Successful Failures and Failed Successes:

Untangling the Obstacles Facing Collaborative Proposal Writing

by

Laurel Brooke Passantino

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Graduate Supervisory Committee:

Thomas P. Seager, Chair
Elizabeth Cantwell
Erik Johnston

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ABSTRACT

The first task faced by many teams endeavoring to solve complex scientific problems is to seek funding for their research venture. Often, this necessitates forming new, geographically dispersed teams of researchers from multiple disciplines. While the team science and organizational management fields have studied project teams extensively, nascent teams are underrepresented in the literature. Nonetheless, understanding proposal team dynamics is important because if left unaddressed, obstacles may persist beyond the funding decision and undermine the possibility of team successes adjunctive to funding.

Participant observation of more than 100 multi-investigator proposal teams and semi-structured interviews with six leaders of multidisciplinary proposal teams identified investigator motivations for collaboration, obstacles to collaboration, and indicators of proposal team success. The motivations ranged from technical interests in the research question to a desire to have impact beyond oneself. The obstacles included inconsistent or non-existent communication protocols, unclear processes for producing and reviewing documents, ad hoc file and citation management systems, short and stressful time horizons, ambiguous decision-making procedures, and uncertainty in establishing a shared vision. While funding outcome was the most objective indicator of a proposal team's success, other success indicators emerged, including whether the needs of the team member(s) had been met and the willingness of team members to continue collaborating. This multi-dimensional definition of success makes it possible for teams to simultaneously be considered successes and failures.

As a framework to analyze and overcome obstacles, this work turned to the United States military's command and control (C2) approach, which relies on specifying the following elements to increase an organization's agility: patterns of interaction, distribution of information, and allocation of decision rights. To address disciplinary differences and varied motivations for collaboration, this work added a fourth element: shared meaning-making.

The broader impact of this work is that by implementing a C2 framework to uncover and address obstacles, the proposal experience—from team creation, to idea generation, to document creation, to final submittal—becomes more rewarding for faculty, leading to greater job satisfaction. This in turn will change how university research enterprises create, organize, and share knowledge to solve complex problems in the post-industrial information age.

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CHAPTER 1

INTRODUCTION

The complexity of scientific problems increasingly requires teams with multidisciplinary perspectives. The first task frequently faced by these new teams is to seek funding for their research venture, often by writing a proposal. Studies suggest the principal challenges to teams in these nascent stages are to identify personnel with the knowledge required to address the research problem and to overcome barriers incentivizing collaboration across disciplines.

A 2015 report on *Enhancing the Effectiveness of Team Science* by the National Research Council specified seven dimensions that create challenges for project teams if not managed, and participant observation of more than 100 multi-investigator proposal teams over seven years Arizona State University (ASU) and semi-structured interviews with six leaders of multidisciplinary proposal teams confirmed these challenges manifest in proposal teams. The research findings identified specific processes hindering proposal team success, including inconsistent or non-existent communication protocols, unclear processes for producing and reviewing proposal documents, ad hoc file and citation management systems, short and stressful time horizons, ambiguous decision-making procedures and resource allocation, and uncertainty in establishing a shared vision of the future to which they are working. Proposal team members found that continually revisiting process inefficiencies was taxing, decreased their satisfaction, and wasted time that could have been spent making new initiatives more productive, more competitive, and more likely to receive funding.

Understanding team dynamics at the proposal stage is important because if left unaddressed, these obstacles may persist beyond the funding decision and undermine the possibility of team successes adjunctive to funding. While a proposal's funding outcome is the most objective way to measure a team's success, applying the three-pronged definition proposed by Hackman (1987) provides additional success indicators: performance as judged by others (i.e., external validation), whether the needs of the team member have been met (i.e., internal validation), and the willingness of team members to continue collaborating (i.e., behavioral validation). The research validated that these success indicators were also present in proposal teams. The multi-dimension definition of success also makes it possible for teams to simultaneously be considered successes and failures—i.e., *successful failure* and *failed success*.

As a framework to analyze team obstacles and develop strategies to overcome them, this work turns to the command and control (C2) approach used in the American military (Alberts & Hayes, 2006). This military doctrine was designed for diverse, multi-organization teams when executing complex missions under uncertainty. The C2 approach relies on specifying the following elements in an organization to increase its agility: patterns of interaction, distribution of information, and allocation of decision rights. Nearly all of the obstacles identified in this research fit within the C2 categories. However, one element was missing: differences in motivations for participating in proposal teams. To address the disciplinary differences and varied motivations for collaboration, this work added a fourth element beyond the C2 framework: shared motivations and meaning-making.

The broader impact of this work is that by implementing a C2 framework to uncover and address obstacles, the proposal experience—from team creation, to idea generation, to document creation, to final submittal—becomes more rewarding for faculty, leading to greater job satisfaction. This in turn will change how university research enterprises create, organize, and share knowledge to solve complex problems in the post-industrial information age.

Benefits Of and Demand For Interdisciplinary Research Teams

As the complexity of knowledge problems increases, so does the need for adaptive responses to creating and organizing the scientific knowledge required to produce new solutions—especially knowledge that integrates many disciplinary perspectives. Several decades ago, the primary model for conducting university research was a single investigator with a few graduate students working in a single lab, and many of today's scientists still train their graduate students to be autonomous and work independently (Hinrichs et al., 2017). As demonstrated by bibliometric analysis of publications and patents, knowledge creation is increasingly dominated by teams rather than solo authors (Wuchty et al., 2007). Even though highly autonomous researchers may be working alone, that doesn't necessarily mean they are working in isolation (Bozeman & Gaughan, 2011).

In their desire to fund research that produces societal benefit, many federal agencies are embracing—and even requiring—interdisciplinary teams. The need for multi-investigator and interdisciplinary teams is sometimes implicit, governed by the types of problems the research aims to solve. Take, for example, the National Academy of Engineering Grand Challenge to provide access to clean water. Solving this challenge

will require not only the expertise of water treatment engineers but also experts in hydrology and water resources to identify water sources, water rights and public policy to identify and solve legal challenges, cost modelers to assess financial feasibility, social scientists to understand water use behavior patterns (e.g., acceptability of reclaimed water and willingness to pay for higher quality water), energy system analysts to determine the effect on the power grid, and more.

It is also becoming common to see explicit requirements in funding announcements for interdisciplinary teams and systems-level approaches. For example, the National Science Foundation (NSF) Critical Resilient Interdependent Infrastructure Systems and Processes (CRISP) program specifies that teams must include at least one investigator who is an engineer, one who is a computer scientist, and one who is a social scientist. As the number of disciplines involved in a research project increases, more people are likely to see how the individual disciplines contribute to a solution that benefits society. A benefit of interdisciplinary projects is that they will resonate with a broader cross section of the population and thus are less likely to be criticized by the public or eliminated by the funding sponsor.

Knowledge specialization in higher education

Throughout the 19th and early 20th century, American universities mirrored the specialization approach of the industrial assembly line. Departmental structures formed to create multiple levels of increasingly smaller disciplines and sub-disciplines in the same way that specialization of tasks on the assembly line allowed for increased throughput, improved reliability, and lower costs. This developmental direction can trace its roots to the Morrill Land Grant Act of 1862 (7 United States Code § 301 et seq.)

during the Lincoln administration, that exhorted universities "… to teach such branches of learning as are related to agriculture and the mechanic arts, in such manner as the legislatures of the States may respectively prescribe, in order to promote the liberal and practical education of the industrial classes in the several pursuits and professions in life."

The dominant metaphor for organization of knowledge during the development of the modern American university has been *the knowledge tree,* which adds new knowledge in smaller and narrower sub-disciplines depicted as limbs, branches, and twigs. While this specialization allows an efficient application of knowledge, it creates cultural divides between academic disciplines and specialized approaches for solving problems (Breckler, 2015). It also increases the pressure to find collaborators with complementary skills when approaching large-scale projects (Iglič et al., 2017).

In the post-industrial age, knowledge creation may be better described as a *knowledge web* of connections (Lima, 2012), where all knowledge connects to all other knowledge in a complex system. Thus, the scientists of the 21st century will be required to work more like spiders building webs and less like horticulturalists cultivating new leaves on the branches of a disciplinary trees (Liu et al., 2019; Seager, 2018b). While today's graduate students may form some connections outside their primary fields of study as they cultivate new leaves on the metaphorical knowledge tree, it is unusual for them to make explicit connections to knowledge created on other branches in other disciplines. Nonetheless, knowledge needs have continued to evolve since these formative experiences, and scientists must adapt to be capable of working in communicative networks that connect across disciplines.

Accountability to funding organizations

Universities aim to create, organize, and disseminate knowledge, and they achieve this through their education and research missions. Resources for education come primarily through tuition and course fees, and most public universities also receive some funding from their respective state governments. Resources for research come primarily from grants and contracts from federal, state, local, private, and philanthropic sources. Funding agencies, particularly public agencies, are under pressure to demonstrate the value of the money they invest. For example, philanthropic organizations must report outcomes to their boards, state agencies must report outcomes to the legislature, and federal agencies must report outcomes to the United States Congress. Each year since 2010, the offices of US Senators Coburn (Retired, Oklahoma), Flake (Retired, Arizona), and Paul (Kentucky) have published a "wastebook" specifically identifying federal research grants that, in their opinion, waste taxpayer funds (Office of Senator Jeff Flake, 2015, 2016, 2017; Office of Senator Tom Coburn, 2010, 2011, 2012, 2013, 2014). While it can be disheartening and embarrassing to be a researcher named in one of these reports, the consequences are dire for the agencies funding these studies. If these reports decrease public opinion and confidence in the research and the organization funding the research, congress may decrease the agencies' budgets.

One way for agencies to avoid having research they sponsor appear wasteful is to increase the complexity of problems addressed, which in turn leads to larger interdisciplinary projects. For example, a study funded by the Defense Advanced Research Projects Agency (DARPA) named in the 2016 wastebook was criticized for

investigating "Why does walking with coffee cause it to spill?" (Office of Senator Jeff Flake, 2016). On the surface, this seems like an unnecessary way to spend government money. However, had the fluid dynamics of this research been put in context of a study that was developing robots to safely transport hazardous chemicals or evaluating ways to reduce lost productivity caused by workplace accidents, its inclusion in the wastebook likely could have avoided.

As the number of disciplines increases, more people are likely to see how the individual aspects contributed to solutions that benefit society, and the programs are less likely to be criticized or eliminated. In their desire to fund research that produces societal benefit, many federal agencies are embracing—and even requiring—interdisciplinary teams. The need for multi-investigator and multidisciplinary teams is sometimes implicit, governed only by the types of problems the research aims to solve. It's also becoming common to see explicit requirements in funding announcements for interdisciplinary teams and systems-level approaches. As described earlier, the NSF CRISP program specifies that teams must be multidisciplinary and even specifies the three disciplines that must be included (i.e., an engineer, a computer scientist, and a social scientist).

The need to integrate multiple perspectives when approaching complex challenges is illustrated by a shift from funding single-investigator projects to multi-investigator projects. For example, in 1998 the NSF made 26% of its awards to multi-investigator projects. By 2005, the percentage of awards to multi-investigator projects increased to approximately 45% (National Science Foundation, 2008), and it has continued to increase since. In 2015, more than half the NSF awards were made to

multi-investigator projects (National Science Foundation, 2017). Other federal agencies have been directed to follow suit. In 2005, the United States Office of Science and Technology Policy issued a memo requiring all federal funding agencies to develop formal policies allowing multiple investigator projects. These polices—which include how agencies receive and review applications from multiple investigators and how they identify and display investigators in public databases—were codified in the Federal Register in 2007 (Agency Recognition of Multiple Principal Investigators on Federally Funded Research Projects, 2007).

Defining Success

In research institutions such as ASU, a proposal's funding outcome is often the sole factor used by administrators in determining a proposal team's success. Admittedly, tracking wins, losses, and dollars are easy ways to quantify success. But, the low funding rate for large, interdisciplinary, multi-institutional research teams (Von Hippel & Von Hippel, 2015) and questions regarding peer-review reliability, reproducibility, and bias (Marsh et al., 2008) make funding decisions an unreliable indicator for the research proposals that grapple with grand challenges.

Nonetheless, formulation of specific hypotheses and research questions related to the success of research teams is complicated by difficulties defining and describing *success*. Several measures of research productivity are present in the existing literature, including bibliographic outputs (Borrego, 2006; Qin et al., 1997; Toutkoushian et al., 2003; Vaughan & Shaw, 2003), rates of funding success (Von Hippel & Von Hippel, 2015), and self-reported non-monetary measures of satisfaction (Stokols et al., 2008; Von Hippel & Von Hippel, 2015). In isolation, each of these poses challenges. Thus,

research into the factors that contribute to or facilitate research team success must adopt a multifaceted understanding of team "success" that incorporates elements of each of these extant measures and remains open to new or ad hoc measures that capture the goals of a specific team.

A multi-dimensional definition of success also makes it possible for teams to simultaneously be considered a success and a failure. Two terms—*successful failure* and *failed success*—can be used to describe these phenomena. A successful failure refers to a team that experiences successes adjunctive to funding (e.g., creation of knowledge, the training of students, professional development for faculty, and economic development in the community). A failed success occurs, for example, when the reality of project execution leads to panic (Bergstrom & Baun, 1994), the research project is unrewarding for the investigators (D. M. Anderson & Slade, 2016), or the group has burnout from the task and doesn't want to continue (Hackman, 1987).

Obstacles Facing Proposal Teams

In the current university setting, one of the foremost motivations for multi-investigator teams are the policies promulgated by the federal agencies from which the teams seek funding. Thus, the knowledge webs between disciplines form when science teams prepare large proposals that request funding to address an important social problem, such as those identified by the National Academy of Engineering Grand Challenges (National Academy of Engineering, 2017) or National Science Foundation 10 Big Ideas (National Science Foundation, 2016). However, such efforts typically encounter several obstacles that inhibit team success, leave knowledge integration far from complete, and fail to achieve the intended broader impacts. These obstacles, if left

unaddressed, may persist beyond the funding decision and undermine successes in later phases of the project.

Recent team science studies suggest that the fundamental challenges to collaborative proposal writing are identifying the knowledge requisite to the research problem, assembling personnel to fill the expertise gaps, and overcoming barriers to incentivizing collaboration. However, science teams typically encounter several additional obstacles that inhibit team success, including inconsistent or non-existent communication protocols, unclear processes for producing and reviewing proposal documents, ad hoc file and citation management systems, short and stressful time horizons, ambiguous decision-making procedures and resource allocation, and uncertainty in establishing a shared vision of the future to which they are working.

Contributions to the Literature

This work refines an existing problem area within team science by examining how team science challenges manifest specifically in research proposal development teams. Understanding team dynamics at this stage is significant to team science because the problems—if not addressed—can stick with the team after a funding decision, inhibiting knowledge creation. Failure to address the obstacles facing proposal teams may result in collaboration becoming taxing for the participants, decrease team member satisfaction, and waste time that could be spent making initiatives more productive.

In addition, this work translates and applies an organizing framework from a different industry and uses it to make recommendations that will help multidisciplinary proposal teams overcome the obstacles and increase their success. The framework—

command and control (C2)—originates in the United States military (Alberts & Hayes, 2006) and relies on specifying the following elements in an organization to increase its agility: patterns of interaction, distribution of information, and allocation of decision rights. To address disciplinary differences and varied motivations for collaboration not captured in the C2 framework, this work added a fourth element to complement the military description of C2: shared motivations and meaning-making. It may seem paradoxical that increasing the rules and organizational structures affords team members more flexibility to pursue their goals. However, the paradox is resolved by realizing that team members who have access to the same information and are trained to use information in the same ways will independently arrive at similar decisions that make the organization operate more fluidly (Alberts & Hayes, 2003).

Dissertation Organization

Chapter 2 presents the research methods, including the research questions, how the participant-observer data and a pilot case study were used to inform the protocol for the semi-structured interviews, and how interview data were coded and analyzed.

Chapters 3, 4, and 5 each follow a similar format: summarize the literature, define the knowledge gap, describe specific research methods to fill the gap, and present and discuss the findings.

- Chapter 3 describes types of collaborations, reasons for researchers to collaborate, and motivations for researchers engage in proposals.
- Chapter 4 identifies obstacles to collaboration in multidisciplinary proposal teams

- Chapter 5 presents a multi-dimensional definition of success for proposal teams and discusses how some teams can be simultaneously considered as successful and also as failures.

Chapter 6 brings everything together and recommends using the command and control (C2) framework to identify and organize the obstacles facing proposal teams. It also offers recommendations to help the teams overcome the most frequently and troublesome obstacles they face and thus increase potential for the proposal team to have successful outcomes.

CHAPTER 2

METHODS

Methods Overview

This research aims to increase the success of proposal teams so that teams can advance knowledge and solve increasingly complex problems facing today's world. In research institutions such as ASU where the Board of Regents and President Michael Crow have established ambitious research expenditure goals and use the National Science Foundation Higher Education Research and Development (HERD) index—which ranks institutions by annual research expenditures—it is tempting to view win/loss as the sole indicator of proposal success. Tracking wins, losses, and dollars is an easy way to quantify success, but it's unreliable due to the low funding rate for large, interdisciplinary, multi-institutional research teams (Von Hippel & Von Hippel, 2015) and questions regarding peer-review reliability, reproducibility, and bias (Marsh et al., 2008). The time delay between submittal and notification, which is often six months of longer, also highlights a need for multi-dimensional and subjective measures of proposal team success prior to the funding decision is known. There is also the phenomenon of an *unsuccessful win*, for example when a team dreads having to perform the work that was proposed or no longer wishes to work with the teammates after award (D. M. Anderson & Slade, 2016; Bergstrom & Baun, 1994).

The basis for this study originated from informal observations of more than 100 proposal teams during my experience on the staff in the office of the Associate Dean for Research and office of the Vice Dean for Research and Innovation in the Ira A. Fulton Schools of Engineering at ASU. As participant-observer between 2013 and 2017, I

observed that proposal teams encountered several obstacles that inhibited team success, left knowledge integration incomplete, and failed to achieve the intended broader impacts. My experience showed that these obstacles typically included:

- Ineffective communication protocols that resulted in confusion, misalignment of efforts, or gaps in assignment of tasks.
- Difficulties distributing relevant information and managing documents—including datasets, experimental procedures, and proposal drafts—or the availability of knowledge that may exist outside a small group of core decision-makers (such as co-Principal Investigators or administrators).
- Ambiguity with regard to decision-making and resource allocation, which eroded adaptive capacity and undermined the motivation of knowledge professionals.
- Uncertainty and confusion in the social construction of meaning, including the lack of a shared vision that would facilitate alignment of individual efforts with a common agenda, and the navigation of multiple cultural norms associated with different disciplines.

To combat recency bias and cherry-picking of data, I developed a more rigorous procedure to collect additional data—first by gathering pilot case study data during a research methods class in Spring 2017 and then by designing and implementing a semi-structured interview protocol. The pilot study was instrumental in beginning to identify and articulate team successes adjunctive to funding (e.g., creation of knowledge, the training of students, professional development for faculty, and economic development in the community). My role as a participant-observer continued in parallel with the pilot case study and research study planning in 2017 and 2018. While I kept more detailed

records about the motivations, obstacles, and successes, I did not conduct formal interviews with my fellow team members during this period.

Using data from the participant-observer role, the case study pilot, and literature sources to identify gaps related to motivation, obstacles, and success metrics, I developed interview questions and pre-populated lists for rank-ordering motivations and proposal obstacles. The interviews with principal investigators (PIs) yielded additional information to validate, expand, and refine preliminary findings related to: uncovering investigator motivations for writing proposals, identifying and confirming the obstacles facing the teams, and understanding proposal team success. The data was also used to examine the relationship between activities that occur during real-world grant writing experiences to understand how some proposal teams can be described as simultaneous successes and failures. In addition, this research identified an existing team organization framework (i.e., command and control, originally developed for the US Military (Alberts & Hayes, 2003)) and adapted it to apply it to proposal teams. The recommendations, if implemented, will shift proposal teams from their current ad hoc approach for overcoming obstacles to teams that have a deliberate design and structure to overcome the organizational obstacles they face, thus increasing likelihood of successful outcomes.

Research Questions

Three critical research questions guided this study:

1. **What motivates investigators to lead or participate in research proposals? (Chapter 3)** Because one of the proposal success criteria discussed in Chapter 5 is to assess whether individual investigators' needs were met, it is important to first understand why investigators write proposals and what makes

them decide whether a team is necessary. The need to align motivations can be taken for granted in some organizations (e.g., military or industrial settings) where projects are handed down from upper levels of the organization because the mission is pre-defined (e.g., national security, reaching profitability targets, and performing job requirements). However, it is critical to consider and align the differences in university teams where teammates operate more like a collection of independent contractors than employees managed in a common organization. In addition, it is unknown whether these motivations are consistent regardless of whether an investigator is leading a team or joining a team led by others.

2. **What obstacles impede proposal team success? (Chapter 4)**

   Understanding team dynamics and obstacles facing teams at the proposal stage is important because if left unaddressed, these obstacles may persist beyond the funding decision and undermine knowledge creation throughout the research project. While many studies have examined obstacles facing teams, there is limited data on the early-stage teams such as those engaged in proposal efforts. Because characteristics of effective science teams change throughout different project execution phases (Borden, 1992), differences between proposal and project execution phases are expected, making this a critical research gap.

3. **What does it mean for proposal teams to be successful? (Chapter 5)**

   Explicit measures of knowledge creation and success are insufficient when assessing the success of proposals teams. Hackman (1987) proposes a three-part definition for team success—performance as judged by others (i.e., external

validation), whether the needs of the team member have been met (i.e., internal validation), and the willingness of team members to continue collaborating (i.e., behavioral validation)—and it is unknown how this will manifest in proposal teams.

The research concluded by developing actionable recommendations (Chapter 6) for proposal teams seeking to overcome obstacles and improve their success. The data was examined against an existing framework that was designed to enhance team agility, achieve self-synchronization, and improve mission outcomes for the Department of Defense (Alberts & Hayes, 2003). By implementing recommendations within the framework, proposal teams will be better poised for success.

Participant-Observer Data Collection

Between January 2013 and May 2020, I was a participant-observer in over 100 proposal teams led by faculty in the ASU Ira A. Fulton Schools of Engineering. A requirement of my job was to work with proposal teams and enhance their success, leading to an increase in research funding for ASU. Although the team composition and research areas differed from proposal to proposal, the teams shared many input characteristics, and all teams shared an explicit common goal of submitting a complete, compliant, and compelling research proposal to a funder. One shared input characteristic is that each team was led by a PI who is a scientific expert in their field. All teams had at least two and as many as 15 participants and had at least one researcher from outside the PI's field of expertise (i.e., all teams were interdisciplinary). Because all PIs were engineering faculty at ASU, they were all subject to a similar institutional environment and structure. ASU's research enterprise is guided by the New American

University design aspirations and compels faculty to engage in knowledge creation that transforms society, is use-inspired, is socially-embedded, and fuses intellectual disciplines (Crow & Dabars, 2015). With respect to conducting research and creating knowledge, the university believes "more is better." As a surrogate for knowledge creation, the university tracks and reports research expenditures (i.e., funding) and makes university research funding goals widely known to faculty. Because multi-investigator, interdisciplinary awards can be orders of magnitude larger than single-investigator awards—up to $10M per year for multi-investigator vs ~$100K per year for single-investigator—increasing the fundability of interdisciplinary research teams is critical to achieving ASU's knowledge creation goals.

The duration of proposal preparation for most teams was four to six weeks from the time the PI assembled the team until the submittal date, though longer and shorter lead times also occurred. At one extreme, the team started working on their proposal more than a year before the funding announcement and continued to work for another six months between when the funding announcement was released and the proposal's due date. At the other extreme, the time between team formation and submittal was on the order of days. Approximately 40% of the proposals were submitted to the National Science Foundation, 25% to the US Department of Energy, 10% to US Department of Defense, and 15% to other federal agencies (National Institute of Standards and Technology, Environmental Protection Agency, National Institutes of Health, and Department of Homeland Security). The remaining 10% were submitted to local governments and private research organizations. The similarity in team composition and

desired outputs provides a foundation upon which to generalize proposal team behaviors observed between when the team formed and when the proposal was submitted.

The data collected from 2013 to 2017 was experiential and was not well-documented, other than in my project-based meeting notes, proposal documents, and email archives. While true that a job requirement was to work with these proposal teams and catalyze their success, I also get personally invested in the teams I support and want to see their proposed research come to fruition. This work was motivated by a desire to be better at my job, which was to help proposal teams submit compelling proposals and receive funding for their proposed research. As I searched for ways to increase team success, coursework in qualitative research methods enabled me to increase my rigor in documenting the participant-observation in 2017 and beyond. The information gathered from participant-observation provided the foundation for this work.

Pilot Case Study

As part of a case study research methods course in spring 2017, I conducted a pilot study on proposal team success. The purpose of the pilot study was to explore early research questions, develop interview protocols, practice conducting interviews, gain experience with qualitative data collection and analysis, and refine the research questions and methods for the formal study. The pilot was an exploratory, single-case, holistic case study (Yin, 2014), designed to identify themes related to the success of proposal team and to identify questions to use in a future study.

Units of analysis

The pilot case study had three potential units of analysis: proposal team, proposal process, and proposal document. Proposal outcome was not considered

because the interviews and study were completed prior to learning the funding disposition. Because substantial literature exists on proposal document competitiveness (G. L. Anderson & Garg, 2001; Coley & Scheinberg, 2006; Gross et al., 1998; Higdon & Topp, 2004; Lemanski, 2014; Lusk, 2004; Pugh & Bacon, 2005), it was not considered further. PIs typically know their technical areas well, but they can become frustrated by the proposal processes (G. L. Anderson & Garg, 2001). As such, the proposal process was included in the case study, even though there is a growing body of literature on processes necessary for proposal development, including dividing proposal authorship (Galdas, 2016), hiring management staff (Kang et al., 2005), and conducting meetings (Lehmann-Willenbrock & Kauffeld, 2012). The case study's primary unit of analysis was the proposal team, including elements of team formation, motivation, collaboration, and communication.

Pilot interviews

The primary data collection method for the pilot study was interviews with five members of a single proposal team, including the PI, other investigators, and a graduate student involved in the proposal. The interviews were conducted approximately six weeks after the proposal was submitted to the funding agency, which was prior to the team learning the funding outcome. Four of the six proposal team members were available for interviews, and one recorded verbal responses to written questions. The last team member was unavailable for interview due to scheduling conflicts. The guide for conducting the semi-structured interviews contained several sub-questions organized around the following topic headings:

- Background information

- Motivations for forming and/or joining proposal teams (in general and specific to this proposal)
- Reflections on success of this particular proposal team
- Defining success for proposal teams (in general and specific to this proposal team)
- Reflections on project vision and technical contributions to this particular proposal
- Reflections on proposal preparation and communications methods

The interviews lasted 30 to 40 minutes and were recorded. Interviews were transcribed using a third-party transcription service, and I performed a quality check by comparing the completed transcripts to the original audio files. The cleaned transcripts for the pilot case study were uploaded into MAXQDA (version 12, VERBI Software GmbH) for qualitative data analysis.

Refining the study and methods

I found that the pilot case study participants had a difficult time separating their experiences on the particular proposal team from prior proposal experiences. As such, a key outcome of the pilot was to shift from having the proposal *team* be the analysis unit to having individual investigators be the analysis unit. While the full study still inquires about participants' experience on proposal teams, it did not require having multiple people from the same team to complete the interview.

Another change between the pilot study and the full study was to reduce the number of questions and to make the questions more general, thus allowing the research participants more freedom to take the responses in a direction meaningful to them. The pilot study had approximately 30 questions, which was reduced to 12 (with a few multi-part questions) for the full study. The full study also incorporated two rank-

order questions that required the participants to prioritize motivations and obstacles. I pre-populated the items on the rank-order lists using my personal experience as a participant-observer and the responses from participants in the pilot case study, though participants were encouraged to add items to the list if desired.

The last change I made between the pilot study and the full study was to refine my target population. When preparing the pilot study, I planned to only interview teams led by PIs in the Fulton Schools of Engineering. However, the pilot study demonstrated that disciplinary differences were important, and thus the target population pool in the full study was not limited to engineering faculty. An additional benefit of the expanded pool is that my staff role was unknown to many of the participants. Although human subjects protection and confidentiality prohibited me from crossing the staff / interviewer boundary, the relative anonymity afforded by participants not having prior interactions with me as professional staff at ASU allowed them to speak more freely during the interviews.

Interview Data Collection

Research participant population

The target population for this research study was investigators who had led large (≥$1M), multi-investigator, multidisciplinary proposals submitted within the prior six months. By limiting to a six-month period, the majority of data was collected before the funding decision was known, thus reducing biases that may be introduced by knowing whether or not a proposal was funded. Another reason to collect data before a funding decision is known is because it can take more than six months for the proposal evaluation cycle, and memory recall of the proposal effort may be harder after that time

has passed. Although the interviewees were targeted and selected based on having recently submitted large proposals, the interview questions allowed participants to discuss proposals from their entire career, not only the recent proposals.

In February 2019, proposal submittal data in ASU's *Monthly Research & Sponsored Projects Pivot Table* was used to identify potential research participants. There were 173 PIs in the database that had submitted proposals within the prior six months valued at ≥$1M and had at least two investigators participating in the team. Of those, 123 had at least two departments engaged (i.e., the proposals were multidisciplinary). In March 2019, I sent a recruiting email to 45 people in the target population. The subset was selected because they led larger proposal teams (i.e., four or more investigators and two or more departments involved). I excluded investigators with whom I had a close working relationship (e.g., had worked on multiple proposals or had worked as their project manager on a funded award). Between April and August 2019, I conducted six interviews with research participants having the characteristics summarized in Table 1.

Table 1. Research Participant Characteristics. The participants spanned multiple technical backgrounds and levels of experience.

Characteristic	**Participant Responses**
Gender	4 female 2 male
Technical background	2 engineering 2 education 2 social science
University role/rank/title	1 Assistant Professor 1 Associate Professor 2 Full Professor 1 Professor of Practice 1 Staff (Executive Director of Center)
Role in proposals	All had served as PI of multi-PI proposal All had also served as a co-PI
Proposal experience	All lead 1 to 5 multi-PI proposals per year All participate in additional 2 to 5 per year Time at ASU ranged from 2 to 14 years

Interview protocol

Research data was collected between April and August 2019 in semi-structured interviews, each lasting approximately 60 minutes. The interview guide (see Appendix A) included an introduction to the research, background information needed as control variables, and twelve questions specific to the participants' prior experience in collaborative research proposal teams. All research participants were provided with a consent form (see Appendix A) and were required to sign the form prior to the interview.

The survey questions were based on my prior professional experience working with proposal teams in the Ira A. Fulton Schools of Engineering at ASU and outcomes from the pilot case study. Possible biases included my professional role as a project manager on proposal teams and a preconceived notion that proposal teams suffer when

teams are not provided with university services such as proposal management staff, graphics and editing support, and red team reviews. To combat this, the interview introduction and questions were structured such that research participants were not evaluating my contributions to the proposal team and instead focused on their proposal experiences. Another method to overcome biases was to include investigators from outside the Ira A. Fulton Schools of Engineering that were unfamiliar with my staff role.

Data analysis

Transcriptions. Interviews were audio recorded, transcribed by a third-party transcription service, and quality-checked by me. The quality check included listening to the recording while reading the transcript and making any necessary modifications. During the quality check, I also removed all identifying characteristics from the transcripts. The transcriptions were loaded into analyzed and organized using NVivo software (version 12, QSR International) for qualitative analysis. Retaining native recording files and transcriptions increases external validity by allowing access for future researchers to replicate the analysis using the identical dataset.

Data coding and analysis. The study used grounded theory (Glaser & Strauss, 1967) and pattern matching (Yin, 2014) while analyzing the interview transcripts to identify commonalities between the participants and to group the commonalities into concepts that are the basis for developing or adapting frameworks. After loading the transcripts into NVivo and conducing the transcription quality review, the I re-read all transcripts. Then I used an open coding method to group the data (Saldana, 2009) into major categories for the top-level questions (e.g., control variables, proposal

motivations, obstacles, success, and mitigation methods). Then I did a second pass within each main question set to identify themes using pattern coding (Saldana, 2009).

Human subjects protection. Although it may have been feasible to consider this study an evaluation to improve university processes that would not require Institutional Review Board (IRB) approval, it is considered a research activity as defined by federal regulation 45 CFR 46.102 (DHHS, 2009) because I wish to generalize and publish results. As such, IRB approval to protect the human subjects was required. The study qualified for expedited review under Category 7, which covers research on individual and group characteristics that employs interview techniques (63 FR 60364-60367 DHHS, 1998). The protocol was reviewed by the ASU IRB and was deemed exempt on 2/7/2019 (STUDY00009620). The IRB application and exemption notificaiton are provided in Appendix A.

To ensure confidentiality, all potentially identifying characteristics (e.g., names, departments, proposal topics, funding agencies, and submittal dates) have been removed from this dissertation and will not be included in any subsequent summaries or publications.

Data security and confidentiality. Interview recordings and transcripts were stored in ASU's Dropbox for Education, which provides a controlled-access (i.e., password-protected), secure online storage solution for ASU faculty and staff. Dropbox was selected as the storage location in accordance with recommendations provided by the ASU University Technology Office Data Handling Matrix. The research followed ASU's Information Technology policies and security protocols for Sensitive Information, which is confidential and protected. Data will be stored for at least 3 years after the conclusion

of the study (i.e., through Summer 2022). Consent forms were kept in a separate location also on Dropbox. Interview participants were assigned a unique identifier number, and the de-identified transcripts were linked to the ID number. A temporary master list linking participant names to the unique identifiers was maintained so that I could contact participants for follow-up questions or clarifications. The temporary master list was kept in a Dropbox folder separate from the interview responses, and the file will be deleted/destroyed as soon as reasonably possible after the conclusion of the study.

CHAPTER 3

RESEARCH COLLABORATION MOTIVATIONS

Literature Findings

Collaboration structures

Several researchers in organizational management have explored institutional structures and worker motivations. For example, prior to the rise of knowledge workers in the post-industrial world, the prevailing thought on worker productivity was *Theory X:* laborers dislike the work they do and thus need constant, top-down, authoritative, controlling management and explicit reward structures in place to maintain output (McGregor, 1960). As work shifted from labor-based to knowledge-based, it required new workplace organizational structures, giving rise to *Theory Y:* workers view their work as fulfilling, are self-motivated, seek and accept responsibility, solve problems creatively, and need little direction (McGregor, 1960). As demonstrated by the knowledge spiral (Nonaka, 1991), knowledge creation always starts with an individual, and because autonomy leads to unexpected acts, individuals will be more committed to an organization and motivated in their pursuit of knowledge creation if they have autonomy (Nonaka & Lewin, 1994).

Within the knowledge-based economy, workers can be further divided into those motivated by fundamental, discipline-driven research (Mode I) and workers motivated by applications-based problem solving (Mode II) (Gibbons et al., 1994). Mode II is where multidisciplinary teams form to work on specific, real-world problems within social and economic contexts. In Mode II, the team composition may change over time in response to the problem requirements. Although having a permeable team may create

challenges if not carefully managed (National Research Council, 2015) as discussed in Chapter 4, the communications and organizations persist in pursuit of the larger goal, further enhancing the network (Bennett et al., 2018). Researchers—particularly academic researchers—tend to align with Theory Y, and the complex problems of today's world lend themselves to Mode II collaborations.

Another form of collaboration often typified in research teams is the network. Podolny & Page (1998) define a network as "any collections of actors...that pursue repeated, enduring exchange relations with one another and, at the same time, lack a legitimate organizational authority to arbitrate and resolve disputes that may arise during the exchange." Networks are *Theory Y* organizations, marked by their lack of hierarchy and conformity, and may include structures such as joint ventures, alliances, franchises, research consortia, relational contracts, and outsourcing agreements. Network organizations provide several functions that benefit research and Mode II collaborations (Podolny & Page, 1998):

- Foster learning. By rapidly transferring information and synthesizing information, networks accomplish things together that can't be done independently.
- Provide status/legitimacy. If one partner has status, others can get status by affiliation.
- Reduce transaction costs, thus reducing economic burdens.
- Provide social welfare benefits such as autonomy for members, greater sense of community, and more equal distribution of wealth.

The most common type of collaboration is an undifferentiated collaboration where investigators work on separate parts of the same problem and bring together

multiple insights toward a common purpose (Bennett & Gadlin, 2012; Borden, 1992). This is similar to having a potluck dinner with the only instruction is to bring a favorite dish. While everyone contributes, the final product might be out of balance (e.g., too many desserts and not enough main dishes) and might not please the palette (e.g., many non-complementary spices). In higher levels of collaboration, namely an integrated or differentiated collaboration, team members have more interactions and regularly discuss team goals, individual objectives, data sharing, and next steps toward their common goals and shared rewards (Bennett & Gadlin, 2012). In the potluck dinner analogy, an integrated collaboration would be where guests coordinate who is bringing each course and also coordinate a theme (e.g., Mexican cuisine). Solving inter- and trans-disciplinary complex problems requires the additional coordination afforded by differentiated collaborations. Funding agencies use phrases like "explain how the total is more than the sum of the parts" or "justify why a center is needed rather than a series of individual projects" to illustrate this requirement.

There are also formal and informal collaborations. Formal collaborations are governed by explicit rules, and informal collaborations are governed by unwritten rules, convention, and social norms (Landry & Amara, 1998). Transaction costs associated with formal collaborations include coordinating, monitoring, and enforcing contracts, making joint decisions, preparing work plans, designing research methodology, preparing publications, and deciding how to use financial resources, human resources, equipment, and data. Researchers are more likely to develop routines for transactions that recur frequently. Researchers can be reluctant to spend the time necessary to overcome the transaction costs and thus tend to choose informal collaborations. However, developing

structures and systems to alleviate the transaction costs is worth it because more follow-on funding tends to result from the formal structures than from the informal structures (Landry & Amara, 1998).

Collaboration motivations

Disciplinary specialization increases the need to collaborate with researchers having complementary skills when problems can't be solved alone (Birnholtz, 2007; Iglič et al., 2017). Researchers in academic settings are more likely to collaborate than researchers in industry, and those collaborations are more likely to be with people outside their discipline than within (Qin et al., 1997). An investigator's willingness to collaborate is in part driven by their prior experience with collaboration (Borden, 1992), and while it didn't affect an investigator's willingness to collaborate, investigators consider factors such as scientific competition and authorship when selecting specific collaborators (Birnholtz, 2007). Good collaborations—which are characterized by an appreciation of how collaboration will improve the final product, voluntary participation in the collaboration, and compatible approach and temperament—lead to enjoyment of the investigators (Borden, 1992).

Having more collaborators also leads to higher faculty job satisfaction (Bozeman & Gaughan, 2011). This is particularly true for faculty-industry collaborations because faculty can more directly see their research contributions to technological applications with social and economic benefits, and the collaborations may also lead to more student job placements.

In a survey of 24 first-authors on multi-author, multi-discipline papers, all respondents said the research topic was critically important when selecting

collaborators, and many (19 of 24) reported that personal acquaintance and financial resources to conduct research were important (Qin et al., 1997). Additional reasons investigators collaborate include filling skill set gaps, having a desire to achieve common goals that would not be feasible without the complementary skills, providing additional funding streams for their work, increasing access to facilities, improving teaching and training, providing additional employment opportunities for students increasing access to information and data, and building their networks (Bennett & Gadlin, 2012; Landry & Amara, 1998; Lin & Bozeman, 2006). Despite early-career researchers being more likely to collaborate than those at more advanced career stages, career advancement is not a significant motivator for collaboration (Iglič et al., 2017).

Proposal motivations

There are many reasons an investigator chooses to write proposals and how they decide to join particular research proposal teams. Differences in motivations can limit the effectiveness of collaborations, but it is also possible to align differing motives toward a common mission such that achieving the collective goal also results in achieving individual goals. Knowledge workers require self-driven motivation, often more than external factors, to engage in their work (Hinrichs et al., 2017).

In the context of academic research proposal teams, some faculty become PIs due to personal ambition, and others become PIs because they feel pushed by administrative pressures (Cunningham et al., 2016). Administrative pressure is also the largest factor contributing to faculty increasing the amount of time spent writing research proposals. However, this pressure can lead to faculty pursuing grants that are misaligned to their research interests and may decrease their job satisfaction (D. M.

Anderson & Slade, 2016). A danger of decreased job satisfaction is that faculty may no longer be interested in teaching or conducting research, thereby compromising student education and new knowledge creation. As such, it is important to make the proposal experience—from team creation, to idea generation, to document creation, to final submittal—more rewarding so faculty enjoy greater job satisfaction, submit more proposals for funding consideration, and create more knowledge.

Intrinsic motivations such as the desire to learn new things and to mentor junior researchers (faculty, post-doctoral researchers, or students) and a sense of obligation such as to get tenure and to obtain funding for students are also factors in faculty deciding to participate in proposal teams. Additional reasons may include access to funding, access to expertise, additional equipment and facilities, and an increase in number of publications (Bozeman & Corley, 2004; Landry & Amara, 1998). Investigators who participate voluntarily in collaborations and who feel there is a good research design are more likely to have good collaborations, thus increasing their enjoyment of the collaborative process (Borden, 1992).

Researchers seek many different characteristics when selecting their collaborators (Bozeman & Corley, 2004). *Task masters* will select collaborators by their ability to adhere to schedules. *Followers* have strong technical skills and select collaborators who provide clear leadership. A *buddy* will select collaborators based on how long they've known each other, the quality of prior collaborations, and whether they have fun together. The *tactician* will select collaborators with complementary skills. The *mentor* is motivated by helping junior colleagues and graduate students and will select collaborators more junior to them. Other desirable teammate characteristics

include disciplinary expertise, funding records, prior publications, and geographic proximity (Landry & Amara, 1998). The same study found the number of years in collaborative research and the increase in transactional costs did not factor into researchers' motivations to collaborate.

Research Gap

The need to align motivations can be taken for granted in some organizations (e.g., military or industrial settings) where projects are handed down from upper levels of the organization because the mission is pre-defined (e.g., national security, reaching profitability targets, and performing job requirements). However, it is critical to consider and align the differences in university teams where teammates operate more like a collection of independent contractors than employees managed in a common organization. Because one of the proposal success criteria (discussed in Chapter 5) is to assess whether individual investigators' needs were met, it is important to first understand why investigators write proposals and what makes them decide whether a team is necessary. In addition, it is unknown whether these motivations are consistent regardless of whether an investigator is leading a team or joining a team led by others.

Research Approach

Initial data were collected as a participant-observer in more than 100 proposal teams over a seven-year period. The early findings and experiences informed the development of two questions used in semi-structured interviews that asked participants to think about their reasons for preparing research proposals and the criteria they use when leading and joining teams:

- What factors/criteria do you consider when deciding to write a proposal?
    - By yourself
    - When deciding to lead a proposal team
    - When deciding to join a team led by others
- With respect to your experiences, please rank the following factors affecting your decisions to write proposals in order of most to least important. You may add others if desired.
    - Opportunity to fund/work with grad students
    - Opportunity to work with faculty outside your discipline
    - Provide funding for yourself/your own salary
    - Demonstrate funding record for career advancement
    - Find the research topic interesting
    - To increase reputation for collaborative work
    - To train others in proposal writing
    - Relevance to societal good [added by participant]
    - Extent to which research promotes my unit/lab/org [added by participant]
    - Building social capital [added by participant]
    - Likelihood of award [added by participant]

Research Findings

The combination of participant-observation and semi-structured interviews yielded several proposal motivations. While some were expected and similar to the items described above (e.g., technical match, exploration of new ideas, providing opportunities for others, and sustained funding), some were more surprising (e.g., impact beyond

oneself and likelihood of award). I was also surprised to learn that participating in proposals was viewed as a detriment to career advancement by some participants. The criteria for selecting teammates was similar between when leading a team and when joining a team. However, investigators were willing to take more risks and join teams they perceived had a lower chance of award and were willing to take fewer risks when leading a team.

Proposal motivations

As noted above, understanding investigators' motivations to participate in proposals is necessary when determining whether or not their needs have been met as a success metric. While some common themes emerged for participating in proposals, there were many diverse reasons cited by participants (detailed below).

Technical match. When asked about the factors they consider when deciding to write a proposal either by themselves or with others, the most common reason and the only answer that was in all participants' top three reasons in the rank-ordering question was that the investigator found the technical topic to be interesting and to be a good match for research they wanted to do. When describing this alignment to elements of the program solicitation, two participants had a more excited tone in their voice, exclaiming "that's my niche!" and "this is exactly for me!" Others were more subdued in their responses, using the word "interesting" to describe the program solicitation and the work. One went on to say that he would not chase solicitations that are "only vaguely related" to what he was interested in doing.

In addition to their own technical expertise and interest, participants also acknowledged that there needed to be a technical match for their potential teammates.

For example, one participant said he asks these questions of himself when deciding whether to propose: "Does it fit generally with the kinds of research that we do and the kinds of problems that we're trying to work on? Does it give us an opportunity to look at questions that fit within the general space of things that we're interested in?" Another noted that she evaluated whether it fit with the work she was already doing in collaboration with others.

Explore new ideas. Another theme that emerged when interviewing participants regarding their motivation to work on proposals was whether the project would allow them to explore ideas outside of their current discipline. When articulating this, one participant talked about only wanting to pursue proposals that allowed her to work on problems that are multifunctional and require people with diverse expertise. If it was a topic that a single PI could pursue, she was not interested. In this case, while recognizing that funding could be constrained when having to distribute the resources across many contributors, doing multidisciplinary work was still important to her even if the available funding was small. Another participant liked how proposals forced him to think creatively about how to solve the specific problem of an agency rather than following his own personal curiosities. He also enjoyed that proposals compelled him to initiate new relationships when filling technical holes. A third participant articulated his driver for proposal work by saying he loves thinking about big and new ideas and how to put teams together to tackle those ideas. He could not remember the last time he applied to a single-discipline program. A specific example of this was a team he put together in response to a NSF solicitation that required combining an engineer, social scientist, and computer scientist on the team.

Students and junior faculty opportunities. The desire to guide junior faculty and provide opportunities for students was cited as a motivator by many of the research participants. One participant attributed her desire to nurture and support others as a mothering perspective. She stated that she wanted junior faculty to learn from her prior mistakes, and she wanted to help them launch their careers after a project is funded by helping them conduct the work and publish their results. Other participants stated a desire to help others develop proposal writing skills and a desire to invite junior faculty to join the team to help them "get a line on their vita." Participants also expressed interest in helping students advance in their academic careers. One participant discussed how she designs proposals and tailors research activities to specific students. Another said he worked on proposals that would be a good fit for current students' interests (for shorter-term projects) or where he could recruit students specifically to work on the funded project if the award is longer-term.

A few participants nearing the end of their careers talked about wanting to see their work continue and benefit others, even after they retired. One noted that without significant external financial resources as a student, she would not have been able to have a professional career. As such, she felt obligated to pursue additional funding that could provide career options to the next generation in her field.

Sustained funding. Nearly all participants mentioned funding as motivator for writing proposals. One participant noted he felt pressured to "just submit and get more funding." In a follow-up question, he elaborated the pressure was administrative (from the Department Head and Dean level) and also that he felt the need to stay on pace with departmental peers. In general, the desire to fund students was stronger than the

desire to fund oneself, though one participant explicitly prioritized receiving summer salary for himself. Another participant initially mentioned funding for herself, but she clarified that having travel funding for conferences was more critical than salary support.

Although mentioned often in the free-form responses to the semi-structured interview questions, when asked to rank-order, the two prompts regarding funding (*funding for self* and *funding for students*) ranked toward the bottom. Two participants differed, one ranking both funding prompts within their top three motivators (behind finding the research topic interesting) and the other raking funding for students second but funding for themself at the very bottom. This is interesting because having the concept appear in free-response answers implies it was on the mind of respondents, but when asked to think about its relation to all other motivators, it was toward the bottom. This may be because the participant had not consciously considered some of the other motivators in the rank-order list until they saw the prompts, but it could also mean that they don't like verbalizing the importance of financial gain as a motivator for proposals.

Impact beyond oneself. Some of the high-risk, high-reward funding agencies such as the Advanced Research Projects Agency – Energy (ARPA-E) and DARPA) use the phrase "if it works, does it matter?" to emphasize that it is not sufficient to have an excellent technical solution, it must also provide real-world impact. Half of the participants described some variation of this when discussing their proposal motivations. For example, one participant stated it was insufficient for the research to be interesting and insisted it must also be impactful. Other participants said the work must fulfill a moral purpose and that the research needed to support societal good. This prompt was added to the rank-order by a participant nearly half-way through the interviews. Any

participant offered this prompt ranked *potential for societal good* within their top three motivators for writing proposals.

Several of the participants also had a strong group identity at the department, college, or university-initiative level and stressed that any proposals had to fit within the group's goals or advance the group's reputation. One participant noted, "we write to the agency's call, but we also have our own goals. Proposed research has to fit the [initiative's] mission and vision, not just bring us money." With respect to reputation, one participant stated she wanted to build social capital to demonstrate the capacity of the group to engage in collaborative work. Another was more explicit in stating, "if it's just research that's just going to support me, I'm not that interested. If this is research that's going to move the college forward, then it's much more likely to capture my interest." In the rank-ordering, participants ranked *to build social capital* toward the middle of the ranked items.

Likelihood of award. Another consideration mentioned by the research participants was the likelihood of being awarded the funding. This was presented both with a positive framing (e.g., being more willing to submit if the perceived chance of funding is higher) and also as avoiding a negative result (e.g., wanting to prevent not being funded). One participant also connected the potential for award to the topic area by saying, "If I'm interested in the topic, it's easier for me to evaluate if I'm going to succeed or not." However, this internal assessment may give an investigator false confidence. Given the low funding rates for federal grants and the lack of reproducibility in the peer review process (Pier et al., 2018), even reviewers or program officers are not able to predict the likelihood of a proposal being funded.

Career advancement and individual reputation. After being embedded in the dean's office of the Ira A. Fulton Schools of Engineering for many years, where external grant funding—along with teaching evaluations—is one of the most-discussed metrics related to faculty productivity and performance, I expected promotion and tenure to be large drivers for proposal engagement. For participants with tenure homes in engineering and natural sciences, it was. For example, one participant stated he needed to write proposals to get tenure and that he needed to keep up with his peers. However, I was surprised to hear from other participants that participating in proposals and pursuing external funding could be viewed as a negative with respect to career advancement and could even tarnish their reputation. In fields such as education and social sciences, external funding was viewed as a distraction. These participants were motivated more by their legacy and by helping others. While I initially attributed this to career stage (those in engineering and natural sciences were in earlier career stages than other fields), stories of how proposals were viewed in their prior performance evaluations and promotion discussions attributed this characteristic to field rather than career stage.

Proposal dissuasions

Three themes emerged when assessing reasons why investigators would decide not to participate in a proposal. The first was that the project was unlikely to achieve the stated goals, which could either be because the technical goals were too ambitious for the performance period or that there was insufficient budget for the personnel and other resources necessary to complete the work. The second reason not to pursue a proposal was that it only benefitted the single investigator. One participant specified she was not

interested in working on proposals that didn't benefit society, and another said she would not work on a proposal that only funded herself. Instead, the proposal needed to result in a project that would advance the college's goals. The last theme was that working on a proposal was viewed as a detriment to one's career. While one participant was pleased with the direction her career took and the type of work she does, she felt that pursuing external funding—particularly early in her career—extended the time it took to get tenure because her department head viewed grant proposals as distractions and would have preferred that she write books. She cautioned assistant professors not to work on grant proposals until they were already far along the tenure path. Another participant said that external funding was a negligible criterion when he was being evaluated for promotion and tenure earlier in his career. If it was considered at all, it had to be a single investigator grant in a single-discipline program to demonstrate excellence in the specific field that would lead to a high impact publication. In this particular case, the proposal or amount of funding was less important than the resulting publication.

Benefits of proposal teams

As described by research participants, there were three primary reasons they engaged in teams for proposal work: to fulfill a sponsor requirement, to fill an expertise gap, and to distribute the workload when writing proposals. Echoing what was described in Chapter 1, participants noted that some funding agencies and specific program announcements explicitly require collaborative grants, and some are even requiring there to be training for the next generation of researchers on how to conduct collaborative research. In one instance, a participant described that they augmented

their team with additional engineering expertise when resubmitting a concept because a reviewer on the first submittal didn't believe the team—as-configured—understood the engineering challenges nor did they have the expertise to overcome the challenges. This is an example of both sponsor requirements and also filling an expertise gap. Another example of designing a team to fill expertise gaps was described by a participant who was working on an proposal for international education programs. They invited a staff person from a research institute who had worked on several projects in the country where the work would be performed because of his on-the-ground knowledge and his connections to high level individuals in the Ministry of Education. Lastly, participants discussed the desire to have additional contributors to the proposal writing and having the necessary support to produce a high-quality submittal. One participant said she has learned over time not to try to do it alone because proposals are hard work. Another talked about when their research unit has multiple ideas for the same solicitation that they will divide and conquer, with different people serving as PI on each submittal but all team members contributing to all of the proposals. She said, "you don't want to be the main PI on more than one, so we distribute." One participant likened the need to bring together teams for proposals to an operatic production: "You had the singers. But behind the cast, there was the makeup, there was the hair, there was the dress. And then there were the stagehands. And everything had to be synchronized. And of course, there was the music. What a production! It's a much smaller scale in a grant, but it's a many-hands type thing."

Drawbacks of proposal teams

Although distributing workload was cited as a benefit of having a team, the transaction costs associated with having multiple contributors was also viewed as a drawback. To combat this, one participant limits the writing team to herself plus only three others, even if the project performance team was larger. Another drawback participants mentioned was when researchers had misaligned motives or conflicting rewards structures that resulted in working across purposes. However, it was also recognized that having different motivations was ok provided that team members were respectful of each other and the differing motives. Other obstacles facing the teams and methods of overcoming these obstacles are presented in Chapters 4 and 6, respectively.

Teammate selection

Whether investigators are building their teams or deciding whether to join a team led by others, the primary consideration, which was mentioned by nearly all participants, was to fill technical gaps. When leading teams, this was evidenced by statement such as "I've got to have a team member for their expertise," "Who do you need in your wheelhouse?," and "I find people to help cover my areas of weakness." When deciding whether to join a team, participants expressed an interest in wanting to be sure they could contribute in a meaningful, technical capacity. The other consideration mentioned by nearly all participants was whether the participant believed they would click, get along, or work well as a team. One participant highlighted their preference to work with people they've worked with previously or people whose work they know very well. An unintended consequence of this approach is that it will take a very long time for professional networks to expand if investigators emphasize working

with prior collaborators over making new connections. Other qualities participants considered whether joining or leading teams included the teammate's reputation with the funding agency and whether or not the participant felt the teammates respected each other.

A difference when leading a team vs. when joining a team was that participants were more concerned about a teammate's responsiveness and their ability to deliver when leading. There was a worry, particularly when a prospective teammate was in a soft-funded position, that a teammate may over-commit and not be able to devote sufficient time to the proposal and to project execution after award. Another concern when leading a team was to be careful when inviting non-tenured faculty to participate because the participant wanted to be sure it was a positive experience for the junior faculty member and wouldn't hinder their career advancement.

A difference when joining a team vs. leading a team was that participants had a higher tolerance for risk when they were not the lead investigator. Participants expressed relief at not being in charge and only needing to make specific technical contributions rather than worry about how the full concept and team come together. One participant said, "my inclination when I'm asked to join a team is to say yes," indicating a willingness to participate, even if it's not quite the right technical opportunity. She had slight trepidation if being asked to join very late because she was worried that there wasn't sufficient time to make meaningful contributions, but she tended to agree anyway. Another participant talked about how he was frequently invited to plug holes in concepts where only the lead investigator had a clear overarching vision for the proposal. A third participant stated he did not need to have a deep

understanding of how the parts fit together when joining a team, stating "I'm more willing to risk when I'm not the main PI."

Participants also talked about dealbreakers that would prohibit them from inviting someone to join their team or would prevent them from joining a team. One dealbreaker was if a prospective teammate had a reputation of wanting to be their own king or queen of the hill rather than working with others on an equal level. Another dealbreaker was when a person wasn't interested in doing the work, only in having the grant on their vita. The last dealbreaker mentioned was that a prospective teammate had to be respectful of all other teammates. An example of respect was that a teammate would come to all group meetings, and even if the topic was not their area of expertise, they would still listen and contribute by asking questions to help determine how their work would complement each other.

Summary

It is critical to understand and document investigators' reasons to engage in proposal work and participate in collaborative teams. Without this information, assessing whether or not a proposal met the investigators' needs, which is one element of success (see Chapter 5), would be impossible.

Interviews confirmed what I had observed over several years of participant-observation: that investigators are most interested in writing proposals because they see a technical match between their work and the sponsor's needs. They also want to provide opportunities and funding for their students. Working with a team is viewed as necessary to meet sponsor expectations and to address ambitious research questions demanded by complex problems. The selection of teammates is mostly driven by a

technical or cognitive fit for the project work, and the affective—how a person feels about the prospective teammates and whether they'd make a good team—was also important to the participants.

I was surprised to learn that funding for oneself was only a minor concern and that only one of the participants was motivated by the positive effect he thought it would have on his career advancement. Also surprising was the prevalence of societal benefit as a motivator for proposal activities and the willingness of investigators to join a team (but not lead), even if they don't believe the proposal is likely to be funded.

CHAPTER 4

COLLABORATION OBSTACLES

Team Dimensions that Create Challenges

A 2015 report on *Enhancing the Effectiveness of Team Science* identifies seven dimensions that create challenges for teams (National Research Council, 2015):

- Large size, while beneficial to distribute work, increases the burden of communication and coordination
- Team member diversity (including disciplines, professions, age, gender, culture, religion, and ethnicity) leads to a lack of common vocabulary, making it harder to communicate
- Team composition changes over time, making it challenging to integrate new team members and to replace historical knowledge
- Solving problems that require deep knowledge integration (e.g., data, tools, theories, and perspectives) increases the time and effort for researchers
- Task interdependence may lead to conflict when team members must rely on others to complete their own work
- Geographic dispersion makes it harder to get together, harder to coordinate electronic tools, time zones, and cultural expectations, and harder to arrive at common understanding of the goals
- Misaligned goals may lead to conflict between team members

The 2015 report provides a useful framework for examining obstacles facing teams, but it does not differentiate between teams in different developmental stages.

The forming-storming-norming-performing model of team development (Tuckman, 1965; Tuckman & Jensen, 1977) states that teams must move through each of these phases to become high-functioning and deliver results. Because proposal teams fall mostly into the first two stages as shown in Figure 1 and because there are differences in team dynamics as they mature through the development stages, the obstacles facing proposal teams will differ from those facing project execution teams.

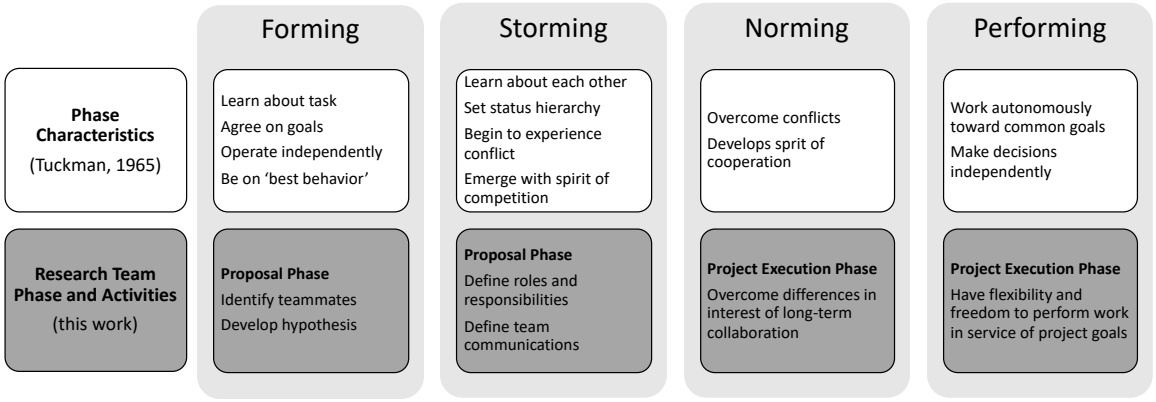

Figure 1. Team Development Phases. Research teams mature through Tuckman's team development phases.

The most critical differences between research teams in the proposal phase and in the project execution stage involve task definition and interpersonal knowledge. For example, proposal teams are still developing research hypotheses and task plans whereas project teams are executing on more-defined and agreed-to plans, and proposal teams likely have at least one if not more team members that are new to the collaboration whereas execution teams have already been together for the proposal phase, so they know more about each other and can trust each other to work toward the same outcomes. Prior studies support the notion that characteristics of effective science teams change throughout different project execution phases such as planning,

information collection and analysis, and dissemination (Borden, 1992), so differences between proposal and project execution phases are expected.

The four team dimensions identified by the National Research Council that apply the most for proposal teams are size, member diversity, knowledge integration, and task interdependence. Goal alignment, which is discussed in depth in Chapter 3, is also important. The other two are less evident in proposal teams. Because proposal teams often form fast and must execute quickly, most proposal teams operate with time horizons on the order of weeks. As such, temporal changes in team composition are less likely. Team members are usually recruited by word of mouth or researchers' prior experiences and connections rather than deliberate analysis of technical requirements or workstyles. The resulting teams tend to be ad hoc organizations guided by a sponsor's funding announcement and the team leader (i.e., the PI). Lastly, geographic dispersion is much easier to overcome in today's hyper-connected world, especially now that virtual meetings have become the norm during the global response to the ongoing health pandemic.

Team size and member diversity

As discussed in Chapter 1, the dominant metaphor for organizing knowledge in the industrial age has been shifting from the *knowledge tree* to the *knowledge web*, resulting in a corresponding change from single-investigator to multi-investigator proposals and research activities. As team size increases from single- to multi-investigator, the larger teams benefit by distributing and sharing the workload, but the burden of communication and coordination increases (National Research Council, 2015). Because the group productivity is equal to the sum of individual productivity minus

losses due to group processes (Steiner, 1972), the increase in transaction costs and coordination burdens can significantly reduce overall team productivity if not managed. Typical transaction costs for proposal teams that are not present for single-PI proposals include negotiating the research objectives, preparing contracts, making joint decisions, designing joint research methodologies, and apportioning resources (financial, human, equipment, and data) (Landry & Amara, 1998). To reduce the burden of the transaction costs, researchers may develop routines and standard procedures. Researchers are more likely to develop these routines for transactions that occur frequently (Landry & Amara, 1998), but they should take care not to turn the routines for saving transaction costs into a maze of bureaucratic busy work as that is likely to leave collaborators unfulfilled (Beck et al., 2017).

As teams expand to include collaborators across disciplines and with different professions, ages, genders, cultures, religions, and ethnicities, it is necessary to acknowledge that each brings its own vocabulary (Bauer, 1990; Cabra et al., 2018). Each discipline also brings different rules of research with respect to measurement-making, resource allocation, standards of evidence, methods of inquiry, standards of proof, definition of knowledge, determination of what is interesting and valuable, norms for accuracy and precision, and level of theory development (Bauer, 1990; Corley et al., 2006). For example, scientists want to lay out facts, whereas humanists find facts mundane and place more value on subtle expression (Bauer, 1990), and the research cycle for data collection, analysis, and publication is faster in fields such as computer science that often produce models and simulations than it is for social science fields that have tedious, labor-intensive data collection processes and slower journal review cycles

(Beck et al., 2017). Another challenge facing interdisciplinary, multi-investigator teams is that there is often not sufficient redundancy or overlap in expertise, which makes it harder to create common ground and spread knowledge (Nonaka, 1991). Disciplinary differences also exist in areas that initially seem unrelated to research (e.g., whether or not to use lecture notes and the number and level of courses required for degrees), but the implicit differences can impede communication and thus need to be recognized and overcome when forming interdisciplinary collaborations (Bauer, 1990).

Knowledge integration and task interdependence

As discussed in Chapter 1, the complex problems facing today's scientists require multiple perspectives. Based on their attentiveness and participation in initial proposal meetings, many faculty enjoy the earliest phase of proposals where they explore new scientific ideas and brainstorm integrative approaches to solving complex problems. The early meetings are often characterized by free-flowing thoughts and enthusiasm when building on each other's ideas. The mood during these meetings is captured by Bennett & Gadlin (2012), when they humorously say: "the only people more foolish than two people falling in love are scientists starting collaboration." Unfortunately, this excitement tends to wane as the deadline approaches and the team must make their ideas explicit in the formal proposal. Faculty tend to find the process and mechanics associated with the later stages of writing, revising, and submitting the proposal document package to be stressful, time-consuming, and frustrating (G. L. Anderson & Garg, 2001).

Because information differentials prohibit teammates from interacting on an equal basis (Nonaka, 1991), achieving deep knowledge integration requires distribution of information. The degree to which proposal team members freely distribute

information depends on many factors, including their field of study, the research sponsor, and the individual's work style. Although many scientists recognize the need for transparency and openness, the academic reward systems, which emphasize innovation over reproducibility, do not incentivize open practices (Nosek et al., 2015). In addition, some academic fields are inherently more insular than others, and some researchers are thus much more cautious than others when it comes to collaborating and sharing information.

The need for confidentiality may also be driven by the research sponsor, such as when an industry partner desires to keep their competitive edge. Publicly-funded research tends to eventually require disclosure, but the agency sponsoring the research or even the individual program may have different attitudes toward confidentiality. For example, the National Science Foundation tends to promote an open culture of sharing results and expects that the data management plan will include instructions for how research results are disseminated to the public. The data management plans for other funding agencies (e.g., Department of Energy and Department of Defense) often contain clauses about how data will be protected and how to mark sections of annual and final reports as confidential, thus indicating a culture of confidentiality. The personal workstyle of an individual researcher also factors into their willingness to share information freely. Some researchers do not want to release early drafts and prefer to wait until they have a polished and nearly-final product whereas others share interim products early and often. As such, establishing the expected frequency for sharing and distributing in-process drafts is important.

Research Gap

Understanding team dynamics and obstacles facing teams at the proposal stage is important because if left unaddressed, these obstacles may persist beyond the funding decision and undermine the possibility of team successes adjunctive to funding, such as meeting individual member needs or continuing collaboration beyond the initial proposal. While many studies have examined obstacles facing teams, there is limited data on the early-stage teams such as those engaged in proposal efforts. Because characteristics of effective science teams change throughout different project execution phases (Borden, 1992), differences between proposal and project execution phases are expected, making this a critical research gap.

Research Approach

Three questions in the semi-structured interview specifically asked participants to think about obstacles they faced when preparing and submitting research proposals:

- Think about a proposal you worked on where you did not enjoy the proposal writing and submission process.
    - What made you not enjoy it as much as the prior example?
    - What things ruin your proposal team experience?
- With respect to your experiences, please rank the following obstacles to interdisciplinary proposal collaboration. You may add others if desired.
    - Geographic dispersion
    - Misaligned motivations for participating in the proposal
    - Difficulty reaching other team members
    - Ambiguous writing assignments

- Inconsistent citation management
- Misaligned expectations when reviewing and commenting on drafts
- Confusing file management and version control
- Unclear decision-making processes
- Insufficient resources available for the scope
- Misaligned vision for the technical components of the proposal
- Deadline-driven (not enough time to complete the proposal)

Additional data were collected as a participant-observer in more than 100 proposal teams over a seven-year period.

Research Findings

The combination of participant-observation and semi-structured interviews confirmed the seven dimensions of teams that hinder collaboration (National Research Council, 2015) also manifest in proposal teams and identified specific processes in each area that hindering proposal team success. The rank-ordering process during the interviews identified the obstacles presenting the greatest challenges that should be resolved to increase team success.

Communication and coordination burdens

Through my participant-observation, I observed that teams tend to begin by prioritizing scientific discussions without explicitly defining how the team will interact and the processes it will use to accomplish its goals. Many team members assume "everyone knows" how to put together a proposal or that the new team will adopt the same methods as a prior team. Often, the PI often does not have a plan for leading and

organizing the team and instead learns by trial-and-error, making success unpredictable (Bammer, 2008). However, failing to make explicit how the team will interact and communicate results in confusion, misaligned efforts, and gaps in task assignments.

Communication protocols. Team members will often use a form of communication (e.g., e-mail, phone call, text) that is most convenient for the sender without considering how—or even if—the message will be received. More importantly, the ad hoc approach does not set expectations for the message urgency and expected turn-around time. One participant complained about team members going offline for a while at a crucial time without contacting their teammates, calling the practice "ridiculous." This was illustrated while preparing a recent proposal when a staff member in the university's office of sponsored research projects needed the PI to answer an urgent question on the day of submittal. To elicit a fast response, the sender used the red exclamation point in their email program to signal that it was a high priority request. The PI, however, had adopted a habit of only checking their e-mail account a few times per day in an effort to reduce interruptions and increase their productivity. Several hours went by without a response, causing the sender to feel they had been ignored. It also increased their stress level because they were unable to proceed without the PI's answer. Eventually, the staff member called the PI, who quickly answered the question. Had the team explicitly discussed the best way to reach each other, the frustration could have been avoided.

Another communications challenge relates to email chains and the use of reply all. Some people view reply all as an essential tool for staying connected to the team whereas others view it as communication clutter. Defining when to include everyone in

conversations vs. when to communicate in smaller groups or one-on-one alleviates the fear of missing out on important communications.

Team meetings. To facilitate team communication, new proposal teams will often set regularly-occurring meetings. One participant noted that a meeting can provide an efficient method of answering several questions quickly instead of the typical practice of sending, reading, and replying to many emails on the same topic. A meeting can also reduce confusion and improve context with non-verbal cues. A problem with using meetings to discuss all items is that there may not be adequate documentation of the outcomes, so participants may forget or misinterpret decisions that were made. Also, sometimes meetings are scheduled, regardless of whether there is anything meaningful to discuss, and not all parts of every meeting will be relevant to all team members. This can be challenging as some team members may disengage during group meetings, and this lack of engagement may be perceived as disrespect to the speakers.

Failure to establish the objectives, outcomes, and follow-up items for each meeting leads to stress when people feel their time is wasted. It can also frustrate teammates when a person misses a meeting or arrives late and requires attendees to repeat discussions. For example, during the several months leading up to a large, institute-level funding announcement, the proposal leadership established a weekly status update conference call for the seventeen team members. Initially, most people attended each week. However, attendance on these update calls dwindled to an average of five participants over a three-month period, likely indicating a lack of value for its participants and an absence of a clear meeting purpose.

Proposal production limitations

Challenges related to producing proposal documents in groups include unclear expectations when writing or reviewing text, managing files and version control, and organizing citations.

Generating and reviewing text. There are two typical approaches to generating written text for proposals. In one approach, the PI delegates in a divide-and-conquer approach. This works well for distributing the workload and having each teammate contribute. A drawback of this approach, as observed in several proposal teams, is potential to produce a disjointed proposal if there isn't sufficient time to integrate all the components. There is also the potential for teammates to feel undervalued if components they wrote are eliminated or reduced in the document. This can be alleviated by clarifying expectations when writing assignments are made. One participant, who felt she was better than most at preparing proposals in a team, starts by sending an email to the proposal co-PIs specifying the text elements she wants her co-PIs to complete and gives a due date. In one particular case, a co-PI pushed back, requesting a template with the proposal headers and section outlines in place so that he would know how the sections he was drafting would fit in with other proposal components. Writing in a team requires significant communications and often negotiations between the teammates. Something she has learned over time is that when making assignments, she also needs to provide an estimated length for the text teammates will be generating and needs to allow for flexibility to move the due date. In general, she tended to be ok with the schedule slipping provided that the a co-PI was responsive and communicated the new timeline in a proactive manner.

In the other approach to generating text, the PI talks with his or her teammates, writes most text themselves, and circulates drafts for feedback. In this approach, the lead author has much more control over the final document. Even so, it's recognized that although the writing was a solitary process, the team contributions to idea generation and concept development were critical. This was illustrated by one participant who first said "that one I did alone," and then corrected herself to say, "I didn't do it alone, really. I *wrote* it alone. Writing it alone is different from collaborating with them as to what their ideas are." Disadvantages of having the PI as lead author include the PI feeling overwhelmed and teammates feeling undervalued if they are not afforded sufficient time to review the proposal prior to submittal. This second approach is illustrated in the words of another participant, who said: "Either I'm in charge of the text, in which case you send me whatever you want, and I'll put it in the text where I want it in the form if I want it. Or you're in charge of the text, in which case I'll send you shit, and you figure out how to put it in there." Both of these approaches mean that one person is in charge of the text and writing rather than the more synchronous or collaborative approach described in the prior paragraph. There was one participant who saw little to no value in trying to write or even generate ideas in a group, calling group brainstorming "a waste of time." She tended to limit team size to no more than three people with very specific technical roles that could complete their work independently.

Irrespective of the approach used to generate text, most teams include review processes (internal, external, or both) when preparing proposals. If teammates are not provided sufficient time to review and the final proposal is not to their liking, it can result in disengaged researchers and can compromise the ability and willingness to

complete research tasks in the event of funding. Editing and reducing or cutting text can also lead to people feeling like their work is not valued within the proposal. One participant summarized this as: "everybody's an editor and nobody likes to have their writing slashed." Many teams default to saying "please review" and fail to define the turnaround time and the types of comments that are desired. A recent review that did not set expectations received comments such as "this proposal lacks a cohesive vision" and "there's a typo in the 3rd line of the 4th paragraph" within the same set of comments. Depending on where the team is in the proposal process, one of these types of comments is unhelpful to the proposal team. For example, typos are irrelevant when still working on the vision, and by the time a team is worried about typos, it's usually too late to change the vision.

File management. File management systems are necessary to avoid feeling confused when the team fails to establish a directory structures, file naming convention, and version control method. These all result in people not knowing what the current version is and accidentally editing or providing comments on an outdated draft. One participant termed this confusion "irritating." A recent proposal team evolved an elaborate system of version numbering, dates, and team member initials to track comments. For example, proposal_v1 was set as a version of record. Anyone modifying or commenting on v1 would create a new file named proposal_v1_abc, where abc was the reviewer's initials. One person was then responsible for combining all comments and creating a consolidated v2 file. The PI of this proposal described it as one person owning the document and deciding which comments to address and which comments to disregard when combining documents and creating a new version. This seemed to work

for this team, however even the PI admitted there is occasional confusion when someone inserts comments into an old version of the document that then has to be merged by the document owner.

File management concern were also evident in this exchange between a proposal manager, the PI, and a Co-PI:

> **Proposal Manager:** V12 is saved in the Dropbox with five people's edits and comments. I've had to re-insert the comments manually three times this week and it takes too much time. We cannot get untracked edits or have comments deleted again by him. I suggest we only send PDFs unless he agrees to track changes.
>
> **PI:** This is not the right version, I'm not sure what he edited. Now we need to reconcile the versions.
>
> **Co-PI:** Yeah. I was afraid of that. It might be my fault. I didn't cc him on version I sent yesterday.

The problems illustrated here are two-fold. First, the proposal manager was challenged to continually reconcile drafts with comments from multiple teammates. Second, there was an issue with distributing files by email because it meant that not all teammates had access to the latest version for providing comments. When distributing files by email, it is easy to accidentally leave someone off the chain or to send around a document before saving changes. This may be avoided by having a common online file storage location. One participant specifically discussed the benefits of this approach, stating that file management is easier with an online team storage drive than when the team used to go back and forth with emailing Word documents. However, online storage may also cause problems when, for example, an organization's firewall settings do not allow its employees to access Dropbox, Google Drive, Box, or other cloud-based locations. This happens sometimes with federal agencies and national laboratories.

Citation management & document style. The consequences of failing to define a citation management system and a style guide are similar: not having a system in place results in lots of rework—usually for a single individual—near the proposal deadline to harmonize and make consistent the fonts, headings, spacing, citation style, and other document elements. There was one instance where citations were so inconsistent that a graduate student had to spend two days during proposal crunch time to fix them. Because of how citations were being managed and inserted, no one else was able to work on the proposal simultaneously, so the team lost two days of working time. The frustration felt by team members was exhibited in the following email exchange between a Co-PI and the PI:

> **Co-PI:** The references are all screwed up. We should have insisted that everyone put their references into a traveling library.
>
> **PI:** Because there's no common traveling library, I asked people to use endnotes in Word. Now everyone is moaning about it.
>
> **Co-PI:** There is a site license at [both universities] for crying out loud. These people are a mess.

Disciplinary differences

The phenomenon described above where a single PI works autonomously with a few graduate students still occurs often in social sciences and humanities fields. According to one participant, although he frequently worked with researchers outside his field, many faculty in his department have never been approached by someone in natural science or engineering fields to work collaboratively on a project. As such, the concept that research is improved by bringing together large teams is foreign to them. He attributed the reliance on individual work to the way that scholarship is organized in his field. He went on to say that once cross-disciplinary collaborations start, it could take

up to six months before researchers are able to bridge language gaps and frame problems in a way that is understandable by the other teammates. This time requirement, when proposals often must come together in several weeks, may be unattainable in proposal teams.

A key difference between disciplines is the reward structure and thus the inherent value place on collaborative proposals. Because the rewards are not aligned, one participant stated that not everybody necessarily is going to work well together when preparing their piece of the project. For example, three participants noted that having a large funding portfolio was more important to promotion and tenure processes in engineering than it was for their disciplines (education and social sciences). The pressure to attain more funding made it more desirable to join teams and improve the odds of getting funding, even if the total amount of funding was diluted by the team participation. While not necessarily a disciplinary difference, one participant stated a concern about career stage diversity. Her concern was that multi-investigator proposals for junior, non-tenured faculty may be viewed as a distraction from their tenure path. As such, she made extra effort to be sure junior faculty would be helped by participating in a proposal or project before inviting them to collaborate.

Another disciplinary difference is evident in how graduate students are funded. The concept that a faculty member acquires a group of students and staff that work with them on collaborative projects directed by the faculty member, is a concept that is very strong in engineering. While it is generally reasonable to assume a similar model in the lab-based sciences such as biology, chemistry, and physics, the funding model and mentorship model in the social sciences and humanities are different from engineering.

As one participant said, "it's totally fluid," referring to the concept that funding is generally centralized at the program, unit, or school level. This, plus the smaller pool of available funding opportunities in the arts, humanities, and social sciences, makes the mechanism for hiring and supporting graduate students different across disciplines.

Meaning-making

Because investigators have many motivations for participating in proposals (discussed in Chapter 3), there can be multiple lenses through which investigators can derive meaning from the experience:

- Technical vision: how will people from different disciplines with different vocabularies and different ways of framing problems agree on a technical approach and outcomes that achieve their respective goals?
- Sponsor perspective: how will the researchers incorporate and consider the meaning a sponsor derives from the work?
- Career progression: how does a researcher reconcile differences between directives from the highest level of the administrative organization and department chairs or promotion letter-writers?
- Success: What does it mean for a proposal and proposal team to be successful? (discussed in Chapter 5)

With multiple lenses and multiple participants, aligning all members of a proposal team is challenging. However, an important distinction here is that to share in meaning-making doesn't necessitate everyone shares the *same* meaning. Rather, everyone can derive meaning in different ways and have different motivations for participation, provided it doesn't conflict with the ability to prepare and submit the funding proposal.

Time horizon

As described earlier, one of the characteristics of proposal teams making them different from project teams is the short time horizon they have to complete their work. Whereas project teams typically complete their work over a period of several years, proposal teams often form only several weeks before the final product is due and are occasionally together for several months prior to a submittal deadline. All participants interviewed mentioned the pressure associated with having to execute quickly. One participant recalled a time where it worked to the team's advantage, though. Because proposals are so challenging to put together, she appreciated that the short duration compressed her frustrations: "the pain of writing proposals—and proposals [are] hard work—the pain of writing proposals was constrained within two weeks. Because we had such a deadline, it was tightly focused." However, most felt that not having sufficient time was an obstacle. For starters, there is not enough time to develop ideas and integrate them into meaningful contributions:

- "[Proposals are] all torture. Because we get an announcement four to six weeks before it's due. Don't think I'm exaggerating"
- "It's not pleasant when I'm brought in at the end of the proposal development"
- "If they're coming to us, starting a proposal process with two weeks left to go? it's a non-starter."

Another obstacle of short timelines was that it led to long days and stressful working hours:

- "I'm okay with being deadline-driven, but I don't enjoy working 25 hours a day just before the deadline."

- "I'm doing 15-hour days on this thing. It's midnight oil and weekends. And sometimes these people follow me into the weekend and will give it that kind of turnaround for me, which I appreciate."
- "The other team didn't go that well. It was pretty deadline-driven, and three days before the final deadline, everyone was going crazy writing like crazy. I prefer proper time management."

Lastly, quality suffers:

- "It's not only pissing me off, it's also like I feel my time is not properly used, because in the deadline mode, the quality of the product is not going to be perfect. It's not going to be good."

Resource allocation

Although there is rarely, if ever, budget and resources to assist in proposal preparation, the anticipated budget for the project execution phase can be an obstacle during the proposal phase. In the excitement of project brainstorming, people may commit to more than they are able to deliver. In one case, a participant noted that even though the team was very excited to work together and excited about the scope of work they were proposing to do, the co-investigators knew that the budget was too tight for everyone to have a dedicated student or post-doctoral researcher working with them. As such, every graduate student was going to have to be shared between at least two investigators. While not necessarily an obstacle during the proposal phase, this has the potential to manifest later in the project and cause friction between investigators. Having a teammate be unrealistic about the scope they could deliver relative to available

budget made one participant "uncomfortable," and another participant commented that it was "not pleasant" when asked to join a team and deliver a set scope without being allocated appropriate resources. In both of these instances, the participant noted this as a characteristic of the proposal process that they did not enjoy.

Leadership and decision-making

Federal grant agencies typically require there to be a single point of contact responsible for all project activities, and universities have adopted this structure to align with the sponsor's needs. Even though larger and more interdisciplinary projects necessitate multiple perspectives, the project administration and ultimate decision-making power tends to rest with the PI. One participant stated this has created a "king of the hill" mentality for some faculty and suggested that these faculty did not enjoy working with others on an equal level. To some degree, the administrative requirement for a single contact point can be overcome by empowering others to make decisions and accepting their decisions within the team. For example, one participant described her approach to creating task plans and deciding on technical direction as follows: "I wanted the task structure upfront. And then within a task, then I let them—the people in that task—go off and make decisions. I'm not going to overrule their decisions… You can get in a lot of trouble with that, if it's not done right."

Geographic dispersion

As noted earlier, geographic separation is becoming less of an issue due to the availability of synchronous communication technologies. Despite the technological solutions, many people still have a preference for in-person connections, explicitly stating that "Zoom is ok, but face-to-face is better." Note the interviews were conducted

prior the onset of the COVID-19 global pandemic, which has shifted nearly all business meetings to an online/virtual format. So regardless of whether meetings are between colleagues in adjoining offices or colleagues across the world, virtual meetings are now the norm. Time zone challenges still exist, especially with international collaborations. The massive increase in virtual meetings is leading to new challenges, notably attendee burnout when meetings are scheduled back-to-back-to-back, losing non-verbal cues and eye contact between meeting participants, and small time delays that introduce awkwardness where natural breaks in conversation existed previously.

Rank-ordering obstacles

Toward the end of the interviews, participants were asked to rank-order eleven obstacles facing proposal teams. They were permitted to add their own obstacles and were also allowed to explicitly exclude some items from the ranking by stating it was not an obstacle rather than being forced to rank items they did not perceive as interfering with their proposal efforts. All participants placed *deadline-driven submittals* in the top three (of eleven potential ranks), signaling that the short time horizon was the biggest challenge. Because this is also the item that most differentiates proposal teams from other knowledge worker teams, it validates studying proposal teams as a subset of all knowledge worker teams rather than assuming they are subject to the same motivations, obstacles, and success metrics.

While not ranked first by anyone, *ambiguous writing assignments* was also in the top three by all except one participant. Three items were split – either ranked very high as an obstacle or explicitly identified as not being an obstacle: *misaligned motivations for participating*, *insufficient resources available for the scope*, and *difficulty reaching*

other team members. The participants who excluded these items from the ranking were the researchers with the least proposal writing experience, so it may be that they had not encountered the problems yet in their more limited grantwriting history. Four items were excluded by almost all participants: *inconsistent citation management*, *confusing file management and version control*, *geographic dispersion*, and *unclear decision-making processes*. This indicates the evidence used to populate the list of obstacles for ranking may have been biased by my prior experiences as a participant-observer staff member rather than reflecting problems encountered by the researchers. It may also be that people have come to accept these as annoyances and no longer seek solutions that would reduce the coordination burdens.

Summary

Words used by participants to describe proposal experiences included torture, painful, not enjoyable, irritating, and stressful, indicating that proposals are not a pleasant experience for most researchers. In addition, members of proposal teams found continually revisiting communications and process inefficiencies taxing, decreased their satisfaction, and wasted time that could have been spent making new initiatives more productive, competitive, and likely to receive funding. Many of the obstacles facing proposal team can be mapped to the seven dimensions inhibiting team science identified by the National Research Council. But the most highly-ranked obstacle (short time horizons) cannot be easily fit into any of the National Research Council team dimensions. As this is also the key differentiator between proposal and project teams, it provides rationale for deeper study of this team type.

I expected there to be disciplinary differences in the approach to solving technical challenges and the language teammates use to describe research. However, perhaps due to strong ties to the engineering discipline and the directives stated by leadership of the Ira A. Fulton Schools of Engineering (which places high value on grant funding and interdisciplinary collaborations), I was surprised to learn that pursuing grant funding was less valued and even viewed as a distraction in other disciplines throughout the university. This obstacle is significant to understand when assembling teams. However, because researchers are motivated by societal benefit and the opportunity to work on interesting problems rather than (or in addition to) the explicit reward structure, it may be easier to overcome the obstacle.

CHAPTER 5

DEFINING SUCCESS FOR PROPOSAL TEAMS

Literature Findings

Measuring knowledge creation

With the purpose of research being to create knowledge, many researchers judge their own success—and have their success judged by others—by measuring and evaluating the knowledge they have created. The problem is, knowledge is difficult to measure because it is an abstract, tacit concept. Before being able to measure it, knowledge must first be externalized—i.e., converted from tacit, subjective insights and making them available to others in an explicit form (Nonaka, 1991). Once explicit, there are many ways to measure knowledge. For example, in industry, explicit knowledge often takes the form of design specifications, software tools, or new products that can be commercialized and monetized (Seager, 2018a).

Large bureaucracies, including university administrators that manage the research enterprise, struggle to work with the tacit. As such, the most traditional and direct measure of knowledge creation in university settings is to first externalize the knowledge by producing publications or patents and then counting them. Because a simple count of publications does not adequately address the quality or usefulness of the knowledge produced or the nature of collaborative behavior (Cummings & Kiesler, 2005), academics have derived additional metrics, including the number of times a particular publication has been cited and the impact factor of the journals where the research was published. Over time, the researcher's body of work can be measured by

their h-index, which attempts to include both number and quality of those publications into a single number.

Although traditional bibliometrics such as citation count and impact factor remain critical when, for example, evaluating promotion and tenure cases for academic researchers, the expansion of knowledge distribution to include web-based publications, videos, reports, data repositories, and other formats necessitates new metrics for evaluating and measuring research success. In addition, the traditional peer-review and publication cycle operates on a time scale of months to years, which is insufficient in the high-speed information age. The lag caused by the publication process makes it difficult to assess research quality until many years after the research occurred and means the data come too late in an evaluation process to provide information for summative assessment and adaptation. As such, several alternative metrics, or altmetrics, complement the traditional bibliometrics by using web-based application program interfaces (APIs) to gather data about page views, web mentions, downloads, saves, and social media mentions such as shares, likes, claps, and retweets. There are documented links between web mentions of published articles and the number of citations of those articles ultimately receive (Vaughan & Shaw, 2003), and the number of Tweets within the first seven days of an article's publication (i.e., the *Twimpact factor*) is also a leading indicator for which publications will become highly-cited (Eysenbach, 2011). This may be a bit of a self-fulfilling prophecy in that articles with more web mentions and Tweets are more widely distributed and thus more likely to be cited by future articles, but it may also mean that only high-quality articles are receiving the initial attention and thus are a reliable leading indicator of future citations in the

peer-reviewed literature. These altmetrics are still in their infancy, but they are gaining popularity. Even the traditional bibliometrics took approximately 20 years to be widely adopted as measures of academic impact (Vaughan & Shaw, 2003).

Multi-dimensional measures of research output

Bibliometrics and altmetrics are decent for capturing explicit knowledge creation knowledge transfer, but they are incomplete metrics because they underestimate extent of collaborations (Iglič et al., 2017). A more-encompassing definition of success for researchers may include additional explicitly-measured research success outcomes such as the number of students mentored/advised to degree completion, the number of collaborators, the number of research collaborators, number of research awards, and amount of research funding secured. Adding subjective criteria will also better capture a team's scientific and human capacity to, for example, develop new network ties, transfer tacit knowledge, acquire and share resources, and mentor career development paths (Bozeman & Corley, 2004; Corley et al., 2006).

Combining traditional output metrics and capacity-based metrics addresses these shortcomings in a multi-dimensional assessment of research quality (Lin & Bozeman, 2006). In some cases, an explicit measure leads to more success in subjective measures. For example, the number of collaborators has been linked to a higher degree of faculty job satisfaction (Bozeman & Gaughan, 2011). Using multi-dimensional measures also addresses cases where a faculty member's shortcomings in one area are balanced by excess capacity in other measures. For example, faculty members who have spent time as full-time employees in industry have fewer publications than their career-academic counterparts. However, because they also tend to support more students,

have more collaboration partners, have more grants, and have higher dollar-value grants, measuring solely by bibliometrics does not adequately define their success as a researcher (Lin & Bozeman, 2006).

Multi-dimensional measures of proposal team success

Relying solely on metrics of knowledge creation are unsatisfactory for those engaged in research proposals because while the proposed research may eventually lead to knowledge creation and publications, it is rare for it to occur during the proposal process. In addition, the short time horizon for proposal activities means that longer-term measures such as mentoring graduate students to degree completion and acquiring/sharing resources may not have the time to manifest during the proposal preparation period.

For these reasons, it is necessary to shift perspectives to include broader measures of success. The metrics that are easiest to measure for researchers engaged in proposal activities include the number or dollar value of proposals submitted in a given time period, the number of collaborators or disciplines, the number or percent of proposals that result in award, and the dollar value of awards. However, placing too much emphasis on efficiency, productivity, and control diminishes creative processes (Hinrichs et al., 2017), and emphasizing quantity over quality and relying too heavily on explicit measures can impede scientific progress and make it easier to game the system (Edwards & Roy, 2017). For example, if being judged on the number of proposals submitted, a researcher is incentivized to submit many proposals—regardless of quality—or even to submit duplicate proposals to multiple sponsors that are not appropriate fits for the research.

Similar to the lag between creating knowledge and being able to measure its quality with bibliometric tools, there is a lag between creating a proposal and learning whether or not it was selected for funding. In addition, the low funding rate for large, interdisciplinary, multi-institutional research teams (Von Hippel & Von Hippel, 2015) and questions regarding peer-review reliability, reproducibility, and bias (Marsh et al., 2008) make funding success an unreliable indicator for the research proposals that grapple with grand challenges. Although obtaining funding for research projects is the most fundamental and objective measure of proposal success, it does not adequately address the quality of the team and processes required to create the proposal. The need for multi-dimensional and subjective measures of proposal team success prior to the funding decision is also apparent when considering the possibility of *unsuccessful wins*, for example when the reality of project execution leads to panic (Bergstrom & Baun, 1994), the group has burnout from the task and doesn't want to continue (Hackman, 1987), or the research project is unrewarding for the investigators (D. M. Anderson & Slade, 2016).

Hackman (1987) proposes a three-part definition for team success: performance as judged by others (i.e., external validation), whether the needs of the team members have been met (i.e., internal validation), and the willingness of team members to continue collaborating (i.e., behavioral validation). When applying this framework to proposal teams, the first criterion can be objectively determined by assessing the funding decision of a proposal. While this criterion is easy to determine, it can take six months or longer to assess.

The second criterion, internal validation, is harder to measure as it requires to first understanding the researcher motives for participating in the team. Investigators have many reasons for joining proposal teams—sometimes known to the researcher and explicitly stated, and sometimes unknown even to the researcher other than it elicits a feeling of satisfaction to the researcher (Flexner, 1939). Some faculty join teams due to personal ambition and desire to learn (Corley et al., 2006; Iglič et al., 2017; Von Hippel & Von Hippel, 2015). Some participate because they want to mentor their students, post-doctoral researchers, or junior faculty to become successful proposal team members (Von Hippel & Von Hippel, 2015). Others write proposals because they feel pushed by administrative pressures associated with tenure and promotion (Cunningham et al., 2016). Administrative pressure is also the largest factor contributing to faculty increasing the amount of time spent writing research proposals. However, this pressure can lead to faculty pursuing grants that are misaligned to their research interests and may decrease their job satisfaction (D. M. Anderson & Slade, 2016). If job satisfaction decreases, faculty may no longer be interested in teaching or conducting research, thereby compromising university missions of student education and new knowledge creation. As such, it is important to make the proposal experience—from team creation, to idea generation, to document creation, to final submittal—more rewarding for the participants.

The last dimension of success falls between the other two with respect to ease of measurement. It is easier to get feedback on whether a teammate wants to continue working together, and there may be definite evidence within a matter of days or weeks if another proposal or project opportunity presents itself. But if a timely opportunity

doesn't arise, this criterion relies on self-reporting of the researchers' willingness to continue the collaboration.

Research Gap

As described above, explicit measures of knowledge creation and success are insufficient when assessing the success of proposals teams. This research aimed to increase understanding of how proposal teams view themselves as being successful or unsuccessful.

Research Approach

Four questions in the semi-structured interview protocol specifically asked participants to think about success of proposals and their proposal team experiences:

- What indicators let you know a proposal submission effort was successful?
- What indicators let you know a proposal submission was (or was not) worth your effort?
- Have you ever experienced a *successful failure*, where the proposal was not selected for funding but you and/or the team derived other benefits?
    - What were those other benefits?
- Have you ever had a *failed success*, where the proposal is selected but you do not look forward to executing it?
    - What made you not look forward to executing the proposal?

Research Findings

The meaning of success

Even prior to delving into questions geared at defining success, nearly all the participants made some mention of "successful" or "unsuccessful" proposals that equated *success* to whether or not the proposal had been selected for funding. This indicates that PIs consider success to be a surrogate term for awarded or funded, which is the simplest and most objective way to measure external validation. For example, one person stated, "I've been successful," and clarified the statement by stating that she had received grant funding. Another participant, who was an assistant professor and new investigator, quipped about his success rate after being awarded the only proposal that he had submitted, stating "I'm one for one. I should just stop trying now, and then I'll always be the best."

Another external validation measure that emerged during the interviews incorporated the funding agency's reaction to the funding request. Specifically, the research participant expressed disappointment and frustration about not receiving feedback. The lack of feedback made her feel she had wasted the team's time and not gotten full value out of the proposal.

When referring to proposals that were not awarded, terminology used by participants included unsuccessful, didn't get it, didn't work, and failure. For example, "no one wants to write a proposal and then come back with a failure," and "I was writing these things and they weren't being funded. I mean, it took a while to get a hit." Another participant also equated unsuccessful with not being funded, and then he attached a feeling of lack of enjoyment by stating "there was a group of us, we spent

three years trying to get a proposal funded by a particular program at NSF, and we were unsuccessful multiple cycles running, in getting that done. That was not fun." This same participant went on to say, "we enjoyed the process of working together to try to figure out what we were going to do, but being repeatedly told, 'No sorry, we're not going to fund you,' was irritating." This also starts to hint at the potential for additional metrics of success in that he enjoyed a certain element of the proposal process, despite not being funded – i.e., a type of internal validation.

Successful failure (i.e., benefits other than award). As stated above, failure was initially equated with a proposal not being award. However, further inquiry revealed that all except one participant were able to identify a *successful failure* – i.e., beneficial outcomes that accrued for the researcher or team following a proposal that was not funded. Only one participant was unable to identify with the concept of successful failure. When specifically asked about whether she had derived benefits from submitting a proposal that was not selected, her answer was "No. It's depressing to lose. I always want to win." For her, the funding outcome was the only measure she used to assess her own and her teams' successes.

As illustrated by the participants quotes in the text box below, two themes emerged when discussing the benefits of unawarded proposals: relationship- or network-building and resubmitting to a future funding opportunity. These benefits co-occurred in several examples, indicating that the value of building the relationship for many participants was in the potential for future collaborations that would lead to funding. This further confirms that the primary success metric remains whether or not a

proposal is selected for funding, and any secondary benefits are in service to longer-term funding goals.

Successful Failures

"I can think of one proposal that I was the PI on at my prior institution where I was trying to network a bunch of people together for a proposal, but ultimately wasn't successful. We had spent six months prior to writing the grant touring [three states] talking to a bunch of people in tribal agencies and doing video conferences with them. That network was maintained, even though the grant proposal was not successful. And it sparked a whole bunch of different types of work that people didn't know about."

"this latest grant was based on a successful failure, which was the year before, where I was not funded. But then I used it as the basis for rewriting it."

"the proposal being funded is sort of the first level of indication. But I think it goes much deeper than that. That is that writing grant proposals ... writing proposals for research is a long game, and it's a game that needs to be done with the right people at the table. So sometimes a very unsuccessful proposal in one area introduces a team that can work deeply and well in another proposal. so sometimes a proposal is successful when the actual proposed grant doesn't get funded, but the team reassembles either to engage in some work with some creative funding and/or engage in the work and get it done through another proposal."

"The proposal itself was not successful, but again, the network got started being built. So people identified common areas of research, they were able to interact with the research and build components of the research or pieces of the research that they could do as they were continuing to seek out other proposals and other funding. So people got together and they have symposiums built on common lines of research that they had not known about before they came into the proposal."

"Sure, where it builds relationships that are valuable. Part of the reason I'm working on this [topic redacted] proposal is because it actually involves two people that I've worked with before. One, I wrote a proposal with, and one I have had some other interactions with. In both cases, it seems there's room for growth of those relationships over time. And so this one is worth doing, even if we don't get funded. I'm putting time and energy into this one for that reason, absolutely. Sometimes it's useful to write proposals to try to pin ideas down, but usually there are better ways to do that."

"If a good idea came out of it and it helped us shape our ideas—funded or not—it's worth it because you get better each time. And we do get the experience of knowing whether we can work, even if you don't do the actual proposal together, just from writing the proposal in some way, you get a pretty good idea if these are people you can work with."

Failed success. The corollary to the *successful failure* is the *failed success*. This refers to situations where a proposal is selected for funding, but the resulting project is not a good experience for the research team. One participant recounted an example

from when he was a graduate student where he said the award was a surprise to the team and described the ensuing project as a disaster. He stated the prime contractor was not interested in the technical components and was irresponsible, leaving project execution to the subcontractors. His advisor was one of the subawardees. As a graduate student, he felt pressure to deliver to the sponsor, even though the prime awardee had lost interest in the project. In his words, "I really wish we hadn't gotten that one."

The feeling of dread associated with failed success was echoed by another participant who described a proposal and resulting project where he was a co-PI. Because the proposal was put together very quickly with little thought about the task plan or how the research would be executed, it was unable to achieve its scientific research objectives. In this particular case, the PI also didn't take the required steps do change course after award and redirect resources to the necessary tasks, which deteriorated the relationship between the PI and the Co-PI.

Another participant described a time when she had recently joined a new institution, and the leaders had asked her to put together a large proposal. In her mind, it was more about demonstrating to the leadership that she had the capacity to prepare a proposal than it was about getting the award or executing the project. While she had some input from collaborators, she wrote the proposal mostly by herself. In her words: "when we got notification that they were going to fund us, I had this moment of elation, and then this huge, crushing feeling of, 'Oh shit. Now we're going to have to do it.' I would say that that's, in many ways, when you're in this game that's probably a fairly frequent feeling. I ended up selling something for $1.8 million that needed a phenomenal amount of development, and that literally was five years of scramble." The

lack of buy-in and team integration during the proposal phase likely led to the struggles in the project performance period.

There were also some near misses where the participant was relieved that it was not awarded because they were not looking forward to continuing the collaboration. A specific example of this occurred when one participant submitted to the Department of Energy, only because she didn't want to pass up an opportunity with the agency. The proposal advanced through several review stages, and at every step the PI (who was the research participant) said the team was saying "We don't want to do this proposal, we don't want to do this proposal." In this case, the team was very engaged throughout the proposal process, and their hesitation was related to the specific scope of work that had been proposed. Another participant described this more generically as: "playing with new ideas is always fun, much more fun than actually doing the work if you get the project." Another example of a near-miss for a failed success occurred when a PI realized that although the team had completed the proposal and it would have been interesting work, it was outside their main lines of inquiry and would have distracted several investigators from their long-term career research goals had it been awarded.

Behavioral validation (i.e., willingness to continue the collaboration)

As alluded to earlier, when participants thought more deeply about their experiences in proposal teams, other success indicators emerged. By far, the most frequently-mentioned benefit was to reassemble the team and try again for another funding opportunity. When viewing through Hackman's multi-dimensional assessment of team success described above, this phenomenon reflects the willingness of team members to continue collaborating. One illustration of this follows where the participant

recounts an experience where a team submitted a proposal, discovered it was not awarded, stayed together, and tried again. When asked about success measures, the participant first mentions the funding decision as the success metric and then further describes other successes: "Well, obviously if it gets funded, but we don't have a lot of that. Then I think it's how we feel about it." This statement also reiterates that the award rate is low, indicating that having additional measures may make a declined proposal more palatable. The first submittal did not advance past the concept paper stage. She was disappointed because the team had been excited about the proposed work, but agency did not provide any feedback on a concept the team felt was a good idea. Because she felt the team wanted to stay together and do the work that was proposed, the PI reacted by telling her team that they would seek other opportunities. Regarding the resubmittal effort, the PI said "I think it's probably the best proposal we've put together. And because everybody in the team's feeling they would like to do this. It's not because we want to have the money, it's because we want to do this, we want to work with these people, and we want to work on these ideas." Although she said that most of the team felt the same way, she acknowledged a need to read between the lines because some people are more expressive then others and some are may only be telling you what you want to hear. At the time of our interview, the participant did not yet know whether this particular proposal would be funded. However, she learned about three months later that it was selected for award.

While the experience was not described as in-depth as the prior example, two other participants also noted that willingness to continue working together and potential for future funding was a successful outcome from an unfunded proposal. One stated, "I

look to see whether or not I can salvage relationships and/or identify people that I might want to collaborate or that I might want to connect to other people who might be better suited to get the research done," and the other stated "After a team has been declined the first time, they come back, they engage more fulsome with me and my team, and they have a much higher likelihood of being successful the second time."

There were also a few examples of the inverse outcome, i.e., when teams did not want to continue working together. This is similar to some of the *failed success* scenarios described above. Whereas those scenarios were based on the type of work and concern over being able to execute on the award, the examples here add a deeper dimension of (un)willingness to collaborate because of team dynamics. One participant described a proposal where the college dean would take grants written by the faculty and add their name as a coinvestigator or even the PI. This experience soured the research participant, who stated "I just didn't do any more of that for a while. Until I trust who I'm working with again." Another example occurred during the execution of an award. Conflict ensued when a budget shortage meant they could only invite ten people into their cohort instead of fifteen. A co-PI on the grant wanted "to just shut it down" and "not do this." The participant disagreed and spent several hours on the phone to come to agreement. "I had to fight my way through it. And so I didn't apply for one of those again. I mean, it was a long time before I tried another one."

Internal validation (i.e., meeting the needs of the team member)

The last component of Hackman's three-part definition of success, internal validation, requires that a researcher is aware of their unmet needs and deliberately enters a team with personal goals for the collaboration. One participant phrased this as

"I only write proposals that I'm happy to lose." At first, this seemed masochistic to me. However, after talking about it further with the researcher, it was intended to convey that he would participate only if he would still be happy having participated, regardless of whether the proposal was selected for funding.

As described in Chapter 3, researchers have wide-ranging motivations for proposal collaboration. However, these may not be explicitly stated or even consciously known to the researcher at the time they enter into the proposal. When reflecting on their prior experiences, participants were able to recall several intrinsic motivations that influenced their view of whether the proposal had been successful. One participant was motivated by building social capital within the research team and increasing the team's capacity to engage in future research. This was echoed by a second participant who wanted to frequent and meaningful engagement with the other researchers on the team: "At the very end, the people that I brought in, if they're really engaged with me. And I push them to get engaged with me. They're reading it, they're tweaking it, they're asking questions, they're sending me drafts of sections. And there's this big sigh of relief when we say, 'Yeah, it's ready to go.' "

One participant also was motivated by career longevity for her field of study, meaning that she felt a proposal has been successful if it helped younger researchers find their career path. She wanted to feel like she had given back to the profession, and assisting junior researchers fulfilled her need.

Other internal measures of success were more mechanical in nature. For example, one participant indicated that uploading a proposal that met all of the solicitation requirements and submitting it on time to the sponsor was a success

measure for proposal teams. Another stated that one of her goals is to be able to sleep in the days leading up to a submittal: "I mean the fact that I didn't have to pull any all-nighters, that means it got better."

Summary

The three-pronged assessment of success proved to be a good framework for organizing the findings on how participants defined success for their proposals with participant mentions of success and failure aligning with one of the elements. As shown in Table 2, approximately 30% of the full proposals were selected for funding and continued to work well together throughout the award period. Approximately 40% of the proposals resulted in a *successful failure* (i.e., the participants achieved goals other than funding or the team was known to continue working together on future endeavors). Only 7% of the proposals resulted in a *failed success*, where the team was selected, but they were unhappy working together and were unable to achieve the desired research objectives set in the proposal. Only one proposal of all efforts in the participant observation resulted in the team not being selected nor having an adjunctive success. In this particular case, the team was so frustrated by the end of the proposal process that several people stated they didn't want to be awarded because they didn't want to continue working together. Note that ~22% of the proposals are not directly captured in Table 2. While it is known these proposals were not selected for funding, it is unknown whether specific internal validations were met or if the team continued to work together. These teams tended to fizzle because there were not opportunities for further work, and it does not necessarily mean they would actively avoid working together in the future.

Table 2. Proposal Outcomes from Participant Observation.

	Internal or behavioral validation observed	**Internal or behavioral validation not observed**
External validation observed (i.e., selected for funding)	~30%	~7% failed success
External validation not observed (i.e., not selected for funding)	~40% successful failure	~1%

Note: data are for full proposals only (n=81). Remaining proposals (~22%) were not selected for funding, but adjunctive success was unknown.

The interview data corroborated the outcomes from the participant observations. External validation was the most common measure of success, and when the terms *success* and *failure* were used, it almost always equated to whether or not the proposal had been selected for award. Only one participant judged success solely by this metric, and all others were able to identify secondary benefits, as summarized by these two participants: "A lot of proposals don't get funded, it doesn't mean I don't think it was worth trying to get it," and " it's really hard to find a proposal that's absolutely worthless." Beyond award decisions, the next most common measure of a proposal's success was the willingness of the team members to continue the collaboration. While this was described as relationship- and network-building, the desired outcome was to revise the proposal or research direction and resubmit in pursuit of funding, indicating that the financial motivations and desire to be awarded may be the underlying driver. Several internal or additional motivations were also mentioned. However, it was rare for these other motivations to be explicitly stated at the outset of the proposal collaboration, making it difficult to assess their contribution to proposal success.

An important outcome here is that most efforts (77% of the proposals in participant observation and experiences from five of the six interview participants) resulted in at least one form of success. This demonstrates a disconnect between the perception of proposals as being evil, torture, and miserable and the reality that most offer benefits to the researchers participating in the efforts.

CHAPTER 6

OVERCOMING OBSTACLES FACING PROPOSAL TEAMS

Input-Process-Output (I-P-O) and Command & Control (C2) Frameworks

After identifying the motivations for proposal collaboration, the obstacles impeding collaboration, and defining what it means for a proposal team to be successful, this research sought an organizing framework for making recommendations that will help teams overcome the obstacles and increase proposal team success. For many decades, the input-process-output model (I-P-O; Hackman, 1983) dominated the team science field as a model for describing team interactions and outcomes (Hall et al., 2018). In this model, inputs include attributes of the individual (e.g., skills and personalities), group (e.g., size and structure), and environment (e.g., stressors and reward structures). Processes include all of the interactions the team uses while working on their task, and outputs are measured by performance, including quality, speed to solution, and number of errors. While it adequately captures many features of collaborative teams, I-P-O attempts to apply a linear model to multi-dimensional teams and tasks.

Another framework for examining obstacles faced by academic teams seeking research funding comes from an unlikely source: the American military. Much like the need for interdisciplinary teams to unscramble wicked problems of the 21st century, the Department of Defense recognizes the need for diverse teams composed of multiple organizations when executing complex military missions. Traditional military operations centers lacked the agility to respond to these challenges, and the Department of Defense thus developed a conceptual model for command and control (C2) of teams

that incorporated three elements: patterns of interaction, distribution of information, and allocation of decision rights (Alberts & Hayes, 2006). By addressing these three dimensions of an organization, military missions were able to achieve a higher degree of self-synchronization that better poised the missions for success.

The obstacles faced by proposal teams can be examined along the same three C2 dimensions used by the military. However, the military description of C2 is missing a key element to address one of the obstacles uncovered in Chapter 4: shared motivations and meaning-making. This is likely because the United States Department of Defense has a pre-defined mission (i.e., "to provide a lethal Joint Force to defend the security of our country and sustain American influence abroad."; US Department of Defense, n.d.). As such, it is not necessary for the individual team members to come to agreement. However, it cannot be taken for granted in proposal teams. Even if all participants are from the same organization and are operating under the same guiding principles (e.g., a university or departmental mission statement), the individual researcher participation motives can vary substantially as discussed in Chapter 3.

It may seem paradoxical that increasing the rules and organizational structures affords team members more flexibility to pursue their goals. However, this is similar to a group of jazz musicians, who require the structure of playing the same song, in the same key, at the same time, and in the same style in order to have the freedom to improvise and express creativity. The paradox of achieving flexibility through rigid structures resolves as follows: if all team members are working toward a common vision (shared meaning making), they know who and how each decision will be made (allocation of decision rights), they have access to the same information (distribution of

information), and they have processes and expectations in place for how they'll interact (patterns of interaction), then they can proceed with confidence and unambiguity when working on the research proposal.

Research Approach

This chapter uses the C2 framework to organize the obstacles facing proposal teams (shown in Table 3) and makes recommendations for how to intentionally design teams and processes to overcome the obstacles.

Table 3. C2 Framework for Obstacles Facing Proposal Teams.

Obstacles (see Chapter 4)	**Placement within C2 framework (see below)**
Communication protocols	Patterns of interaction
Team meetings	Patterns of interaction
Generating and reviewing text	Distribution of information
File management	Distribution of information
Citation management & document style	Distribution of information
Disciplinary Differences	Shared meaning making
Time horizon	Patterns of interaction
Resource allocation	Allocation of decision rights
Leadership and decision-making	Allocation of decision rights
Geographic dispersion	Patterns of interaction

The recommendations for overcoming obstacles were informed by the research participants and my first-hand experience as a participant-observer in more than 100 proposal teams. Although none of the interview questions directly addressed overcoming obstacles, the questions around enjoyment of the proposal process often yielded responses about methods that do and do not work well with respect to proposal teams, leading to recommended practices.

- Think about a proposal you worked on where you enjoyed or learned from the proposal writing and submission process.
    - What made it enjoyable?
    - What other things elevate your proposal team experience?
- Think about a proposal you worked on where you did not enjoy the proposal writing and submission process. Take a minute to compare this to the example(s) you just mentioned.
    - What made you not enjoy it as much as the prior example?
    - What other things ruin your proposal team experience?

Research Findings

When making recommendations, it's important that the recommendations refer to variables that can be changed, that changing the variables will result in non-trivial differences in performance, and that the recommendations are easy to understand so that teams can use them (Hackman, 1987). A key recommendation deriving from this research is to shift proposal teams away from haphazard approaches and instead operate in a framework that has been intentionally designed to overcome the challenges teams typically face. The C2 elements provide structure to the processes in need of design. While many example approaches are described in this chapter, there is not a 'one-size-fits-all' tactic that will increase proposal team success because each team has different composition and needs. As such, the most critical recommendation is that each component of the C2 framework is discussed at the proposal outset so the team can arrive at a clear approach—by design—for preemptively overcoming the stated obstacle rather than hoping an ad hoc approach addresses the team's needs. For example, a

team discussing and collectively deciding and committing to use a file management system is more critical than selecting any of the specific file management systems that are described in this chapter.

Patterns of interaction

By making explicit the patterns of interaction—e.g., communications and meeting protocols, working hours and days, proposal schedule, and team working locations—proposal teams will be better equipped to overcome obstacles and become more successful. In addition to an initial discussion to set communications expectations, periodically revisiting the processes and talking about improving communications within the team is also needed (Beck et al., 2017).

If the team is fortunate to enough to be able to co-locate during proposal preparation, many communication challenges can be overcome easily by creating a proposal work room. However, this may be impractical for many teams. In absence of co-location, the team should develop a communications plan that includes the following elements: how and when each communication mode will be implemented, expectations for response time during and outside of typical working hours, and the timeline for proposal completion. These elements are particularly important when team members are physically separated across the nation and world or even in different buildings on the same campus.

Communication modes and meetings. In a survey of 24 first-authors of multidisciplinary, multi-author papers (Qin et al., 1997), 83% favored interactive communication such as phone and personal visit over non-interactive communications. These findings were echoed by the participants in the current study, one who

recommended meetings face to face whenever possible (note: interviews were conducted prior to the COVID-19 pandemic in 2020 when nearly all meetings shifted to an online format for more than a year). However, it was also recognized that with multi-regional and multi-national teams—and subsequently during the ongoing global health crises—bringing everyone together in the same room may not always be feasible. In those cases, conducting virtual meetings using videoconferencing platforms was preferred. Regardless of format, having the team decide on a cadence and the objectives for regular team meetings is important. To keep the team moving between regularly-scheduled meetings, one PI recommended to have unscheduled, on-the-fly calls because more can occur in a quick phone call than in several emails.

A project meeting technique borrowed from the project management literature is to use an *Agile* method such as *Scrum*. In Scrum, the team assembles every day for a 10- to 15-minute meeting where each person answers three questions: What did I do yesterday? What will I do today? What's in my way? If the obstacles cannot be addressed quickly during the daily scrum, a subset of team members will schedule a smaller meeting to discuss and resolve the problems so progress can continue. This meeting cadence and information exchange allows the team to stay informed about other aspects of the project and reduces misunderstandings about expectations while allowing team members to help each other achieve their tasks (Pirro, 2019). Scrum, which evolved in the software development industry, is rarely applied to academic research teams with the designed rigor. However, a handful of the 100 proposal teams where I was a participant-observed implemented a modified version of this technique,

meeting a few times per week instead of every day and providing brief status updates and next steps in a round-robin format.

Working hours and response time. As learned through participant-observation of many proposal teams and confirmed by the interviews, the short time horizon of proposal efforts leads to a lot of proposal preparation occurring during non-standard working hours, and proposal teams rarely define expectations for normal working hours and days for each team member. For some people, end of day means 5 PM, and for others it means midnight. Some people work during evenings and weekends, and some do not. Some people like to start early every morning, and others prefer to work later into the evenings. Each team member does not need to keep the same working hours, but teammates need to know and respect the workstyle patterns of others when making requests or when transferring documents for sequential writing or editing. If this is ignored, people who don't work late into evenings may become annoyed at urgent requests sent to them after 5 PM, and failure to hand off documents at the end of the day may mean that someone who tends to work early in the morning does not have access to the necessary files to complete their work.

One very practical example of needing to define work hours is when teams span several time zones—especially when conducting international work. When someone in Arizona promises to complete a task for review by someone in Asia by Thursday morning, it's important to understand *which* Thursday morning. Another example occurred recently when a team member who routinely works very late at night and into the early morning neglected to properly save and 'unlock' the document they were

editing. When the PI arrived at the office the next morning, they were unable to work because they did not have the most recent version of the document.

I recently saw an e-mail signature file that explicitly addressed differences in work schedules and sets expectations for the sender and recipient: "Due to my own work schedule, you may get emails from me outside of normal working hours. Please do not feel pressure to respond outside of your own working pattern. If there is urgency I will indicate in the subject line." A proposal team that has talked about these expectations and work patterns ahead of time will ensure that workflow isn't interrupted waiting for input during someone's non-working hours.

One approach adopted by a group that writes many proposals with several overlapping teammates is to make explicit a communications protocol that includes response time associated with different forms communication. For example, e-mails are for informational items that don't require response or can afford a response time on the order of days, text messages or other messaging apps are for items needing a response on the order of hours, and phone calls are for items needing a response on the order of minutes.

Proposal schedule. As described earlier, proposal teams must often operate on a time horizon where they complete their work in a matter of weeks to months. According to one participant, this short turnaround time makes proposals torture, and others noted it causes stress and can even result in having to pull all-nighters. As such, it is critical for the team to set a proposal schedule with interim deadlines. Having large teams and interdependent tasks can lead to conflict when it is necessary to rely on others before completing work (National Research Council, 2015). An example of an

adverse effect caused by not adhering to deadlines occurred recently the team had arranged for an external third-party review of a proposal draft. The external reviewers had agreed to a specific review window, and the team missed the window. Although the reviewers were able to complete a review approximately one week later than planned, the team did not have sufficient time to address comments and revise the proposal in a thoughtful and comprehensive manner before submittal. One participant expressed that poor time management has a negative effect on proposal quality and that he gets "pissed off" because his time has been wasted. In extreme cases, a proposal without a schedule or with a mismanaged schedule can result in a missed submittal deadline. In the words of one participant, "there's no such thing as a late grant. You just have to wait another year." In addition, the online submittal portals used by many federal agencies are subject to technical glitches, increasing the risk of non-submittal if cutting it too close to the deadline.

When developing a schedule, the team should decide how much slack to incorporate such that a delay does not adversely affect the critical path to the final product. One participant, who said he "prefers proper time management," insists that all proposals he leads be completed two weeks prior to the sponsor's deadline to allow time for final review by the project team, institutional compliance review, and any glitches that arise during uploading the proposal to the sponsor. Another participant recommends setting a timetable and being clear about each deadline when making assignments while still allowing for some flexibility to negotiate the deadlines, provided there are advance communications and status updates so that the schedule changes don't impede other aspects of the proposal development.

Dedicated time and space. Another method of overcoming the abbreviated time horizon is to create a dedicated time and space for the team to plan and write the proposal. When asked to talk about an enjoyable proposal experience, one participant recounted a large proposal for a program based in a foreign country. On less than two weeks' notice, the five-university team traveled to the foreign location for six days of intensive work: two days of stakeholder meetings, two days of training, and two days of proposal writing. Co-location provided several advantages, including being able to collect data from stakeholders in a condensed timeframe, being able to get fast answers to questions because all necessary expertise was in the room, and—in her words—"constraining the pain of writing proposals" to a tightly focused period.

While this example of an intense, six-day push is not typical and may be impractical for many proposal teams, another recommendation for overcoming obstacles related to time horizon and communication lags is to establish a proposal work room, sometimes called a *war room*. The war room is a dedicated, physical space to facilitate proposal development and can be a repurposed conference room or similar space. While not everyone will work in the room full time, it's important the location be dedicated to the proposal effort so that white boards, sticky notes, and other tools can remain throughout the proposal period without another group using the room and removing all the notes and items. This allows people to read the walls and catch up if they missed some discussions and also allows people to come and go whenever they are focusing on proposal tasks. However, having some set times when the full team will be present will facilitate the information exchange and will reduce lag time caused by waiting for input.

Distribution of information

Setting the expectation up front regarding how and when information will be shared is critical to avoid stress caused by researchers feeling they do not have access to relevant and recent information and proposal leaders not being able to understand proposal status at glance. Information distribution also includes setting protocols for how proposal documents will be generated, shared, and reviewed by team members.

Document generation. The obstacles facing proposal teams regarding document production include how text is generated, how document formatting occurs, and how citations are managed. As discussed in Chapter 4, there are two primary approaches for generating written text for proposals. In the first approach, the PI assigns sections to team members and compiles all inputs into a single document. Advantages of this approach include distributing workload and having each teammate contribute. However, writing by committee is hard, and this divide-and-conquer approach can result in disjointed proposal if components aren't adequately integrated. When using this approach, the PI should be explicit about the content needed and the schedule for completing drafts. It may also help to circulate an abstract, objectives document, project workplan, and project milestones so that contributors can align their content with the overall vision. This is particularly important for sponsoring agencies that require a formal task plan, schedule, and milestone chart so that all team members are aware how the work will be organized. The sample text will also help teammates match style and level of detail needed for the proposal document.

In the other approach, the PI or a lead writer gathers verbal input from the team and is the primary author for the narrative. This results in a more cohesive document,

but there is potential for the lead writer losing technical nuances and for teammates not feeling like an important contributor to the final product, which could result in disengagement after award. When using this approach, it is important for the lead writer to maintain open and frequent communication with the teammates to ensure that these drawbacks do not manifest.

Participants described document formatting and citation management as necessary annoyances but did not characterize them as barriers to proposal development. However, practical experience shows that not having a pre-defined style guide, template, and citation management system will create unnecessary stress and require rework in the final days before submittal. By spending time early in the proposal process deciding how each of these will be addressed, proposal teams can devote more energy to developing the narrative and less time worrying about the final production, thereby increasing proposal quality and decreasing stress among the proposal team.

With respect to formatting, many funding announcements will specify a preferred font and a minimum font size, but nuances such as whether to right-justify or full-justify text, whether to indent paragraphs, how much space to include between paragraphs and bullets, and other document style choices are left to the proposing team. Defining and following these protocols simplifies final document production and results in a document that looks and feels cohesive. To make final formatting easier, it is advisable to set up a document template using the style guide features embedded in word processing software.

There are many software packages designed to facilitate citation management. However, because there are so many, it is rare for all contributing authors to know how

to use and to have access to the same one. Recommended methods to simplify citation management include creating a traveling library used by all contributing authors, having each author export their references to a common format that can be integrated by an individual, selecting a reference format and having each author use their own software to conform to the selected style, or having each author note their references using a commenting feature in word processing software and assigning the task of citation management to an individual. While the first method is the most ideal in terms of reducing rework, the transaction cost associated with training all team members how to use the traveling library may not be practical. Especially if the plan will require an individual having to collate and enter references into a common platform toward the end of the proposal preparation period, it's important to discuss the citation management plan at the proposal outset and allow time in the schedule for this work to be completed so that it doesn't create a bottleneck when nearing the submittal deadline.

Document sharing and version control. Although none of the interview participants explicitly considered version control or file management to be obstacles, they were identified as annoyances to overcome during the proposal process. However, based on participant-observation, these annoyances create stress as the teams approach deadlines. The teams with more explicit processes in place were able to devote more energy to improving proposal quality and content than to the mechanics of data sharing and, for example, determining whether they were reviewing the most recent version of a document. Because it affects team member stress and proposal quality, it would be an oversight to neglect this component of proposal preparation as an element of information distribution.

File and data sharing can be done in a number of ways. For example, researchers can each keep a local file structure with any new versions or additional files distributed to all in email. This allows each researcher to organize files according to their individual preferences, but it almost certainly guarantees that someone will be missed in an email chain or that the investigator will not quickly be able to locate the correct and most recent version of a document. Another drawback is that proposal files can get large, and size limitations on email servers may limit distribution.

Another method is having all files stored on a shared internet-based collaboration platform (e.g., Box, Dropbox, Google Drive, Sharepoint, Microsoft Teams) where every team member has read and write access to the files. The advantage is that everyone is always working from common documents and can work concurrently to co-develop proposal text. A downside to this is that security settings in some national laboratories and corporate entities may not allow access to internet-based collaboration sites. Some platforms are more amenable to concurrent work than others and have different mechanisms for maintaining a historical record of changes, so the workstyle of the team members and workflow for generating and editing documents should be considered when selecting a collaboration platform. It is also important to develop a file naming convention, directory structure, and method for version control in online drives so that all users can easily find the information they are seeking.

Some teams used a less-common hybrid approach where all teammates had *read-only access* to an online storage site, but only a small subset (e.g., the PI and proposal manager) has *write/edit access* to curate the content by uploading or modifying files. This approach also allows all team members to access a common

document set and reduces the transaction costs associated with setting up and maintaining file structures and naming conventions. However, it also burdens a small number of people with the responsibility of continuously updating the files, even if the desired changes are minor (e.g., a reviewer with read-only access is unable to fix minor typos in the version of record online without going through the PI or proposal manager).

With respect to version control, many of the online collaboration platforms do this automatically. However, participant-observer experience showed that many investigators are not yet comfortable with this and fear they will not be able to resurrect an older version if needed. As such, the most common approach is to create version numbers indicated in the filename. While some teams define a process for what constitutes a new version and who can create a new version, others resort to an ad hoc approach such as the process described by one participant, "I save it as a new version when it feels like there have been a lot of changes or when I'm afraid my computer might crash." A more robust system was described in Chapter 4 where one person owns the task of up-versioning and is responsible for consolidating and resolving all comments from the prior version—which were received as tracked-changes files with initials differentiating in the file name—as the new file version is created. A downside of these approaches is they both rely on an individual to have the final say on what is in a new version and that versions can get crossed in the mail, requiring the document owner to merge and consolidate potentially conflicting comments. An advantage to using the automated version control provided by the online platforms is that teammates can edit concurrently in a collective, collaborative fashion. However, this make it difficult to see what has been edited and may lead to multiple editors making conflicting changes.

Document review. The last obstacle to overcome with respect to distribution of information is for the proposal teams to define processes and expectations for how document reviews will occur and how comments will be integrated into the drafts. In this context, document review refers to sharing drafts within the team for the purpose of editing and clarifying content rather than reviews provided by external personnel serving as mock panelists.

Common mistakes made by proposal teams include waiting too long to distribute review drafts, not specifying the purpose of the review, and not setting a deadline for when comments should be returned. Teams are sometimes hesitant to release drafts for review because they don't feel the content is complete enough to be reviewed. The drawback of this approach is that there may not be sufficient time to address the comments and strengthen the proposal before having to submit to the agency. Also, circulating early drafts with the explicit purpose of getting input on the vision, project structure, and technical approach will help sharpen the focus for the proposal details and will reduce the potential for rewrites.

Often, a lead writer will send out a document with only the instructions: "please review." Instead, the PI should be explicit about the type of comments desired, the timeline for completing the review, and the process for returning comments. For example, a review occurring early in the proposal development period is likely to require higher-level comments such as the overall structure, project vision, and the presentation of the technical approach. Providing wordsmithing or copyediting during early stages is often counterproductive when the team is still solidifying the approach. Likewise, the team may not be able to adequately address comments requesting sweeping changes to

the vision or overall approach if the comment is provided close to the submittal deadline. In the very late review stages, comments should be limited to those identifying typos, grammatical errors, or fatal flaws. For these reasons, it is important to provide the team with several opportunities for input and to specify what sort of comments are desirable in each review cycle.

In addition to fellow researchers providing review comments, the team should also consider having a technical layperson such as a proposal manager or a member of the research administration team review draft documents to ensure the proposal is understandable to audiences outside the immediate field and that the proposal adheres to all of the funding agency requirements.

Depending on the type of comments being solicited, the process for providing comments may vary. For example, comments on overarching vision may be best delivered and discussed in a team meeting or as bullet points or a narrative in the body of an email whereas detailed line edits and proofreading comments are best provided as a tracked-changes file. In some cases, lead writers may be amenable to their teammates editing directly in a shared, collaborative file. This has the advantage of everyone having agency and feeling ownership of the product, but it can cause confusion if multiple reviewers make conflicting changes in the document.

Allocation of decision rights

The third element of command and control for proposal teams relates to how decision rights are allocated. Typically, decision rights and conflict management during proposals are granted or assigned for the benefit of institutional audit needs rather than by the problem-solving needs of the teams. Four common decision-making strategies

are: having a single person in charge, arriving at consensus, voting, and distributing different types of decisions to different people.

At one extreme for making decisions and managing conflict, an individual person (often the PI) is responsible for all decisions, spanning all levels of importance. While this approach satisfies the institutional need to assign fiscal and compliance responsibility to an individual, it can slow decision-making, erode adaptive capacity, and undermine the expertise of other team members. In this approach, the PI is ultimately responsible for everything, from the largest overarching matters (e.g., setting the vision, allocating resources between participants, and deciding who to include on the team) to the smallest details (e.g., where to put the page breaks and the order of biographical sketches). Even in cases where, for example, departmental staff prepare supplemental documents such as biographical sketches or budgets, the PI must approve the documents before they can be submitted to the sponsoring agency. A concern with this approach is that it can cause bottlenecks if the PI isn't available to answer immediately, can tax the PI with decisions that aren't critical, and can make team members feel undervalued if their expertise is not adequately considered in decisions.

At the other extreme, teams would make all decisions by a consensus. While egalitarian, this approach may be too time consuming and impractical, especially for smaller decisions. If using this method, a team must also establish escalation criteria and identify arbitrators in the event team members cannot reach a decision, and this typically defaults to the PI. More often, teams make decisions by vote. The full team, or a subset of the team depending on the criticality of the decision and who is affected by the decision, will discuss the alternatives and collectively vote on how to proceed. This is

rarely a formal vote and is more often a discussion where everyone weighs in, and the most popular opinion advances. Even when deciding by vote, the PI often has more influence on the outcome than others as team members tend to defer to the leader.

In hybrid decision structures, the team may distribute decision authority to several team members, depending on the type and importance of the decision to be made. For example, the PI makes decisions about technical direction, a project manager makes decisions about schedule and budget, a proposal manager makes decisions about document production (e.g., style guide), and the sponsored projects office makes decisions that ensure compliance with federal and university rules governing research. Within the technical scope, it may also be appropriate to distribute decisions about research thrusts or sub-projects to the leaders and performers of those various elements. Distributing the decision rights empowers team members and instills a sense of ownership for the outcomes but requires robust planning so that people understand which decisions will be allocated to them and are prepared to accept responsibility and authority for making those decisions. This hybrid approach also requires teammates be willing to accept the decisions made by others.

Shared meaning making

In military applications of C2, addressing the prior elements (i.e., patterns of interaction, distribution of information, and allocation of decision rights) allows the team to self-synchronize and drives missions toward success (Alberts & Hayes, 2006). However, even when taken together, these three elements do not address one of the key obstacles that was identified in this research: shared vision of the future to which the team is working. This omission from the C2 framework is likely because the military

mission is typically well-defined. Because there are many reasons an investigator chooses to write proposals, factors for how they decide to join particular research proposal teams, approaches for overcoming engrained disciplinary differences, and lenses for deriving meaning, the shared meaning may not be immediately evident in proposal teams.

As discussed in Chapter 4, one participant noted that it may take up to six months to overcome the language gaps and differences in framing problems evident in different disciplines. Because proposals often must come together in several weeks, overcoming this gap may be unattainable in proposal teams. The approach cited by multiple participants to overcome these disciplinary differences was to have frequent discussions about the technical approach and problem-framing where team members are willing to question and also be questioned about disciplinary differences. Two participants used the phrasing "what if…" and expressed it was necessary to explore and evaluate the merits and drawbacks of possible outcomes arising from a change in approach. In a specific case, the team arrived at a new technical approach that no one had anticipated at the start of the discussion. She went on to say the outcome was "better than we imagined when we started, because the team all participated." The short time horizon for proposals may also be a benefit when it comes to proposals because there is not time to engage in what one participant termed "theory wars." However, this could backfire and turn the project into a failed success if the differences in approach manifest during the project executing phase and prevent the project team from achieving the project's research goals.

Discussions about meaning-making are led rather than managed. One PI I observed with several teams over many years signaled this to his teams by continuously saying: "we can do whatever we want, so what do you want to do?" This leadership strategy encouraged people to examine and articulate what they wanted to do and why, which allowed the leader to be more intentional about incorporating the desires of team members into the proposals and projects. A method for determining what you want can be borrowed from the Japanese concept of ikigai, which roughly means *reason for being*, and is defined as the intersection of what you love, what you're good at, what you can be paid for, and what the world needs. Other phrases that can be used to encourage discussions about meaning-making include "what do you want to get from this [proposal, meeting, research project, etc.]," and "there's an unstated problem we're trying to solve." A way to get a team to return to focus is by stating "that's not what we're trying to do" and then redirecting everyone's attention to the question needing discussion.

One surprising finding emerging from the interviews related to making meaning was that participants said it was ok if specific proposal motivations were misaligned provided that all team members were working toward the greater good of creating a compelling and interesting research proposal. This could be considered a form of adaptive meaning-making, where investigators are conscious in acknowledging the different lenses for making meaning and purposely accept this is ok. For example, it was acceptable if one person's primary reason for participating was to train their graduate student in writing proposals, another person's reason was to secure conference travel funding for themselves, and a third person wanted to explore new ideas because none

of those motivations conflicts with the ultimate goal of preparing and submitting the research proposal.

Summary and Recommendations

As summarized in this work, there is substantial literature on working in and assessing effective and successful project teams and knowledge workers, but there is comparatively little information on designing proposal teams to be more successful. To fill this gap, I collected data as a participant-observer and through interviews on motivations, obstacles, and successes of proposal teams. I examined the data against the C2 framework, which was designed to enhance team agility, achieve self-synchronization, and improve mission outcomes for the Department of Defense (Alberts & Hayes, 2003). Through this framework, several recommendations for overcoming the obstacles are presented. By implementing these recommendations, proposal teams will be better poised to achieve one or more of the three elements of success—external validation, internal validation, and willingness to continue the partnership (Hackman, 1987).

As discussed in Chapter 5, the multi-dimensional definition of success means that proposal teams can be considered successful even if the proposal is not selected for funding. This was confirmed by the research participants. Except for one person, all participants were able to identify with the concept of a *successful failure*, where the team derived benefits from the proposal other than being selected for award. However, the most often cited success metric in absence of funding was to keep the team together and try again, meaning that the ultimate goal remained a desire to be funded.

The most critical recommendation from this research is that at the outset of proposals, the team should discuss each element of the C2 framework (i.e., patterns of interaction, distribution of information, and allocation of decision rights) plus shared meaning to arrive at a clear approach for preemptively overcoming the stated obstacle—i.e., the team should shift from haphazard approaches to an intentional design of proposal writing processes. This discussion will also reveal how much the investigators understand the potential obstacles and their potential collaboration blind-spots prior to embarking on the proposal.

Embedding proposal managers or research development professionals in proposal teams can help investigators create intentional design for the C2 framework elements. Due to the differences in proposal team composition and preferences of the team members, the specific processes included as recommendations in this chapter may not be applicable to all teams, but that does not reduce the importance of the team selecting or determining processes they will follow. For example, it is more significant for the team to develop a plan for managing references than it is for me to recommend a specific reference management software in this work. This is also supported by the interview data. The participant who set the clearest expectations for their team throughout the proposal process (e.g., setting timelines for writing, having a "what-if" approach for bridging disciplinary differences, and establishing a review process that incorporated a standard file naming convention) was the only person who expressed an enjoyment of proposals. All other interview participants had a negative view of proposals, describing them using words such as necessary evil, torture, and miserable.

The broader impact of this work is that by implementing processes to address the obstacles, the proposal experience—from team creation, to idea generation, to document creation, to final submittal—should become more rewarding for faculty, leading to greater job satisfaction. This in turn will change the way university research enterprises create, organize, and share knowledge suitable for the post-industrial information age.

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APPENDIX A

INSTITUTIONAL REVIEW BOARD APPROVAL AND APPLICATION

EXEMPTION GRANTED

Thomas Seager
Sustainable Engineering and the Built Environment, School of (SEBE)
Thomas.Seager@asu.edu

Dear Thomas Seager:

On 2/7/2019 the ASU IRB reviewed the following protocol:

Type of Review:	Initial Study
Title:	Successful failures and failed successes: Untangling the obstacles facing collaborative proposal writing
Investigator:	Thomas Seager
IRB ID:	STUDY00009620
Funding:	None
Grant Title:	None
Grant ID:	None
Documents Reviewed:	• Passantino IRB Form-Social-Behavioral-Protocol_02-06-19.docx, Category: IRB Protocol; • Passantino IRB Recruitment.pdf, Category: Recruitment Materials; • Passantino IRB Interview Guide_02-06-19.pdf, Category: Measures (Survey questions/Interview questions /interview guides/focus group questions); • Passantino IRB Consent Form_02-06-19.pdf, Category: Consent Form;

The IRB determined that the protocol is considered exempt pursuant to Federal Regulations 45CFR46 (2) Tests, surveys, interviews, or observation on 2/7/2019.

In conducting this protocol you are required to follow the requirements listed in the INVESTIGATOR MANUAL (HRP-103).

Sincerely,

IRB Administrator

cc: Laurel Passantino
Thomas Seager

Instructions and Notes:

- Depending on the nature of what you are doing, some sections may not be applicable to your research. If so, mark as "NA".
- When you write a protocol, keep an electronic copy. You will need a copy if it is necessary to make changes.

1. Protocol Title

Include the full protocol title

Successful failures and failed successes: Untangling the obstacles facing collaborative proposal writing

2. Background and Objectives

Provide the scientific or scholarly background for, rationale for, and significance of the research based on the existing literature and how will it add to existing knowledge.

- Describe the purpose of the study.
- Describe any relevant preliminary data or case studies.
- Describe any past studies that are in conjunction to this study.

This study aims to increase the success of proposal teams so they can advance knowledge and solve increasingly complex problems facing today's world. Two critical research questions will guide this study:

A. What does it mean for proposal teams to be successful?

In research institutions such as ASU, it is tempting to view win/loss as the sole factor determining proposal team success. Admittedly, tracking wins, losses, and dollars are easy ways to quantify success. But, the low funding rate for large, interdisciplinary, multi-institutional research teams (Von Hippel & Von Hippel, 2015) and questions regarding peer-review reliability, reproducibility, and bias (Marsh et al., 2008) make funding success an unreliable indicator for the research proposals that grapple with grand challenges. The need for multi-dimensional and subjective measures of proposal team success prior to the funding decision is also apparent when considering the possibility of "unsuccessful wins", for example when the reality of project execution leads to panic (Bergstrom & Baun, 1994) or the research project is unrewarding for the investigators (D. M. Anderson & Slade, 2016). Preliminary data gathered during a case study research methods class in Spring 2017 indicated several team successes that are adjunctive to funding (e.g., creation of knowledge, the training of students, professional development for faculty, and economic development in the community). This study will build on the findings from the case study methods class and use interviews to expand our understanding of proposal team success.

B. What are the obstacles impeding proposal team success?

Recent team science studies suggest that the principal challenges to collaborative proposal writing are identifying the knowledge requisite to the research problem and overcoming barriers to incentivizing collaboration. However, science teams typically encounter several additional obstacles that inhibit team success. Based on personal

and professional observations of the graduate student (L. Passantino) through her job (which required participation in several proposal teams over the last 5 years), these obstacles include inconsistent or non-existent communication protocols, difficulties distributing relevant information, an ambiguous allocation of decision rights, and uncertainty in establishing a shared vision of the future to which they are working. Moreover, these obstacles, if left unaddressed, may persist beyond the funding decision and undermine the possibility of team successes during the project execution phase. Failure to address the obstacles facing teams may result in collaboration becoming taxing for the participants, decrease team member satisfaction, and waste time that could be spent making initiatives more productive. This study will validate prior observations with intentional and systematic data collection around the obstacles facing proposal teams.

Through interviews with faculty, staff, students, and other stakeholders invested in the academic research proposal process, this study will be the first step in developing a framework that shifts proposal development from ad hoc team formation to a deliberate design of multi-investigator and multi-institution research teams that overcome organizational obstacles, including a redefinition what it means for a proposal team to be successful. The interview data will be used as inputs to a survey instrument that will examine the relationship between activities that occur during real-world grant writing experiences to understand how some proposal teams can be described as simultaneous successes and failures and to make recommendations that increase successful outcomes for the proposal teams. A separate IRB application will be prepared for the survey in future phases of this work.

Anderson, D. M., & Slade, C. P. (2016). Managing Institutional Research Advancement: Implications from a University Faculty Time Allocation Study. Research in Higher Education, 57(1), 99–121. https://doi.org/10.1007/s11162-015-9376-9

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3. Data Use

Describe how the data will be used.
Examples include:

- Dissertation, Thesis, Undergraduate honors project
- Publication/journal article, conferences/presentations
- Results released to agency or organization
- Results released to participants/parents
- Results released to employer or school
- Other (describe)

The primary use for data collected in this study will be a dissertation by Laurel Passantino. De-identified data will also be presented at professional conferences and disseminated in journal articles. Lastly, findings (in aggregate) may be used to improve internal processes at ASU for developing teams to prepare and submit funding proposals. Results will only be released in aggregated form to participants.

4. Inclusion and Exclusion Criteria

Describe the criteria that define who will be included or excluded in your final study sample. If you are conducting data analysis only describe what is included in the dataset you propose to use.

Indicate specifically whether you will target or exclude each of the following special populations:

- Minors (individuals who are under the age of 18)
- Adults who are unable to consent
- Pregnant women
- Prisoners
- Native Americans
- Undocumented individuals

All study participants will be adults over the age of 18 who are able to consent. The other special populations listed above (pregnant women, Native Americans, and undocumented individuals) will not be specifically included or excluded from the study provided that they meet all other criteria for the study (see Question 6).

5. Number of Participants

Indicate the total number of participants to be recruited and enrolled*:*

I expect to interview approximately 15-20 participants in this research phase.

6. Recruitment Methods

- Describe who will be doing the recruitment of participants.
- Describe when, where, and how potential participants will be identified and recruited.
- Describe and attach materials that will be used to recruit participants (attach documents or recruitment script with the application).

The graduate student involved in this work (Laurel Passantino) will be responsible for recruiting interview participants. Sample recruiting email attached. The target population includes people invested in the research proposal writing processes and outcomes, including university faculty and researchers (tenure and non-tenure track), support staff, university administrators, and students/post-docs on proposal teams. To facilitate access, the study will begin with personnel at ASU. Participants will also be recruited from the pool of faculty and staff at institutions collaborating with ASU on proposal efforts. Although demographic data will be collected as control variables, it will not be used as exclusion/inclusion criteria.

Through her prior experience on staff in the Fulton Schools of Engineering and specifically working with multi-PI proposal teams, Laurel has access to many individuals in the target population. A sample recruiting email is attached.

7. Procedures Involved

Describe all research procedures being performed, who will facilitate the procedures, and when they will be performed. Describe procedures including:

- The duration of time participants will spend in each research activity.
- The period or span of time for the collection of data, and any long term follow up.
- Surveys or questionnaires that will be administered (Attach all surveys, interview questions, scripts, data collection forms, and instructions for participants to the online application).
- Interventions and sessions (Attach supplemental materials to the online application).
- Lab procedures and tests and related instructions to participants.
- Video or audio recordings of participants.
- Previously collected data sets that that will be analyzed and identify the data source (Attach data use agreement(s) to the online application).

Research data will be collected using a 30-60 minute structured interview with approximately 15-20 people invested in collaborative research proposal writing. The interview guide (attached) includes an introduction to the research, background information needed as control variables, and 12 questions specific to the participants' prior experience in collaborative research proposal teams. Interviews will be audio recorded, transcribed by a third-party transcription services, and quality-checked by the researcher. Identifying characteristics will be removed from the transcripts by the researcher. The transcriptions will be analyzed and organized using MAXQDA or similar software for qualitative analysis. The interviews will be conducted over a 2-3 month period. Participants may be contacted for clarifications or additional follow-up unless they opt out of additional communications during the interview (see Interview Guide Question 12 and consent form.)

8. Compensation or Credit

- Describe the amount and timing of any compensation or credit to participants.
- Identify the source of the funds to compensate participants
- Justify that the amount given to participants is reasonable.
- If participants are receiving course credit for participating in research, alternative assignments need to be put in place to avoid coercion.

Participants will not be compensated.

9. Risk to Participants

List the reasonably foreseeable risks, discomforts, or inconveniences related to participation in the research. Consider physical, psychological, social, legal, and economic risks.

There are no foreseeable risks to participating in this study.

10. Potential Benefits to Participants

Realistically describe the potential benefits that individual participants may experience from taking part in the research. Indicate if there is no direct benefit. Do **not** include benefits to society or others.

By participating in the study, participants may see their own research proposals in a different light and recognize value in their efforts, even if the proposal is not selected for funding. In addition, the recommendations for overcoming obstacles will be shared with participants, thereby offering opportunities for them to increase their own successes.

11. Privacy and Confidentiality

Describe the steps that will be taken to protect subjects' privacy interests. "Privacy interest" refers to a person's desire to place limits on with whom they interact or to whom they provide personal information. Click here for additional guidance on ASU Data Storage Guidelines.

Describe the following measures to ensure the confidentiality of data:

- Who will have access to the data?
- Where and how data will be stored (e.g., ASU secure server, ASU cloud storage, filing cabinets, etc.)?
- How long the data will be stored?
- Describe the steps that will be taken to secure the data during storage, use, and transmission. (e.g., training, authorization of access, password protection, encryption, physical controls, certificates of confidentiality, and separation of identifiers and data, etc.).
- If applicable, how will audio or video recordings will be managed and secured. Add the duration of time these recordings will be kept.

- If applicable, how will the consent, assent, and/or parental permission forms be secured. These forms should separate from the rest of the study data. Add the duration of time these forms will be kept.
- If applicable, describe how data will be linked or tracked (e.g., masterlist, contact list, reproducible participant ID, randomized ID, etc.).

If your study has previously collected data sets, describe who will be responsible for data security and monitoring.

The only people with direct access to the data will be Thomas Seager (faculty sponsor) and Laurel Passantino (graduate student). Interview recordings and transcripts will be stored in ASU's Dropbox for Education, which provides a controlled-access (i.e., password-protected), secure online storage solution for ASU faculty and staff. Dropbox was selected as the storage location in accordance with recommendations provided by the ASU University Technology Office Data Handling Matrix. The researchers will follow ASU's Information Technology policies and security protocols for Sensitive Information, which is confidential and protected. Data will be stored for at least 3 years after the conclusion of the study. All data and transcriptions will be deidentified prior to storage/analysis such than no personally identifiable information can be used in manuscripts, presentations, or dissertations. Consent forms will be kept in a separate folder also on Dropbox. Interview participants will be assigned a unique identifier number, and the de-identified transcripts will be linked to the ID number. A temporary master list linking participant names to the unique identifiers will be maintained so that the research team can contact participants for follow-up questions or clarifications. Participants will only be contacted for clarifications if consent has been obtained. The temporary master list of names and ID numbers will be kept in a Dropbox folder separate from the interview responses, and the file will be deleted/destroyed as soon as reasonably possible after the conclusions of the study.

12. Consent Process

Describe the process and procedures process you will use to obtain consent. Include a description of:

- Who will be responsible for consenting participants?
- Where will the consent process take place?
- How will consent be obtained?
- If participants who do not speak English will be enrolled, describe the process to ensure that the oral and/or written information provided to those participants will be in that language. Indicate the language that will be used by those obtaining consent. Translated consent forms should be submitted after the English is approved.

The graduate student assigned to this project (L. Passantino) will be responsible for obtaining consent from all participants. Participants will be asked to sign a written

consent form (attached) prior to the interview, and it will be confirmed verbally at the start of each interview.

13. Training

Provide the date(s) the members of the research team have completed the CITI training for human participants. This training must be taken within the last 4 years. Additional information can be found at: Training.

Thomas Seager 5/31/2017
Laurel Passantino 2/18/2017

CITI PROGRAM

Completion Date 18-Feb-2017
Expiration Date 17-Feb-2021
Record ID 22382110

This is to certify that:

Laurel Passantino

Has completed the following CITI Program course:

Human Research (Curriculum Group)
IRB – Social & Behavioral Research (Group 2) (Course Learner Group)
1 - Basic Course (Stage)

Under requirements set by:

Arizona State University

CITI
Collaborative Institutional Training Initiative

Verify at www.citiprogram.org/verify/?w21ec76b8-1d0c-49ba-980f-e064fbc62c12-22382110

Recruitment email

Hi _____,

As part of my PhD research, I am conducting a study to better understand team successes and failures in proposal writing. The study involves a 30- to 60-minute interview regarding your prior experience related to writing collaborative research proposals. Your participation in this study is voluntary. If you choose not to participate or to withdraw from the study at any time, there will be no penalty. Are you interested?

Contact me with any questions (laurel.passantino@asu.edu or 480-965-1154) or to schedule an interview time. I am currently scheduling interviews during the weeks of March 18 and March 25.

Laurel Passantino

Participant Consent Form

Successful failures and failed successes:
Untangling the obstacles facing collaborative proposal writing

I (Laurel Passantino) am a graduate student under the direction of Thomas Seager in the School of Sustainable Engineering and the Built Environment in the Ira A. Fulton Schools of Engineering at Arizona State University. I am conducting a research study to enhance understanding of what it means for proposal teams to be successful and the obstacles inhibiting those successes.

I am inviting your participation, which will involve a 30- to 60-minute interview regarding your prior experience related to writing collaborative research proposals. You have the right not to answer any question and to stop participation at any time. Your participation in this study is voluntary. If you choose not to participate or to withdraw from the study at any time, there will be no penalty. You must be 18 or older to participate in this study.

There are no foreseeable risks or discomforts to your participation.

The results of this study may be used in reports, presentations, or publications but your name and any identifying information will not be used.

I would like to audio record this interview. The interview will not be recorded without your permission. Please let me know if you do not want the interview to be recorded; you also can change your mind after the interview starts, just let me know. By signing this form, you are also consenting to be contacted with follow-up questions or clarifications unless you opt out during the interview process. There will be a specific question during the interview to document your preference for future communications.

If you have any questions concerning the research study, please contact the research team at thomas.seager@asu.edu or laurel.passantino@asu.edu. If you have any questions about your rights as a subject/participant in this research, or if you feel you have been placed at risk, you can contact the Chair of the Human Subjects Institutional Review Board, through the ASU Office of Research Integrity and Assurance, at (480) 965-6788.

By signing below, you are agreeing to be part of the study.

Signature:

Name:

Date:

Interview Guide

Successful failures and failed successes:
Untangling the obstacles facing collaborative proposal writing

This study aims to **increase the success of proposal teams**.

Throughout this interview, I will be asking questions about your experiences in proposal teams—that is, team dynamics up through the proposal submittal. Any type of proposal can be considered during this research, including federal, industrial, community, foundation, or philanthropic sponsors as well as internal submittals.

I'm looking at two critical research questions:

- What does it mean for proposal teams to be successful?
- What are the obstacles impeding proposal team success?

The findings will be used in a framework that shifts proposal development from ad hoc team formation to a deliberate design of multi-investigator and multi-institution research teams capable of overcoming organizational obstacles.

In this first step, I'll be interviewing faculty, staff, students, and other stakeholders invested in the academic research proposal process.

The interview data will be used to develop a survey instrument that will examine the relationship between activities that occur during real-world grant writing experiences to understand how some proposal teams can be described as simultaneous successes and failures and to make recommendations that increase successful outcomes for the proposal teams.

The primary use for data collected in this study will be my dissertation.

De-identified data will also be presented at professional conferences and disseminated in journal articles.

Findings (in aggregate) may also be used to improve internal processes at ASU for developing teams to prepare and submit funding proposals.

May I record this interview?

1. Background & demographics [control variables]

    - What is your Rank/Title (e.g., Faculty/Staff/Other)?
    - If faculty: what is the composition of your research group

	#PhD	#MS	#Post-Doc	#Res Sci	#ugrad
Funded					
Unfunded					
Others?					

    - What is your role in proposals?
    - How many multi-investigator proposal teams have you led…
        - in the last 12 months?
        - Overall?
        - Over what time period?
    - How many multi-investigator proposal teams have you participated in (not led)…
        - in the last 12 months?
        - Overall?
        - Over what time period?

2. What factors/criteria do you consider when deciding to write a proposal?

    - By yourself
    - When deciding to lead a proposal team
    - When deciding to join a team led by other

3. Think about a proposal you worked on where you enjoyed or learned from the proposal writing and submission process.

    - What made it enjoyable?
    - [Follow up on team composition, size of proposal, time allotted, role of participant]
    - What other things elevate your proposal team experience?

4. Think about a proposal you worked on where you did not enjoy the proposal writing and submission process. Take a minute to compare this to the example(s) you just mentioned.

    - What made you not enjoy it as much as the prior example?
    - [Follow up on team composition, size of proposal, time allotted, role of participant]
    - What other things ruin your proposal team experience?

5. What indicators let you know a proposal submission effort was successful?

6. What indicators let you know a proposal submission was (or was not) worth your effort?

7. Have you ever experienced a "successful failure", where the proposal was not selected for funding but you and/or the team derived other benefits?

    - What were those other benefits?

8. Have you ever had a "failed success", where the proposal is selected but you do not look forward to executing it?

    - What made you not look forward to executing the proposal?

9. Now that you've been thinking about your proposal experiences, please rank the following factors affecting your decisions to write proposals in order of most to least important. You may add others if desired.

    - Opportunity to fund/work with grad students
    - Opportunity to work with faculty outside your discipline
    - Provide funding for yourself/your own salary
    - Demonstrate funding record for career advancement
    - Find the research topic interesting
    - To increase reputation for collaborative work
    - To train others in proposal writing
    - Relevance to societal good
    - Extent to which research promotes my unit/lab/org
    - Building social capital
    - Liklihood of award
    - [see Question 2 and/or 7 for additional items]

    [Ask follow-ups on rank order answers]

10. With respect to your experiences, please rank the following obstacles to interdisciplinary collaboration. You may add others if desired.

    - Geographic dispersion
    - Misaligned motivations for participating in the proposal
    - Difficulty reaching other team members
    - Ambiguous writing assignments
    - Inconsistent citation management
    - Misaligned expectations when reviewing and commenting on drafts
    - Confusing file management and version control
    - Unclear decision-making processes
    - Insufficient resources available for the scope
    - Misaligned vision for the technical components of the proposal
    - Deadline-driven (not enough time to complete the proposal)
    - [see question 4 and/or 8 for additional items]

    [Ask follow-ups on rank order answers]

11. Is there anything else you think I should know or keep in mind as I keep talking to people about their experiences working on proposal teams?

    - Is there anything we haven't talked about that you think is important to understanding the success or failure of proposal teams?

12. May I contact you again with follow-up questions or clarifications?