or at least as many secondary stakeholders as possible, especially those who are affected by it negatively and significantly and over a comparatively long period of time – whereby 'affected' can manifest itself multi-dimensionally, such as, in the economic, financial, emotional, health and quality of life spheres - should experience preferably a 'net gain' or at least no 'net loss' from their involvement, whether desired or undesired, in the project. Such type of engagement is also very beneficial for the project because it may significantly reduce or even eliminate serious (including existential) risks and very negative consequences to it which could ensue from hostile actions initiated by non- or improperly engaged secondary stakeholders. Such actions, which are the expression of the stakeholder psychological attribute behavior, were discussed by the authors with numerous examples from across the globe in their 2017 UMD project management symposium paper *Adversarial Project Stakeholders. Influencing Projects With Options*.

Project Stakeholder Engagement: The Criticality of Influencing Stakeholder Behavior

An engagement framework for secondary stakeholders which apparently commands much interest in the literature and in practice is being widely applied on projects divides strategies into five broad categories arranged in ascending order of engagement intensity: Information and Communication, Consultation, Incentives, Participation or Involvement, and Partnership or Empowerment. This somewhat resembles the management strategies used on the primary stakeholders. Each engagement category offers considerable space and numerous possibilities for creatively engaging project stakeholders. In practice projects tend to use a combination of these strategies whereby examples of partnership or empowerment appear to be relatively few and far in between. The five category framework evidently account for most of the stakeholder engagement observed on complex projects but it has two shortcomings: first, it excellently covers individuals, organizations - and even countries (which also can be stakeholders on certain schemes as the authors argued in their paper *Stakeholders and Transnational Projects* which was presented at the 2016 UMD project management symposium) – but it cannot be connected to non-human or inanimate entities such as the natural environment, fauna and flora, and cultural assets, which all fall under the broader notion of the term stakeholder and which often to some extent or the other are adversely, sometimes severely, affected by CCID-projects in particular. These projects usually are expected – and now are almost universally required – to ensure that their negative impacts on the latter are at least minimized. This implies a form of 'special engagement' for these stakeholders which does not fit in any of the five above-mentioned strategy categories. Some examples of this engagement type are included in the next section.

Based on their research the authors propose here an alternative engagement strategy framework which is consistent with the five strategy category framework above in the sense that it also aims to influence stakeholder behavior but which is more focused and systematic and hence possibly more efficacious. In their 2017 UMD project management symposium paper *Understanding Project Stakeholder Psychology*. *The Path to Effective Stakeholder Management and Engagement* the authors argued that influencing stakeholder behavior is critical for projects because by excercising the options available to them stakeholders can directly impact projects in the positive or negative sense. Stakeholder behavior is normally (but not always) a reflection of the attitude they develop towards the project and which results from juxtaposition of their motivation and concern, as well as expectation and perception. Behavior is dynamic; sometimes it changes significantly even over brief time periods to reflect changes in stakeholder motivation and concern, expectation and perception. To understand stakeholder behavior it is hence very important for projects throughout their life-cycles to continuously, thoroughly and carefully monitor and assess these four attributes. Stakeholder behavior towards projects can be categorized as supportive, adversarial or indifferent. Supportive and adversarial behavior can be further subcategorized into passive behavior (i.e. stakeholders will not exercise their options for or against the project) and active behavior (i.e. stakeholders will exercise their options for or against the project provided circumstances permit them to do so). Activeness is measured on an intensity scale which ranges from marginally active on its lower end to very active on its higher end. It is reasonable to conjecture that stakeholders who form attitudes that are more strongly supportive of or opposed to the project will adopt active rather than passive behavior towards it and, moreover, their activeness will be located higher up on the intensity scale than other stakeholders who feel less strongly about the project. Engagement strategies used by the project hence must first and foremost focus on influencing secondary stakeholder behaviors by constantly attempting to steer or keep them in favor of the project and in doing so reduce or eliminate the risks to it.

In Table 1 the authors suggest desirable stakeholder management and engagement strategies for projects along with their respective goals for the three stakeholder behavioral categories: supportive, indifferent, and adversarial. These strategies can be universally applied in all project categories, CCID and otherwise, irrespective of project location. While the strategies in principal apply to both primary and secondary stakeholders, they are more applicable for the secondary stakeholders because their observed behavior on CCID and other large and complex projects often spans the whole behavioral spectrum from highly supportive to extremely adversarial, is more volatile over time, and the risks they pose for projects may be higher than those posed by the primary stakeholders who as voluntary participants in projects are seeking to attain net gains from them, are moreover contractually and legally obligated to fulfill their commitments to the projects and who can be assumed to confine themselves for the most part to the (active) supportive category. Improperly managed or neglected primary stakeholders may, off course, sometimes drift in to the indifferent and, on occasions, even into the adversarial behavioral categories which can spell considerable trouble for the projects.

Table 1: Engagement Strategies & Goals by Stakeholder Behavioral Category

Behavioral Category	Stakeholder Management / Engagement Strategies & Their Goals
Supportive	1. **Retention**: To retain the interest of supportive stakeholders, especially the active and influential ones, in the project over time.

	2. **Enhancement**: To enhance the number of active supportive stakeholders and the intensity of their support for the project. 3. **Discouragement**: To discourage actively supportive stakeholders, especially powerful or influential ones, from transforming into passively supportive, indifferent, or adversarial stakeholders. 4. **Conversion**: To convert passive supportive stakeholders, especially those wielding considerable actual or potential power and influence, into active supportive stakeholders. 5. **Mobilization**: To mobilize supportive stakeholders to form a unified and visible front in support of the project. 6. **Utilization**: To solicit and incorporate supportive stakeholders' ideas, suggestions and other inputs for the benefit of the project. 7. **Persuasion**: To persuade powerful or influential active and passive supportive stakeholders to exercise their power and influence in support of the project. 8. **Appeasement**: To address both the general and specific concerns of supportive stakeholders to the maximum feasible extent.
Indifferent	1. **Prevention**: To prevent indifferent stakeholders, especially those possessing considerable actual or potential power or influence, from transforming into adversarial stakeholders over time. 2. **Conversion**: To convert indifferent stakeholders, especially actually or potentially powerful or influential ones, into supportive stakeholders over time.
Adversarial	1. **Prevention**: To prevent passive adversarial stakeholders, especially powerful or influential ones, from transforming into actively adversarial stakeholders. 2. **Negotiation**: To influence passive and especially active adversarial stakeholders to support the project by encouraging supportive stakeholders to enter into dialogue with them. 3. **Division**: To create and promote discord among adversarial stakeholders to prevent them from joining forces against the project (keeping ethical considerations in mind). 4. **Awareness**: To convince adversarial stakeholders that they stand to benefit, not lose, from the project.

	5. **Incentivization**: To provide incentives to adversarial stakeholders in exchange for a reduction or elimination of their opposition to the project.

Source: Developed by the authors

Every identified strategy thus has one basic goal which it seeks to accomplish. Strategies are executed through one or more specific 'Strategy Implementation Measures' (SIMs) and it is these SIMs which interface directly or indirectly with the secondary stakeholders and determine the behavior they adopt towards the project. SIMs are generally context-sensitive; what works well in one project environment may not work well or not work at all in another. Hence, the project can and must promptly modify or redesign them as and when they are shown to be ineffective or are demonstrably less effective (and efficient) than envisaged. Failure or delayed rectification of non- or underperforming SIMs and their substitution with alternative, more effective (and efficient) SIMs not only constitutes a waste of project resources with little or nothing to show by way of return but would, moreover, make the project engagement system appear inept and, in the worst case, may actually aggravate rather than pacify its stakeholders. Hence, SIMs must be carefully chosen and as effective (and efficient) as possible. This necessitates a thorough and careful analysis using high-quality available information about the stakeholders, in particular and as already mentioned above, their motivation and concern, and expectations and perceptions. SIMs effectiveness can be assessed by using quantitative or qualitative Performance Indicators (PIs) and pre-specified targets. By comparing the achieved results with the target values the SIMs engagement effectiveness can be determined accurately. This requires continuous monitoring of SIMs throughout the project life-cycle. This simple relationship which exists between strategies and their associated SIMs, PIs and targets can be elucidated by a simple example: Suppose the project decides to execute its retention strategy for its active (secondary) supportive stakeholders by disseminating information to them about the project's monthly activities through a printed and circulated special newsletter (i.e., the SIM) and to which it expects to receive at least one hundred written and oral appreciative comments per month (i.e. the target). The PI indicates however that while initially the number of comments received by the project office exceeded one hundred, thus surpassing the target, the number has progressively declined over the passing months to the extent that they number less than forty in the previous month. This means that the SIMs effectiveness is dropping over time and consideration be given to substitute this SIM with an alternative one if the target level of appreciative comments is to be maintained.

Secondary Stakeholder Engagement in Practice: Good Practices From Across the Globe

Scores of good examples of project stakeholder engagement were discovered when researching for this paper. Due to the space constraint only a few were selected for presentation in this section. To avoid conveying the impression that stakeholder engagement is purely a voluntary service performed by CCID-projects (as well as by projects in other fields), it may be noted that engagement is sometimes also a legal, policy or procedural requirement on which grant of approval for projects hinges.

All entities falling in the category of secondary stakeholders (and primary stakeholders too), from individuals to organizations, have motivation (i.e. needs, wants) and/or concern in relation to the projects affecting them. Based on their motivation and concern they develop expectations and perceptions through which they then form attitudes and adopt behavior which is supportive, indifferent or adversarial towards the projects. To tilt stakeholder behavior towards the supportive category – which, after all, is the fundamental goal of sensible stakeholder engagement - projects must endeavor to simultaneously maximize stakeholder motiva-

tion, mitigate or where possible eliminate stakeholder concern, and ensure that positive stakeholder expectations and perceptions prevail over time. Projects apparently are consciously attempting to do so. Incentives, especially economic ones, are a particularly effective means. To address the stakeholder crucial motivation factor 'employment and income generation' many of the CCID-projects reviewed by the authors emphasized their job creation effect, notably during the construction phase, numbering in some cases hundreds, in other cases thousands of newly-created jobs in various skill categories. In economically depressed areas marked by chronically high unemployment and deprivation project-driven job creation is especially important, even when it is mostly temporary, exceptions being when jobs of longer duration are created when projects subsequently enter their operational phase after completion. Besides jobs, some of the CCID-projects reviewed highlighted the business opportunities they provided local businesses desirous of supplying them items, inputs and services of any type available and required by the projects. By prioritizing their procurement from local sources, CCID-projects can contribute, sometimes significantly, to the development of the local economy, earning them much stakeholder goodwill and support in the process. Completed CCID-projects often have the consequential effect of attracting further investment into their localities which in turn result in fresh job creation and business generation opportunities. Some CCID-projects reviewed, such as shopping malls, museums, and theme parks, also pointed out the improvement in the quality of life for residents and outsiders they offered on completion which in turn rendered the localities more desirable places to live in and boosting property values and rental incomes.

Virtually all projects reviewed apparently had robust systems in place to communicate general and specific information about the project to all or groups of secondary stakeholders. This was done, for example, through project websites and/or a combination of numerous other information mediums such as newsletters, press releases, public information events, media interviews, dedicated phone lines and so forth. Communicating information directly from and about the project is a very important engagement measure as it may help address misgivings or apprehensions stakeholders have about projects instead of them having to rely on other non-project sources.

Dirt and dust, noise, vibrations, traffic hazards and diversions, and reduced pedestrian access to homes and businesses constitute some of the main general concerns secondary stakeholders have about large building construction projects in particular. Consequently, many such projects have implemented various 'mitigation measures' to reduce or eliminate the adverse impacts their construction activity on local residents and businesses. Oftentimes such measures are a pre-requisite for obtaining construction permission from local public administration and their adherence is carefully monitored by public officials. A case in point is the 360 Residences project in San Jose, California. Specific engagement measures identified in the project's construction impact mitigation plan included, inter alia, erecting signage and covered walkways and protected pathways at and around the construction site, introducing a vibration monitoring program to ensure that vibration ceiling levels were not exceeded and affected local residents were warned in advance about pile driving activity schedules, making acoustic barriers around pile driving equipment and muffling all construction equipment, using water trucks and street sweepers to prevent dust from exceeding pre-specified ceiling levels, and using dust bags and filters for power tools. Other notable engagement measures included coordinating with the nearby California Opera to minimize any adverse impacts of construction work on the Opera's performances, and offering monthly project progress updates as well as the opportunity for stakeholders to provide their feedback about the project through a project website.

In recent years the off-site fabrication of building components and their shipping and rapid assemblage at construction sites is attracting considerable interest and popularity. By adopting this approach large structures which normally take months to complete can be erected in a few weeks or even in days. This is a highly effective engagement measure because it drastically reduces the period of inconvenience for local residents who normally would be compelled to endure the nuisance caused by months of building and other construction activity undertaken in close proximity of their homes and workplaces. Several examples come from China: in Changsha in China's Hunan province just 19 days were required to erect a 57-story office building, a time-lapse of which is available on YouTube.

The lack of consultation on projects is often cited empirically as constituting a main reason for generating secondary stakeholder discontent with and opposition to projects. An interesting example where excellent consultation greatly facilitated an initially controversial project comes from the New Zealand town of Kaikoura. Located on the east coast of New Zealand's southern island the town, a popular tourist destination, historically has been prone to flooding with consequent often considerable damage to residential and commercial property. A proposed and seemingly effective solution to this problem was the construction of a flood wall but this scheme was not regarded enthusiastically by the town's local population. To gain the support of the town's residents, the project team adopted a listen-and-learn approach and incorporated their concerns and suggestions especially into the project's design and its execution phase. The result of this engagement was a wall design which not only was effective in keeping floodwater away and protecting Kaikoura against several different flooding risks, but which was also aesthetic and artistic in appearance and in harmony with the localities natural beauty. When residents saw a visualization of the design, their general mood swung in the wall's favor and other initially skeptical stakeholders soon opted to follow suit. To minimize the project's impact on tourism, construction was undertaken over a six week period during the off season and the wall's concrete panels were pre-cast off-site and their size reduced for easy transportation.

Incentives can be a powerful engagement force which if chosen wisely can swing secondary stakeholders in favor of projects. Incentives can manifest themselves in financial, material and other forms. Examples witnessed on projects include the donation of school books, computer and medical equipment, food supplies, provision of student scholarships, and even creation of parks and playgrounds for local residents. Sometimes cash itself may suffice as an incentive: the British Government is currently offering 2.5 million pounds per year to a local community which would be willing to host an underground nuclear waste storage facility project.

Many examples of successful stakeholder involvement and participation in projects come from social development and natural resource development schemes in developing countries which are financed, directly undertaken or assisted by regional and international development banks and/or development organizations. Stakeholders – who are also known as 'beneficiaries' – in such projects, which, inter alia, typically include health, education, gender and minorities empowerment, poverty alleviation, provision of access to clean drinking water and basic sanitation, and forestry and water resource management – are increasingly being given the opportunity to participate or involve themselves in projects which significantly affect them. This participation can occur during different project phases and at different points in time, namely, before project initiation, during the project life-cycle and/or after project completion. Direct stakeholder involvement is viewed as not only offering projects a higher chance of successfully achieving their goals but also, and perhaps more importantly, guaranteeing the sustainability of project results and outcomes which is increasingly being ack-

nowledged as constituting the yardstick of success in such projects. Modes of stakeholder participation or involvement which are being increasingly applied include participatory need assessment, participatory project design and planning, participatory execution, and participatory monitoring and appraisal. The participation intensity is variable and may be higher on some projects, lessor in others. Several organizations have developed sophisticated 'stakeholder engagement toolkits' detailing the types, processes and tools of stakeholder participation in projects. Some toolkits encompass dozens of specific stakeholder engagement measures. Participation by secondary stakeholders in projects is also the subject of a growing body of research and several published case studies which show that higher levels of stakeholder participation go hand in hand with higher project effectiveness and sustainability. Irrespective of its manifestation, participation gives stakeholders a sense of ownership of, responsibility for and identification with the projects which will ultimately affect them and their lives, often profoundly over an extended period of time.

An interesting example of high-level stakeholder participation in the context of renewable energy projects comes from the German state of Brandenburg where a proposed scheme to construct a wind park on farmland outside the small town of Schlalach-Muehlenfliess initially encountered opposition from the local population. A working group created by local residents, *Wind Power in Schlalach,* took up the responsibility for negotiating with prospective wind power companies. The group came up with the idea of a 'pooled space model' under which the annual lease income for the wind park would be put in a common fund and distributed among the 100 or so small land owners proportionately in relation to the size of their land leased out to the chosen wind power company Enercon. Through this arrangement each land owner was guaranteed an annual income of about 3,000 Euros from the fund. Local community participation led to selection of the wind park's turbine model. To attract the support of other stakeholders, a citizen's foundation was created which received a small share of the income generated by the wind park and which was allocated for youth programs and road repairs. In addition, the community was to benefit from the taxes generated by the wind park. Wind Power in Schlalach even came up with the idea to purchase shares in Enercon in future, which would make it a co-owner of the company and guaranteeing it additional income in future.

An excellent example of project stakeholder engagement was demonstrated by Petro-Canada. Now defunct, this Canadian energy corporation was rated highly for its fair, ethical and professional approach in its dealings with its secondary stakeholders in all its projects and operations inside and outside Canada. Its concise and succinctly formulated one-page document *Stakeholder and Community Engagement Policy*, approved by Petro-Canada's CEO, spelled out the corporation's approach emphasizing, inter alia, the importance of information sharing and consultation with its stakeholders as well as listening to them and understanding their needs, concerns and expectations, building trust and respectful relationships as well pursuing collaboration with them for mutual benefit, demonstrating social and cultural sensitivity, and incorporating stakeholder suggestions and seeking to develop solutions with them jointly. Three examples selected from the many posted on Petro-Canada's website show how the corporation implemented its 'win-win' policy in practice:

Example 1: In 2005 Petro-Canada signed production-sharing contracts for three exploration blocks off-shore from the Caribbean Islands of Trinidad & Tobago. The local fishing community was identified as a key secondary stakeholder and major part of the local economy. To engage these stakeholders several measures were adopted. A prominent one was safety at sea training courses for local fishermen covering basic boat and engine maintenance, use of safety equipment and survival techniques, and the donation of radar reflectors for local

fishing boats and GPS hand-held units to course participants. To ensure that drilling and fishing activities could take place simultaneously and to compensate local fisherman for their non-access to the 500 meter safety zone around the drilling rig, Petro-Canada installed twelve 'fish aggregating devices' to attract fish and create a fishing ground, and provided a chart with the GPS coordinates of the fish aggregating devices along with laminated cards for use in fishing boats. Furthermore, to reduce the possibility of interaction between Petro-Canada vessels and local fishing boats and their fishing gear a defined route for the corporation's vessels approaching the exploration site off Tobago was approved.

Example 2: In 1995 Petro-Canada sought to expand its lubricants facility at Mississauga in Ontario province. The proposed project was opposed by many residents concerned at the potential noise, odor, safety and adverse environmental repercussions. Drawing on its experience at another of its facilities, Petro-Canada set up a Public Liaison Committee, consisting of elected public officials, community representatives, public health experts, the Ministry of Environment, and officials from the Petro-Canada lubricants facility, to communicate between the facility and local community. A technical subcommittee was created consisting of local residents with experience in industry with a view to review technical issues prior to a discussion about them in the public liaison committee. Additional measures included air monitoring programs to measure and report facility emissions, and technical measures to ensure that emissions remain within acceptable levels. Independent consultants were tasked with reporting on air quality upwind and downwind of the facility on a quarterly basis. The overall result was that an open and effective dialogue between Petro-Canada, the community and elected public officials took place through the Public Liaison Committee and communication improved considerably to the extent that there was a marked decrease in the number of complaints received by Petro-Canada from local residents and each complaint received was reviewed and responded to.

Example 3: For its Fort Hills Mine project in Fort McMurray, Canada, Petro-Canada made 180 'regulatory conditions and commitments' to the inhabitants of the mine area. Quite diverse in scope, these included local participation in the reclamation planning and design process, provision of funding for a First Nation daycare facility, collaboration with the local school industry for funding diverse events and other educational support measures for First Nation students, promoting student employability skills, development of a community/youth camp and hiring of camp services, provision of funding of First Nation elder committees, distancing the mine behind the 100-year high water mark, creating a visual buffer of vegetation between the Athabasca river and the mining operations for aesthetic effect, minimizing disruption to marine and wildlife, fish relocation and other bio-conservation measures.

As a stakeholder the natural environment has since decades been a major source of controversy especially in relation to CCID-projects. With the advent of environmentally or eco-friendly 'green technology' in recent years, several coal-fired power plant projects in planning, execution or operation across the globe have opted to voluntarily incorporate this still nascent, evolving technology into their technical design, despite the considerable incurred additional cost plus other uncertainties which accompanies it, in order to reduce their chemical emissions (and consequent contribution to global warming and environmental damage). In the building construction context, the concept of 'green building' as an eco-friendly alternative to conventional building has likewise garnered increasing attention and interest culminating in the construction or renovation of numerous large structures inside and outside the United States which fall in this category.

Interesting technical design features incorporated into projects can sometimes serve the purpose of effectively 'engaging' animal stakeholders. Many highways, for instance, were constructed with 'wildlife crossings' to enable animals to safely cross them, thereby reducing the likelihood of road accidents and consequent human and animal mortality and injury. These crossings include underpass tunnels, viaducts and overpasses (mainly for large or herd-type animals), canopy bridges (for monkeys and squirrels), tunnels and culverts (for small mammals such as otters, hedgehogs and badgers), and amphibian tunnels (for frogs and other amphibians). To facilitate mobility of marine life, amphibian tunnels and fish ladders or fishways have been installed at many dams and other man-made obstructions constructed on rivers and waterways across the world to enable fish to bypass the barriers.

CCID-projects often are undertaken at places with important historical, archeological or cultural significance, raising serious concern at the possibility of the projects causing damage to sites and structures deemed protection-worthy. In some cases it has been possible to save famous structures – which can be considered as stakeholders in the broader sense – simply by dismantling and relocating them to safe places located outside the project area, and then subsequently reassembling them. A famous case in point is the relocation in the late 1960s of the pharaonic Abu Simbel Temples in Egypt from their original site, which was submerged by water after construction of the Aswan High Dam, to a site located above the dam water level. Because of road or highway construction projects the relocation measure has on many occasions has been extended to cemeteries as well as the habitats of rare animals, insects and trees. Oftentimes re- or translocation is a measure required by law.

On occasions projects have applied successful stakeholder engagement measures which apparently revolved around deference shown by the projects towards their secondary stakeholders. Three interesting, simple and cost-effective examples from Pakistan were shared with one of this paper's co-authors by his graduate students based on their personal past work experiences. In one example, a large national engineering public-sector company was tasked with executing projects in the remote hilly Kohistan region in northern Pakistan. Being outsiders the team initially encountered skepticism and distrust from the deeply conservative local population. By modifying their behavior for the duration of their stay in the area – for instance, by wearing local-style clothing, not shaving, communicating through translators in the local language Pashto, and not wandering around during prayer time - the team was able to bridge the gap and complete their work successfully without resistance or interference from the locals. In the second example, a hunter with extensive knowledge of the area and its terrain was interfering with a conservation project of the World Wildlife Fund in a forested region of northern Pakistan. As an engagement measure the World Wildlife Fund hired the hunter for their project leading him not only to cease his own hunting but, given his acquaintanceship and influence with other local hunters in the area, to encourage them to roll back their own hunting activities. In the third example, a peace-keeping military contingent was dispatched from Pakistan to a West African country ravaged by civil strife. To gain the confidence, goodwill and respect of the distrustful local population, the contingent came up with the idea to clean up a local cemetery thinking that such an unconventional gesture would be regarded with much appreciation by the locals. This turned out exactly to be the case and the contingent subsequently encountered less problems dealing with the local population than contingents from other countries.

Concluding Remarks

The authors' research reveals that projects are applying numerous and diverse measures as part of their strategies for effectively managing and engaging their primary and secondary

stakeholders on large and complex projects, especially in CCID. As the chosen examples show, project stakeholder management and engagement offers enormous space for creative, interesting and effective solutions within the cost, time and other constraints under which projects operate. Both projects and their stakeholders can benefit immensely from such management and engagement which is ethically desirable and which, if pursued by projects systematically, whole-heartedly and professionally, and is sustained over time, can bring about attainment of the best possible overall solution – namely, a 'win-win' situation - for both sides. It is a field of tremendous practical significance for projects which undoubtedly could still benefit from more extensive and in-depth research in future.

References

A Handbook of Public & Stakeholder Engagement. Published by Dialogue by Design.

Aurangzeb Khan, Miroslaw Skibniewski & John Cable, *Adversarial Project Stakeholders. Influencing Projects With Options.* Paper Presented at the fourth annual Project Management Symposium Organized by the Project Management Center for Excellence at the University of Maryland, College Park, USA, on 04-05 May 2017.

Aurangzeb Khan, Miroslaw Skibniewski & John Cable, *Understanding Project Stakeholder Psychology: The Path to Effective Stakeholder Management & Engagement*, in: PM World Journal (online), Vol. VI, Issue IX – September 2017.

David I. Cleland & Lewis R. Ireland, *Project Management. Strategic Design & Implementation*, McGraw-Hill, 4. Edition, 2002, pp. 161-190 (Chap. 6: stakeholders).

Guide to Successful Corporate-NGO Partnerships. Published by the Global Environmental Management Initiative (GEMI) and the Environmental Defense Fund.

Heather J. Aslin & Valerie Brown, *Towards Whole of Community Engagement: A Practical Toolkit*, Department of Agriculture, Fisheries & Forestry, Bureau of Rural Sciences, Murray-Darling Basin Commission, Government of Australia.

Karen Kroll, *Water Under the Bridge*, in: PM Network, November 2007, pp. 45-48.

Libby Ellis Lowe, *Trial by Fire*, in: PM Network, August 2009, pp. 45-48.

Max Hislop, Mark Twery & Heini Vihemaeki*, Involving People in Forestry,* UK Forestry Commission.

Richard A. Fuchs, *Town Turns Wind Power into Community Business*, Deutsche Welle (online).

UMD Project Management Symposium

Using Schedule Data to Improve Project Management[1]

Anne E Johnson

Contributing Author: Susan Hostetter

Demographic Statistical Methods Division, U.S. Bureau of the Census

4600 Silver Hill Road, Washington, DC 20233-7400; Anne.E.Johnson@census.gov

ABSTRACT

Like many project managers, I faced challenges such as under-estimated costs and effort, timelines and budgets too tight to meet the needs of sponsors, and the inability to make data-driven decisions. In response to these challenges, I developed methods using schedule data to improve the overall management of my projects. In this paper, I will describe my methods and discuss how these methods contribute to specific project management benefits such as:

- Identifying cost efficiencies
- Managing the budget more effectively
- Improving cost estimation and resource planning
- Reducing overall project risk
- Improving transparency with staff and sponsors
- Supporting informed, real-time decision making

INTRODUCTION

My Division

The Demographic Statistical Methods Division (DSMD) of the U.S. Census Bureau operates in a unique environment within the Federal Government. DSMD provides a variety of statistical services, such as sampling, quality assurance, and survey methodology research in order for the Census Bureau to execute over twenty demographic surveys. The work DSMD performs on all of these different surveys is sponsored by several external government agencies that each have their unique operating styles, needs, and requirements.

Although much of DSMD's work is essential to successfully executing each survey, DSMD also has the capability and staff expertise to perform research and analysis in order to improve surveys leading to cost savings and improved efficiencies. Given the current environment of the federal government, we are constantly at risk of decreasing budgets, and therefore find ourselves

[1] This paper is released to inform interested parties of ongoing operations and to encourage discussion of work in progress. Any views expressed on operational issues are those of the authors and not necessarily those of the U.S. Census Bureau.

competing for our research-type work to take priority and receive the appropriate funding. Additionally, there are risks to operating in a reimbursable work environment, making it essential for DSMD to keep costs low and quality of deliverables high.

Project Server at the Census

The US Census Bureau introduced Microsoft Project Server a few years ago to improve project and portfolio management, as well as, provide required reporting information to the Chief Information Officer and to Congress. Microsoft Project Server is a web-based application that serves as a database of project schedules and associated information, a portal for employees to charge their work hours to tasks on projects, as well as providing customizable reports for resource and schedule management, amongst other useful project management features.

A bureau-wide mandate was put in place for all staff to report their weekly work hours into Project Server to the associated mission-enabling service or survey life-cycle component. At the same time, the need for project management was becoming increasingly realized across Census. Having the project server infrastructure in place allowed Project Managers to execute and manage schedules based on actual work hours charged by project teams. Added benefits to collecting this schedule data are to analyze and use the data to improve planning for future projects, create transparency with our sponsors and survey directors, and improve resource and cost management.

It is important to note that this did not happen overnight or without a few headaches. Developing quality schedules and getting staff to accurately charge their work hours was necessary in order to successfully collect useful data. To accomplish this, the project managers needed to create comprehensive and manageable schedules with tasks that staff could easily understand and charge their work hours through Project Server. This was no easy task. It took the Demographic Statistical Methods Division (DSMD) approximately two years to achieve reportable project schedules.

Once DSMD was able to collect useful schedule data, the Management Operations Office (MOO), the project management office within DSMD, began exploring our options for using the data to tackle some of our division's challenges and solve some of these recurring problems.

CHALLENGES

To use schedule data to increase DSMD's efficiency and resolve some of our common issues, we first needed to identify these challenges and address the source of our problems. Below are the biggest challenges DSMD needed to overcome.

Poor Schedule Development & Management

Prior to using Project Server to manage our schedules, DSMD was relying solely on the "best guess" of the SMEs to input effort into the schedules. We knew we needed to revise our schedules but developing schedules from scratch is a time-consuming and tedious process and it is often challenging to get staff, especially leadership and SMEs, support and attention when developing schedules. Assisting the project management staff was not considered a high priority.

Not only are they busy with their work, it was difficult for staff to fully grasp the benefits of having accurate schedules when, up to this point, they had only witnessed the struggles of trying to maintain over-complicated schedules.

When staff began charging their work hours to schedules, we realized that we were mostly receiving unusable schedule data due to over-complicated and/or inconsistent format of schedules. The schedules we developed had too much detail resulting in confusion and too high burden on staff to actually report their time accurately each week. This lead to staff often charging to overhead or non-scheduled tasks when they did not understand the tasks or did not have the appropriate tasks available on their timesheets.

Underestimation of Costs & Poor Budget Management

Prior to collecting schedule data via Project Server, the MOO relied solely on the "best guess" of the SMEs to input effort into cost estimates. We also experienced numerous other issues when developing cost estimates because of our lack of consistent and documented procedures, not properly accounting for risk and uncertainty, not incorporating enough time for training, on-boarding, knowledge sharing, leave, and other non-project related staff time.

We were often underestimating costs because of the desire to produce "low" cost estimates in order to compete against contractors or other agencies to improve the likelihood that our proposed work, typically research projects, would be approved by our sponsors. We quickly realized that these low-ball estimates just ended up hurting DSMD. We often did not have enough funding to cover our staff or we ended up with budget deficits because we did not originally request adequate funding.

DSMD often would not anticipate how much our sponsors and survey directors would be involved in our work. We would regularly go over budget on work hours solely from addressing sponsor or survey director's feedback and comments on deliverables. Also, DSMD did not have a proper change management protocol in place, making it much more common for the sponsors and survey directors to ask for additional work without providing more funding. Obviously, this often lead to scope creep and budget overruns.

As mentioned before, staff were charging their time to overhead or non-schedule tasks when they did not understand the tasks or have the appropriate tasks on their timesheets. This made it challenging to manage the budget because, when looking at the schedule, it would seem as if the project was adhering to the baseline, or even ahead of schedule and under budget. In reality, the staff overhead/non-schedule charges were negatively impacting the budget, with a delayed realization of the effects due to lack of insight into these non-scheduled tasks. Even when realizing there were budget concerns, it was often difficult to pinpoint the source of the issue. The PMs monitored the budget using the standard monthly reports received from the budget office. These high-level reports were not easily understood without a background in finance and did not provide enough detail to properly manage the budget. Additionally, management was not as invested in budget monitoring and management as they should have been.

Lack of Transparency, Understanding, & Communication

DSMD performs complex statistical work that can often be difficult for the sponsor/survey directors to understand. As a result, it is challenging for them to fully grasp the importance of the work. Our overly-detailed schedules would often create confusion instead of helping survey directors to learn our processes. Staff charging to non-scheduled tasks/overhead made it almost impossible to determine what they were actually working on, adding to the difficulty of keeping survey directors and sponsors up-to-date on projects.

Also, without a risk management process in place, DSMD tended to realize issues before even identifying them as possible risks. At times, this lead to unanticipated budget and schedule issues, making it hard to defend our requests for more time or funding on projects.

Not only did DSMD often struggle to maintain good communication and transparency with our survey directors and sponsors, we also needed to improve our internal communication and transparency with staff and leadership. DSMD management were minimally involved with the budget and schedule formulation and monitoring and the MOO PMs were often delivering information in a format that was not easily comprehensible to those outside of the project management discipline. We did not have standard reports to communicate budget or schedule updates to DSMD management or to our sponsors and survey directors.

Insufficient Funding and Poor Resource Allocation

In this time of decreasing federal budgets, DSMD occasionally receives insufficient funding for projects making it difficult to support a full staff. As a result, DSMD is forced to make tough decisions about how to prioritize work and make appropriate staff assignments, as well as, determining whether we will be able to fill vacancies.

DSMD underwent a reorganization, moving to matrixed, pooled-staff structure in order to better address the ebbs and flows of work on different surveys by having the flexibility to move staff around, to promote knowledge sharing and staff development. This allows staff the opportunity to work on different surveys depending on the needs of the project, as well as the interest and expertise of individual staff. In order for this structure to function successfully, DSMD needed to put in place strong resource management processes. It took DSMD managers some time to move on from being territorial over their staff and be willing to utilize the matrixed structure.

DSMD had insufficient information regarding staff work assignments prior to capturing all of our division's work on schedules. It was very difficult to determine which staff were over or under allocated other than by asking them or their supervisors and hoping they were aware of their staff's full workload. This made staffing decisions on projects much more challenging and subject to more risks. Also, DSMD had a difficult time evaluating staff performance on specific types of tasks or skills without usable schedule data.

SOLUTIONS

After identifying our challenges and understanding the causes, we were able to start developing solutions for these problems. A common cause across DSMD's issues was simply a lack of information that lead to misunderstanding and inability to make informed decisions. As we

started to collect quality schedule data, we realized that this information could be used to solve a lot of our common challenges. Below are some of the methods we developed.

Improved Schedules

The MOO PMs worked tirelessly with SMEs and project teams to develop and continuously revise schedules until finally landing on a suitable breakdown of the work without overburdening staff with excessive tasks. The MOO used past schedules and staff input to compile a list of products and tasks that the division worked on across all surveys and projects. We then analyzed, consolidated, and standardized the list of products to achieve a comprehensive suite of DSMD work. This lead to the development of a standardized work breakdown structure that can be applied to most surveys and projects, Figure 1 below.

Figure 1. DSMD Work Breakdown Structure.

1. **LEVEL 1: DIVISION**
1.1. ***LEVEL 2: PORTFOLIO***
1.1.1. **Level 3: Program**
1.1.1.1. Level 4: PROJECT-TYPE
1.1.1.1.1. Level 5: Project
1.1.1.1.1.1. Level 6: Product
1.1.1.1.1.1.1. Level 7: Work Package
- Resources/Cost Estimates/Budget Actuals/Schedule are reported at the Work Package Level
- MOO and SDs neither have nor need visibility below the Work Package Level

1.1.1.1.1.1.1.1. Level 8: Activity
- Activities and Sub-Activities (at levels 9 and lower) are not included in the Project-Type standard WBSs
- Activities and Sub-Activities are created by each project as needed for project-level cost estimation and project control
- Resources, cost estimates, budget actuals, and schedule are rolled from Activities and Sub-Activities to the Work Package level for reporting

As a result, we are able to maintain consistency of task names and meanings across surveys and project schedules making it easier for staff understand the schedules and to report their time accurately. The MOO also created standardized procedures for incorporating non-project work hours on schedules in order to capture majority of staff's time on schedules. For example, we developed a division-wide training schedule that staff charge to when they participate in self-administered or classroom training. After DSMD implemented the improved schedules, staff charging to overhead decreased from 56% in fiscal year 2016 to 31% so far in 2018[2].

When Project Server became available to use there was a long learning period for both the PMs and the rest of the staff. Once the MOO was up-to-speed on the software, we began uploading and activating our schedules for staff to charge to within Project Server. The MOO developed standard, documented guidelines and began educating staff on how to report their time properly in Project Server. Staff now are more comfortable with the Project Server software and schedules. For Example, they pay attention to their remaining hours and communicate to the PMs when they think they might need more time on tasks. By reviewing the schedule at the regular team meetings and by frequently communicating with staff, the PMs ensure the schedules are always up-to-date and that staff are engaged with the schedule monitoring process.

Not only does the reliable data improve the overall monitoring of schedules and project performance, it also has greatly enhanced future planning. The standardized list of DSMD products allows for schedule data from specific tasks to be directly comparable across surveys

[2] These statistics do not include DSMD admin or project management staff.

and projects leading to improved task duration and effort estimation on future projects. When drafting a schedule, we can access the data from completed schedules of similar projects or prior survey cycles for new estimates leading to more accurate schedules. As the quality of our schedules continuously improve, projects begin adhering closer to their baselines making it easier for the teams to anticipate the risk of possible deviations from the baseline.

Streamlined, More Accurate Costs Estimation

Using actual effort charged to schedules to formulate costs on future projects greatly improved the accuracy of DSMD's cost estimates. We no longer need to rely solely on SMEs "best guess," instead the MOO PMs provide the schedule actuals to staff to support and guide their estimates for future work. To assist with the estimation of effort, I linked completed task data to the list of DSMD standardized products in order to determine average effort required for each product. Table 1 below shows the average effort based on project type for some of DSMD's deliverables where data is available at this point. This information is intended to serve as a foundation for which effort and duration estimates are based and as check to ensure our estimates are reasonable. As a result of this data, DSMD Leadership and SMEs are now more comfortable and efficient with the cost estimation process and more accurate with their estimates.

Table 1. SM Standard Products - Average Effort by Project Type and Grade.

ID	Deliverable/Product	Analysis of Existing Data			Experiment			Contact Optimization		
		GS-12	GS-13	GS-14	GS-12	GS-13	GS-14	GS-12	GS-13	GS-14
SM-5	Report	270	57	29	65	48	8	94	12	7
SM-6	Recommendations	0	0	0	0	0	0	0	0	0
SM-7	Analysis	420	99	22	74	38	7	213	106	28
SM-8	QA	0	0	0	10	7	2	0	0	0
SM-9	Proposal Development	0	0	0	0	0	0	0	0	0
SM-10	Operations Plan				0	0	0			
SM-11	Analysis Plan	76	10	24	113	0	17	92	22	3
SM-12	Expert Review									

A second improvement to the costs estimation process was to standardize our procedures for incorporating non-deliverable related work hours into the cost estimates. We did this to ensure we are appropriately capturing costs for time expended on training, onboarding, leave, project support, and other non-deliverable related tasks. For example, we will add three days of training and $1,500 for each full time employee to account for training that may occur throughout the year.

When estimating effort and costs for research proposals and projects that tend to have more uncertainty, additional steps are taken to account for risk. Table 2 shows a simplified version of the cost estimate data gathering steps used to incorporate risk and uncertainty.

Table 2. Cost Estimation Data Gathering Process.

Determine scope	Work with sponsor/survey director to determine project requirements.

Gather data	PM develops data gathering spreadsheet for Lead Scientist (LS) and provides average effort from similar completed projects for reference.
Estimate effort	LS develops 3-point effort estimates (optimistic, most likely, and pessimistic) for tasks based on project requirements and historical data. The LS also assigns a level of confidence in estimates for each task (guesstimate, low, medium, or high).
Build in risk/uncertainty	PM runs the 3-point estimates through a model that uses the PERT formula, a normal distribution, and confidence level to calculate effort estimates with uncertainty built in.
Estimate costs	PM inputs effort estimates through cost estimation worksheet.
Review estimates	LS reviews cost estimate.

With schedule data to support our estimates, DSMD can provide the sponsor with solid, defensible estimates that lead to realistic project budgets and schedules. This gives DSMD a competitive advantage by enabling high quality work that will meets the sponsor's need and comes in on schedule and on budget. Additionally, if the sponsor pressures DSMD to lower our costs, we can have a data-supported conversation with them on where to cut project scope.

Better Budget Formulation & Monitoring

DSMD uses schedule data to understand how all the projects and surveys fit together at the division level. The data provides resource usage for past and currently active projects that is useful for budget formulation. To do this, the MOO PMs use past and present schedule data to determine the appropriate level of staff they should allocate to each survey or project for that fiscal year. We then compare that to a top down estimation approach to determine the adequate level of funding to cover our staff. This simplifies our resource allocation and budget formulation process for current and out year planning. Table 3 is an example of DSMD's budget planning documents (BPD) showing how a resource's paid days are split across multiple projects.

Table 3. Fiscal Year 2019 DSMD BPD Sample.

Project Code	Resource- Branch	PayGrade	PayPlan	Series_	Tour_	EmployeeType	Paid Days
0902087	Resource 1 - Branch 02	12	GS	1530	FullTime	Permanent	260
Project View	Resource 1 - Branch 02	12	GS	1530	FullTime	Permanent	260
0906000	Resource 2 - Branch 20	11	GS	1530	FullTime	Permanent	25
0957000	Resource 2 - Branch 20	11	GS	1530	FullTime	Permanent	30
0959000	Resource 2 - Branch 20	11	GS	1530	FullTime	Permanent	38
0976000	Resource 2 - Branch 20	11	GS	1530	FullTime	Permanent	25
1465X01	Resource 2 - Branch 20	11	GS	1530	FullTime	Permanent	27
7370019	Resource 2 - Branch 20	11	GS	1530	FullTime	Permanent	45
7421019	Resource 2 - Branch 20	11	GS	1530	FullTime	Permanent	70
Project View	Resource 2 - Branch 20	11	GS	1530	FullTime	Permanent	260

Management is now more invested in budget monitoring because the MOO PMs began creating monthly budget variance reports and other custom reports that are more easily understood than

the reports that admin provides. The schedule data allows us to provide more detailed project-level cost information, instead of just program-level information found in the admin reports. I meet with management monthly to review these reports and discuss any budgetary concerns. As a result, we are able to pinpoint the specific cause of budget concerns more easily and anticipate potential budget issues before they occur. Below is a list of the reports I provide management.

1. Monthly Budget Variance Report
    - Update monthly, at least two days prior to monthly budget meeting
    - Fiscal year (FY) specific report showing a budget snapshot of all projects and surveys worked on in the given fiscal year
    - Compares original operating plan, current operating plan, and actual expenditures
    - Updated based on financial monthly report (FMR) data, schedule data, and Census Data-Warehouse cost information
2. Survey Specific Budget Reports
    - Update monthly, at least two days prior to monthly budget meeting
    - Project specific costs by fiscal year
    - Expended funds based on the actual work reported to schedules
    - Cost Estimates of remaining work
    - % of work completed and % of duration completed on the project
    - Original cost estimate and revised/current cost estimate (if applicable)
    - Baseline effort
    - Monthly FMR data (i.e. total allocation, expenditures, remaining funding, etc. by project code)
3. End of Fiscal Year Budget Report
    - Total FY expenditures by project code and project
    - Original FY allocations
    - Funding adjustments and associated justifications
    - Percentage of staff covered by project code

The goal has always been for DSMD schedules to be developed and baselined to match the effort and timelines used to produce our cost estimates. Now that the MOO PMs are more easily able to achieve this, monitoring the budget is directly linked to schedule performance. With staff knowledge of this, they are more cognizant of the hours they are spending on tasks leading to more accountability and improved performance.

Improved Communication & Transparency

With regular meetings, improved team communication, and up-to-date, accurate schedules, it is much easier to communicate status updates to our sponsors and survey directors at a moment's notice. The MOO PMs work with survey directors and DSMD management to determine the best way to present schedule and budget data in a routine and timely manner that will suit their needs. In some cases, that means linking our schedule to the survey director's schedules in order for them to monitor our work in real-time without having to reach out for a status update.

For internal bi-weekly team meetings, I have schedule snapshots and status reports available for staff to review prior to the meeting. The status reports are created using data pulled from the schedules, see Table 4 below. During the meetings we go over this information in order to make updates to the schedule, identify new risks, status on current risks, create action plans for issues, and discuss general project progress.

Table 4. Status Report for 2018 NSCH Review of Mailed Correspondence.

PROJECT NAME: 2018 NSCH REVIEW OF MAILED CORRESPONDENCE		
Meeting Date: 3/19/18	Project Code:	
Project Manager: Anne Johnson	Project Lead:	
PROJECT INFORMATION		
Description of Project: Conduct an expert review of the NSCH contact materials that are currently planned for use in the 2018 survey.		
Project Start Date: 3/1/18	Project End Date: 4/18/18	% Work Complete: 26%
SCHEDULE STATUS		
This project is ahead/behind schedule: On Schedule		
Drivers causing schedule variance:		
Planned Hours: 373.5hrs (updated to include CR hours)	Schedule Hours: 366.25hrs	Reserve Hours: 7.25hrs
PROJECT UPDATES		
3/14/18 CR for additional follow-up postcard approved by ADDP. They would like this task completed by 4/6/18.		
PROJECT ISSUES		

By continuously monitoring schedules to identify potential risks before they are realized, we have improved our risk management ability. We have increased our capability to make data-driven, real-time decisions based on the schedules that are updated and published weekly.

With our new standardized WBS, the schedules are more easily understood and embraced. By capturing more work on schedules and reducing overhead charging, we are now able to fully understand what staff are actually working on.

Enhanced Resource Management

Now that DSMD captures nearly all of staff work on schedules, including project and non-project time, we are able to analyze an employees' availability, or lack of, in order to make informed assignments to project work. Using Project Server resource reports that pull information from our current schedules, we can see the full suite of work staff are assigned to in order to determine which resources have the availability to take on additional work. Providing resource capacity and availability reports, see Table 5 below, to management on a monthly basis allows us to easily decide how to shift work amongst resources if needed, fully utilizing our matrixed structure. For example, analyzing resource reports helped DSMD realize that, with the current set of projects, there is an increasing need for staff with skills in questionnaire design and

development. At the time, only a few staff members had expertise in this skillset and were therefore assigned to more work than they had the capacity for. We used this information as an opportunity to cross-train staff on questionnaire design and development to avoid over-allocation of resources in the future.

Table 5. SM Resource Capacity vs. Availability Report.

Resource Name	Project	February	March	April	May	June	July
Resource A	**Capacity**	**148**	**176**	**168**	**176**	**168**	**168**
Resource A	**Availability**	**13.04**	**-4.5**	**47.24**	**70.41**	**93.23**	**165.96**
Resource A	DSMD 2018 Conference Papers	13.06	15.53	14.82	8.65	0	0
Resource A	DSMD_Customer Satisfaction Survey Development	18.85	34.63	34.26	41.18	18.57	0
Resource A	DSMD_FY18_Training and Knowledge Sharing Schedule	3	3.57	3.4	3.57	4.46	2.04
Resource A	DSMD_RP17_NSCG_Paradata Analysis	48.47	51.58	36.13	27.69	20	0
Resource A	DSMD_RP17_NSCG_Web Enhancement and Mobile Optimization	4.58	0	0	0	0	0
Resource A	DSMD_RP17_NSSRN_Questionnaire Design	12.44	22.68	0	0	0	0
Resource A	DSMD_RP18_NSCH_Questionnaire Design	34.53	52.51	32.14	24.5	31.74	0

Time Available (%)
38%

Analyzing schedule data provides insight into specific strengths and skills sets of staff allowing us to make more informed resource decisions on projects and has made it easier for management to assign work. For example, one team member may take half as much time as another to write an analysis plan, so if a project has a tight schedule, it would be in our best interest to assign the work to the team member that is capable of working faster.

CONCLUSION & NEXT STEPS

DSMD now has a wealth of new and improved project management methods in place made possible because of the collection and analysis of schedule data. We have improved our relationships and trust with our sponsors and survey directors, increasing their willingness to utilize our services and initiate future work. DSMD leadership and staff have enhanced their understanding and recognized the benefit of our project management processes. We are now able to make data-driven, real-time decisions helping us to more effectively manage our resources, budget, and schedules. In order to stay on this path of progress, DSMD will need to execute the following next steps.

- Continue to find innovative ways to use schedule data to improve our processes. With the burden imposed on staff to report their time each week, we should always be making an effort to use the data collected to improve the efficiencies of the division ensuring their efforts are worthwhile.
- Maintain an up-to-date Project Management Plan. The PM plan ensures accountability and is crucial in order to pull all of these new methods and procedures together so they can be utilized consistently and effectively.
- Collecting ongoing lessons learned is essential in order to continuously improve our processes, projects, and schedules.