

**What Sustains Inter-institutional Collaborations? An Exploratory Study of Research
Collaborations between Faculty at HBCUs and PWIs**

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ACADEMIC ABSTRACT

Despite the significant growth of inter-institutional research collaboration, there has been a disparity of partnerships between universities with different history, missions and identities. In competition for limited resources, inter-institutional collaborations among Predominantly White Institutions (PWIs) and research-intensive universities appear more frequent and better supported than between PWIs and Historically Black Colleges and Universities (HBCUs) or other minority-serving institutions (MSIs). Developing grant funding strategies is one way to enhance collaboration between faculty at HBCUs/MSIs and faculty at PWIs and improve pathways for success among traditionally underrepresented groups. The Institute for Critical Technology and Applied Science (ICTAS) at Virginia Tech, a research-intensive PWI, launched a unique seed funding program, the ICTAS Diversity and Inclusion Seed Investment (ICTAS D&I Investment), in 2016 to build direct faculty-to-faculty research partnerships between faculty at Virginia Tech and faculty at various HBCUs/MSIs.

With the rarity of such initiatives and recognizing the primacy of the topic, this doctoral study was defined in the context of the ICTAS D&I Investment to investigate the little-understood phenomenon of research collaboration between faculty at HBCUs/MSIs and faculty at PWIs. The study informed by several bodies of literature including social psychology, inter-organizational relationships, and ethics and moral philosophy. A qualitative multiple case study approach was employed to explore factors that influence the sustainability of collaboration considering the perspectives of faculty in the context of the ICTAS D&I Investment. The ICTAS D&I Investment-related reports as well as survey and interview data were collected from 15 faculty members representing eight collaborative teams, across Virginia Tech and six different HBCUs.

The findings indicate that potential collaboration and sustainability of partnerships rely on dynamic interactions between three dimensions in *temporal* context: *Structure*, broader

institutional and contextual elements, *Diversity*, similarities and differences between team members' characteristics, abilities, and identities, and *Relation*, interactions and exchanges between collaborators and their outputs in *doing* collaboration. The study shows ICTAS has been successful in facilitating fruitful collaborations among faculty participants at different institutions. Based on the findings in this study I recommend that forging and maintaining long-term relationships of collaborative teams across HBCUs and PWIs need attention to the importance of capacity building over time and broader organizational and administrative factors such as support structure and credit allocation. Further, I recommend that administrators and policymakers to develop similar programs as a strategy for broadening participation and enhancing diversity, equity, and inclusion, not merely as a means for enhancing research productivity.

What Sustains Inter-institutional Collaborations? An Exploratory Study of Research Collaborations between Faculty at HBCUs and PWIs

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GENERAL AUDIENCE ABSTRACT

Research collaborations between faculty members have become a common practice in higher education. The number of research collaborations across institutions, inter-institutional research collaborations, has increased significantly over the last few decades. However, there has been a disparity of partnerships between universities with different history, missions and identities. Collaborations among elite universities and Predominantly White Institutions (PWIs) appear better supported and far more common than collaborations between Historically Black Colleges and Universities (HBCUs) or other minority-serving institutions (MSIs) and PWIs. Considering the rarity of faculty collaboration across HBCUs/MSIs and PWIs and the lack of research studies on the process and dynamics of faculty collaboration, this dissertation study aimed to enhance the understanding of research collaboration between faculty at HBCUs/MSIs and PWIs. The study was defined in the context of a seed funding program, the ICTAS Diversity and Inclusion Seed Investment Program (ICTAS D&I Investment) at Virginia Tech. The program aims to facilitate research partnerships between faculty at Virginia Tech, a PWI, and faculty at HBCUs/MSIs.

The general phenomenon of interest was faculty research collaboration across HBCUs/MSIs and PWIs. The dissertation specifically investigated factors that facilitate sustainable collaboration between faculty at HBCUs/MSIs and a PWI, primarily through understating faculty experiences with collaboration. In this study, sustainability has been characterized as continued working relationship between faculty at Virginia Tech and faculty at HBCUs/MSIs beyond the funding period, when they first received support through the ICTAS D&I Investment. Fifteen faculty members representing eight collaborative teams, across Virginia Tech and six different HBCUs, participated in this study. The primary sources of data were individual interviews and survey questionnaires. The data analysis and comparison across different teams indicated several factors essential to sustainable inter-institutional faculty collaboration. The factors were further aggregated to three broader dimensions: *Structure*, broader institutional and contextual

elements; *Diversity*, similarities and differences between team members' characteristics, abilities, and identities; and *Relation*, interactions and exchanges between collaborators and their outputs in *doing* collaboration. In addition, the findings indicated that time plays an essential role in team processes. Based on the findings in this study, I recommend that forging and maintaining long-term relationships of collaborative teams across HBCUs and PWIs need attention to the importance of capacity building over time and broader organizational and administrative factors such as support structure and credit allocation. Further, I recommend that administrators and policymakers to develop similar programs as a strategy for broadening participation and enhancing diversity, equity, and inclusion, not merely as a means for enhancing research productivity.

This dissertation is dedicated in loving memory of my father,
Davood Jalali

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Chapter 1: Introduction

Research collaborations between faculty members have become a typical practice in higher education. Faculty members increasingly engage in collaborative work, individually or as part of a team, within their own institution or across institutions. Inter-institutional collaborations as a form of collaboration across domain and boundary, discipline, institutions, and countries, have grown significantly over the past several decades (Jones et al. 2008). Despite the overall growth in collaborations across universities, collaborations among elite schools and research-intensive institutions appear to dominate multi-university partnerships. Faculty tend to collaborate with individuals affiliated with institutions with similar status levels as their own, independent of geographic distance (Jones et al. 2008). Overall, inter-institutional collaborations among Predominantly White Institutions (PWIs) and research-intensive universities appear more frequent and better supported than between PWIs and Historically Black Colleges and Universities (HBCUs) or other minority-serving institutions (MSIs). This dissertation focuses on a process-oriented illustration of inter-institutional collaboration, involving faculty at a PWI and faculty at HBCUs/MSIs, facilitated by a seed funding program, and explores the nature and quality of collaborative relationships to examine factors that influence continuity of partnerships.

Professional development and faculty growth, developing the links and social capital, learning and innovations, and publications and knowledge production are among some of the major benefits of research collaboration that have been widely discussed within the literature (Austin and Baldwin, 1991; Bozeman et al. 2001; Bozeman et al. 2013; Clark, et al. 1996; Creamer, 2004a; Sonnewald, 2007). As such individual faculty may have different reasons to engage in collaborative relationships, such as increasing productivity, gaining access to expertise, equipment, technology, or other resources, student training and mentorship, and professional service (Katz and Martin, 1997; Lee and Bozeman, 2005; Melin, 2000). Meanwhile, different structural factors have either pressed the need for collaboration, such as increasing specialization, creation of new subfields, and the need for productivity (Baldwin and Austin, 1995; Younglove-Webb et al. 1999), or facilitated increasing amount of collaboration, such as development in information and communication technology, established funding opportunities, or physical proximity (Bozeman and Boardman, 2014; Cummings and Kiesler, 2005; Katz and Martin, 1997; Sonnenwald, 2007).

In competition for limited resources, however, elite and research-intensive institutions have privileged to access resources that strengthen the patterns of institutional stratification, (Torres-Olave et al. 2020); inequality is increasing (Leachy, 2016), and social distance has become of greater importance in research collaboration (Jones et al. 2008). In addition to broader structural elements such as resource advantages and journal leadership (Jones et al. 2008), studies in social psychology and organizational behavior suggest that people in general are more attracted to similar others and tend to form homogeneous groups. This line of argument, despite its widespread applications, should be cautiously considered, and needs to be interpreted along with potential influence on individuals' attitudes and motivations, especially in relation to major features of surface-level diversity in groups, such as race, age, or sex (Harrison et al. 2002). The ways we think about and imagine one another shape and define our relations (Buber, 1958; Royce, 1885). Ideally, to foster relations, one should imagine another beyond set of categories and considering them as the "whole being" (Buber, 1958). The extension of this moral argument is widespread in studies in domains of psychology and social psychology, particularly in research in exploring stereotyping and prejudice towards others (Fiske and Neuberg, 1990; Greenwald and Banaji, 1995).

At the macro-level, there are inherent uncertainties (Ring and van de Ven, 1994) and challenges of communication and coordination (Cummings and Kiesler, 2005) in inter-organizational relationships. Further, in the context of collaboration between majority and minority universities there is a potential concern of uneven relationships. In such context and considering the lack of broad structures that facilitate collaboration across different types of institutions become important to help forging collaborative relationships and help with enhancing research productivity, diversity, resource sharing, creativity, and innovation.

The Institute for Critical Technology and Applied Science (ICTAS) at Virginia Tech, a research-intensive PWI, has deployed a unique seed funding program, the ICTAS Diversity and Inclusion Seed Investment (*ICTAS D&I Investment*), since 2016 to build faculty research partnerships between faculty at Virginia Tech and HBCUs/MSIs. This dissertation was defined in the context of the ICTAS D&I Investment and presents a process-oriented understanding of inter-institutional collaboration based on the perspectives of faculty whose projects were supported through this seed funding, specifically by focusing on questions about the continuity of research collaboration beyond the duration of the funding period.

1.1 Statement of the Problem

Some studies have reported different collaborative activities and partnerships between HBCUs/MSIs and PWIs. A few studies report partnerships between research-intensive PWIs and HBCUs/MSIs in the broad area of medicine centering around addressing health disparities (Carey et al. 2005; Ofili et al. 2013). Another group of studies reported initiatives centered around creating educational and research opportunities for students, broadening participation, and creating a pipeline for the student population, in particular in Science, Technology, Education, and Mathematics (STEM) (Ghee et al. 2014; Jalali et al. 2021a; Jenerette et al. 2008; Stassun et al. 2010; Williams et al. 2011). Minority-majority partnerships have often been concerned with creating opportunities for undergraduate and graduate students rather than interventions at the level of faculty (Campbell and Tumin, 2020). There is almost no picture of the dynamics of relationships and collaborations between faculty at HBCUs/MSIs and faculty at PWIs.

Beyond the specific focus of this study—faculty research collaboration between HBCUs/MSIs and PWIs—a large body of the literature examined collaboration between individuals, groups, or organizations. Empirical studies of research collaborations predominantly rely on quantitative approaches to address a variety of issues, among them: presenting patterns of collaboration over time in particular fields or areas, for example, by employing bibliometric analysis of publications; examining factors that influence formation or persistence of collaboration; or examining ways by which collaborations influence outcomes, such as productivity (Biancani and McFarland, 2013; Bozeman et al. 2001; Bozeman et al. 2013; Dahlander and McFarland, 2013; Lee and Bozeman, 2005; Newman, 2001).

There are two limitations with most of these quantitative studies. First, the primacy of outcomes resulting from the collaboration is the dominant theme across these studies. The concept of collaboration is often treated and operationalized as the products of collaboration—primarily publications. Second, more importantly, despite providing critical and useful insight about the structure, trend, and various factors that may affect collaboration, they overlook the dynamics and processes of collaboration and what individuals experience from their collaborative relationships, or different choices they make throughout the process of collaboration (Bozeman et al. 2016; Melin, 2000).

Some other limited empirical studies incorporate qualitative approaches and take into account the perspectives of faculty to study the nature of their collaborative relationships (Baldwin and Austin, 1995; Bozeman, et al. 2016; Creamer, 2003; Creamer, 2004b; Jeffrey, 2003; Melin, 2000). However, their analysis focuses on individual faculty in research teams or universities and overlooks dynamics of collaborative relationships among faculty embedded in different institutions with different missions and identities.

This dissertation study contributes to the literature by improving our understanding of the process of inter-institutional research collaboration between faculty at HBCUs/MSIs and faculty at a research-intensive PWI. By employing multiple case study, this work aims to understand similarities and differences between collaborative teams and explore factors that influence the sustainability of their collaboration.

1.2 Significance of the Study

This study explores the little-understood phenomenon of research collaboration between faculty at HBCUs/MSIs and faculty at PWIs. The lack of literature on the process and dynamics of collaboration has been reported by others (Bozeman et al. 2013). When it comes to studies at multiple levels, considering both individual and institutional elements, the situation is even less encouraging. In other words, there is an underrepresentation of studies examining collaborative relationships of faculty across different types of institutions. As pointed out earlier, this study is novel because as-yet there is no other research on the dynamics of relationships between faculty involved in collaborations between HBCUs/MSIs and PWIs.

There are several features of this study, bearing on assumption, methods, and theory, that are worth noting. First, this study moves beyond the product-oriented picture of collaboration that is evident even in some qualitative studies where they focus on successful instances of collaboration in terms of research products and/or outcomes, often with limited perspective on success (e.g., high records of publications). Second, in contrast with most empirical studies that are based on perspectives of one collaborator, which at best present a limited picture of the dynamics of collaboration and face a major limitation (Bozeman et al. 2016), this study centers around teams and intends to hear perspectives of collaborative partners at both HBCUs/MSIs and PWIs. Third, this research looks at faculty collaboration by navigating two bodies of literature: Social psychology literature on teams and teamwork (Harrison et al. 2002; Ilgen et al. 2005;

Kozlowski and Bell, 2013; Marks et al. 2001), and the inter-organizational domain on the dynamics of inter-organizational relationships (Gray, 1989; Gray and Wood, 1991; Ring and Van de Ven, 1994; Vangen and Huxham, 2003). The complexity of studying collaboration and theoretical gaps is discussed further in Chapter 2.

In addition to the different ways this study contributes to the literature, there is important practical significance. As was discussed earlier, this study was motivated and defined in the context of the ICTAS D&I Investment. With the rarity of such initiatives and studies in this area, this dissertation recognizes the need and primacy of the topic, calls for further attention, and builds a foundation to motivate administrators and policymakers to develop similar programs at other institutions and operationalize findings to diminish the probability of missed opportunities to enhance collaboration and enhancing pathways for success among traditionally underrepresented groups.

The purpose of this qualitative multiple case study was to enhance the understanding of faculty research collaboration across HBCUs/MSIs and PWIs, specifically by exploring factors that influence the sustainability of research collaboration, considering the perspectives of faculty whose projects were supported through the ICTAS D&I Investment between 2016 and 2019. In this study, sustainability has been characterized as a continued working relationship between faculty at Virginia Tech and faculty at HBCUs/MSIs beyond the funding period when they first received support through ICTAS D&I Investment. Similar conceptualizations of sustainability have been used in the study of collaboration across disciplinary and organizational boundaries (Cummings and Kiesler, 2007) and international university-to university partnerships (Wilson, 2012).

The phenomenon of interest in this study is faculty research collaborations across HBCUs/MSIs and PWIs. The focus of this study was on collaborative teams embedded in the context of inter-institutional relations. As such a case was defined as a collaborative team, which includes at least one faculty at HBCU/MSI and one faculty at Virginia Tech. The central research question this study seeks to investigate is: *What factors facilitate sustainable collaboration between faculty at HBCUs/MSIs and faculty at a PWI?*

1.3 Context of the Study

Research centers and institutes typically provide some level of support for facilitating different research activities, in which collaboration is encouraged (Biancani et al. 2018; Boardman and Corley, 2008). The ICTAS D&I Investment promotes research collaboration across different types of institutions. ICTAS expects the partnerships to result in research proposals. The hope is that collaborative partners at Virginia Tech and HBCUs/MSIs maintain their collaborative relationships beyond the duration of the funded partnership.

Declines in public funding over the past few decades and engagement of universities in commercial marketing (Zusman, 2005) have prompted the growth of research centers and institutes, often promoting interdisciplinary research and addressing emerging new research priorities. Research centers' major functions are often to facilitate different forms of technology transfer, such as applied and commercial research and patenting, and publishing (Boardman and Corley, 2008). Although these organizational entities vary significantly in terms of resources, structure, and mission, they typically provide some level of support for different research activities, in which collaboration is encouraged, internally or externally. Boardman and Corley (2008) refer to research collaborations as one thing that research centers have in common. Seed grant programs are one of the strategies that research centers employ to provide faculty with funding opportunities to encourage research activities (Biancani, et al. 2018).

ICTAS at Virginia Tech is one such center that offers seed funding for promoting research collaborations within and outside the university. Within ICTAS, the D&I Investment is a key program design to build faculty research partnerships across institutions that primarily serve systemically marginalized populations.

This investment provides resources for travel, joint publications, reciprocal visits for teaching and guest lectures, and provides access to the Virginia Tech facilities to the faculty and at HBCUs/MSIs as well as research and education opportunities for students at both institutions. Funds are awarded based on peer review conducted by faculty with interest in growing HBCU/MSI research partnerships at Virginia Tech. The following criteria used to evaluate the proposals submitted by Virginia Tech faculty:

1. Clearly identify their partnership with an HBCU/MSI
2. Describe their plans for next steps such as joint proposals or joint publications
3. Discuss the degree that proposed research can affect a significant population

4. Describe the sustainability of collaboration beyond one year

Virginia Tech faculty awardees are asked to submit a report at the end of the year and list various collaborative activities, including publications, grant proposals applied for and received, and the total number of students funded.

The ICTAS D&I Investment has been operational since 2016. Between 2016 and 2022, 108 funded seed investments have been made and 37 partner institutions have been involved in the program. As was discussed in Chapter 1, the focus of this dissertation is on the partnerships that were facilitated between 2016 and 2019 – the fiscal years of 2017, 2018, and 2019.

During this period, 50 awards in the amount of \$10,000 each were made to help build and foster collaborative efforts between Virginia Tech faculty and HBCUs/MSIs partners. As a result, 49 projects (one project received two funded seed investments) and twenty-three different HBCUs/MSIs were involved in the program. Figure 1 presents all partner institutions (and sites) involved in the program. In total, 23 HBCUs/MSIs engaged in the program between 2016 and 2019. Within Virginia Tech, six colleges and four centers/institutes were involved with the ICTAS D&I Investment, with most of the awards associated with the Virginia Tech College of Engineering and the College of Science. The distribution of funds among Virginia Tech colleges and departments that were involved with the ICTAS D&I Investment within these fiscal years is presented in Table 1. The list of abbreviations is presented in Appendix A.

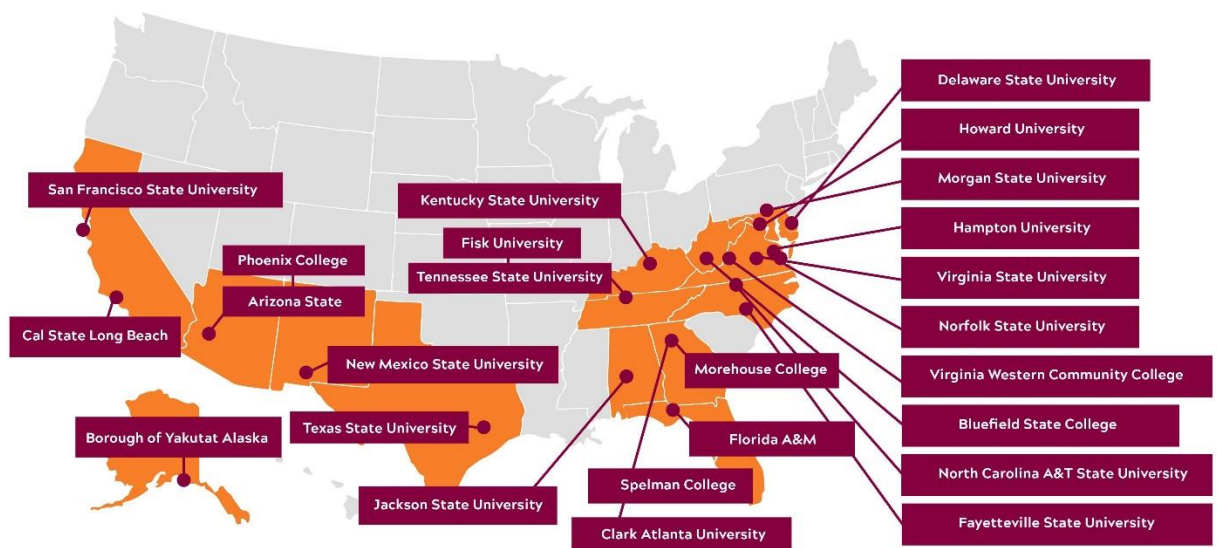


Figure 1. ICTAS D&I Investment partners

Table 1. Virginia Tech departments and colleges involved with the D&I Investment (2016-19)
(The number of awards is presented in parentheses)

Year	College of Engineering	College of Science	College of Veterinary Medicine	College of Agriculture and Life Sciences	College of Architecture and Urban Studies	College of Liberal Arts and Human Sciences	Centers and Institutes
2017	ME (2) EE (1) AOE (1) CEE (3) ChE (2) ECE (1) BEM (2)	Phys (3) Chem (1) Stats (1)	PHS (1)	FST (1)			MII (2)
2018	BEM (3) CEE (1) ME (1) MSE (1) BSE (2) ISE (1) EE (1)	Biochem (1) Chem (1) Math (1)					ICTAS (1)
2019	BEM (3) BSE (1) ME (1)	Chem (1) Phys (2)		SOPES (1) APS (1) FST (1)	SOAD (1)	AHRM (1) SOE (1)	HRAREC (1)

It should be noted that there have been two major changes in the structure of the ICTAS D&I program since 2018. The first involved an additional requirement for fall 2018 awardees in which the faculty are now expected to participate in the annual HBCU/MSI Research Summit. The Summit is a collaborative effort between Virginia Tech and HBCUs/MSIs and is organized by the Virginia Tech Graduate School. This event offers an opportunity for faculty and students to engage in discussion to initiate and plan research partnerships, summer research opportunities, and other teaching and research collaborations. Another major change in the structure of the program was transition in the duration of research partnerships from a one-year program to a two-year program. Beginning in 2019, there was a separate call for the recipients of 15 awardees in 2018 to apply again for another year, an opportunity to renew funding for an additional year of financial support for the original proposal. Since then, the ICTAS D&I Investment has been

formally a 2-year program. It remains an open question as to whether the structural changes facilitated more interaction and influence the process of collaboration.

1.4 Researcher's Experience

My experiences as a researcher certainly influenced the evolution of this research project and its different stages. First, as a graduate assistant in the Graduate School's Office of Recruitment, Diversity, and Inclusion, I was given an opportunity to serve as the lead graduate student with responsibilities related to planning, organizing, coordinating, and evaluating the university-wide HBCU/MSI Research Summit between 2018 and 2020. In collaboration with the program's leaders, I initiated a study, incorporating qualitative and quantitative measures to evaluate the effectiveness of the program. By learning from faculty and students, the goal was to better understand participants' experiences and improve the major components of the program. Through engagement in the Summit and my interviews with faculty at HBCUs/MSIs and Virginia Tech, I developed an understanding of the phenomenon of collaboration between faculty at HBCUs/MSIs and faculty at PWIs.

Second, during the same period, I worked closely with the ICTAS Diversity and Inclusion Coordinator. While I was developing research ideas for what it eventually became my dissertation, I was given permission to review the organizational documents, mainly proposals, and reports submitted by Virginia Tech grantees. I also had first-hand opportunities to hear feedback from Virginia Tech faculty during meetings with the ICTAS Director and the Diversity and Inclusion Coordinator. During that period of time, I suggested incorporating a more holistic measure for collecting data from faculty to report on both tangible and intangible outcomes of their collaborative relationships.

Third, I came to this research with my beliefs and values about the primacy of relation and imagination within our social contexts. As a researcher, my work has been primarily concerned with ethics in both interpersonal and broader social contexts, where I emphasized the importance of the qualitative character of others' experiences (e.g., Jalali et al. 2021b). The choice of qualitative approach and particular issues I focused on in this research study are influenced by my prior research experiences and overall orientation towards relational perspectives.

1.5 Overview of Chapters

In this chapter, I addressed the basic foundation of the research study, including the need, purpose, and significance of this research study and the context in which this study was defined and implemented. In Chapter 2, I review the literature on research collaboration and build on theoretical foundations in two bodies of research, social psychology and inter-organizational domain, to introduce a conceptual lens for studying faculty collaborations across universities. In Chapter 3, I review the methodology and how the multiple case study approach was operationalized in this research study. I discuss sampling strategies, data collection, approaches for data analysis, and indicators of the quality of the research. I present the results and findings of this study in Chapter 4. Lastly in Chapter 5, I elaborate on the results in dialogue with the literature and conclude the dissertation.

Chapter 2: Review of the Literature

As described in Chapter 1, there has been little research on the process of faculty collaboration and the dynamics of interpersonal and inter-institutional relationships, specifically in the context of HBCU/MSI-PWI partnerships. Considering the focus of this study, exploring factors that influence the sustainability of research collaboration, there is a need to develop a process-oriented study of research collaboration to better understand how different phases and activities evolve and what potential factors may influence the continuity or discontinuity of collaboration. Different aspects of research collaboration have been addressed through various channels, including journals in various fields and areas such as *Administrative Science Quarterly*, *Higher Education*, *Research Policy*, *Social Studies of Science*, and *The Review of Higher Education*, to name a few. In discussion that follows, I use the insights in different domains such as management and social psychology.

In this chapter, I first discuss partnerships between HBCU/MSI and PWIs from a broader perspective. Next, I examine engineering education literature in relation to research collaboration. Then, I explore critical issues discussed in the prior literature on research collaboration, address common ways research collaboration is defined and operationalized, and explore studies in which the processes and dynamics of collaborations have been a major concern. Finally, I introduce two theoretical orientations that provide insights to understand faculty collaboration across universities, namely social psychology literature on teams and the inter-organizational domain. I build on the two bodies of literature to develop a conceptual framework as a lens to explore collaboration between faculty at HBCU/MSI and faculty at Virginia Tech.

2.1 HBCU/MSI-PWI Partnership

In general, higher education institutions are not structured to support collaborative approaches (Kezar, 2005), especially in the context of inter-institutional collaboration between institutions with different identities and missions (Duffield, et al. 2013). Limited reported collaborative initiatives between HBCUs/MSIs and PWIs have often been concerned with providing opportunities for students and broadening participation, particularly in STEM fields. For example, creating opportunities for students to consider pursuing graduate degree programs

at PWIs has been one of the major motivations of such partnerships. In general, PWIs offer programs at the graduate level that may not be available at some of the minority-serving institutions. In addition, PWIs often benefit from additional funding and institutional resources (Upton & Tanenbaum, 2014).

The partnership between Vanderbilt University and Fisk University, the Fisk-Vanderbilt Masters-to-PhD Bridge Program (Stassun et al. 2010), for example, is a collaborative initiative centered around students that provide opportunities for students for additional instructional and/or research experience at both institutions. Students accepted to the program get to interact with faculty and receive support and mentorship to prepare for doctoral studies. Among more comprehensive programs, the Leadership Alliance is an initiative that involves more than 30 institutions, including research-intensive institutions and MSIs (Ghee et al. 2014). Students in the program take a primary role in undertaking a research project during 8- 10 weeks of summer research experience. The program provides opportunities for mentorship and enhancing students' research and professional skills.

One unique collaborative initiative involving both students and faculty is HBCU/MSI Research Summit, a collaborative effort between Virginia Tech and various HBCUs/MSIs. Each year, students and faculty from HBCUs and MSIs are invited to Virginia Tech for a two-day program (Jalali et al. 2021a). The objectives of the summit are to:

1. Develop on-campus opportunities for HBCU and MSI students to learn about Virginia Tech's advanced degree programs and provide Virginia Tech graduate programs an opportunity to recruit prospective students
2. Facilitate in-person interaction among faculty to build relationships and foster cross-institutional research partnerships
3. Facilitate discussion about shared degree programs and inter-institutional agreements.

The initial assessment of the HBCU/MSI Research Summit focused on students' evaluations of the initiative in 2018, the program's effectiveness concerning faculty research collaboration has not yet been presented.

As noted earlier, the focus of minority-majority partnerships has been mostly on student-level interventions, and there is not much evidence about partnerships at the faculty level (Campbell and Tumin, 2020). Regardless of the type of initiatives and partnerships, the efforts must move beyond reaching particular diversity indicators (e.g., participation in initiatives by

individuals from historically, systemically marginalized backgrounds). The efforts that are primarily focused on indicators such as participation numbers may overlook the importance of building long-term capacity by focusing more holistically on relationships that can naturally self-sustain over time. There are indeed broader structural barriers (e.g., funding, management, and coordination) to building strong on-going relationships between HBCUs/MSIs and PWIs where capacities and capabilities of partner institutions are recognized and respected. In connection with the context of this dissertation study, different priorities, reward structures, and, more importantly, the historical background of race and privilege need to be taken into account, and deficit models of relationships between minority-majority institutions need to be rejected (Castenell, 2002).

In a study of inter-institutional research collaborations, Fitzgerald, et al. (2018) observe a difference between researchers engaged in an interdisciplinary consortium, comprising of five partner institutions, including one HBCU. The authors report that scholars at the HBCU, among five institutions engaged in the center, were least likely to collaborate with other members; the authors elaborated on the reasons:

This might be because these scholars are more focused on teaching than research in accordance with their institutional mission, consider single-authored works to have more value for them, or have fewer people willing or available to collaborate with them in fields represented in the Center. The educational focus of the academics at the HBCU was exemplified in an interview in which a participant was asked what he would like the Center to do to help his career; he answered, “One of the big things is just resources and opportunities to create opportunities for students” (Fitzgerald, et al. 2018, p. 9-10).

While the speculation might represent some potential reasons for the lack of involvement of HBCU scholars, it certainly does not provide a complete answer to the *why* and *how* of such observations. Closely related, if existing conditions get treated as normal by researchers, practitioners, and policymakers, the importance of quality and dynamics of relationships and overall improving the avenues for facilitating partnerships may be overlooked.

2.2 Research Collaboration and Engineering Education Literature

The scholarship of engineering education has built on knowledge structure and different bodies of literature, engineering, education, and other disciplines such as psychology and sociology (Klassen and Case, 2020).

Within engineering education, there have been limited studies on the dynamics of research collaboration, in general, and faculty collaboration across universities in particular. Most studies have been concerned with the number and overall patterns of collaborative research produced within engineering education research (EER) (Abdelhamid et al. 2021; Jesiek et al. 2011; Nowaz and Strobel, 2016). Increasing funding opportunities, expansion of engineering education, and increasing numbers of engineering education research centers have contributed to the growth of collaborative research in engineering education (Jesiek et al. 2011).

While there has been a good deal of attention on collaboration as an area of research within engineering education literature (e.g., Cross et al. 2021; Gillen et al. 2021), only a few empirical studies explored faculty research collaboration. This is surprising considering the fact that the development of engineering education as a field is owed significantly to collaboration between faculty with different backgrounds. Engineering education scholars described the need for contribution from multiple disciplines for engineering education scholarship (Borrego and Newswander, 2008). Although there have been some discussions on the process of research collaboration within which some important factors such as trust and power relations have been discussed (Borrego, 2006; Borrego and Newswander, 2008), not only is there a gap in empirical studies in this area but it also appears that faculty research collaboration as an area of research has been underemphasized. The studies concerned with research collaboration in engineering education literature often maintain the conventional product-oriented illustration of collaboration by focusing on co-authorship or publications (Jalali et al. 2021c).

Reflecting on the overall pattern of engineering education scholarship, there is a growth in the number of Ph.D. programs, research centers, and journals in engineering education. However, with the increasing number of engineering education researchers, which is also evident in bibliometric studies of co-authorship, dynamics of collaborator seeking and collaborative relationships and their broader structural and policy issues have been overlooked in engineering education literature.

Within engineering education, in 2015 an important step was taken by deans of engineering from various institutions across the United States. They signed a document and committed action in response to the underrepresentation of women and other minority demographic groups. One of the major commitments was to develop partnerships across institutions, namely between research-intensive institutions and non-PhD minority-serving

institutions. While such an initiative may indeed lead to connections and collaborative relationships between faculty, and it is most certainly welcome, there is a need to recognize that initiatives and partnerships at the faculty level can create a valuable capacity that will help both faculty and students population at partner institutions.

2.3 What is Research Collaboration?

Research collaboration is conventionally perceived and operationalized using co-authorship. Co-authorship has been a primary focus on a significant body of works on research collaboration. Katz and Martin (1997) question the implicit assumption about the meaning of research collaboration and emphasize its conceptual ambiguity. The authors propose some criteria to distinguish who collaborators are in terms of researchers' contribution, authorship, and responsibility for different steps or elements of the research. They argue that there is a difference between collaboration and co-authorship, and co-authorship is not beyond a partial indicator of collaboration, "[C]o-authorship can never be more than a rather imperfect or partial indicator of research collaboration between individuals" (Katz and Martin, 1997, p. 11)

Bozeman et al. (2013) go beyond the argument made by Katz and Martin and suggest that co-authorship is one of the various outcomes resulting from the collaboration. They define collaboration as, "social processes whereby human beings pool their human capital for the objective of producing knowledge" (Bozeman et al. 2013, p. 3). Bozeman and Boardman (2014) offered a similar definition in their review book on research collaboration and team science; they define collaboration as, "social processes whereby human beings pool their experience, knowledge and social skills with the objective of producing new knowledge, including knowledge as embedded in technology" (p. 2).

There are several features in these definitions critical to every collaborative activity. First, collaboration is a social process; it involves a connection between individuals and should be defined and explored as a social activity. Second, collaboration is about what researchers bring to the context of their relationship, human capital, and social capital (Bozeman et al. 2001; Bozeman et al. 2013). Broadly speaking, human capital refers to skills and abilities researchers develop through their educational and other professional experiences; and social capital refers to network ties and linkages.

Lastly, as defined by Bozeman and his colleagues, collaboration is primarily concerned with outcomes in the form of publications, patents, or technology development. Importantly, they recognize that a collaborative effort may not succeed in terms of products listed above. However, such an effort must aim at producing knowledge. What is contradictory in the definitions is the inherent emphasis on capacity building by highlighting the primacy of social capital and human capital, yet remaining concerned with a limited range of outcomes resulting from the collaboration.

Sonnenwald (2007), in a review of research literature on scientific collaboration— often used interchangeably for research collaboration—defines scientific collaboration as: “interaction taking place within a social context among two or more scientists that facilitates the sharing of meaning and completion of tasks with respect to a mutually shared, superordinate goal.” (p. 645).

The author also adds that individual scientists may bring additional goals. This definition does not explicitly address human capital. However, it emphasizes the primacy of goals, whether shared or individual, rather than specific scientific outcomes.

2.4 In What Ways Research Collaboration Get Operationalized?

As noted earlier, many studies operationalized research collaboration in terms of co-authorship. While this approach certainly has several benefits, including verifiability, stability over time, data availability, and ease of measurement (Katz and Martin, 1997), it is limited in a sense that it neglects the perspective of individuals of whom they refer to as actual collaborators and their level of engagement. In other words, co-author notion of collaboration overlooks *who* collaborators are and *how* collaboration evolved and took place. For example, Dehlandar and McFarland (2013), in their exemplar study on collaboration persistence using a longitudinal dataset of faculty collaborations at Stanford University between 2003 and 2007, operationalized the formation and persistence of faculty collaboration through indicators of knowledge production, mainly publication and grant application.

Others consider a different concept of collaboration and use self-reported data collected through a questionnaire to categorize what is and is not collaboration (Bozeman and Corley, 2004; Lee and Bozeman, 2005). For example, Lee and Bozeman (2005), in their study on examining the effect of collaboration on research productivity based on the data from 443 scientists affiliated with the U.S. research centers, asked respondents to identify the number of

their collaborators with whom they were involved in research collaboration within the past 12 months. Lee and Bozeman (2005) used two measures of productivity, normal count and fractional count of peer-reviewed journal papers. The authors address the focus on the number of collaborators (not number of collaborations) as a limitation of how the concept of collaboration is operationalized.

Another group of studies conceptualized collaboration as part of the concept of scientific and technical human capital, S&T human capital (Boardman and Corley, 2008; Bozeman and Corley, 2004; Ponomariov and Boardman, 2010). S&T human capital at the individual level is defined as the sum of an individual's knowledge, skills, resources, and professional linkages and networks (Bozeman et al. 2001). Bozeman et al. (2001) distinguished between internal resources, including cognitive skills, scientific and technical knowledge, and context and craft skills, and external resources, including social capital and network ties, which individual researchers bring to the collaboration.

2.4.1 The S&T Human Capital Model

With S&T Human Capital Model, the concept of collaboration may go beyond the state of collaborative engagement of individual researchers and include the entire research team or even the research field. This alternative lens to evaluate scientific work is longitudinal, considers the life cycle of scientists, examines social connection, and is capacity-oriented (Bozeman et al. 2001). What is unique about this model is that while the focus remains on productivity, the outcomes or indicators of the success of collaborations would go beyond co-authorship or citation counts and includes increases in S&T human capital of collaborators.

In a recent conceptual study, Corley et al. (2019) propose a revised and expanded S&T human capital model in which they incorporate cultural factors that influence researchers' career development. The authors categorize cultural factors into five components: gender, race, socio-economic status, nationality, and academic discipline. They argue that personal experiences within diverse cultural contexts and working with people with different cultural backgrounds performs as another asset, in addition to human capital and social capital that influence scientist's overall capability and career trajectory.

Although S&T human capital, in general, recognizes some structural elements and broader social relationships with the emphasis on social capital as in knowledge exchange, it

remains concerned with performance consistent with the primary intent of the approach in the evaluation of collaboration and reliance on quantitative measures; as such, it is not often concerned with the quality of relationships between individuals. There are some similarities with the approach of S&T human capital and the broad category of studies employing social network analysis. While both may differentiate between stronger or weaker relationships, for example, they are not often concerned with individual reasons, attitudes, and values and how the relationship itself influences those reasons. In the remaining of this section, I expand on social network perspective.

2.4.2 The Social Network Perspective

Recently, social network analysis advanced our understanding of who seeks whom for collaborative relationships and why certain relationships are created, maintained, persisted, or dissolved (Rivera et al. 2010). With its roots in relationships between social entities or units (Wasserman and Faust, 1994), network analysis represents a potent technology at the core of social capital (Burt, 2000). Burt (2000) argues that social capital at its core has two constituents: network analysis and the critical issue of performance. Studies incorporating social network seek to explain why certain positions in networks of relationships lead to different outcomes.

Among fundamental concepts in network analysis are actors, representing individual people, organizations, or other social entities, and ties representing a link that relates actors to one another. For example, faculty members who engage in a collaborative relationship in a given context can be considered as nodes, and their relations can be described as collaboration ties. Some faculty members may be linked to one another through other types of relations, for example, family relations or serving on a dissertation committee.

Although social network studies are primarily quantitative, employing descriptive and statistical methods (Wasserman and Faust, 1994), they theorize and operationalize important concepts that define and influence relationships between individuals. For example, in the context of faculty collaboration, research studies could collect data from faculty directly or through the records about the frequency of communication or geographical proximity of individuals to explore their influence on the outcomes of collaboration and examine the different levels of performance.

Social network literature focuses on the study of relationships, often focusing on the structure of relationships and categorical attributes. The central argument is that the actors within networks are defined in relations and that interconnected relationships can explain outcomes and behaviors such as satisfaction and performance (Brass et al. 2004). Some of the factors that have often been highlighted at different levels (e.g., interpersonal or inter-organizational) in network studies are: homophily, multiplexity, and proximity. I later elaborate on these factors in this chapter.

A major limitation of network approach is rooted in its desire to examine patterns and focusing on structural aspects (Emirbayer and Goodwin, 1994; Dehlandar and McFarland, 2013). Emirbayer and Goodwin (1994) argue that subjective meaning and motivation are often neglected or addressed unsatisfactorily in network analysis. The authors criticize the assumption of pre-structured individual identity that is often operationalized in network studies where network researchers explain social process on the basis of attributes such as age, gender, or ethnicity and emphasize the primacy of changes rooted in dynamics of events and actions within social structures.

2.5 What Do We Know about Collaboration Process?

As discussed in Chapter 1, one of the primary limitations of the literature on faculty research collaboration is the lack of attention to the developmental processes of collaboration and the dynamics of interpersonal relationships.

Baldwin and Austin (1995) in their study of faculty research collaboration emphasize the lack of information about the process of collaboration. Similarly, Kezar (2005) argues that the process of collaboration or its development has been overlooked in the literature. In a more recent study, Bozeman et al. (2013) review the literature on research collaboration in university—at individual-level—and argue that there is underrepresentation of studies examining the dynamics of relationships between researchers. Overall, there is a gap in literature focusing on the process and the dynamics of collaboration, in particular collaboration across institutions.

The conventional quantitative studies of research collaboration, which focus on publications, cannot tell us much about individual motivations (Melin, 2000), psychological antecedents, or various aspects of the processes of collaboration (Bozeman et al. 2013). Lee and Bozeman (2005) raise a similar concern about the lack of studies in particular in connection with

the dynamics of collaboration seeking and motivational and psychological factors, or structural factors such as proximity that may play a role.

In this section, I first address major themes used mostly in quantitative studies of research collaboration that illuminate different areas of the phenomenon under study in this project, in particular factors that can influence and explain the persistence of relationships between collaborators in connection with the process of the collaboration as well as its antecedents and outcomes. Then, I explore empirical qualitative studies centered around the process and dynamics of research collaboration. In the review that follows, I extend the understanding of the phenomenon under study by broadening the review (Stake, 2010), particularly by incorporating studies in organization and inter-organizational domains.

2.5.1 Common Themes in Studies of Research Collaboration

2.5.1.1 Homophily

Homophily refers to the tendency of people to interact with individuals like themselves, either by preference or through opportunities induced by structural constraints (McPherson and Smith-Lovin, 1987; McPherson et al. 2001). McPherson et al. (2001), in a comprehensive review of the studies on theoretical principles and empirical studies on homophily in social networks, argue that people with certain qualities such as age, gender, race, class, and educational background tend to form relationship and interact with people like themselves. The authors also argue that homophily similarly influences tie dissolution, but in a weaker way compared with creation of ties.

For example, with regards to persistence of relationships, which is at the center of this dissertation study, assertive mechanisms, Rivera, et al. (2010) hypothesize that persistence depends on “compatibility” and “complementarity” of actors’ attributes, their similarities and dissimilarities. Homophily strongly influences actors’ attachment; “Importantly, homophily shapes attachment even in contexts where diversity is explicitly valued and encouraged.” (Rivera, et al. 2010, p. 95).

Dahlander and McFarland (2013) examine the speculation of the influence of homophily on the persistence of relationships. The authors utilize a longitudinal dataset of faculty collaborations at Stanford University. In the study, publications and grant applications were

used as measure for tie persistence and operationalized homophily through multiple indicators categorized into two groups: status homophily (gender, age, ethnicity, education, and tenure status) and value homophily (intellectual similarity based on citations used in publications). They concluded that tie persistence results from some of the same factors that McPherson et al. (2011) discussed, i.e. organizational foci and value homophily, with less relevance compared to tie formation. Dehlandar and McFarland (2013) found that two qualities of ties, tie strength and tie multiplexity, that are only available after tie formation play a major role in influencing tie persistence. In their study, tie strength was operationalized by the number of published papers and grants and tie strength was operationalized by the number of different networks two individuals have a tie, for example serving on a dissertation committee, grant, and application).

Tie strength and tie multiplexity are two critical network concepts that help to provide insights about the inner dynamics of relations; however, as this is the case with Dehlandar and McFarland's study, are often operationalized through outcome-based indicators. With such limitations, we do not have insight into the interactions, relationships, and behaviors between collaborators and their influence on tie persistence.

2.5.1.2 Tie Strength

Granovetter (1973) defines the strength of interpersonal tie as: "...a (probably linear) combination of the amount of time, the emotional intensity, the intimacy (mutual confiding), and the reciprocal services which characterize the tie." Tie strength is a key concept in network studies representing relational mechanism on network changes. Relational mechanisms speculate the influence of direct and indirect links between individuals on network changes (Rivera et al. 2010). Within the context of faculty research collaboration, one of the implications of relational mechanisms is that some form of direct relationship in the past influences the connection between collaborative partners; repeated interactions are not only a measure of the strength of a relationship but also can represent trust (Rivera, et al. 2010). In addition, the dynamics of reciprocity may influence the stability of a relationship. One such proposition asserts that the possibilities of reciprocal reward are greatest when there is continued interaction between two partners (Newcomb, 1956).

In general, network theorists take the frequency of interactions as an indicator of strength. There are different explanations for the basis of these interactions; one primary basis is

homophily. For example, it is hypothesized that it is more rewarding to interact with someone with similar values, who is more “empathetic” (Ingram and Morris, 2007).

Among empirical studies on research collaboration, Cummings and Kiesler (2008) use the concept of tie strength as an indicator of intensity of working relationships among collaborators. The authors measure tie strength using a 3-point scale, whether the collaborators work directly together on project and publish, work directly but do not publish together, and do not work and do not publish together. They develop a model and examine hypotheses on the effects of proximity, homophily, and familiarity to predict collaborative tie strength. The sample included 3911 pairs of senior researchers from 475 projects, mostly multi-university collaborations, in the Information Technology Research initiative funded by the National Science Foundation (Cummings and Kiesler, 2008). Among findings they reported that distance and disciplinary differences were negatively related to tie strength, and prior experience was positively associated with tie strength.

2.5.1.3 Proximity

Among broader social and environmental factors, one assertive mechanism that influences changes in social relationships is geographical proximity (Rivera et al. 2010). In the context of collaboration across the boundaries, for example, inter-institutional collaboration, distance may impede interactions and negatively influence collaborative relationships. Communication and coordination costs have been reported as a major cost of collaboration between institutions (Cummings and Kiesler, 2005). Ongoing communication is crucial in task coordination, mutual learning, integration of research results, and maintaining trust (Sonnenwald, 2007).

Intuitively, faculty who collaborate across institutions face more challenges to advance their work as they don’t have the opportunities to have frequent face-to-face interactions. Information and communication technologies such as email and videoconferencing may play a primary role. Overall, the frequency and types of communication and coordination strategies may influence the dynamics of the collaboration.

In an empirical study of the influence of research collaboration on productivity, Lee and Bozeman (2005) created a “collaboration cosmopolitanism scale,” range from 0 to 5, that indicated the extent by which researchers engage in collaboration in proximate work

environment. Although there were some differences across disciplines, the findings suggest that most people collaborate with others in their immediate environment.

2.5.2 Qualitative Studies

To understand the nature of collaboration, we should go beyond the structural elements and quantitative measures of collaboration and examine the processes and essences of collaboration. Kraut, et al. (1987) emphasize the importance of personal relationships in research collaboration; "...establishment and maintenance of personal relationship is the glue that holds together the pieces of a collaborative research effort" (p. 53). The importance of interaction, relationship, and building trust in partnership and collaboration have been reported both at institutional and individual levels (Kezar, 2005; Melin, 2000). Bozeman et al. (2013) raise a concern about the lack of studies examining the dynamics of collaboration; "...few studies examine the personal relationships between collaborators and the collaboration process in general." They argue that there is a need to incorporate large surveys and interviews to examine the process of collaboration.

Qualitative studies, by their nature, pay attention to the quality of participants' experiences and help researchers explore and describe the nature of experiences relying on understanding various participants' experiences. Although the qualitative approach has been proven its benefit in studying relational dynamics and process of collaboration in different settings (Doz, 1996; Jeffrey, 2003; Larson, 1992; Steinmo and Rasmussen, 2018), there is little research in the area of faculty research collaboration, in particular across different types of universities.

Several studies incorporated qualitative approaches to study research collaboration between faculty (or scientists) (Bozeman et al. 2016; Chompalov et al. 2002; Creamer, 2003; Creamer, 2004b; Melin, 2000; Shrum et al. 2001). Most of these studies relied on the perspectives of one collaborator rather than using data from both sides of collaboration to explore collaborative relationships. Bozeman et al. (2016), in an interview-based study focusing on research collaboration effectiveness, explore the perspectives of 60 U.S faculty about what they categorized as good or bad collaboration and various factors relevant to each. Building on the previous literature on research collaboration, the authors develop and employ a provisional model of research collaboration effectiveness, including factors that they speculate, may

positively or negatively impact collaboration. The model included three major constructs: external factors, collaborator characteristics, and team management. Based on the results, the authors suggest a revised model of research collaboration effectiveness; they distinguish between team characteristics, such as complementary expertise, gender issues, or work style fit, and characteristics of individual team members, such as S&T human capital and personality pathology. The revised model moved towards incorporating properties of teams by highlighting “team characteristics,” “individual team member,” or “team management” (Bozeman et al. 2016). Considering the vast literature on teams (or groups), different attributes in the model presented in the paper remained under-explored. There is indeed an underrepresentation of studies incorporating team characteristics the work to study and understand research collaborations.

In Bozeman et al.’s study, the interpretation and adjustment to the model primarily focus on the report of incidents based on the perspective of one collaborator. Although the paper emphasizes interpersonal dynamics, it relies mostly on structural factors to label good or bad collaboration rather than exploring dynamics of relationships and how certain factors led to variation in collaboration effectiveness and performance. The limitation about the reliance on the perspective of one collaborator, which was noted by Bozeman et al. (2016), similarly applies to several other studies on research collaboration.

Among a few qualitative studies that explored research collaboration across organizations, Chompalov et al. (2002) examine 53 inter-organizational collaborations involving three or more organizations in physics and related sciences. They explore different structures through which knowledge production and scientific inter-organizational collaboration are organized and managed. The authors reported four distinct types of collaboration: bureaucratic, leaderless, non-specialized, and participatory. The categories developed considering the level of formalization and hierarchy. The authors report that among seven specialties in physics, particle physics has a recognizable pattern of organizing and this branch of science dominated participatory collaborations, which represented least level of hierarchy and formalization. In such collaborations, the collaborative partners are interdependent, and there is less reliance on formal contracts and power structure (Chompalov et al. 2002).

The study was part of the project undertaken by Shrum et al. (2007) that benefited from interview data conducted by the American Institute of Physics’ Center for History of Physics. The project relied on qualitative analysis of interviews as well as statistical analysis to examine

structural dimensions of inter-organizational collaborations. Using the same dataset, Shrum et al. (2001) use the interview data to explore the concepts of trust, conflict, and performance. The authors reported that there is no relationship between trust and performance of inter-organizational collaboration, and there was no significantly higher trust in projects formed on the basis of previous relationships. Both findings are in contrast with dominant observations reported in the literature on inter-organizational relations (Gulati, 1995; Gulati and Gargiulo, 1999; Larson, 1992). The authors argue that trust is important in so far that projects with higher levels of trust have lower levels of conflict.

Overall, this project (Shrum et al. 2007) is among a few studies of scientific collaboration at the inter-organizational level that centered around qualitative data. The project was limited to collaboration in branches in physics, and there was a range of participants, including physicists, graduate students, engineers, postdocs, computer specialists and technicians. Nevertheless, it sheds light on various concepts at the heart of developmental processes of collaboration, among them interdependence, hierarchy, formalization, trust, and power relation, which have been repeatedly highlighted as critical issues in the process of collaboration (Ring and Van de Ven, 1994) and factors contributing the successful collaboration by highly recognized scholars in inter-organizational domain (Mattessich and Monsey, 1992).

Among a few studies informed by the perspectives of researchers at both sides of a collaborative relationship, Creamer (2004b) explores how collaborators deal with conflict and differences of opinion as an element of relational dynamics. The participants included 12 research teams and sources of data reported were one-on-one semi-structured interviews, document analysis of selected publications and curriculum vita, and joint interviews and observation of four pairs. Participants were asked to describe how they negotiated substantive differences of opinion. Based on the analysis of data, Creamer distinguishes between three groups of team members: like-minded groups, triangulator groups, and multipliers. Creamer reports that while all collaborative partners experience differences of opinion, they make different meanings of such a process.

One unexpected finding, Creamer argues, was that three had different disciplinary backgrounds among five collaborative pairs in the category of like-minded. The participants described the similarities in ways they think and differences of opinion were either highly unlikely or impossible. Considering the sample of long-term collaborators studied, Creamer

speculates that collaborators develop shared worldviews and familiarity with each other's expertise that mitigate disciplinary differences over time. While limited in terms of focusing on long-term collaboration and treating success primarily based on publications, the study highlights the importance of process and relational dynamics. Through high level of interactions and exchanges of ideas, in-person or at a distance, over time, collaborative pairs are able to become familiar with and respect one another's expertise and perspectives and develop a nonhierarchical relationship and shared worldview (Creamer, 2004b).

The studies reviewed above focus on particular issues or factors in the process of collaboration and describe effective collaboration practices primarily based on qualitative data. At a broader level, Kezar (2005) explores the developmental model of collaboration in higher education institutions. The study was not exclusively concerned with faculty research collaboration and considered various forms of collaboration such as team teaching, partnership with K-16 schools, and industry. Kezar (2005) employs a case study of four public comprehensive institutions that demonstrated extensive collaboration and structural support for facilitating collaboration. The author conducted a total of 80 interviews with faculty, staff, and administrators, 20 at each site. The sources of data, in addition, included observation of collaboration, such as meetings of groups, and documents pertaining collaboration and four institutions. A stage model of collaboration emerged from the analysis included three stages: Building Commitment, Commitment, and Sustaining. The model prescribes prominent features in facilitating collaboration at macro-level. Importantly, relationships (or campus networks as described by Kezar), were introduced as the most important condition across the stages. However, relationships among individuals and relational dynamics are essential insofar as they facilitate the process of collaboration. In other words, the model as a whole pays more attention to structural and administrative dimensions of facilitating and developing collaboration, such as executive support, leadership, rewards, and formalizing the network, and is less focused on the internal dynamics and interpersonal relationships of collaborative activities per se.

Independent of methodological and practical limitations, the findings from qualitative studies of collaboration play an essential role in better understanding of what collaborative endeavors between faculty entail and how and why various factors play a role in the process and outcomes resulted from collaboration. As described earlier, one primary limitation of these studies, with the exception of Bozeman et al. (2016), is that only successful collaborative

relationships have been considered. The studies often incorporated the narrow consideration of the notion of success; in those concerning collaborative relationships between researchers/faculty, the focus has often remained on prolonged working relationships and/or high number of publications. Overall, the dominant picture in the literature either underemphasized the perspectives of collaborators at different sides of collaboration, or merely focused on limited considerations of success in collaboration, for example by treating publications as central. Importantly, there is a shortcoming with regards to consideration of different individual attributes and different institutions, and there is almost no study of the dynamics of collaboration between HBCUs/MSIs and PWIs.

2.6 Theoretical Foundations

The studies directly concerned with studying faculty research collaborations discussed different, and in some cases opposing perspectives concerning the use of theoretical approaches to collaboration (Austin and Baldwin, 1991; Baldwin and Austin, 1995; Clark et al. 1996; John-Steiner et al. 1998). Some scholars highlighted the use of a single model in studying collaboration (Austin and Baldwin, 1991); some rejected the use of theoretical orientations (Clark, et al. 1996); and yet other scholars emphasized the need for adopting multiple modes of collaborative practice in developing appropriate theoretical frameworks (John-Steiner et al. 1998).

Before elaborating on conceptual foundations, I shall briefly reflect on the studies that specifically debate the use of theory in studying collaboration. While it is undoubtedly the case that there are differences in collaboration process across collaborative partners (teams), especially considering the contextual variations. However, this fact by no means limits the development and use of theoretical perspectives. Although compared with hypothesis testing nature in quantitative studies, the use of conceptual framework by no means defines all factors or indicate causal relationships; without theoretical orientation, there is not much to rely on to execute a research study. In fact, as discussed by scholars in qualitative methodology, there is a need to incorporate theoretical models to guide the research process (Anfara and Mertz, 2015; Creswell and Poth, 2018; Maxwell, 2005; Merriam, 1995; Stake, 2010; Yin, 2018). Merriam (1998) highlights the primacy of theoretical framework: “The framework of your study will draw upon the concepts, terms, definitions, models, and theories of a particular literature base and

disciplinary orientation. This framework in turn will generate the “problem” of the study, specific research questions, data collection and analysis techniques, and how you will interpret your findings (Merriam, 1998, p. 46). Ways by which conceptual frameworks get “constructed” and the study shapes and evolves, nevertheless, are influenced by my personal experiences, beliefs, and values that I bring to the study (Maxwell, 2005).

In this section, I focus on two bodies of literature that provide theoretical understanding of the phenomenon of faculty research collaboration across universities and can be used as foundations to develop perspectives to examine the issue under investigation. I first review the literature in social psychology on teams and models of team process. Then, I review the literature in the inter-organizational domain explaining developmental processes of relationships between organizations.

2.6.1 Social Psychology Literature on Teams

The concept of team, as a unit of analysis, has been widely discussed in different bodies of literature, mainly social psychology, as well as management and organizational domain, where various concepts and constructs have been empirically studied. In general, two or several individuals working on a task can be considered as a team (or group). Various concepts and constructs on teams and teamwork have been theoretically advanced and empirically applied in studies in various settings, for example, field studies of teams of employees in organizations and experimental studies in classroom setting in which students work as a team on projects. Frameworks and models of team development and team performance pay close attention to developmental processes and dynamics of interpersonal relationships that is a primary interest in this dissertation study.

As discussed earlier, research is increasingly conducted in teams rather than by a solo investigator (Wuchty et al. 2007), and collaboration between researchers, in particular multi-university collaboration, is growing significantly (Jones et al. 2008). However, there has been little research on application of conceptual foundations of teams literature, team processes and emergent states, in the context of collaborative relationship and team science (Hall et al. 2018).

Interdependency and desired outcomes are described as two major constituents of teams. Cohen and Bailey (1997) define team as “a collection of individuals who are interdependent in their tasks, who share responsibility for outcomes, who see themselves and who are seen by

others as an intact social entity embedded in one or more larger social systems (for example, business unit or the corporation), and who manage their relationships across organizational boundaries.” (p. 241). Team members utilize their resources to achieve outcomes that are beyond capabilities of individual members (Marks et al. 2001).

To develop a better understanding of the concept of team, as discussed in social psychology literature, we need to distinguish between team process, “what” team is doing, and teamwork, “how” they are doing it (Marks et al. 2001). Team processes are at the heart of different models of team performance and effectiveness. Models of team effectiveness often defined around input-process-outcome (I-P-O) frameworks. The recent developments in conceptualizing team processes moved from static model of I-P-O, and took into account the dynamics and interactions between different phases, where linkages and the reciprocity between them and temporal dynamics are recognized (Kozlowski and Bell, 2013; Ilgen et al. 2005; Marks et al. 2001).

Input is often represented by various resources available to teams that can be categorized into internal and external factors. Internal factors include elements such as composition, demography, personalities, and group structure; and among external elements are rewards and training (Kozlowski and Bell, 2013).

Team processes represent: “mechanisms that inhibit or enable team members to combine their capabilities and behaviors” (Kozlowski and Bell, 2013, p. 29). Marks et al. (2001) clarify different processes and states that may be involved in this stage by identifying cognitive, verbal, and behavioral activities: “Team process involves members’ interdependence acts that convert input to output through cognitive, verbal, and behavioral activities directing towards organizing taskwork to achieve collective goals” (p. 357). Kozlowski and Bell (2013) discuss three process mechanisms for behavior, coordination, cooperation, and communication. Coordination refers to activities need to manage interdependencies, cooperation refers to willful contribution of personal efforts, and communication is the system team members rely on to enable coordination and cooperation.

Outcomes are defined as criteria employed to assess the effectiveness of team actions. Importantly, effectiveness is not only about the performance and productivity, it is also about member satisfaction and team viability (Kozlowski and Bell, 2013).

Ilgen et al. (2005) in their review of domain of research on teams, suggest input-mediator-output-input (IMOI) framework and distinguish between three stages of team development, forming stage (IM), functioning stage (MO), and finishing stage (OI). The authors modified static and linear development from input to process to output. Each stage has three aspects, affective, behavioral, and cognitive. Similarly, Kozlowski and Bell (2013) categorize three set of team processes underlines effective team functioning: cognitive, affective, and behavioral. Cognitive mechanisms refer to construct such as team learning or team mental models. Behavioral constructs represent how team members perceive relational dynamics and to what extent they are attracted to group and tasks such as cohesion. Other constructs in this category represent motivational elements too such as collective efficacy.

2.6.1.1 Team Diversity

One of the most dominant themes across research on teams in psychology and management is team diversity. A common form of diversity studied in organizations is demography. The literature often highlights the negative impact of diversity on ways team function and its performance. Within social psychology literature, diversity often defined in relation with “surface-level diversity” or “deep-level diversity”. Demographic differences, for example in age, sex, and race, or education are often categorized as “surface-level diversity”, and differences on the basis of psychological features, values, personalities, and attitudes are identified as deep-level diversity (Harrison et al. 1998; Harrison et al. 2002).

Although the results of research on homophily have been inconsistent, some studies described the negative impact of heterogeneity with regards to surface-level diversity on team functioning and relational dynamics of teams (Harrison et al. 2002). In contrast, similarity in psychological aspects reinforces individual’s values and beliefs (Harrison et al. 2002). Similarities in attitudes increase attraction, and higher team cohesiveness (Harrison et al. 1998). Over time, team members have more opportunity to interact, exchange information, and learn about one another’s values and attitudes; as a result, stereotypes about surface-level diversity can be replaced with deeper-level knowledge about individuals.

In terms of operationalizing deep-level diversity, there are differences between empirical studies done in lab settings and the nature of faculty research collaboration. Deep-level diversity has been operationalized by various indicators such as differences in satisfaction, organization

commitment, task meaningfulness, and outcome importance. The importance of outcomes can also be explained by the degree of alignment between outcomes for individuals and outcomes for teams. As these get closer, individuals become more motivated to spend more time together (Harrison et al. 2002). Within the context of faculty collaboration, deep-level diversity can be represented by differences in faculty perspectives in relation to the extent by which faculty value their collaboration or their commitment to get to the proper outcomes.

As team members interact more often, and over time, the effect of surface-level diversity/demographic difference will diminish, and other features impact team outcomes such as level of agreement about goals and the level of commitment (Harrison et al. 2002). Harrison et al. (2002) argue that to create effective teams, managers should maximize differences in knowledge, abilities, and skills, and minimize differences in attitudes, values, and dispositions. Considering the preferences to create homogeneous teams, with regards to surface-level diversity, organizations need to employ policy and consider rewards for developing heterogeneous groups (Harrison et al. 2002; Hinds et al. 2000).

2.6.1.2 Team cohesion

Team cohesion is a widely recognized concept in social psychology literature that describes aspects of team dynamics. Some scholars describe and operationalize team cohesion as one primary concept that represents the multifaceted construct: social integration. Social integration generally refers to degree to which members in a team are psychologically linked or attracted toward one another (Harrison et al. 1998; O'Reilly et al. 1989) and has been reported as a strong predictor of team performance in various studies (Harrison et al. 2002).

Team cohesiveness is often operationalized as attraction between group members: interpersonal attraction or liking (Hogg and Abrams, 1988). Cohesiveness embraces a wide range of effects, among them, enhancing productivity, efficiency, improving job satisfaction, facilitating intergroup communication (Hogg and Abrams, 1988).

Marks et al. (2001) distinguish between team processes and emergent state. Emergent states refer to qualities that represent member attitudes, values, cognition, and motivation (Marks et al. 2001). Although these qualities may change over time, and influenced by different elements of team inputs, processes, and outcomes; time cohesion is the only emergent state, the authors argue, that has an enduring quality. Many researchers have distinguished between two

types of cohesion: task cohesion and social cohesion (Cohen and Bailey, 1997; Gully et al. 1995; Kozlowski and Bell, 2013; Marks et al. 2001). As a fundamental quality of group, cohesiveness can be theoretically explained by frameworks focusing on interindividual interdependence or interindividual similarity.

2.6.1.3 Familiarity

The history and extent of the relationship between members of teams may influence their subsequent interactions. The team literature emphasizes team familiarity as a fundamental concept that affects team performance. Over time and by increasing the prior interactions, the number and quality of communications would evolve, and interpersonal communication becomes more established (Harrison et al. 2003). Over time, team members are able to know each other more, deep-level diversity became more important, the trust would develop, and uncertainty would decrease (Harrison et al. 2003; Hinds et al. 2000)

Hinds et al. (2000) argue that there are three mechanisms for uncertainty reduction in teams: homophily, reputation for competence, and familiarity. With regards to familiarity, success in previous relationships intensify its effect. Familiarity is often operationalized through the amount of interactions among members of a group (Harrison et al. 2003; Hinds et al. 2000).

Theoretically, there is an interaction between familiarity and concepts used in social networks, among them strength of ties and multiplexity that are employed in relation with the duration and intensity of relationships. Longer term interactions and multiplex relationships help team members to develop interpersonal knowledge that facilitates interpersonal attraction and cohesiveness (Hinds et al. 2000)

Balkundi and Harrison (2006) in their meta-analysis found that network structures and relation-based factors have an important impact on performance and viability. Over time, team members develop both interpersonal familiarity and task familiarity. The shared understanding among team members helps improve team effectiveness, which is both about task (performance) and interpersonal social relationship (viability). Team viability, which is closely related to cohesion, describes members' satisfaction with their membership and their behavioral intent to remain in the team and is supported by informal connections both instrumental and expressive within teams (Balkundi and Harrison, 2006). Within the context of this study, it is expected that faculty with prior working relationships, especially successful experiences (both in terms of their

relationships and products resulting from collaborations), bring important capital to their working relationships.

The concept of viability is central to our understanding of the sustainability of collaboration. Before presenting the literature on inter-organizational domain, I discuss the concept.

2.6.1.4 Team Viability

Within the theoretical and empirical studies on teams, two dimensions have been discussed in relation with team effectiveness; one is task performance, that is defined in relation to productivity and outputs and degree by which team handled their task, which is not the primary concern in this study, and another team viability, which represents satisfaction of group members to continue working together and maintain their working relationships (Balkundi and Harrison, 2006; Kozlowski and Bell, 2013). The concept of team viability, for example, has been used in the studies of virtual teams (Whiting et al. 2020).

2.6.2 Inter-organizational Domain

Faculty collaboration takes place in the context of inter-organizational relationships where individuals from two (or multiple institutions) who represent their institutions invest in a relationship defined in a broader context.

Within the context of this dissertation study, inter-institutional research collaboration facilitated by ICTAS D&I Investment, there is no explicit connection between institutions at higher administrative levels; and ICTAS does not perform any major governance or administrative role. As the structures of collaborations and decision-making processes move from an institutional level to an individual level, the type of relationships between collaborators becomes closer to interpersonal rather than inter-institutional. However, faculty are embedded in their universities and have various roles and responsibilities. Their involvement in collaborative relationships may be facilitated or constrained by various contextual and environmental factors. The fact that collaborators come from different institutions adds another level of complexity to the studies of the collaboration process and certainly needs to be accounted for.

Models of inter-organizational relation explain how cooperation across organizations form, evolve, and dissolve over time (Van de Ven, 1976; Ring and Van de Ven, 1994).

Considering the structures of the widely recognized models, we can refer to the antecedent-process-outcome framework proposed by Wood and Gray (1991), three phase framework proposed by Gray (1989), problem setting, direction setting, and implementation, and iterative and cyclical framework introduced by Ring and Van de Ven (1994). Similar to the models on teams in social psychology literature, it would be useful to conceptualize inter-organizational collaboration process by interconnection between input, process, and outcome. Below I elaborate on each phase.

Inter-organizational relation formed when two or more organizations come together to address a complex and achieve goals that are beyond capacity of individual organization (Gray, 1989; Van de Ven, 1976; Vangen and Huxham, 2003). Each organization brings its resources and capabilities and unique perspective; Gray (1989) argues that each organization represents a limited perspective and is by diversity of perspectives that organizations able to see different aspects of a problem which is not possible by their individual limited vision. Organizations form alliances, seek resources and capabilities (Gulati and Garguilo, 1999); they may each have differing interests (Thomson and Perry, 2006). It may also be the case that for some collaborations, partners have shared interest; in such cases, the partnership is often motivated by commitment of addressing an external problem (Thomson and Perry, 2006; Van de Ven, 1976).

At the heart of collaboration process is communication and negotiation to develop shared understanding and joint expectations and decision making. Negotiation is a common concept that has been used by scholars in inter-organizational domain to describe the process of collaboration. However, negotiation to develop expectations and decision making is not about bargaining processes but is about “conversational interactions” through which organizations develop shared expectation, interpretation, and agreement on courses of action (Gray, 1989; Ring Van de Ven, 1994). Through these interactions, various norms and roles emerge. This process, Gray (1989) argues, creates negotiated order. Negotiated order as a model recognizes informal structure shaped in settings in which groups engage in developing agreements beyond formal rules and structures (Day and Day, 1977).

Gray (1989) argues that the process of collaboration causes changes in interaction among those who are involved. To develop a theory, the collaboration can be considered as negotiated orders created among stakeholders. The important characteristic of negotiated order perspective is “cognitive and expressive character” of relations (rather than objective and instrumental)

(Gray, 1989). Gray and Wood (1991) clarify: “Negotiated order theory thus focuses on the symbolic and perceptual aspects of inter-organizational relationships, particularly on the evolution of shared understandings among stakeholders of the domain’s structures and processes, limits, and possibilities” (p.10).

In the process of collaboration, organizations (representatives from organizations) encounter the duality of individual identity and shared collaboration identity (Ring and Van de Ven, 1994; Thomson and Perry, 2006). Through communication and exchanges, organizations are able to develop sense making and maintain their relationship.

Collaboration across organizations will ultimately result in outcomes that will influence future relationships between engaged organizations. Importantly, inter-organizational scholars recognize that outcomes are not only about achieving goals addressing problems or satisfying resources and capabilities, it is also about perceived satisfaction with the outcomes. Ring and Van de Ven (1994) argue that assessment of inter-organizational relation is based on efficiency and equity. Efficiency is defined in terms of costs and benefits in its economic meaning; equity is about fair dealing. Van de Ven (1994) elaborate on several features that fair dealing may imply, including fair rates of exchanges and benefits proportional to investments.

In contrast to faculty collaboration that is motivated by and carried out by individual faculty, inter-organizational collaboration needs structure, governance, and administrative arrangement. Thomson (cited in Thomson and Perry, 2006) argue that the “black box of collaboration” consists of five key dimensions: governance, administration, organizational autonomy, mutuality, and norms of trust and reciprocity. Governance refers to the broad structure that governs and facilitates reaching agreements on actions and goals. Administration represents another structural dimension in collaboration process, as defined by Thomson and Perry (2006), refers to administrative structure that links governance to actions.

Thomson and Perry (2006) argue that various factors, including internal relationships, external factors such as ambiguity and shifting membership, may influence the five key dimensions. Huxham (1996) distinguishes between purpose and advantage resulting from the collaboration, “collaborative advantage,”-- that cannot be achieved by a single organization-- and the output in practice, the nature of the collaboration, “collaborative inertia.” Huxham argues that there is a lack of attention to collaborative inertia--- as a central aspect of collaboration. Further,

Huxham (1996) conceptualizes the nature of collaboration based on five themes, among which three emerged from the concerns expressed by practitioners: common aims, power, and trust.

2.6.2.1 Trust

One of the most common themes in inter-organizational domain is trust. In the context of faculty research collaboration across universities, trust plays a critical role. Considering the historical background of race in the U.S. as well as lack of knowledge, assumptions, and stereotypes about different institutions, trust may influence the formation and persistence of faculty collaboration between HBCU/MSI and PWI.

There is an inherent complexity and ambiguity in inter-organizational relation is inherently, and trust is a primary mechanism to deal with uncertainty (Ring and Van de Ven, 1994; Vangen and Huxham, 2003). Trust has been repeatedly reported as an important factor in successful collaboration (Vangen and Huxham, 2003).

There are different perspectives on defining trust. Vangen and Huxham (2003), in their review of research on trust, distinguish between two arguments about trust. One argument is that trust is developed based on expectations, either future-based in which trust is argued to be related to expectations about aims and behavior of collaborator in future, or historically rooted, where information about collaborators, their reputation, and competence serve as the basis of forming expectation. A similar argument can be applied in the context of faculty collaboration across universities. However, contextual elements may add another layer of complexity.

Another argument of trust is in connection with the concept of risk. Vangen and Huxham (2003) elaborate that experience of trust can reduce the risk of collaboration, and creation of trust would imply taking risk. Ring and Van de Ven (1994) use trust based on faith in the moral integrity or goodwill of the collaborative partner. They argue that interpersonal interactions can increase trust, which influences socio-psychological bonds between collaborators.

2.6.2.2 Power

The picture of collaboration as power sharing, in which all parties have “countervailing power” (Gray, 1989), has been criticized. Hardy and Phillips (1998) argued that scholars who advocate negotiated order theory have not provided reasons why organizations/groups in power would share power in collaboration; even though power sharing “might” happen when

collaboration is concerned with convergent goals, but it would be unlikely to consider that when there is conflict in goals.

Hardy and Phillips (1998) provided a framework for analyzing the dynamics of inter-organizational domains in which three aspects of power are highlighted: formal authority (legitimate right to make decision), control of critical resources, and discursive legitimacy (speaking legitimately for issues). Political orientations to collaboration emphasize the role of power relations and political effects. The importance of the political effects of collaboration can be better seen when collaboration leads to partners' accession to power, in particular when the stakeholders have different goals or there is an unbalance in power (Hardy et al. 2003).

There wouldn't be surprising, considering social construction of a domain as presented by negotiated order theory, those in power make an effort to increase their power and advantage through collaboration (Hardy and Phillips, 1998); "When we understand how the powerless exercise power, we will be in a better position to understand and evaluate the social construction and development of domains" (Hardy, 1994, p. 293). Hardy (1994) emphasizes that political dynamics in inter-organizational relations questions two major assumptions present throughout inter-organizational literature, (1) organization is preferable to fragmentation and (2) cooperation is preferable to conflict. In connection with the areas proposed in my proposal, mainly the quality of experiences of researchers in particular with regards to the notion of inclusion and what dynamics may be constructed as a result of this quality between the partners--- in which factors such as power relations and race play a role--- political orientation seems to me as a plausible approach to be adopted, considering the fact that I approach this issue with tendency to change the preexisting structures and to learn how we can make influence on the process of collaboration.

Studies of inter-organizational collaboration have focused mostly on functional aspects of collaboration (Hardy and Phillips, 1998; Hazen, 1994). The focus in such studies becomes limited on problem solving and gaining resources, etc. with presumption that there would be common goals, in which role of power relation are often underemphasized (Hardy and Phillips, 1998). Hazen (1994) used critical perspective in inter-organizational collaboration and emphasized the need for studying collaborative relationship through critical lens in particular when there is conflict in interests and unbalance in power.

2.7 Conceptual Model

In this chapter and Chapter 1, I noted the lack of process-based studies of collaboration and claim that this dissertation addresses that gap by executing a process-oriented study of research collaboration. Before building on theoretical foundations to address a preliminary conceptual model for this study, I shall explain what I mean by process when referring to process-based (or process-oriented) study. In this context, I would consider process mainly in relation with time and the role of temporal changes in the interaction between different phases of collaboration. It also certainly emphasizes the activities and procedures that take place in *doing* collaboration. Although there is indeed a lack of studies in connection with processes of collaboration (and its underlying dynamics) in the context of faculty research collaboration, there is almost no empirical study of faculty collaboration in which the issue of time has been prioritized.

Now, I continue by clarifying the conceptual model used in this study. Figure 2 presents a pictorial model representing interconnections between different phases of faculty collaboration. Preconditions encompass team diversity, team interdependence, and prior experience factors. As discussed earlier, team diversity includes surface-level diversity such as differences in race, gender, and nationality, and deep-level diversity, including differences in attitudes, beliefs, and values. Team interdependence highlights the degree to which team members need each other in the process of collaboration and take into account individuals' skills, expertise, and resources. Prior experience highlights the influence of familiarity and the impact of perceived pre-existing relationships.

Processes encompass different activities and adjustments made throughout the collaborative relationship. Processes, bolded in Figure 2, are the main focus of this study's data collection. Some underlying activities that define the quality of this stage are frequency and quality of communication, decision making, dealing with conflict, and trust. As indicated by the linkage between processes and preconditions in Figure 2, processes may influence preconditions over time. For example, as team members interact, their beliefs and values as related to collaboration may be modified.

Lastly, similar to team effectiveness and inter-organizational relation models, outcomes represent various indicators through which the success of a group (or inter-organizational relation) can be examined. Here, I distinguish between two categories of outcomes: conventional

outcomes and holistic outcomes—In the literature the compound concept of effectiveness is often shrunk to outcomes in terms of publications. The first category refers to what is commonly discussed as outcomes in the literature (indicators of conventional success), such as research proposals or publications. The second category includes other measures of building capacity and quality of relationships between individuals. For example, training and mentorship of a student or perceived strong attachment (team cohesion) are considered outcomes. Perception of success can influence the processes and preconditions in collaboration, as illustrated in Figure 2. For example, the feeling of attachment may increase individuals’ motivation and commitment in relation to tasks and their goals. Considering this model, repeated episodes of doing collaboration could be considered as indicator of holistic outcomes that interacts with the psychological aspects of the team and individuals’ assessment of the process and other outcomes of inter-institutional collaboration.

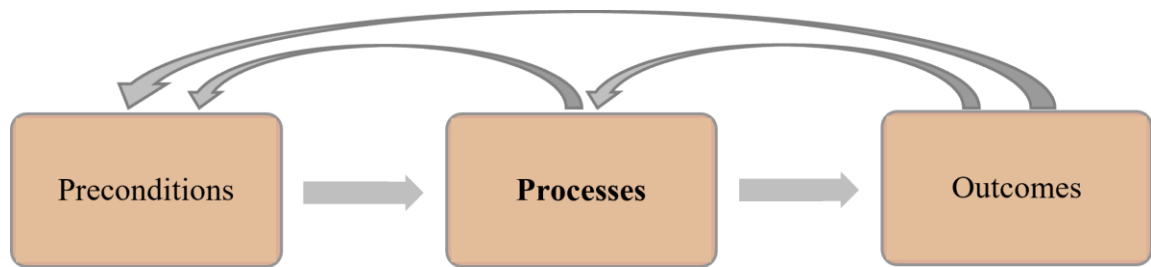


Figure 2. A pictorial model of faculty research collaboration across universities

Chapter 3: Methodology

3.1 Introduction

As discussed in Chapter 1, the purpose of this study was to improve our understanding of faculty research collaboration across universities, focusing on the factors that influence the sustainability of collaboration between faculty at HBCUs/MSIs and faculty at a PWI, within the context of ICTAS D&I Investment. The central research question that this study seeks to investigate was: *What factors facilitate sustainable collaboration between faculty at a PWI and faculty at HBCUs/MSIs?* Figure 3 illustrates the connection between the general interest and specific research question in this study. Capturing the interconnection in this format was inspired by what Marshall and Rossman (2011) and Merriam (1998) described in the funnel shape. The top area represents a general issue or general area of interest that narrows down to a specific question. Marshall and Rossman (2011) also emphasize that along the way researchers identify their focus, e.g., individuals, groups, or events.

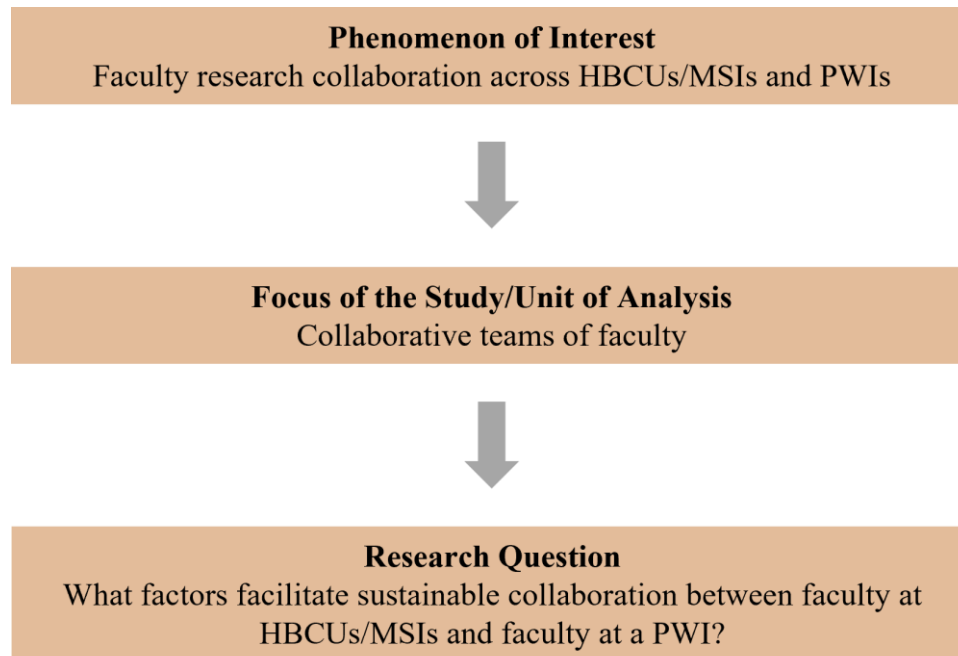


Figure 3. Illustration of connection between the area of interest and the research question

This dissertation study evolved as I became more familiar with the literature and practical issues. When I was first introduced to ICTAS D&I Investment and began exploring research

ideas, I soon realized that there is little research in the area of faculty collaboration across universities, let alone between HBCUs/MSIs and research-intensive PWIs. While the general area of interest became evident early on, the focus changed. The initial motivation was to develop strategies to evaluate the outcomes of the research collaborations resulting from the ICTAS D&I Investment (Jalali et al. 2019). I was specifically interested in exploring unconventional outcomes, focusing on the relational dynamics of collaborations, and moving beyond the dominant product-oriented picture of collaboration. I also realized that study of the process and the dynamics of collaboration has remained under-explored, specifically in connection with different types of universities. The objective was to focus on the process-oriented illustration of inter-institutional collaboration and explore the nature and quality of the collaborations, specifically in connection with broad areas of diversity, equity, and inclusion (Jalali et al. 2019).

The study's focus was then shifted and narrowed to explore factors that may influence sustaining faculty research collaborations across universities (Jalali et al. 2021c). From a research perspective, I was curious to know what is happening in teams of collaborators that some persist and some dissolve over time. Arriving at this focus was also influenced by my involvement in HBCU/MSI Research Summit, as I described in Chapter 1, and speaking to faculty informally or formally during interviews. Furthermore, in practice, ICTAS is interested to see collaborations sustain over time. In general, organizations often benefit from collaborations that are maintained over time because of fewer start-up costs, improved certainty and trust, and the influence of stable patterns of collaboration on communication between individuals (Dahlander and McFarland, 2013), which helps individuals to mitigate communication and coordination costs of collaboration (Leachy, 2016). The overarching goal of the ICTAS D&I Investment is developing robust partnerships between faculty at HBCUs/MSIs and faculty at Virginia Tech. While the term "robust partnership" may conceptually refer to outcomes, duration, quality, or combination of these, ICTAS is specifically concerned with the impact in terms of proposals funded and financial gain, (partially) to justify this investment, which from an organizational perspective seems reasonable. Such an objective may seem instrumental; nevertheless, funded proposals imply the persistence and longevity of collaboration of teams of collaborators.

3.2 Philosophical Perspective

Among major paradigms or philosophical worldviews, I primarily take a constructivist view. Consistent with the constructivist worldview, this study assumes that individuals develop “varied and multiple” views and meanings subjectively, and their subjective meanings are influenced historically and culturally (Creswell and Creswell, 2018). With motivation and interest in exploring different views and meanings associated with certain things or processes, employing this perspective (Creswell and Creswell, 2018; Gall et al. 1996; Guba and Lincoln, 1994). With a constructivist approach as an epistemological orientation in conducting case studies, researchers examine how different participants' meanings illuminate the phenomenon under investigation (Yin, 2018).

3.3 Research Design

According to the criteria proposed by Creswell and Creswell (2018) for selecting the research method, I chose a qualitative method in order to understand factors that can explain the sustainability of research collaboration. First, qualitative research is well-suited for this study because faculty collaboration across universities is an underrepresented and complex area. Qualitative studies that pay attention to the nature and essence of phenomenon help improve our understanding (Creswell and Poth, 2018; Merriam, 1998).

Second, qualitative research seeks to understand the phenomenon of interest from participants' perspectives (Creswell and Poth, 2018; Merriam, 1998). This research was defined to learn from faculty experiences with collaboration. The qualitative studies consider the meaning that individuals assign to people's experiences; the goal then is to learn meaning constructed and made by individuals in given situations (Creswell and Creswell, 2018; Merriam, 1998). In connection with the importance of participants' views, I shall note that while ICTAS employed limited means to capture the experiences of Virginia Tech faculty, such as invitation for in-person meeting with the Director of ICTAS and the Diversity and Inclusion Coordinator, there was no means in place to reach to faculty at the other side of collaboration. I was particularly motivated to hear from faculty at HBCUs/MSIs about their collaboration experiences. In other words, this research aimed to hear participants' voices that might not be heard otherwise (Creswell and Poth, 2018). With my interest in people's experiences, the aim

was to describe this given situation in depth, so meaning could be understood (Borrego et al. 2009; Merriam, 1998).

Third, qualitative research emphasizes the primacy of contexts and contextual factors (Creswell and Poth, 2018). This study is sensitive to the context within which faculty collaboration occurs. Faculty collaborations are embedded in a broader organizational context and inter-organizational relationships that may facilitate or constrain collaborative relationships. In summary, qualitative research is the suitable approach for this study.

3.3.1 Case Study as the Method of Inquiry

Among common qualitative approaches, narrative research, phenomenological research, grounded theory research, ethnographic research, and case study research (Creswell and Poth, 2018), case study design was considered for this study. A case study is an exploration of a bounded system or systems (cases) in a specific time and place (Creswell and Poth, 2018). Similarly, Yin (2018) suggests that a case study, as an empirical method: “investigates a contemporary phenomenon (“the case”) in depth and within its real-world context, especially when the boundaries between phenomenon and context may not be clearly evident.” (p. 15). Case studies concentrate on particular situations, events, programs, or phenomena (Merriam, 1998); the importance of a case is often defined in connection with what it represents in relation to the phenomenon of interest (Merriam, 1998; Stake, 2006). In addition, case studies are descriptive and provide rich description of the phenomenon (Merriam, 1998).

Cases for case studies can be individuals, groups, organizations, events, activities, or programs (Baxter and Jack, 2008; Hancock and Algozzine, 2017; Yin, 2018). A desired case, Yin (2018) argues, should be “a real-world phenomenon that has some concrete manifestation” (p. 31). Specific parameters such as time, location, or certain people involved in the study clarify the contextual bound (Creswell and Poth, 2018; Miles et al. 2020; Yin, 2018). Placing boundaries on a case can help avoid addressing too broad of a given issue or problem (Baxter and Jack, 2008). In summary, two elements have been repeatedly discussed regarding initiating case study and selecting cases, what demonstrates a case in real-world and what the bounded context is.

In this study, a case was defined as a “collaborative team” of faculty, representing two or more faculty (from Virginia Tech and partner HBCU/MSI institutions) whose projects were

supported by the ICTAS D&I Investment. The first obvious bounding is that this study was defined in the context of ICTAS D&I Investment; in other words, while outside of this seed funding program, there may be many collaborative teams representing faculty at HBCUs/MSIs and faculty at PWIs, those are considered as context. Second, in terms of individuals included in collaborative teams, I used the proposals and report Virginia Tech faculty submitted to ICTAS, people within a group defined based on these documents, and as such, a case was bounded. Third, the duration and scope of data collection also separate what is included in this study and data that is contextual and external to the case (Miles et al. 2020).

Overall, considering the focus of this study on (bounded) collaborative teams to learn about the broader “practical” problem of faculty collaboration and to illuminate the understanding of the sustainability of faculty collaboration across different types of universities, case study is a suitable approach.

3.3.1.1 Multiple Case Study

One of the critical decisions regarding research methods used in case studies is whether *single case* or *multiple case* design should be employed. In this study, I employed multiple case study. I elaborate on this choice, informed by the comprehensive accounts of case study, in particular methodologists Yin and Stake. Multiple or collective case studies employ several cases. Multiple case studies are about understanding something beyond a single case; what Stake (2005, 2006) calls “quintain” can be a group, category, or phenomenon. Each case belongs to a collection of cases with some characteristics in common. The single case is of interest in study in that it belongs to a particular collection of cases (Stake, 2006). Individual cases share certain qualities or characteristics, and as members of a quintain, they are bound together (Stake, 2006).

The analogy described by Stake is very helpful in understanding the design decisions made in this dissertation study. The potential research designs that could be considered for this study are embedded single case study and (holistic) multiple case study (Yin, 2018). In the first design, attention is given to subunits within one context (Yin, 2018). Each case would include two or several embedded units of analysis; in the context of this dissertation study, for example, this could translate to faculty at Virginia Tech and faculty at HBCUs/MSIs. Embedded subunits within a single case study are within a boundary of a particular context, in the case of my dissertation study, HBCU/MSI-PWI inter-institutional relation. Yin (2018) discussed five

rationales in choosing single case study in connection to how a single case to theoretical foundations of study. A case selected might represent a critical, unusual, common, revelatory, or longitudinal case. In contrast, in a holistic multiple case study, each case is defined in its context and is located in its situation (Stake, 2006). In other words, the choice of multiple case study implies that the result of the study bears on the differences between contextual elements.

In addition to the two designs explained above, it may very well be the case that a researcher focuses on a macro level of the inter-organizational dyad, either as a whole or organizations separately, and shift the focus of study from dyads or teams of collaborators to what can be learned from the experiences of organizations. As discussed in Chapter 2, considering the extent of governance and administrative involvement in the collaborative partnerships supported by ICTAS and my interest in exploring the phenomenon at the micro-level, the study focuses on teams and individual faculty.

Multiple case studies pay attention to different contexts and help develop a deeper understanding of cases' processes and outcomes and the chance to test (not just) to develop hypotheses and a good picture of a locally grounded causation (Miles et al. 2020). Multiple case study was used in similar studies focusing on research collaboration, for example, in a study on the role of personal and other kinds of proximity on collaborations by Dutch nanotechnology researchers (Werker et al. 2016).

In this study, I selected cases who had a continuing collaborative relationship and expressed a desire to continue their professional relationship. I explain more details about the cases and practical limitations I encountered in the sampling and data collection sections. I expected to learn from the cases, their similarities and differences, to better understand the factors that contribute to their sustaining collaboration. The teams of collaborators were expected to be influenced by unique contexts in which they were bounded, as such context will be described, regardless of evidence of their influence on each one of the cases (Stake, 2006). I avoid generalizations about HBCUs and acknowledge the uniqueness of each context.

3.3.2 Systems Perspective

A feature of this research is the attempt to bridge micro and macro perspectives. The primary source of data is the perceptions and feelings of individual faculty, and the unit of analysis is a collaborative team of faculty. At the same time, the research recognizes that faculty

are embedded in the broader inter-organizational relationships. Multilevel perspectives acknowledge that phenomena at the micro level are embedded in macro contexts, and phenomena at the macro level are influenced and often emerged by lower-level dynamics (Kozlowski and Klein, 2000). Figure 4 illustrates the multi-level dynamics in inter-institutional faculty collaboration. Concerning the interaction between individuals and teams, Kozlowski and Bell (2013) clarify:

Teams are composed of individuals and are embedded in a nested organizational systems structure. Teams per se do not think, feel, or behave; individuals do, but individuals think, feel, and behave in an interactive context that can shape their cognition, affect, and behavior such that it has emergent collective properties. These emergent properties evolve over time and are further constrained by higher-level contextual factors. (p. 71)

As described by Kozlowski and Bell, time plays a vital role in team processes. The primacy of time in the studies of faculty collaboration has often been overlooked, and the studies commonly deal with examining the collaborations in one shot at a particular time, often concerned with what they achieved or how they did what they did, for example, publications. To understand what is going on in collaborative teams of faculty, I collected the data at three points. Recognizing the foundational importance of the first year of collaboration, the screening survey, and interviews employed in the study were primarily concerned with understanding how developmental processes at earlier stages influence faculty perceptions and decisions regarding continuing their working relationships.

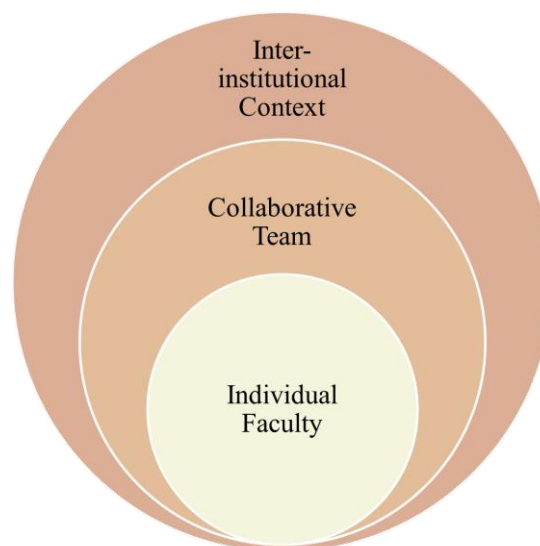


Figure 4. Multi-level dynamics of inter-institutional collaboration

3.3.3 Ethical Considerations

Prior to data collection, I submitted the research plan, including the rationale, data collection and analysis procedures, consent process, benefits and risks associated with the study, to the Institutional Review Board (IRB) at Virginia Tech. The research protocol was reviewed and approved by IRB. A few key points regarding the rights of participants and confidentiality are essential that I elaborate on in what follows.

Potential participants were first introduced to the study when they received an invitation email requesting their participation. The invitation emails (initial recruitment and interview) are presented in Appendix B. In the initial email, I included a link to the initial screening survey to identify the initial pool of faculty willing to participate in the study and collect data on demographic information and their collaborations.

The surveys used in this study were designed using Qualtrics software. An electronic consent information sheet was included at the beginning of the survey. Participants were informed about the purpose and procedure of the project, risks and benefits associated with it, and the voluntary nature of their participation. A button was added to the electronic information sheet with language "If you would like to participate in this survey, please click "NEXT" to go to the survey." The surveys used in this study are presented in Appendix C. The consent information sheets for the survey and interview are presented in Appendix D.

No identifiable information was collected through the survey. A unique study ID was provided for each participant, and only the researcher has had access to this data using VT ID and password. Based on the survey data, potential interviewees were selected and were invited for semi-structured interviews. The consent information for the interview was shared by participants through email. In addition, at the beginning of interviews the contents of the information sheet was discussed verbally with prospective participants. The interview protocol is presented in Appendix E. The interviews were conducted virtually via Zoom, and participants could opt-out the camera function/video-recording if they were not comfortable.

3.4 Data Collection Procedures

One of the features of case studies is the use of several sources of information to provide a thick description (Creswell and Poth, 2018; Yin, 2018). The major sources of the data in this study included documents, survey questionnaires, and interviews. Documents were primarily used

to collect historical and contextual information. I used existing organizational documents and official online documents. The organizational documents included the proposals and final reports (in the form of slides) submitted to ICTAS by Virginia Tech faculty. The proposals include information about collaborative partners and institutions, the proposed area of collaboration, and the proposed plan for collaboration. In the summary reports, faculty are asked to include information about their relationship with collaborative pairs and the outcomes resulting from their research collaboration. I also reviewed online documents (websites) to capture basic information about the contexts in which individual faculty work, including institutional history and mission.

Data collection from participants concerned with the research question occurred in three phases: screening surveys, interviews, and follow-up surveys. Figure 5 presents these phases and their timeline. The process began with an invitation email to the initial pool of participants introducing the research and requesting their response to the screening survey. The details about sampling will be discussed in the following section.

The screening survey was used for two reasons. First, it served as a means for selecting the participants. Second, it served as a means of collecting case study evidence. The questionnaire included questions about the quality of interactions and collaborators' visions and beliefs about collaborative endeavors they were engaged in. The demographic information was also collected through the survey and used to present the research sample of the study. The survey questionnaires are presented in Appendix C.

The primary source of data collection was one-on-one interviews with individual faculty members. After identifying the interviewees based on the initial survey, the participants were contacted for schedule time for interviews. Interview protocol is presented in Appendix E. In average, each interview took 56 minutes. Lastly, I incorporated a survey questionnaire about a year after conducting the interviews, mainly to examine the most recent status of collaboration whether or not the collaborative teams continued their working relationships. I also included questions about their overall satisfaction and outcomes resulting from their partnerships.

As described in the figure, there was about two months gap between the screening survey and interviews and about a year gap between the interviews and the follow-up survey. Before moving on, I shall once again emphasize the importance of the temporal element in this study. Case study is a particularly suitable design for studies focusing on process rather than outcomes

(Merriam, 1998). By understanding participants' perspectives about their collaboration experiences, the reasons and factors influential in their decision-making and overall collaboration processes can be illuminated.

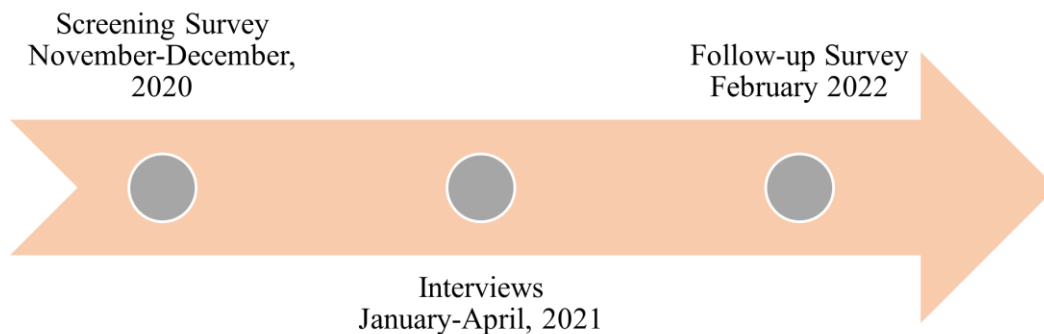


Figure 5. The three phases of data collection

In summary, data collection procedure focused on the salient issues based on speculations followed by the conceptual model developed in Chapter 2. For example, I expected that the quality of communication and the degree of attachment influence team's relational dynamics and as such impact the longevity of collaborations. While interview questions were open-ended and exploratory in nature, survey questions focused on a few constructs and concepts in the model, which are discussed in the literature, for example, mutual respect, trust, and frequency of communication.

3.4.1 Sampling Procedure and Case Selection

The sampling procedure included two phases. In the first phase, I identified an initial pool of participants using the documents supported to ICTAS. In the second phase, I employed purposeful sampling and chose the cases based on the data collected through a screening survey. Below, I describe each phase in detail.

In order to identify the pool of potential participants, I used the documents submitted by Virginia Tech grantees to ICTAS, including proposals and reports. Before elaborating, it should

also be noted that while the ICTAS D&I Investment has been operational since 2016, this project only considered groups of faculty who received grants between 2016 and 2019. This was reasonable considering the initial phase of data collection, December 2020, and the focus of the project on the sustainability of collaboration. A total of 39 projects were funded within the three years. Considering seven repeated collaborations, 45 different collaborations were identified. Next, I considered three criteria to finalize the initial pool of potential participants. The funded projects further considered for this study if within the documents:

1. HBCU/MSI had been identified
2. HBCU/MSI faculty had been identified
3. Virginia Tech faculty awardees were not among the members of the dissertation committee

As a result, I excluded four projects, and a total of 85 HBCU/MSI faculty and Virginia Tech faculty, representing 38 distinct collaborative teams, were identified as an initial pool of participants.

In the second phase, the recruitment began by sending an invitation email, individually, to Virginia Tech faculty and their collaborative partners. Email invitations are presented in Appendix B. The email invitations, including the link to the screening survey, were sent to and all 85 faculty received the invitation to participate in the study. Among 85 faculty, 28 faculty, 8 representing HBCU/MSI and 19 representing Virginia Tech, completed the survey. In order to select the cases (units of analysis), I incorporated purposive or purposeful sampling (Merriam, 1998). This type of sampling aims to focus on an information-rich sample (of cases) from which most can be learned. The selection criteria in choosing the units of analysis initially were:

1. Representation of a minimum of two members of a team, preferably from HBCU/MSI and Virginia Tech
2. Variation in the duration of collaborations

To develop a better understanding of dynamics of teams, it was necessary to capture multiple perspectives. In addition, collecting data from several informants could enhance the accuracy of the research. Also, considering the dynamics of inter-organizational relationships, and consistent with the intent of this project, it was necessary to include perspectives on both sides of collaboration. Regarding the second criterion, I encountered a pragmatic limitation. First, most respondents had started their collaborations in 2018. Also, among 28 faculty respondents, only

three representatives indicated that they did not have a continuing working relationship. For example, one faculty member indicated their project was over and noted that a few proposals were submitted but not funded. In addition, one faculty noted that they were not aware of collaboration, and there was never a working relationship.

The invitations for interviews occurred on a rolling basis to deal more effectively with multiple perspectives presented within each team. It should be noted that none of the faculty whose collaboration dissolved did not participate in the interview. In addition, for one of the cases, collaborative team, where one faculty at HBCU and one faculty at Virginia Tech expressed their willingness to participate in the study, only one of them accepted the invitation.

In order to evaluate the duration of collaboration, a question was included in the screening survey, and faculty were asked to respond whether or not they had a continuing working relationship. In summary, I initially planned to employ variation in terms of duration of collaborative relationships employing a particular type of purposeful sampling, maximum variation sampling (Merriam, 1998) comprising a minimum of two members; however, due to practical constraints regarding the availability of participants, I only considered faculty who indicated that they have had continuing working relationships. A combination of purposeful and convenience sampling was employed in the study (Merriam, 1998). Nevertheless, I still selected the cases on the basis of conceptual grounds (Miles et al. 2020).

In summary, 20 faculty received the invitation for interviews. 15 faculty members, including 7 HBCU faculty (there was no representative from other minority serving institutions) and 8 Virginia Tech faculty accepted the invitation and were interviewed. From the initial pool of 38 collaborative teams, eight teams participated in this study. In other words, the study explored one out of five collaborative teams representing the teams supported through ICTAS D&I Investment between 2017 and 2019. Figure 6 represents a summary of the sampling procedure.

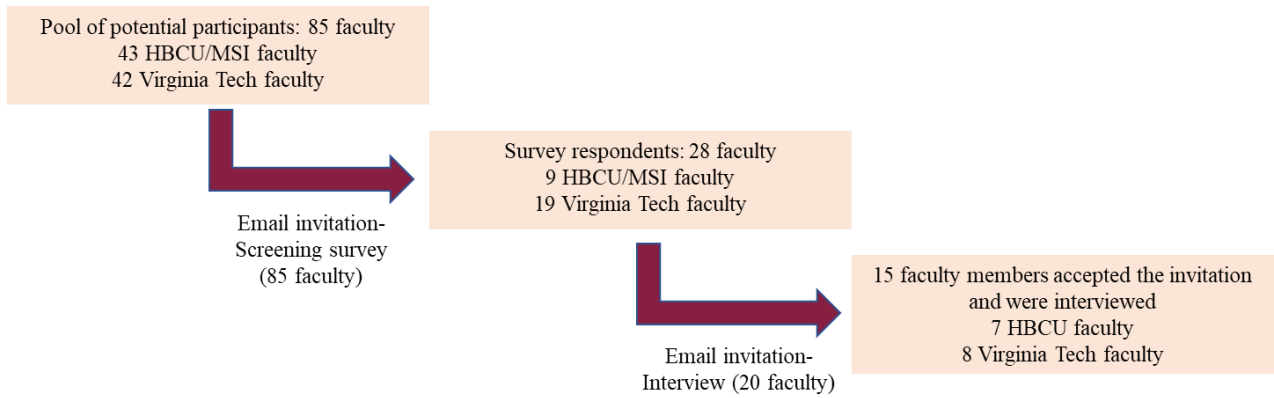


Figure 6. An illustration of the sampling procedure

3.4.2 Description of Cases

Out of eight cases included in this study, one team, including one faculty from HBCU and one faculty from Virginia Tech, could not engage in collaborative relationships; I was told about it during the interview. However, since the pair of faculty have had several years of working relationships, I decided to include this team as another source of evidence. The membership structure of these cases is presented in Figure 7.

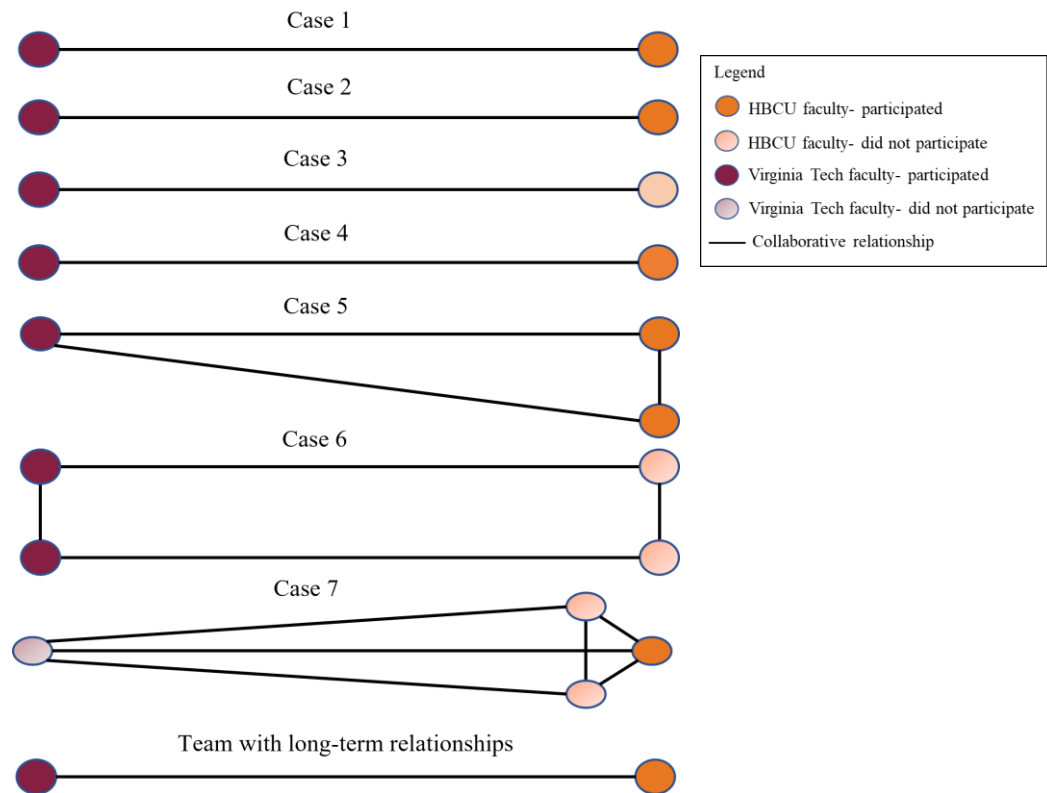


Figure 7. Membership structure of collaborative teams

Participants' demographic information is presented in Table 2, based on self-reported data. The diversity represented is by itself a success for ICTAS D&I Investment. Indeed, the literature rarely indicated that programs attracted diversity in race and gender in particular. Nevertheless, the data collection started a few months after the second year of support for those collaborative teams who received funding in 2018-19.

Table 2. Faculty participant demographics

By Discipline		By Rank	
	Number of Participants		Number of Participants
Agriculture	3	Assistant Professor	2
Biochemistry	2	Associate Professor	6
Biomedical Engineering	2	Professor	4
Chemistry	2	Not on Tenure Track	3
Civil and Environmental Engineering	1	Total	15
Education	2		
Food Science and Technology	1		
Physics	2		
Total	15		

By Race		By Gender	
	Number of Participants		Number of Participants
Asian	4	Female	8
Black	6	Male	7
White	5	Total	15
Total	15		

The structural and configural characteristics of each team are presented in Table 3. A point should be discussed regarding the fiscal year projects get funded (first became funded). As described in Chapter 1, there was a transition from a one-year program to a two-year program beginning 2019. In other words, the grantees in 2018, compared with those in 2016 and 2017, had extra support and could choose to continue beyond one year. It may very well be the case that a collaborative team wouldn't continue for a variety of reasons, for example, lack of expected interpersonal dynamics.

Table 3. Structural and configural characteristics of teams

Case Number	Fiscal year	Number of members	Gender	Race	Age group
Case 1	2016-17	2	Female Male	Black White	40-44 65 or older
Case 2	2017-18	2	Female Male	Black White	40-44 40-44
Case 3	2017-18	2	Male	White	40-44
Case 4	2018-19	2	Male Male	Asian Asian	40-44 40-44
Case 5	2018-19	3	Female Female Male	Asian Asian Black	35-39 45-49 45-49
Case 6	2018-19	4	Female Female	Black Black	55-59 55-59
Case 7	2018-19	4	Male	White	35-39
Team 8	-	2	Female Female	Black White	55-59 55-59

As presented in Table 3, only faculty members who participated in the study are included. Table 4 summarizes the number of participants in each phase of data collection and presents their perspectives regarding the sustainability of collaboration, based on responses to the screening

and follow-up surveys. As noted above, I included a question in the screening survey asking participants whether or not they had continuing working relationships. On the follow-up survey, participants were asked to select one of the following options:

1. You and your collaborative partner(s) have had continued working relationship.
2. You and your collaborative partner(s) did not collaborate on any project or task but have a plan to do so.
3. You and your collaborative partner(s) did not collaborate on any project or task, and there is no active collaboration plan.
4. Other (please describe)

There are three potential limitations worth considering. First, the perception of continuous working relationships might differ between and across collaborative team members. Second, the screening survey was primarily concerned with the relation across institutions. Most questions for example, the Likert scale item “You considered the quality of the working relationship to be very strong” primarily aimed at capturing relationships between one faculty member at HBCU and one faculty member at Virginia Tech (whom they identify as their primary partner) in the first year of their collaboration through ICTAS D&I Investment. The goal was to capture the interpersonal dynamics within the context of inter-organizational relationships. Pragmatically, designing a survey including names of individuals and asking participants to rate and/or provide comments about each individual would have made the survey extensive, besides concerns for accuracy and protection of human subjects. In addition, the very fact of comparison resulting from it could have impacted the responses. Third, relying on the responses of one individual for dyads or two individuals for teams comprising of three or four members limits our understanding of what is going on in teams. This latter is a limitation of this study.

As presented in Table 4, those who responded to the surveys all indicated they had a continuing working relationship. It is also worth noting that there were no conflicting views between respondents in each collaborative team. Also as noted above, Case 8 dealt separately in this study as an extra source of evidence and not necessarily in relation with other cases, since the collaborative relationship of the partners in this case was not in the context of D&I Seed Investment.

Table 4. Distribution of participants in each phase of data collection and perception of sustainability based on survey data (+ represents continuing relationships based on the responses)

	Number of team members	Number of interviewees	Number of respondents to follow-up survey	Sustainability	
				Screening survey	Follow-up survey
Case 1	2	2	1	+	+
Case 2	2	2	2	+	+
Case 3	2	1	1	+	+
Case 4	2	2	1	+	+
Case 5	3	3	2	+	+
Case 6	4	2	1	+	+
Case 7	4	1	1	+	+
Team 8	2	2		+	

3.4.3 Interview

The primary source of data collection was one-on-one interviews with faculty. After identifying the interviewees based on the initial survey, the participants were contacted to schedule time for the interview. I incorporated a semi-structured interview. While I followed an interview protocol, I posed probing and follow-up questions based on what interviewees expressed or discussed. See Appendix E for interview questions. In planning for case study design, Stake (1995; 2006) discusses how “issues” around studies serve as conceptual structure for organizing case studies; including topics in connection with “potential” and “latent” questions can be included as issues. The issues I am concentrating on, primarily reflected on interview questions, would differ from what others may focus on in carrying out such study. Key areas addressed during the interview were: motivations in engaging in collaboration, membership structure and responsibility of each member, trust and relational dynamics, outcomes resulting from the collaboration, and broader institutional factors.

The interview protocol followed a chronological order, starting with exploring prior working relationships. Then, a major part of the interview focused on faculty experiences in the first year collaboration through ICTAS D&I Investment, and finally, the experience after the first year and the overall process of the collaboration were emphasized.

A total of 15 faculty members were interviewed. Interviews were recorded using the recording feature on Zoom. Each interview took about an hour. The Zoom transcription did not provide accurate data, and I transcribed the interviews. I was cautious of including directional questions. Overall, the main questions were “descriptive”, and developed to obtain participants’ perspectives about what/how events happened and how they experienced them (Brinkmann and Kvale, 2014).

3.5 Data Analysis

The data analysis consisted of two major phases: within-cases and cross-cases (Merriam, 1998; Miles et al. 2020; Stake, 2006; Yin, 2018). In this study, and consistent with the nature of multiple case studies, the wholeness of each case was maintained (Yin, 2018). The process was primarily concerned with what I wanted to learn from this study considering the purpose of the research (Auerbach and Silverstein, 2003; Merriam, 1998). I also noted ideas repeated and emphasized by an individual or mentioned by several individuals, which appeared to be unrelated for further consideration through organizing and reorganizing groups of ideas.

I first explored different patterns within the cases. During this phase, within-case analysis, I organize the data into categories and look for a holistic picture representing a given case. In every case, I noted the relevant and important ideas from the first interview transcript. I used In Vivo Coding as the primary method in which words or short phrases from the language used by participants are used to represent the data (Saldaña, 2021). The initial coding further helped me to navigate through the data. I repeated the same process for other members of each collaborative team (if any). Next, I created another file organizing similar and repeating ideas and look for similarities and critical differences. I then group the similar ideas into a common category. In categorizing the ideas, I paid attention to implicit topics they share (Auerbach and Silverstein, 2003). Then, I chose a name for each category, mainly relying on actual language used by the participants. I repeated the same steps for each case. Data collected through questionnaires were summarized and presented separately; and used to supplement and/or augment the qualitative findings (Bloomberg and Volpe, 2018). The analysis across cases started with comparing and contrasting ideas representing categories. I then created a master list of categories and organized all the similar ideas. The differences were noted and recorded in

another document. Finally, I revisited the number and the name of a master list of categories considering four criteria for categories proposed by Merriam (1998); categories should be:

1. Exhaustive-- encompassing all important and relevant ideas
2. Mutually exclusive-- each group of ideas should belong to one category
3. Sensitizing-- the names of categories should be sensitive to the meaning represented in data
4. Conceptually congruent-- categorized by the same level of abstraction

3.6 Quality of research design

The importance and impact of any research investigation rely on incorporating means throughout the research process to ensure accuracy, credibility, trustworthiness, and reliability. One of the main questions is the extent to which the findings capture what has been claimed; in other words, how does the relationship between variables and results establish? I employed two strategies to enhance the credibility of this study. First, I used triangulation as one of the most common approaches in establishing the quality and credibility of studies (Patton, 2002).

Triangulation refers to including multiple and diverse data, observers, methods, or theories for the purpose of taking out doubts that can be resulted from a single approach, perspective, or interpretation (Patton, 2002). Creswell and Poth (2018) argue that one of the main features of qualitative case studies is presenting an in-depth understanding of the case; that's why there is a need to incorporate several sources of data to develop an in-depth understanding. In this study, I utilized different sources of data to establish credibility and explore consistencies and inconsistencies in findings. In addition, to improve the credibility of the study, I requested my co-chair to provide feedback and opinion on the list of categories and findings. The list of categories with the excerpts shared with my co-chairs and the list went through two rounds of revisions.

Concerning the reliability of this study, I developed documentation, protocol, and database for the study to ensure consistency and stability (Yin, 2018). The process of development and the various phases in research design were presented to help others imagine going through the stages and making adjustments as needed. The use of multiple data and building on perspectives of multiple individuals further enhances the reliability of this study (Merriam, 1998).

It should be noted that the goal of this study, similar to most qualitative studies, is not to generalize the results, instead to explore the patterns in connection with the propositions and to help develop alternative explanations (Yin, 2018). Stake (1995) used the term “naturalistic generalization” as something that readers should make utilizing strategies researchers use, such as providing rich description and narrative accounts. Nevertheless, this multiple case study speaks to other similar settings considering the rich description provided and the multiple instances included (Merriam, 1998).

Chapter 4: Findings

4.1 Introduction

This dissertation study aims to better understand faculty research collaboration across different types of universities, specifically considering the perspectives of faculty at a PWI and faculty at HBCUs/MSIs. As discussed in Chapter 1, this qualitative study was defined in the context of the ICTAS D&I Investment and focused on teams of collaborators whose partnerships were supported through the ICTAS grants between 2016 and 2019. This research employed a multiple case study method to investigate the following central research question: *What factors facilitate sustainable collaboration between faculty at HBCUs/MSIs and faculty at a PWI?*

I analyzed eight collaborative teams, comprising seven cases bounded by the scope and time in the context of ICTAS D&I Investment, and one collaborative team that has maintained collaborative relationships for several years. The data were obtained through a screening survey, follow-up survey, individual interviews, documents submitted to ICTAS, and online information about different institutions. In this chapter, I present the results of this qualitative study. I begin with the findings from interview data across the cases organized by major categories developed in the analysis and then present the summary of the results of the information collected through surveys. The list of key categories include:

- Equitable Share of Power
- Interdependence
- Mutual Benefits (Success of the Project, and Building Capacity)
- Similar Social Experience (Background Experiences in Common, and Identity-Based Experience)
- Mutual Respect
- Financial Support
- Institutional Differences
- Developing Personal Relationships
- Conducive Communication
- Fairly Open Communication Style
- Clear Roles and Responsibilities

4.2 Factors that Influence the Sustainability of Inter-institutional Collaboration

In this section, I present the main findings of the study based on the perspectives of faculty about their collaboration experiences throughout the process of partnership.

Equitable Share of Power

By *Equitable Share of Power*, I mean the perceived minimal hierarchy in the distribution of power among collaborative partners. The experiences described by almost all members of collaborative teams in one way or another presented the importance of equitable share of power throughout the collaboration process. In the context of research collaboration between faculty at HBCUs and faculty at PWIs, there might be an assumption about the disparity of resources (whether or not there are actual disparities) for carrying out the projects. Further, the distribution of the ICTAS grant provides Virginia Tech faculty the relative upper hand in terms of influence over resources, and as the recipient of the grants they are ultimately responsible for the management of the project. As described in Chapter 1, the ICTAS D&I Investment provides resources for travel, joint publications, reciprocal visits to teach and offer guest lectures, and access to Virginia Tech facilities for the HBCU/MSI faculty, and exposing students to increased research and educational opportunities at both institutions. Although the grant provides some opportunities for mutual engagement of collaborative partners, nevertheless, the relationships between faculty are embedded in macro-level dynamics of HBCU-PWI relationships that influence perceptions of collaborators and the reality of collaborations. Several faculty described how such dynamics play a role in the formation and earlier stages of collaboration. One HBCU faculty describes his hesitation in reaching out to Virginia Tech faculty considering presumed dynamics between smaller universities and universities that have “bigger name”:

I don't know that I had any expectations [prior to our working relationship]. But I might say that someone from a smaller university or school that isn't quite as notable might be a little hesitant to reach out to somebody from a bigger name. And there might be a perception that somebody from a university with a bigger name might not have time for somebody from a smaller university. And so, I think that psychological dynamic can exist. I think that's important to understand.

Another HBCU faculty reflects on her expectation prior to the collaborative working relationship and addresses the potential risk of opportunism in majority-minority relationship:

I was coming from a minority institution, a lot of times one of the things that comes along with being at those institutions is that you have a lot of bigger institutions try to

enactment smaller institutions only to make a number. And not to really bring up the research platform and the students and faculty, at that university. And so, when I walked in, I didn't know what to expect.

The faculty further describes how after early exchanges, her trust improved, and their collaboration unfolded towards engagement and building on the capacity of both partners rather than a deficit model of collaboration:

But at the end of it, after we had conversations and really try to figure out where we fit into whole scheme of what the research was doing I realized that they had our best interest...[It is not] why you want me to be in there, but how you want me to be in there, you know, it's not about just saying, oh, well, I just want you to be a part of this collaboration and I'm off throw money at you, no, you know, if we're going to move forward and really build something and develop something long-lasting, we have to figure out how that, how that type of collaborative effort can be built from my end and bridge to their end. And if it is to start off small and then build up over time, how does that look What does that look like? So, I think, moving from just talking about what are my needs as opposed to how can we do something research and build a project together.

The selected remarks above help to illustrate the overall psychological conditions that underlie relationships between majority and minority institutions. Such conditions are, in particular, necessary for faculty without prior working relationships. The participants in this study discussed positive experiences during the collaboration process in relation to fair and balanced partnerships in which what each partner brings to collaboration, their capacity, and capabilities are respected. The comment below by an HBCU faculty member indicates how there was not any rigid hierarchy in their groups, and members could function independently:

Even though like I said, [she] takes a lead a lot of the times, we don't have an hierarchy. We don't have like ranking of responsibility or ranking of power. So, there is no one, feel, answer to anyone within the partnership and there is no one who feels like they can. There's no one who pressure or there's no one on whom pressure can be accepted.

Another faculty member notes how lack of hierarchical structure helped them to adjust to one another, how they could collaborate effectively, and the ways their respect for differences in personalities and working styles enhanced their working relationship: “We adjusted along the way because it wasn't hierarchies. Everybody was a team and teams you just adjust and that's what we did. And that was never, I don't remember any glitches in in terms of making adjustments.”

The longevity of collaboration further begs the question of mutual recognition of partners beyond the relational dynamics in teams towards broader institutional factors that influence credit allocation among faculty. Several faculty discussed institutional power differentials in terms of academic credit allocation and the relevance to the power structures in their collaboration. One HBCU faculty member raises the importance of a balanced allocation of credits:

If there's a way to shares some of the credit for getting the award, because even of course, it would be great to have the money that would pay for a week or a summer month or somewhere half a month or to have the money so I can directly get the equipment myself, but also from movement in terms of my academic dossier, have something I can show that you know [I] was arguably the PI or co-PI or subcontract for this ICTAS grant because that you know that counts towards my academic productivity as well.

The collaborative partner of the faculty member quoted in the previous comment discusses a similar concern in connection to credit allocation:

I actually went back to ICTAS and said, you know, is there anyway, when we budget these in the future that we can buy out time for our collaborative partner, because that I think was the biggest challenge we faced. Him having enough time that wasn't dedicated to either administrative roles or teaching. And on this side, we're supposed to equally balanced across the three, teaching, research, and service...The idea, and I know it's incredibly complicated, but figuring out a way for us to buy out some teaching time for our faculty, I think it would be really, really helpful for being able to find a graduate student on the other campus.

Another Virginia Tech faculty uses the analogy of a “two-tier system” of benefits and the paradox of diversity initiatives where there is a disparity of benefits for their stakeholders:

If they were going to double the amount they gave, they could give dollar directly to the other institution, sort of an equal weight. And I know that that so anytime you forming a partnership, that's centered around diversity, you want to avoid something that looks like a two-tier system, or it looks like, well, I get \$10 thousand and you get \$2 thousand. You want to avoid that because it says, oh, we're not equal. So, but I do realize the limitations with that, because if you take if you guys take thousands of dollars or if ICTAS takes thousands of dollars and they started giving away tens of thousands of dollars to other institutions, it doesn't make people in the state of Virginia very happy. And it doesn't make all sorts of people very happy. But in a perfect world, you could do that. You could say, well, each, you can boilerplate it where you say each partner gets this amount and its equal and its equivalent. Now you write the proposal and go out and do what you're going to do. I just don't know if that's practical.

Interdependence

Interdependence refers to the state in which collaborative partners need to rely on one another to achieve the goals of collaboration, fulfill their respective self-interest, and/or achieve shared objectives. This dependence may come in various formats, such as information, skills, expertise, or resources. The comment below from an HBCU faculty member describes the importance of complementarity in expertise in forming and maintaining collaborative relationships:

I know what type of expertise I need for my project. So, when I visited Virginia Tech [during the HBCU/MSI Research Summit], I met [Name]. So, we discussed a potential collaboration and I told him I want this type of expertise, he mentioned to me, [Name] has this expertise... So I think he like, each one [of us] has different expertise and we just want to see how these expertise can be mutual together to move forward the project.

The notion of complementarity was discussed by most of the participants. As another example, a Virginia Tech faculty member discussed the complementarity in terms of the expertise of the faculty in theoretical and experimental physics; he says of his collaborative partner: “He's an experimentalist. So, he does all kinds of experiments [with] active matter, particularly study soft matter systems. And I'm a computational physicist or I'm also a theoretical soft matter physicist. So, it's kind of complimentary in terms of our expertise.”

Others noted different resources and capabilities connected with fieldwork, research development and implementation, and experimentation. One HBCU faculty member describes how the partnership provided possibilities for testing the data collected in the field.

We don't have, for example, in [HBCU] some of the ability to do some of the testing, I mean, much smaller university. So, collaborating with larger institutions is really important for us, you know, we serve traditionally underserved people, limited resource minorities, we really are. The HBCU land grants were created specifically to serve the underserved... They [Virginia Tech faculty] just mentioned things that they wanted, information that they wanted data that they wanted to collect. And the vast majority of that was perfectly fine. It was just the exact kind of stuff that we would want to collect. We're happy that somebody else collect it and test it. We can go out and take the samples, but can we get it to a lab in a reasonable amount of time? you know what I mean, can we really see what we're looking at, we don't have that capability.

Another HBCU faculty member discusses complementarity in terms of not only instruments, equipment, and/or access to the field but graduate students who could help and play a role in collaborations: “I'm doing research, I have a lot of good instrument or equipment, I bought it. But sometimes we don't have students. And I really want to have like a close collaboration relationship. So, people can share expertise, can share like an instrument, benefit students.”

Mutual Benefits

Almost all participants expressed mutually beneficial relationships and some degree of satisfaction with the outcomes of their collaboration. In general, faculty emphasized two areas: *Success of the Project* and *Building Capacity*. Success of the Project refers to the perception of successful outcomes resulting from the project undertaken through ICTAS D&I Investment. For example, the two Virginia Tech members of a collaborative team I interviewed repeatedly addressed how successful the project was and expressed a desire to continue the type of work they initiated. For example, one Virginia Tech faculty member explicitly describes the success of the project as one primary factor that influenced the continuity of collaboration:

[We continued] because the project was successful. And we would like to grow the project. The seed grant from ICTAS allowed us to pilot it. It allowed us to work out issues and to make the program run smooth. And yes, we will continue it because it was successful, and it helps [HBCU] and Virginia Tech to contribute to its land-grant mission.

This faculty member further reflects on how their collaboration can contribute to partnerships at a broader institutional and systemic level:

But without a doubt, it is contributing to institutional collaboration because it was a success. I think we can demonstrate how you can collaborate with colleagues on the other side of the state that you may not have known well, but you can build a project that can help each institution to accomplish some of its goals and have it to be effective. It's really a good example, a very simple example of how majority institutions can work with minority-serving institutions and both of us to achieve benefits from that collaboration.

In another case, the collaboration provided an opportunity for all team members to serve on the committee of a Ph.D. student at Virginia Tech, which was highlighted as one major benefit resulting from the partnership. One HBCU member of the team highlights the primacy of this outcome:

This relationship actually has resulted in a co-supervision of us. Because we are now co-supervising a student. So you see, this is the thing, I think that the impact of ICTAS is... Like I mentioned, we don't have a graduate program here. So, through this partnership, I'm able to engage with the student to serve on committee. And so, that has been one of the biggest benefits derived from this relationship.

Another aspect of mutuality discussed by most faculty was *Building Capacity*. Building Capacity refers to perceived potential resulting from working relationships that enable collaboration into the future, not necessarily immediate outcomes of projects. For example, both members of a collaborative team discussed how their collaboration built the foundation for future endeavors. An HBCU faculty member discussed the capacity they created as a “strong initial foundation” for the continuation of collaboration: “My collaborator and I have built upon strong initial foundation of collaboration. And it's just something that we wanted to continue. That we just wanted to continue, we have plans, we have a timeline and we're wanting to continue to pursue.” This faculty further discusses the benefits that resulted from collaboration in terms of an established connection formed around complementary expertise: “So, I think the major benefits were just having a colleague in a similar area with that complimentary expertise. So having someone that could discuss items with ideas with their head. A slightly different perspective, but enough that we could work together.”

The comment above highlights the mutual interdependencies that could continue to benefit the partners. Another HBCU faculty discusses how the “initial groundwork” developed can help others, and not necessarily themselves, to pursue collaborative relationships across the two institutions:

I think that the initial groundwork of the relationship, I think that we cut a little path for folks to want to talk to people at Virginia Tech a little bit more. For folks at Virginia Tech, who want to talk to people in [...] a little bit more and if that happened, that was great. And so, there's a channel out there, you know, so if somebody ever comes up and says hey, we want to work with so and so in [...] they can say, we've had a relationship with those back over there and we talked to them a couple of years ago, let me just reach out and see what's going on. Just having that is worth it, and this is something that Virginia Tech put the money up for. So [...] side, it was no money in, just some time, you know, absolute benefit for us.

Similar Social Experience

Most faculty discussed how similar social experiences with their partners played a positive role in developing and maintaining their collaborative relationships. The similarities can be further categorized into two overlapping yet distinct groups: *Background Experiences in Common* and *Identity-Based Experience*. *Background Experiences in Common* refers to similar previous experiences faculty members shared through their educational background or career trajectory. The comment below from a Virginia Tech faculty captures several elements of shared experiences with his collaborative partner, including academic path and tenure status:

We have a kind of similar academic pathway. He got the bachelor's degree from Taiwan and I got my bachelor's degree from mainland China. And then we both got our PhD degrees in the United States, after our college time in other countries. We have a similar path, so we know each other's backgrounds pretty well. In that regard, we have a very good foundation of mutual understanding. So, we don't see much obstacles in terms of understanding each other, supporting each other... But as I said, we're following similar academic path. So that's also a good factor. So let me put it this way. For two assistant professors, when they talk to each other is easier for them to understand each other. They face similar pressure, it's easier for them to support each other. Just, you are in the other person's shoes, you know what the other person is feeling. And is facing. So, it's easier for the communication.

These similarities were perceived as important in facilitating communication, enhancing mutual understanding, and developing empathy towards the collaborative partner's experiences. Another Virginia Tech faculty member describes how similar past experiences influenced their communication styles in terms of accommodating one another in their collaborative team:

[W]e did international trainings, our PhD. So in other word, we get our degrees in a different country like you and myself, right, maybe. There are more communication details we could provide in terms of collaboration during collaboration process. And we know more in terms of how to explain different aspects and not really assuming your international, but we always try to explain more in the ways that we could understand it better. I think that's a positivity.

Other comments shared by the faculty described commonality in experiences in terms of affiliation with institutions. For example, one HBCU faculty describes the positive influence of her affiliation with Virginia Tech as an influential factor in the dynamics of relationships:

“Relational dynamics for me was a little bit easier because I came from Virginia Tech. So, it was

a little bit easier for me to interact and engage with people because I really kind of had affiliation with different people that they might have been connected with.”

Another aspect of social experience is the category of *Identity-Based Experience* that refers to shared experiences primarily based on particular dimensions of identity, such as gender, race, and nationality. Several described and reflected on different aspects of their identity and how their identities played a role in the process of collaboration. For example, one HBCU faculty describes how being an under-represented racial minority (one Black and one woman) could support the longevity of their collaborative relationship:

Because my collaborator and I both are part of under-represented groups in engineering, I think there it did help. And in terms of just understanding some of the challenges and that we were facing from a professional standpoint. So, I think that can help to support the collaboration or the longevity of the collaboration and the potential for longevity.

His collaborative partner similarly highlights the primacy of their identities:

I think the fact that we are both from under-represented groups was helpful in that. I don't know how that would have played hadn't been there... I found it to be for positives of what we both... Some of the work that we're doing has expanded out and it was asking interesting questions that were not related to the initial ICTAS grant. I think to certain extent the positive about being both in the Engineering ranks anyway, being both from a minority group was helpful at times because we didn't understand everything the other one was going through culture, but pieces of it we had experienced before. So, I think that was a positive.

Several faculty members also highlighted nationality. For example, one Virginia Tech faculty explains how the background he shares with his partner helps in fostering interpersonal communication and enhancing trust: [We] have similar backgrounds and we are both Chinese. And then that similar background obviously is, is a, is a factor leading to these collaboration. It's easy for us to communicate. That can boost our trust for each other. So that actually it definitely is a positive factor.”

Further, two faculty members discussed how their experiences rooted in identity influenced the collaboration positively. For example, one faculty discusses the shared experiences of being “brown people” (a colloquial term for racial minorities who associate with darker skin pigment):

So, they influenced our collaboration in a very positive way because we had common experiences. Not only common experiences in our lives, being both a brown people in the United States, but also common experiences in terms of, the disenfranchisement, of acknowledging and recognizing the disenfranchising policies or disenfranchising experiences of the communities that we care a lot about. So, for us, it felt our communication was eased, because the fact that we are both activists in these areas. So, for us, it would not have been a barrier. It was actually an empathize, a springboard, a catalyst for our relationships. So, it was easy for us to form relationships because of it.

Overall, the comments illustrate how shared experiences can create a foundation to develop a better understanding and enhance and ease communications both in task-related interactions and outside the research space.

Mutual Respect

Mutual respect refers to the feeling of regard and appreciation of one another in teams of collaborators. Most faculty explicitly discussed the influence of mutual respect on the process of collaboration and specifically on the relational dynamics of collaborations. One HBCU faculty discusses mutual respect as a major factor capturing the success of their collaboration: “I think we had a greater respect for each other and our capabilities and what we can actually do. And so, I think that drove him wanting to get me involved in more collaborative type efforts that they were, they will try to make with minority-serving institutions.” Similarly, her collaborative partner discusses how mutual respect positively influenced the quality of their communication: “I think we have mutual respect for one another, and I don't think there's ever been any problem in the content of the communication, that's always, we trust one another.”

Importantly, respect described by faculty is not merely about what collaborators bring to collaborations, it is about value and regard for each other as a whole – understanding one another as persons with a complex life that is more than the sum of their identities and professional activities (Buber, 1958). An HBCU faculty member describes respect as the “key pillar” in team exchanges that enable a sense of an equitable relationship.

So, I think the key really, I think the key pillar that made that possible was mutual respect. That we have respect for each other both as individuals and as professionals... So, because of that respect and understanding that we're in this together, there was no there was no sort of policing. Like there's no one who has taken that role of making sure that everyone knows where they are and what they do and sort of they need to report to

me, and they need to satisfy my requirements. I think that was mutual respect, mutual understanding.

Another Virginia Tech faculty describes the interplay of the relational dynamics and fairness of collaboration:

Everybody was on the same playing field even though they were requesting our support, it wasn't at the deficit line of thinking in any direction. And so that was mutual respect across the group. We're working together as a team ... So, because of the fact that the types of exchanges that we had, in terms of the fact that everybody respected everybody and everybody, even though they were coming to us to get us to help them to learn, we will also [be] learning from there. So, I would say that because of the type of communication and the respect that we have for each other and the fact that we were all organized around, around the mission that we all were vested in, the exchanges were successful, and everybody made sure everybody understood what was being stated.

Financial Support

Faculty repeatedly discussed the importance of secured funding in developing and sustaining partnerships. *Financial Support* refers to funding from different bodies that enable faculty to compensate for costs associated and support necessary for initiation and continuation of collaboration. Several faculty highlighted the primacy of funding as a catalyst for shaping collaborative relationships with their respective partners. For example, one Virginia Tech faculty points out: "I don't know that I would have reached out to him to build this collaboration if it hadn't been for the opportunity that ICTAS provided. So that was very helpful." Another faculty similarly emphasizes the importance of funding "I think the biggest thing about the funding, it is giving people an opportunity to try something that they probably wouldn't have otherwise. So that's incredibly powerful."

Funding was also discussed as an element that affects maintaining and continuing collaborations. As demonstrated by the following comment by an HBCU faculty member, there is a connection between the level of collaboration and the amount of funding that contributes to a similar interest shared by both partners:

I think that the level of funding is going to dictate the volume of collaboration, and the frequency of it. So, you know, if you're getting a bunch of money to look at something that's going to become your priority, so if, for example, their next big grant is only water quality in [...] counties in [...], then my guess is we're going to spend a whole lot of time together. But yeah, I mean, it's not about actually money, having money or not having

money. I don't think I think it's about having money that goes into the same aligned interests. That you have to sort of investigate.

This faculty member further emphasizes the necessity of funding in building relationships: “[B]uilding the relationships, the things that you don't collect data on cost the most, they're getting together, going to the lunch, whatever, all of that stuff that you're not really collecting data on, that you are not publishing, that you are not doing any of that, that ends up costing the most.”

Other participants shared how funding influences their partnerships. On a positive view, one Virginia Tech faculty emphasizes receiving support from ICTAS as one of the main reasons in the continuation of collaboration: “I think the why is a large part of it is we've continued to receive support from ICTAS. Which is really important just because we needed the support that we needed the time.” Giving a critical, negative view, another Virginia Tech faculty discusses the challenges with receiving funding after several attempts with his collaborative partner: “[I]t's hard to get funding. And I'm not just talking about ICTAS, you know the success rate at NSF is not very good... there's no issue with constancy of purpose, but constancy of funding has been an issue.”

Overall, funding is an important factor in building and maintaining collaborative relationships between HBCUs and PWIs, creating opportunities for more interactions, and supporting undergraduate and graduate students.

Institutional Differences

Institutional Differences captures broader contextual organizational factors that affect collaboration, specifically differences in institutional priorities that may facilitate or constrain the partnerships between HBCUs and PWIs. Most faculty addressed the influence of institutional differences in terms of variation in priorities and loads of work in their respective institutions. One HBCU faculty discusses his institutional commitment to teaching and service as a major factor that could influence continuity or discontinuity of collaboration:

A big one is just going to be like teaching and service responsibilities for my institution and department. I think those are really the biggest ones because that tends to influence, have an impact on essentially time spent working on the collaboration or time to meet,

that kind of thing. So, whenever there are major disruptions or additional responsibilities in those two areas, it does tend to disrupt the continuity of, at least on my end, the continuity of the collaboration. So, the meeting frequency or communication frequency may go down just due to other duties.

Similarly, his partner at Virginia Tech raises concerns about the ways that differences in institutional mission influence involvement in the collaboration:

I think that [institutional differences] probably the biggest influence that we had. [HBCU] is not that they are not a research institution because they are, but their mission is much more... it's all about education. But their teaching load is so much higher than ours, that was one major challenge. Number of courses that he was teaching in a semester did not leave a lot of time for him to do research.

For some faculty, teaching or service load was not an issue; they described the limitations in organizational support that facilitates different aspects of carrying out research in general and research collaboration in particular. One HBCU faculty references the structural differences between Virginia Tech and their respective HBCU and provided an example on management of finances:

So even then, it is to say that really Virginia Tech and [HBCU] should work very closely in these, in this field alone. But even then, the institutional differences, which is to say the administrative structure, their capacities and the efficiencies that support individual scientists, there [is] such a difference. For example, what I said about the management of finances or obtaining of permissions or clerical and technical support available to the scientists. They are very big disparities which sometimes interfere with these kinds of collaboration.

These broader organizational differences can play a role in how faculty evaluate the overall process of their collaboration, in particular its fairness. An HBCU faculty describes such dynamics commenting on the role of institutional factors when he uses the term “trickle-down effect” and emphasizing the paradox of support and expectations:

I think one of the ways that has influenced is just somewhat a trickle-down effect and expectations on us as collaborators. So, expectations and support. So, while, you know, when you do have different expectations, we do have different missions. So, for example, with Virginia Tech having somewhat, [there] are several systems already in place that are providing support from my opinion, from my viewpoint, support for research and time for that. That allows my collaborator to do certain things that I may not have the same support to do. So, it does sometimes feel like it's on uneven footing where I am trying to essentially play catch up just because I'm dealing with a different set of structures and support or lack of support and that kind of thing.

Several faculty explicitly discussed the need for inter-institutional connections at the “administrative level” to address the issues reported above and to move towards long-term collaboration. For example, one HBCU faculty member points out that:

If this program [want to] be sustainable. And so really in the administration level, need to talk... And I feel I don't know for Virginia Tech side but for our side, I feel is become individual scientists that collaborate. I know her, she knows me, we collaborate, but in order to be sustainable is more faculty member involved, I think at least at top level people need talk and get, you know, guidance for us, “Okay, what's benefit we get if we collaborate.”

Another HBCU faculty shares a similar concern:

I was going to say that if this ICTAS partnership, it should be extended to the administrators too, they should be made to talk to each other and sort of learn from each other same with the scientists working. It's something to think about because a lot of the times the institutions try to bring the scientists together, they want them to get into collaborative arrangements like what we are discussing, but a lot of the times they forget that sometimes these scientists, they may, they all have excellent training. They all have the interest work. But the level of support and the resources that they may be very different. And so it would help if the administrators also have to each other.

This faculty member also describes the only experience with misunderstanding or conflict in their team, and the way it was influenced by institutional factors:

[T]he only moment where there was some sort of friction where there was some sort of misunderstanding arose from administrative side. I don't think, we cannot make, we cannot impose upon the administration, especially at the level of the administration, to help forge relationships between scientists. But it would help a lot in making sure that, that collaboration, that we have are sustained and that we can. So, I think if there was better understanding between Institutions, if there was more on essentially more knowledge at each institution of what goes on at the other institution. And I'm not saying that it's not there, I don't know I feel it's benefits both.

Developing Personal Relationships

The experiences with collaborations shared by the participants highlighted the value of a relationship that goes beyond project-focused or task-centered relationship and encompasses expressive relationships. *Developing Personal Relationships* addresses relationships that involve attachment between collaborative partners, beyond work partners, in collaborative teams. A comment from a Virginia Tech faculty describes how she and her collaborative partner

developed a desire to learn about one another and grow their relationship based on interpersonal communications outside of research:

[S]ome of our communications, we're not always a whole and complete on the science side that first year again... So, getting to know each other a little bit more in terms of the things that are important to us are things that we value, our family, our kids, those kind of things.. If I came away learning something new about him and about the work that he was doing at his institution that was even outside of our research collaboration, I consider that [communication] to be a valuable, successful part of our partnership when we're building that collaboration... Getting to know him as an individual and not just a researcher, I think helped a lot with that. Us being open and honest about the demands and the time that we had to give to this collaboration, I think were instrumental in making that shift.

Similarly, an HBCU faculty member notes how she and her partner speak about their everyday experiences specifically related to their family roles:

If we and her talk because, you know, we don't, we use Chinese talk most time because we're not talk about too much science. When we have the science, sometimes we talk about, you know, we use English... because she's mom, I'm the mom. So, we talk about mother issue, is not like science issue, of course, is going to help us to get a better understanding. ...at least for me to better understand her, what type of the person beyond the work. Also, she can understand me beyond the work what type of the person, you know, so get a better idea. So how to work together.

In discussing their experiences, several faculty reported friendship and close relationships with their collaborative partners. One Virginia Tech faculty reflects on her long-term relationship with her partner and highlights expressive aspect of their relationships:

We're friends to this day. So, I'm happy that check that where they have problems emotionally, they will have a problem no matter what. I've had experiences where that wasn't a good fit. But I've had mostly with [...], I've had a very good relationship that I can say we are still friends to this day.

Developing personal relationships demands successful communication and exchanges between partners. In the process, faculty need proper communication means to naturally and readily interact with one another.

Conducive Communication

Conducive Communication addresses adequate frequency and medium of communication that ensures fruitful collaboration outcomes. The comment below by a Virginia Tech faculty member captures the essence of this category:

I will say that the communication was very conducive to the needs of the project. I would say that, it was because of the fact that we had successful communication and we were able to implement two weeks, a really great STEM educational experience for the students. And so, I would say that the frequency was very the need of the project and very successful in that the two weeks of programming basically went off without a glitch. And so, I would say that was that within itself was as a success.

In terms of frequency of communication, almost all of the participants expressed a positive evaluation of the frequency of communication. One HBCU faculty member points out: “I’ve been happy with the methods and the frequency of communication.” Similarly, his partner evaluates the number of communications as adequate:

I don't think we needed more then. We can talk about the current state of things, but at the time, I think that was good. That was a good sort of frequency for us to be able to stay on track with the project and with what we were planning to do as we're also starting to work on some grant applications at the time.

In most cases, collaborators described the transient nature of the work and how communication varied depending on demands. For example, depending on program implementation or grant submission deadlines, faculty may work on distinguishable periods more closely and have more frequent and deeper interactions. Overall, the faculty described that, on average, the rate of communication was once or twice a month. In terms of communication mediums, faculty used various mechanisms, including email, phone calls, video-conferencing, and face-to-face meetings. Most teams relied primarily on emails and phone calls. Except for two collaborative teams, all other teams met at least twice during the first year of collaboration. In addition to seminar exchanges and travel for collecting sampling, HBCU/MSI Research Summit provided an opportunity for in-person time for six collaborative teams. Several faculty discussed the primacy of video-conferencing and face-to-face meetings. One HBCU faculty describes the importance of communication in face-to-face meetings in connection with building trust in working relationships:

You know, you feel people through a little bit of communication here and there. And then certainly after the first face-to-face meeting that we met and we got a chance to sit and talk and hang out and get to, you know, be right in front of somebody. You get that opportunity to really sort of put those two people in your head together now, because even talking over phone or an email, and now you get now you get them in real life, so you get finally put two people together. So certainly, after that, definitely a high degree of trust.

Similarly, a Virginia Tech faculty comments on the benefits of “seeing a person’s face” to avoid unclarities in communication:

Because sometimes leaving a voicemail message or sending an e-mail, sometimes things may not be clear. So, it would require additional follow-up to get clarity on the steps needed to address an issue or to continue to follow through on a portion of the project. So, I think communication, the frequency of communication was necessary. And it certainly helped me. I think it would have helped if we had had, like we're having virtual meetings now for the last year, it would have been really much more helpful if we had had virtual meetings when we were planning [...] rather than just phone meetings. I mean, at least you can talk, but I think there's something to be said by being seeing a person's face and having communications.

Overall, the adequate frequency and use of different communication mediums is critical in developing task and personal relationships, making decisions, and ensuring proper implementation of tasks, and reflecting on various aspects of the process of working relationships.

Fairly Open Communication Style

In addition to mechanics of communication in terms of frequency and mediums, collaborators discussed the (relational) quality of collaboration in one way or another. “Fairly Open Communication Style” addresses the mode of interaction in which collaborative partners freely and openly discuss their perspectives. Most faculty described positive experiences about how their team climate accommodated everyone expressing their perspectives. Faculty members were considerate of differences in opinion and quality of communication. For example, one Virginia Tech faculty discusses their “fairly open communication style” where they respectfully challenged each other:

I think there are differences in our content expertise. That's that we never really had a challenge with, because I knew he knew those areas far better than I did, and I think my perception from him was the same on the other side, and so we would just defer to each

other or have a conversation about you know back and forth question, like, well, “what do you think about that versus this”, and “why did you choose that”. So, I think [we have been] fairly open in our communication style, when we're thinking about things that are, that are similarities, we don't mind. Neither one of us minds challenging in a respectful way what somebody's bringing forward and having a dialogue about what might be the best way. And then, sometimes that took two weeks. OK. I need to go do some more reading. Let me take a look about it. Or whatever it happens to be.

Similar ideas were discussed by her collaborative partner, when they described the process of decision making in their working relationship:

I think in terms of general decisions, we spent a lot of time thinking through steps. Well, you know what we needed to do for the study. And then in addition to kind of try to formulate those steps, we would just research the different possibilities and really just see which one kind of stuck out to us or which one, which one we felt was the best avenue to pursue. And we really hadn't, if there was a difference of opinion, and that will be something? we just maybe Table, come back to agree that we are back away from and go do some more reading about it, and then come back in a week or two and make it, make another decision. But generally speaking, it was kind of a research based decision-making practice.

The verbal and nonverbal interactions can create a context where it is “easy to communicate,” which has a positive influence on interpersonal relationships. The following comment from an HBCU faculty demonstrates how the team accommodates such dynamics:

[W]hen we work as a team, we understand we should [be] working as a team. Sometimes you're not always agree everything because you'll have your individual who cannot agree everything but I like [our] team is when we don't agree, So we can I can tell. I want and I see these if [...] didn't agree she's going to say, I don't think that's a good...I know a lot of people have ego, just don't want see, and so my idea is best but for our team I feel everyone is “okay. I present my stuff if she doesn't agree, or even [...] don't agree.” But as long as what they propose makes sense. We said, okay, we're great...We understand each one, our background, our expertise different, people will think going to be different, but we understand our goal.

Being “very open in communicating” help collaborators in the process of decision making. Several faculty discussed this quality in terms of sharing clear expectations. For example, the comment below from an HBCU faculty member describes the positive nature of communication,

I think me and [...] are amicable in terms of our relationship. And so, I don't think it was any friction of frustration about what it is that we were looking for and what it is that he was interested in offering my university and students. So, I think he was very open with what it is that they will try. They were planning and I was open with what it is and expecting from it.

Further, several faculty discussed the importance of free and open communication in relation to arriving at a mutual agreement and mutual understanding in their teams through discussion and reciprocal exchanges. Such “natural” arrival at mutual agreement discussed by a Virginia Tech faculty member whose communications in the team enhanced by the type of collaboration they carried out centered around a mission:

Once you have, in my opinion, a connection in terms of that, in terms of your mission, your goals, your interest, the rest is easy, especially when you're dealing with a project that is organized around a social justice mission, you know, is less about you and is more about the mission. So that makes the conversation easy. So basically, what we would do was learning from each other in terms of what our what our interests were, but not only that, but what our experiences were. And we were able to connect with these experiences. So, you know, my imagining of our collaboration or our ability to communicate in collaboration was fueled by our just goals and mission. For me that's where I connected, and for him, that's where he connected. And you know, that within itself allowed us to, to find that happy medium in the work that we were doing, which automatically, in my opinion, and my opinion actually contributed to the quality of the communication that occurred...we have *a meeting of the minds* in terms of how we perceive the challenges and how we plan to address those challenges.

Clear Roles and Responsibilities

Clear Roles and Responsibilities addresses how team members experience clarity regarding related expectations to their roles and actions needed to achieve desired outcomes of collaboration. An HBCU faculty member describes how they had a clear task allocation among team members:

We have a very clear task sharing arrangement. Everyone's clear. Everyone has a responsibility and everyone has a role to play that don't tails to the other person's responsibilities... In terms of the relationships and the responsibilities, they [rely] on me to produce a crop and to prepare it to a form where they can take it on from there and do the analysis. And I do my part and they do their part. And we look at the data together...

The process of task allocation and arriving at clear perceptions about roles and responsibilities requires clarity as well as trust in communication and exchanges. A Virginia Tech faculty describes how they developed an understanding task-based roles:

So we wrote down all the tasks that we needed to do ... we just kind of listed. And then we again looked at expertise and responsibility, who have the capacity and where the funds may have fallen, and decided who would be responsible for what.

The emphasis on capacity noted by this faculty member creates a basis for the allocation of responsibilities. Several faculty discussed the roles of team members in connection with the skills, expertise, and resources each one offers. A Virginia Tech faculty points out: “Our joint project is a collaboration between an experimental group and a theoretical group or a modeling group. My group is a theoretical group or modeling group. So, most important data came from my partner’s group.” Similarly, his collaborative partner at HBCU notes this theoretical-experimental project: “In terms of the model development, that's mostly on his side. I did take part, I did talk to his student discussed about how a model will be more realistic and so on.”

4.3 Results from Survey Data

As discussed in Chapter 3, I employed a screening survey and follow-up survey in this dissertation study. I used the screening survey to identify the initial pool of participants, and to collect both demographic information as well as information about collaborative relationships primarily focusing on the first year of collaborations through the ICTAS D&I Investment. The follow-up survey collected information about the recent state of collaborations. In this section, I present the main results from the survey data.

One of the major questions in the screening survey was about faculty experiences with their working relationships during the first year of collaboration. On a Likert scale ranging from “Strongly agree” to “Strongly disagree,” faculty indicated the extent of their agreement with each statement. The summary results for their evaluation are presented in Table 5. As shown in Table 5, most statements primarily focus on the relational components of collaboration, emphasizing concepts such as trust, communication, and respect.

Table 5. Faculty evaluations of their relationships with primary collaborator at partner institutions (SA: Strongly Agree, A: Agree, SoA: Somewhat agree, SoD: Somewhat Disagree)

	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7
You envisioned long-term professional relationships with your collaborative partner.	SA SA	SA SA	SA	SA A	SA SoA SA	SA A	A
You considered the quality of the working relationship to be very strong.	A SoA	A SA	SA	A A	SA SoA SA	SA A	SoA
You felt what you bring to the collaboration is appreciated and respected by your partner.	A A	SA SA	SA	SA	SA A SA	SA SA	A
You didn't have any problems getting in touch with your partner when you need to contact them.	SoD A	SA SA	SA	SA SA	SA SA SA	SA SoA	A
Your partner took your opinions seriously when decisions were made about the collaboration.	A A	SA SA	SA	SA SA	SA SA SA	SA SA	A
You and your partner could engage in clear and honest dialogue.	SA A	SA SA	SA	SA SA	SA A SA	SA SA	A
You and your partner shared similar goals and ambitions about the collaboration.	A A	SA SA	A	SA SA	A A SA	SA A	A
Your partner understood and respected differences, such as race, ethnicity, gender, nationality, etc.	SA A	SA SA	SA	SA SA	SA A SA	SA SA	SoA
You didn't have any doubt about your partner's abilities and competencies.	SA A	SA SA	SA	SA SA	SA SA SA	SA SA	A
You felt your collaborative partner cares about the collaboration.	A A	SA SA	SA	SA SA	SA SA SA	SA SA	A
The collaboration was beneficial to both partners.	SA SA	SA SoD	SA	SA SA	SA SA SA	A SA	SoA

Table 6 summarizes the main results obtained from the follow-up survey. As noted in Chapter 3, all respondents maintained their working relationships and expressed positive perceptions about the longevity of their collaborations.

Table 6. Faculty evaluations of their overall experience with their collaborative partnership
(SA: Strongly Agree, A: Agree, SoA: Somewhat agree)

	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7
You envision maintaining a long-term professional relationship with your collaborative partner(s).	SA	SA SA	SA	SA	SA SA	SA	SoA
You consider the collaboration with your partner(s) worthwhile and beneficial.	SA	A SA	SA	SA	SA SA	SA	SoA
You care about your collaborative team.	SA	A SA	SA	SA	SA SA	SA	SoA

As discussed earlier, faculty envisioned long-term collaboration and reported continuing working relationship with their partners. Further, the data collected from the surveys indicate several qualities salient in collaborative teams: group cohesiveness, trust, mutual respect, mutual benefits, quality of communication, and shared goals and visions. Some of the same factors were described by faculty in interviews in depth, as discussed earlier. I shall address one critical observations about trust. Faculty described rather complex and in some cases differing perspectives about trust. First, most faculty highlighted the importance of temporal changes and described how their perceptions about trust improved over time. Second, both future-oriented and historical accounts of trust were described by faculty (Vangen and Huxham, 2003). In other words, some faculty described the absence of particular expectations and trust was primarily based on anticipation of what will be resulted from collaboration; on the other hand, some faculty noted either what they knew about their partners, reputation, or their previous relationships on different capacities (Vangen and Huxham, 2003). In addition, in contrast with

my initial orientation about trust, primarily based on abilities and competencies, other critical factors such as motives and good faith discussed (Ring and Van de Ven, 1994). Yet, the primary observation was that trust is not only about psychological dynamics of inter-personal relationships, but also integrated with broader structural elements, historical background and institutional dynamics (Rousseau et al. 1998). Several faculty members, from HBCUs as well as Virginia Tech, described how collaborations between HBCUs and PWIs disproportionately favor PWIs, often merely to meet diversity numbers or requirements. In summary, the complex and multi-level dynamics described by faculty make it challenging to make a conclusive argument about trust. I speculate that consistent with prior studies on collaboration, for example Gulati (1995), and studies on faculty research collaboration (Bozeman et al. 2016; Melin, 2000) trust plays a major role in collaboration however beyond the explicit impact of trust per se, pre-existing relationships, and the frequency and quality interactions. Put more simply, there is a good chance that trust is a defining factor, perhaps the defining factor, in successful long-term inter-institutional research collaborations and trust cannot be taken for granted as something that occurs without deliberate institutional support.

Chapter 5: Discussion and Conclusion

5.1 Introduction

The goal of this doctoral study was to enhance the understanding of faculty research collaboration across HBCUs/MSIs and PWIs. Considering the lack of studies examining the dynamics of relationships between faculty, in particular across HBCUs/MSIs and PWIs, the study of inter-institutional collaborative teams has the potential to inform researchers about factors that contribute to successful and effective collaborations and provide insights for subsequent empirical research. Further, such a study has the promise to provide insights for designing initiatives and facilitating inter-institutional collaboration at the broader administrative level.

As described in Chapter 1, this study was defined in the context of a seed funding investment, the ICTAS Diversity and Inclusion Seed Investment Program (ICTAS D&I Investment) at Virginia Tech. The study examined the perspectives of faculty whose projects were supported through the ICTAS D&I Investment between 2016 and 2019. I employed a multiple case study approach to explore factors that influence the sustainability of faculty collaboration beyond the duration of the funded partnership. The unit of analysis was defined as collaborative teams of faculty. The pool of potential participants included 85 faculty members from Virginia Tech and 23 different HBCUs/MSIs, representing 38 distinct collaborative teams. Employing a sampling procedure focusing on teams with continuing working relationships led to a sample of 15 faculty members representing eight different collaborative teams, including seven teams bounded in the context of ICTAS D&I Investment and another team that maintained a long-term collaborative relationship as an additional source of information.

The findings described in Chapter 4 indicate several factors that influence the sustainability of collaboration. The major categories listed below were informed inductively from the perspectives of faculty about their team experiences:

- Equitable Share of Power
- Interdependence
- Mutual Benefits
- Similar Social Experience
- Mutual Respect

- Financial Support
- Institutional Differences
- Developing Personal Relationships
- Conducive Communication
- Fairly Open Communication Style
- Clear Roles and Responsibilities

In this chapter, I first propose an organization for the findings of this study. I then reflect on the findings and present recommendations for ICTAS and other similar research institutes.

Limitations and future directions for research will be discussed next. Lastly, I provide a summary of this research study.

5.2 Sustainable Collaboration between Faculty at HBCUs and PWIs

In Chapter 2, I described a conceptual model of faculty collaboration building on social psychology literature on teams and studies in inter-organizational domain. I developed the model in order to better understand the phenomenon of faculty collaboration across universities and factors that may influence the sustainability of collaboration. The model includes three interconnected phases: preconditions, processes, and outcomes. As shown in Figure 2, Chapter 2, I presumed interconnections between the different phases of collaboration. Faculty perceptions about their lived experiences with the collaboration process are influenced by their team-level experiences. Further, collaborative teams are embedded in a broader inter-institutional context that may facilitate or impede faculty collaboration across institutions. The model also highlights a cyclic iterative process of episodic working relationships rather than linear directional stages. In other words, collaborative partners work closely with each other in distinguishable periods of time (Marks et al. 2001) on a particular task or simultaneously on several tasks to achieve the desired outcomes where there are interactions between different phases.

The findings in this study show a chronological picture of team developmental processes. More specifically, the findings indicate that factors (more or less) pertaining to each of the three phases can influence the sustainability of collaboration. Figure 8, below, presents a classification of major categories, reported in chapter 4, in relation to different phases of faculty collaboration. The classification is primarily based on how faculty characterized their experiences in

interviews. I distinguished contextual elements from other factors to better represent the multi-level dynamics of inter-institutional collaboration. Considering interview and survey data collected from seven cases and the additional interviews with two faculty in a collaborative team with relatively long-term working relationships, there were no particular issues that could lead to contradictory interpretations.



Figure 8. Major categories resulted from the study

Data related to Similar Social Experience highlights the importance of preconditions in forging and facilitating sustainable working relationships. As described in Chapter 4, faculty discussed similarities in their social experiences connected to background experiences, such as education, or their identities, primarily race and nationality. The results support the importance of homophily in providing more opportunities for interactions and developing shared understanding (Balkundi and Harrison, 2006; Hinds et al. 2000). However, the results did not support the proposition that heterophily, specifically in relation to surface-level diversity, may result in conflicts and reduced quality of working relationships. The findings demand further retrospection, whether such results represent an anomaly or a feature of what is going on regarding the teams' experiences within the context of this study. I further elaborate on this distinction in this chapter.

The next group of factors is concerned with the processes of collaboration. As expected, the findings indicate the influence of relational dynamics on the longevity of collaborations highlighted in the previous studies on faculty research collaboration (Bozeman et al. 2016; Creamer, 2004b; Melin, 2000). Frequent and effective communication and interaction between collaborative partners is an essential aspect of partnership that enhances trust, fosters interpersonal relationships, and help with consensual decision-making.

I labeled the next group of factors *overlapping* since it was practically problematic to distinguish the importance of these factors in relation to a particular stage, based on ways by which faculty described their experiences. *Interdependence*, for example, is considered in relation to preconditions that facilitates developing a collaborative relationship, as a component of collaboration processes, or as a way some faculty imagined and evaluated their relation in future. *Equitable share of power*, as another example, can also well spread across the three phases of collaboration, based on what participants experienced. What can be learned from such dynamics? The results are consistent with what has been reported in the literature in interorganizational domain. Scholars in this domain often highlighted the salient factors of interdependence, perceptions of shared power, and mutuality, often in relation to particular stages of collaboration (Gray, 1985; Thomson and Perry, 2006; Thomson et al. 2007). Gray (1985), for example, describes the development of inter-organizational relations in the three stages, problem-setting, direction-setting, and structuring. Among the conditions facilitating the three phases are perception and recognition of positive outcomes and interdependence, distribution and redistribution of power, and degree of ongoing interdependence (Gray, 1985). Nevertheless, what has been underemphasized in the literature is the necessity to treat these factors more holistically throughout the collaboration process. By making the case explicit about this dynamic, I argue that researchers can develop a more holistic understanding of collaboration to explore and evaluate working relationships among faculty.

Lastly, the importance of contextual factors, Financial Support and Institutional Differences, were prevalent in the accounts described. The influence of these factors is intertwined with the lived interpersonal experiences of teams of faculty. While there has been almost no picture of the dynamics of faculty research collaboration across HBCUs/MSIs and PWIs, a few empirical studies of faculty research collaboration emphasized the importance of broader institutional factors (Bozeman et al. 2016).

5.3 Implications of the Findings

What is the implication of the findings? I argue that the results first and foremost show the complexity of the phenomenon of faculty research collaboration across HBCUs and PWIs. There is continuous interaction between different factors during the collaboration process. *How* collaborative relationships evolve would relate to *who* collaborators are, *what* they bring to collaboration, *what* organizational and environmental factors exist, and *how* they are able to adjust the influence of various factors over *time*. The *why* of the continuation of partnerships depends on the dynamics just stated. Different factors may influence one another; there is also interaction at interpersonal and inter-organizational levels. Further, the influence of temporal changes needs to be recognized. Considering this interactive and complex picture of collaboration, a more holistic illustration of the dynamics of collaboration is proposed through a broader organization of the categories. The categories can be aggregated into an overlapping relationship between three dimensions: *Structure*, *Diversity*, and *Relation*. These dimensions, I argue, are the key pillars of sustainable inter-institutional collaboration. Figure 9 presents the relationships between the three dimensions. By *Structure*, I refer to the broader institutional and cultural, or contextual, elements that influence the process of faculty collaboration. By *Diversity*, I mean the similarities and differences between team members' characteristics and identities. These variabilities are rooted in individuals' backgrounds, experiences, and expectations that influence collaborative teams. Lastly, by *Relation*, I refer to both interactions and exchanges between collaborators and their outputs in *doing* collaboration.

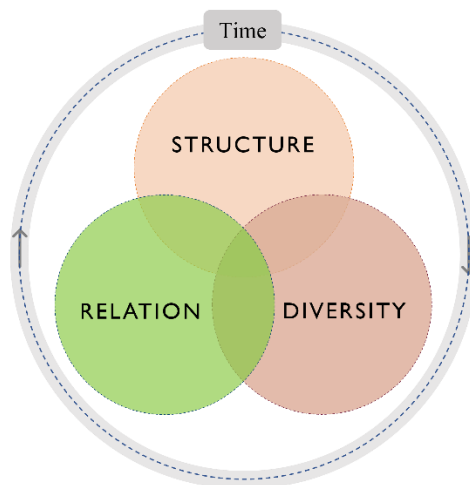


Figure 9. Key pillars of sustainable inter-institutional faculty collaboration

The three pillars and the temporal element illustrated above help us to picture sustainable inter-institutional faculty collaboration. What can we learn from this illustration in research and practice? First, the data collected from individual collaborative teams indicate that the teams with *richer interactions and a higher level of interdependence* are less likely to experience inactive collaboration and present a more positive attitude in making adjustments during the collaboration process. In other words, there are interactions between the perception of processes and/or outcomes with the degree of interdependence and *mutual goals*. *The more interdependence and the deeper interactions, the higher the plausibility of sustaining collaborations* (Harrison et al. 1998; Gray, 1985).

Second, the longevity of collaboration is not merely the function of cohesive teams, where there is a feeling of closeness and attachment between collaborators, or team viability where team members are satisfied with their membership and willing to continue their collaborations, or whether they found their collaboration worthwhile. The longevity of successful collaboration depends on broader structural factors that influence and in most cases constrain the collaboration process. In other words, while the relationships that lack cohesion, shared experiences, or depth of task interdependence are more susceptible to dissolution, structural factors such as availability of funding and institutional differences constrain and/or enhance the continuation of collaboration. Moving towards some degrees of formalization (Thomson et al. 2007; Thomson and Perry, 2006; Van de Ven, 1976) where partnerships are recognized at the broader institutional level can create pathways and ease developing and maintaining future partnerships across institutions.

Third, the collaborative teams that participated in this study represented differences at different levels, among them in relation to demographic attributes. *Surface-level diversity is important but inasmuch as it reflects shared values and facilitates shared understanding*. What helps the most in building relationships in this process, independent of surface-level heterogeneity, is productive interactions through the frequency and quality of communications. I argue that *underneath successful interactions is the appreciation for individuals as whole and respect for their differences* (Buber, 1958; Dussel, 1985; Matheis, 2017). Such appreciation and respect create a climate in which different perspectives are encouraged and valued (Creamer, 2004b), and there is a balance and equitable share of power. As a result, decision-making and

dealing with differences among faculty becomes something natural and organic throughout the collaboration.

Forth, consistent with what has been reported in social psychology literature, familiarity helps with reducing uncertainty and enhancing interpersonal attraction (Balkundi and Harrison, 2006; Hinds et al. 2000). I further emphasize the role of *temporality*, where through rich interactions over time, faculty are able to enhance their subsequent communications, decrease uncertainties in partnerships, and develop a sense of equality. During these exchanges, team members develop collegial relationships, learn more about one another, and over time the role of deep-level diversity becomes essential. Overall, previous and repeated interactions and history of collaborations, in particular successful working relationships, facilitate further interactions and sustainable collaboration.

Further, I shall reflect on the study and its findings in relation with theoretical perspective and methodology and ways by which this work enhances our understanding of the phenomenon of faculty collaboration. This study further clarified the importance of relationships in studying faculty research collaboration where the focus is on subjective meanings on the basis of individuals' perceptions, values, and beliefs (Bozeman et al. 2016; Creamer, 2004b; Melin, 2000; Shrum et al. 2007). With the large number of happenings and variables (Stake, 2006; Yin, 2018), qualitative multiple case study is an appropriate approach to investigate faculty collaboration across institutions. What was unexpected in this study was the primacy of structure and broader institutional factors that proved to be essential in the sustainability of collaboration across HBCUs/MSIs and PWIs. This observation further highlights the importance of incorporating theoretical orientations that incorporate micro- and macro-level elements and acknowledge the interactions at different levels, which adds another level of complexity to the studies of faculty collaboration across institutions. While interactions between different factors have been highlighted in the inter-organizational literature, the factors often treated in relation with separate phases that is merely a simplification of a complex interdependent phases where there is continuous interaction between happenings and contexts where the boundary between the two is unclear. Future empirical studies can further uncover this complexity.

5.4 Recommendations for ICTAS and Similar Research Institutes

Most faculty discussed the primacy of the funding through the ICTAS D&I Investment and noted the impact of the program as the “springboard” and “catalyst” for forging collaborations between faculty at HBCUs and Virginia Tech. The comment below from a Virginia Tech faculty captures the value of this initiative at ICTAS: “I just want to reiterate that I think that the ICTAS diversity and inclusion investment project is smart, and it facilitates engagement and promotes engagement with units outside of your own. So, I think it's a wise investment that hopefully we'll have a long-term impact.”

The ICTAS D&I Investment successfully facilitated forging partnerships between HBCUs/MSIs and Virginia Tech. The cases examined in this study show that the D&I grant from ICTAS helped faculty develop sustained collaborative relationships that otherwise would not have been possible. Importantly, several teams began their working relationships through this grant. In addition, considering the self-reported demographics, most participants were African American women; that within itself is a success and shows how such an initiative can increase participation of underrepresented minorities. Furthermore, most participants perceived the program's planning and implementation as straightforward regarding funding procedures and requirements. It appears that ICTAS created a clear and welcoming procedure for supporting inter-institutional partnerships. I shall also point out a positive structural change in the ICTAS D&I Investment from a one-year to a two-year program, which is consistent with what was discussed by participants and what have been reported in the literature that developing relationships takes time. In other words, the temporal element plays an absolutely essential role in team building. Despite these positive factors, the following are the proposed recommendations to improve the ICTAS D&I Investment: Establish Formal Institutional Collaboration, Develop Faculty Community, Maintain and Strengthen the Connection with the HBCU/MSI Research Summit (or other similar collaborative initiatives), and Prioritize Capacity Building. In what follows, I elaborate on the key recommendations.

5.4.1 Establish Formal Institutional Collaboration

Based on the perspectives of the participants, institutional differences, such as size, history, mission, and demographics, both in terms of priorities and support structure, create a burden for individual collaborators with explicit implications at the team level. Addressing these

issues ultimately depends on ways by which administrators work in making sure that collaborations are recognized and credits and resources are redistributed. Different levels of access to the support structure, control over valuable resources for collaboration, and differences in credits and what gains from partnerships may impede the continuation of collaborations. I recommend that ICTAS should seek ways to establish connections with HBCUs/MSIs at broader organizational and administrative levels and work closely with the other units to translate the practices of inter-institutional collaboration for developing relationships toward different types of agreement: the possibility of buying time for HBCU faculty for engaging in research projects, faculty exchanges, student research experience, and establishing formal ways for credit allocation for faculty at HBCUs, as well as establishing memorandum of understanding (MOU). With creating some broader organizational structure around this initiative, ICTAS (or other similar research institutes) can further remove the boundaries across institutions and create pathways for relationship building and collaborations that might not exist otherwise.

5.4.2 Develop Faculty Community

Without a proper support structure, partnerships across different types of institutions are fragile. In particular, intervention at the early stages of team building is critical to better facilitate long-term working relationships (Dahlander and McFarland, 2013). While ICTAS currently provides support for reciprocal visits, I recommend creating a structure for facilitating more in-person interactions among members of collaborative teams and between teams whose projects are supported by the ICTAS D&I Investment. It is critical to recognize that this group of faculty members share similar interests and experience in building collaborative relationships across HBCUs/MSIs and PWIs, which has remained uncommon when considering the overall picture of inter-institutional faculty collaboration. I recommend building a community of practice (Wenger, 2000) where ICTAS provides meaningful interaction among faculty where they can discuss their experiences with projects, different ways of navigating inter-institutional collaborations, or funding opportunities. Networking events or workshops centered around team building can enhance the connection among the community members, provide opportunities for sharing knowledge, and lead to learning and appreciation of the differences and capabilities among the members (Wenger, 2000). With the rarity of collective understanding and mutual appreciation of partnership between faculty at HBCUs/MSIs and PWIs, efforts in building community can

change the culture around inter-institutional collaboration where collective visions are formed and ultimately help grow the community.

5.4.3 Maintain and Strengthen the Connection with the HBCU/MSI Research Summit (or other similar collaborative initiatives)

Collaborations between HBCUs/MSIs and PWIs are embedded in the historical background of racial inequity and differential privilege. Further, there is a mistrust of potential opportunistic behavior in merely meeting the numbers as related to diversity. In other words, not only the capacity and capability of faculty and students at HBCUs have remained underemphasized, HBCUs are often susceptible to opportunistic behaviors in majority-minority partnerships. Forging new partnerships without prior working relationships is very challenging in such a context. Based on the experiences of faculty, perception of trust and personal relationships developed over time, mainly as a result of reciprocal exchanges and interactions. In other words, to forge relationships and nurture a sense of collegiality among faculty members, there is a need to create contexts for networking and fostering relationships. The HBCU/MSI Research Summit provides a unique opportunity for connecting faculty members and helping to establish and foster collaboration both at personal and institutional levels. I recommend that ICTAS continues to integrate the ICTAS D&I Investment with the HBCU/MSI Research Summit and further strategize to provide meaningful opportunities for students who are at the center of most collaborative relationships between faculty at HBCUs/MSIs and faculty at Virginia Tech. Further, to expand and deepen the interventions, I recommend organizing a special ICTAS session for the Summit attendees and providing opportunities for the D&I Investment grantees to share their experiences with other faculty interested in building inter-institutional partnerships. Such interaction creates a more equitable two-way exchange, which helps with bringing more visibility to efforts undertaken by collaborative teams and developing a better appreciation for capabilities at partner institutions.

5.4.4 Prioritize Capacity Building

The efforts of broadening participation are often centered around what PWIs or research-intensive institutions can offer to underrepresented minorities. The very potential of mutual relationships between institutions in building capacity has often been underemphasized. The

ICTAS D&I Investment proved that even limited funding could create the possibility of mutual relationships. The findings of this study indicate that faculty perceptions of outcomes and success of their collaboration are both about conventional outcomes such as publications or grants, and relationship and capacity building. In other words, partnerships across HBCUs and PWIs will likely enhance the capacity to create opportunities for students, extend the community around collaborations, and build foundations for further collaborative endeavors and increase the likelihood of publication. While ICTAS pays attention to the holistic impact of the projects in reviewing the proposals, I recommend that ICTAS recognize these priorities in practice and develop strategies to better translate them into funding and evaluating the ICTAS D&I Investment. For example, supporting HBCU students who are active in funded projects through summer research experiences and/or establishing formal pathways for sharing resources could further support long-term collaborative relationships between faculty.

5.5 Limitations and Direction for Future Research

There are several limitations in this study that are important to be noted:

1. Not all collaborative relationships were primarily concerned with research. As described in Chapter 3, the primary focus of one of the collaborative project was on student recruitment. Although the partners in this team have worked on collaborative research, and I tried to solicit their perspectives about working on particular research projects or proposals, some differences should be acknowledged.
2. In two cases, I relied primarily on the perspectives of one faculty member. Considering my focus on collaborative teams of faculty, the experience of one team member limited my analysis of the team.
3. Despite my motivation to hear different experiences, the results primarily showed relatively positive experiences. This might not constitute a limitation in the traditional sense, and yet it is important to call attention to the lack of negative experiences. Additional research and alternative data collection methods could reveal other problems experienced by collaborative teams that were not identified using the methodologies I employed.

As noted earlier, there was a lack of conflict in the accounts described by the participants. If there were any misunderstandings and conflicts in their working relationships, those were

primarily connected to the broader structural level, such as differences in institutional support rather than interpersonal relational means and qualities. However, I argue that this observation is more a feature of this study than a limitation. In other words, the experience of collaborative teams provided evidence that under proper structural support, faculty are interested in developing collaborative relationships across HBCUs/MSIs and PWIs, which proved to be fruitful.

The opportunities for future research exist in connection with sampling strategies and broadening the scope of research investigation:

1. Future research can employ a selection of cases in a way that presents differences in the duration of the collaboration. Capturing the differences in perceptions of sustainability is critical in understanding how developmental processes unfold and what factors may influence teams differently.
2. Another avenue for research is to explore the structural and configural characteristics of teams. It is expected that there are differences in teams with various sizes or different formats of structural support.
3. The claim about sustainability, persistence of inter-institutional research collaboration, should be further explored through longitudinal studies. Consistent with the literature in social psychology and the inter-organizational domain, the changes over time should be studied to understand the reality of interinstitutional collaborations.
4. Surface-level diversity and deep-level diversity are often treated separately in the literature. Future investigations can explore the interactions between these two in the context of inter-institutional faculty collaboration.

5.6 Summary

This dissertation study was developed to study the process of faculty research collaboration between different types of institutions, specifically by exploring factors that influence the sustainability of collaboration between faculty at HBCUs/MSIs and faculty at a PWI. The study was defined in the context of the ICTAS D&I Investment and employed a qualitative multiple case study approach to explore eight collaborative teams of faculty. The results indicate a dynamic interaction between different phases of collaboration and presented factors in relation to preconditions, processes, and outcomes of collaboration as well as broader contextual elements. The factors were further summarized into three key pillars of sustainable

inter-institutional collaboration relation, diversity, and structure, that with time formed critical elements in maintaining long-term collaborations. The study shows ICTAS successfully developed fruitful collaborations across HBCUs and Virginia Tech. In the long-term, such a model of support for inter-institutional collaboration creates a strategy for broadening participation and enhancing diversity, equity, and inclusion, not merely as a means for enhancing research productivity.

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Appendices

Appendix A. List of Abbreviations

AHRM	Apparel, Housing, and Resource Management
AOE	Aerospace and Ocean Engineering
BEM	Biomedical Engineering and Mechanics
Biochem	Biochemistry
BSE	Biological Systems Engineering
ChE	Chemical Engineering
CEE	Civil and Environmental Engineering
Chem	Chemistry
EE	Engineering Education
ECE	Electrical and Computer Engineering
FST	Food Science and Technology
HBCUs	Historically Black Colleges and Universities
HRAREC	Hampton Roads Agricultural Research and Extension Center
ICTAS	Institute for Critical Technology and Applied Science
ISE	Industrial Systems Engineering
Math	Mathematics
ME	Mechanical Engineering
MII	Macromolecules Innovation Institute
MSE	Materials Science and Engineering
MSUs	Minority-Serving Institutions
PHS	Population Health Sciences
Phys	Physics
PWIs	Predominantly White Institutions
SOAD	School of Architecture and Design
SOE	School of Education
SPES	School of Plant and Environmental Sciences
Stats	Statistics

Appendix B. Email Invitations

Subject line: Invitation to Participate in a Research Study on Research Collaboration between HBCUs/MSIs and PWI

Dear Dr./Professor

My name is Yousef Jalali and I am a PhD candidate in the Department of Engineering Education at Virginia Tech. I am working on a dissertation project exploring different factors influencing sustainability of faculty research collaboration across institutions. You were selected as a possible participant in this study because you have been identified as a faculty member in a collaborative project funded through ICTAS Diversity and Inclusion Seed Investment (ICTAS D&I Investment) between 2016 and 2019. This research study has been approved by Virginia Tech Human Research Protection Program (IRB# 20-417).

The purpose of this study is to gain an understanding of your experiences of the collaboration process; provide key findings and recommendations that can help improve the program and the development of similar programs; and to contribute to the literature in particular with respect to collaborations between Historically Black Colleges and Universities (HBCUs) or other Minority Serving Institutions (MSIs) and Predominantly White Institutions (PWIs).

Your participation in this study will involve completing a brief questionnaire, a virtual interview, and possible follow-up questions. The survey will take about 15 minutes to complete.

Based on the data collected through the survey, participants will be selected for an individual interview. If you are selected, I contact you to schedule time based on your preference for the virtual interview. The virtual interviews will be recorded with your permission. The interview will take between 60 to 90 minutes.

Your participation is voluntary and confidential. In reporting the data, no personally identifiable information will be linked with your responses. You may choose not to complete the survey or you may stop the survey at any point. The consent is implied with the submission of the survey.

If you are interested in learning more about the study, please click the following link: Your personal code for completing the survey code is: ----

If you have any questions about this research study, please contact me at yousef@vt.edu, 715-821-1644.

Should you have any questions or concerns about the study's conduct or your rights as a research subject, or need to report a research-related injury or event, you may contact the Virginia Tech Human Research Protection Program at irb@vt.edu or (540) 231-3732.

Sincerely,
Yousef Jalali
Doctoral student, Virginia Tech

Interview

Subject line: Research Study on Research Collaboration between HBCUs/MSIs and PWI
Dear Dr./Professor

Thank you for your interest in participating in the dissertation study that explores different factors influencing sustainability of faculty research collaboration across institutions. This research study has been approved by Virginia Tech Human Research Protection Program (IRB# 20-417).

I would like to invite you to participate in a virtual interview in which I will be asking you about your experiences with research collaboration that initiated or fostered as a result of ICTAS Diversity and Inclusion Seed Investment Program. The interview will take between 60 to 90 minutes. Please read the attached informed consent document.

With your permission, I will audio-record the interview to ensure about capturing accurate record of the discussion. The video recording is optional and you can opt-out if you choose to. Only the researcher has access to the interview recordings. Please note your participation is both voluntary and confidential. When transcribing the recordings, pseudonyms (i.e., false names) will be used for your name and for the names of any other people who you mention. In reporting the data, no personally identifiable information will be linked with your responses.

If you are interested in participating in interview, please reply to this email. After hearing from you, I will email you to schedule a time (based on your preference) for the interview.

If you have any questions about this research study, please contact me at yousef@vt.edu, 715-821-1644. Should you have any questions or concerns about the study's conduct or your rights as a research subject, or need to report a research-related injury or event, you may contact the Virginia Tech Human Research Protection Program at irb@vt.edu or (540) 231-3732.

Sincerely,
Yousef Jalali
Doctoral student, Virginia Tech

Appendix C. Surveys

Screening Survey

Study of Research Collaboration Between HBCU/MSI and PWI

Start of Block: IRB Information Sheet

Information Sheet

Information Sheet for Participation in a Research Study

Principal Investigator: Dr. Vinod Lohani

Other Personnel: Yousef Jalali

IRB# and Title of Study: IRB# 20-417, Sustaining Faculty Collaboration: An Exploratory Process-Based Study of Research Collaboration Between HBCU/MSI and PWI

You are invited to participate in a research study that explores different factors influencing sustainability of faculty research collaboration across institutions. You were selected as a possible participant because you have been identified as a faculty member in a collaborative project funded through ICTAS Diversity and Inclusion Seed Investment (ICTAS D&I) between 2016 and 2019. This form includes information about the study and contact information if you have any question.

This study is being conducted by Yousef Jalali, a PhD candidate in the Department of Engineering Education at Virginia Tech. The outcomes of this dissertation study will provide ICTAS with key findings and recommendations that can help improving the program and also inform development of similar programs at other institutions; and contribute to the literature where there is a lack of studies that focus on process-based illustrations of collaboration among faculty from different institutions, more importantly Historically Black Colleges and Universities (HBCUs) or other Minority Serving Institutions (MSIs) and Predominantly White Institutions (PWIs).

WHAT SHOULD I KNOW?

If you decide to participate in this study, your participation will involve completing a brief questionnaire, a virtual interview, and possible follow-up questions. Based on the data collected through the survey, participants will be selected for an individual interview. The interview will

be audio recorded for the accuracy of the transcript. The video recording is optional and you can opt-out if you choose to. After the interview, you may be contacted for follow-up questions for clarification. In addition, the proposals and reports submitted to ICTAS for the ICTAS D&I grant will be reviewed for information about research projects, activities, and outcomes.

The study should take approximately 75-120 minutes of your time.

The risks associated with participating in this research are minimal. The risks are those associated with basic computer tasks, including boredom, fatigue, or mild stress.

Your participation in this study is voluntary. If you volunteer to be in this study, you may withdraw at any time without consequences of any kind. You may also refuse to answer any questions you don't want to answer and remain in the study.

CONFIDENTIALITY

I do my best to protect the confidentiality of the information collected in this study, but the study team cannot guarantee 100% confidentiality. In reporting the data, no personally identifiable information will be linked with your responses. When transcribing the interview recordings, pseudonyms will be used for your name and for the names of any other people who you mention. These pseudonyms will also be used in preparing all written reports of the research. Research records will be stored securely and only I will have access to the records. After the completion of the project, the data will be stored in a locked cabinet at Virginia Tech for two years. It is possible that the Institutional Review Board (IRB) at Virginia Tech will view this study's collected data for auditing purposes. The IRB is responsible for overseeing the protection of human subjects who are involved in research.

WHO CAN I TALK TO?

If you have any questions or concerns about the research, please feel free to contact me at yousef@vt.edu, 715-821-1644. You are not waiving any legal claims, rights or remedies because of your participation in this research study. If you have questions regarding your rights as a research participant, contact the Virginia Tech HRPP Office at 540-231-3732 (irb@vt.edu).

If you would like to participate in this study, please click "NEXT" to go to the survey.

End of Block: IRB Information Sheet

Start of Block: Default Question Block



ID Please enter your personal code (4 digits number) that I sent to you.

Page Break

Intro

Please reflect on your collaboration with ONE collaborative partner. Even if you collaborated with more than one faculty through ICTAS D&I Investment please focus on your experience in one collaborative relationship.

The survey will take about 15 minutes to complete. I appreciate your response to my request to complete the survey.

**Sincerely,
Yousef Jalali
Doctoral student, Virginia Tech**

Page Break

Q1

Considering your research collaboration with ONE collaborative partner at HBCUs, MSIs, or Virginia Tech: during what fiscal year did your collaborative project get funded for the first time through ICTAS D&I Investment?

2016-2017

2017-2018

2018-2019

Q2 Have you had a continuing working relationship with the collaborative partner to this day?

Yes

No

Please clarify if needed.

Q3 Thinking about when you FIRST received the grant from ICTAS and began your collaborative project: which option best describes the total duration of your working relationship since then?

- More than 36 months
 - Between 24 and 36 months
 - Between 18 and 24 months
 - Between 12 and 18 months
 - Between 6 and 12 months
 - Less than 6 months
-

Q4 Have you had any professional or social relationship with your collaborative partner before working on your supported collaborative project through ICTAS? In other words, did you know the collaborative research partner in professional or social contexts PRIOR TO embarking on the collaboration supported by the ICTAS D&I Investment?

Yes (please describe the duration)

No

Page Break _____

Part 2 Thinking specifically about your FIRST year of the collaboration through ICTAS D&I Investment, please respond to the following questions.

Q5 During the first year, what has been the frequency of communication with your collaborative partner, including any contact such as face-to-face meetings, emails, telephone calls, online meetings, etc.?

- More than once a week
 - About once a week
 - About once every two weeks
 - About once a month
 - About once every two months
 - About once every four months
 - Other (please describe) _____
-

Q6 How frequently have you and your collaborative partner used face-to-face meetings as part of the collaboration during the first year?

- About once every two weeks
 - About once every month
 - About once every two months
 - About once every four months
 - Other (please describe) _____
-

Q7

Below you will find a list of indicators of research collaboration. Which of the following

**have resulted from your collaboration through the ICTAS D&I grant at the first year?
Please select all that apply.**

- Building rapport and relationships
 - Co-authorship and co-publication
 - Collaboration on teaching and pedagogy
 - Developing/writing grant proposals
 - Grant application(s)- submitted
 - Funded grant application(s)
 - Professional networks and linkages
 - Recruitment of students
 - Resource development and sharing
 - Student training and mentorship
 - Technology development
 - Other (please describe)
-

Q8 Considering your experiences during the first year of your collaboration through the ICTAS D&I grant: please indicate the extent to which you agree or disagree with the following statements.

	Strongly agree	Agree	Somewhat agree	Neither agree or disagree	Somewhat disagree	Disagree	Strongly disagree
You envisioned long-term professional relationships with your collaborative partner.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
You considered the quality of the working relationship to be very strong.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
You felt what you bring to the collaboration is appreciated and respected by your partner.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
You didn't have any problems getting in touch with your partner when you need to contact them.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Your partner took your opinions seriously when decisions were made about the collaboration.

You and your partner could engage in clear and honest dialogue.

You and your partner shared similar goals and ambitions about the collaboration.

Your partner understood and respected differences, such as race, ethnicity, gender, nationality, etc.

You didn't have any doubt about your partner's abilities and competencies.

You felt your collaborative partner cares about the collaboration.

The collaboration was beneficial to both partners.

Q9 Which of the following challenges or difficulties did you encounter in the process of working with your research collaborator? Please select all that apply.

- Communication quality
 - Cultural differences
 - Differences in institutional priorities
 - Frequency of communication
 - Gender dynamics
 - Geographic distance
 - Personality differences
 - Work style differences
 - Other (please describe)
-

Q10 In a few sentences, what do you think facilitated continuing working relationships with your collaborative partner?

Q11 In a few sentences, what do you think impeded continuing working relationships with your collaborative partner?

Page Break

Part 3

Career and Demographic Information

Please enter the information that best represents you.

Page Break

Q12 What is your home institution?

Page Break

Q13

What is your department/program affiliation at your home institution?

Page Break

Q14 In what discipline did you earn your highest degree?

Page Break

Q15 What is your tenure status?

- Tenured
- On tenure track
- Not on tenure track
- Other (please describe) _____

Page Break

Q16 What is your academic rank?

- Assistant professor
- Associate professor
- Professor
- Other (please describe) _____

Page Break

Q17 Can you please add a list of 5 to 10 keywords that best describe your primary research interests?

Page Break

Q18 What is your racial/ethnic background?

- American Indian or Alaska Native
 - Asian
 - Black or African American
 - Hispanic/Latino
 - Native Hawaiian or Other Pacific Islander
 - White or Caucasian
 - Self-Identify (Please describe)
-
- Prefer not to disclose

Page Break

Q19

What is your gender?

Female

Male

Self-Identify (please describe)

Prefer not to disclose

Page Break

Q20 What is your age group?

- 29 and under
- 30-34
- 35-39
- 40-44
- 45-49
- 50-54
- 55-59
- 60-64
- 65 or older
- Prefer not to disclose

End of Block: Default Question Block

Start of Block: Block 2

Q21 What is your citizenship status?

- U.S. citizen since birth
- Naturalized U.S. citizen
- U.S. permanent resident
- Non-U.S. citizen
- Other (please describe) _____
- Prefer not to disclose

End of Block: Block 2

Follow-up Survey

Follow-Up- Study of Research Collaboration Between HBCU/MSI and PWI

Start of Block: Default Question Block



ID Please enter the personal code (4 digits number) that I sent to you.

Page Break

End of Block: Default Question Block

Start of Block: Block 1

Q1

Which statement most accurately describes the status of your collaboration within past 12 months?

- You and your collaborative partner(s) have had continued working relationship.
 - You and your collaborative partner(s) did not collaborate on any project or task but have a plan to do so.
 - You and your collaborative partner(s) did not collaborate on any project or task, and there is no active collaboration plan.
 - Other (please describe) _____
-

Q2 Since the beginning of your collaboration through the ICTAS Diversity and Inclusion Seed Investment, which of the following have resulted from your collaboration? Please select all outcomes that apply.

HBCU/MSI students received training and mentorship (please indicate the number) _____

Virginia Tech students received training and mentorship (please indicate the number) _____

Publications (please indicate the number)

Grant proposals drafted (please indicate the number)

Grant proposals funded (please indicate the number and dollar value)

Grant proposals submitted, award decision not yet known (please indicate the number) _____

Resource development and sharing, e.g., equipment, technology, facility (please describe) _____

Other (please describe)

Q3 Considering your experiences with your collaborative partnership/team: please indicate the extent to which you agree or disagree with the following statement.

	Strongly agree	Agree	Somewhat agree	Neither agree or disagree	Somewhat disagree	Disagree	Strongly disagree
You envision maintaining a long-term professional relationship with your collaborative partner(s).	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
You consider the collaboration with your partner(s) worthwhile and beneficial.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
You care about your collaborative team.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Q4 If there are any other outcomes (tangible or intangible) that resulted from your collaboration, please describe them below.

Q5 In a few sentences, what do you think facilitated (or impeded) continuing working relationships with your collaborative partner(s)? In other words, what helped or hindered your overall working relationships with your collaborative team?

End of Block: Block 1

Appendix D. Consent Information Sheet

Consent Information Sheet- Survey



Information Sheet for Participation in a Research Study

Principal Investigator: Dr. Vinod Lohani

Other Personnel: Yousef Jalali

IRB# and Title of Study: IRB# 20-417, Sustaining Faculty Collaboration: An Exploratory Process-Based Study of Research Collaboration Between HBCU/MSI and PWI

You are invited to participate in a research study that explores different factors influencing sustainability of faculty research collaboration across institutions. You were selected as a possible participant because you have been identified as a faculty member in a collaborative project funded through ICTAS Diversity and Inclusion Seed Investment (ICTAS D&I) between 2016 and 2019. This form includes information about the study and contact information if you have any questions.

This study is being conducted by Yousef Jalali, a PhD candidate in the Department of Engineering Education at Virginia Tech. The outcomes of this dissertation study will provide ICTAS with key findings and recommendations that can help improving the program and also inform development of similar programs at other institutions; and contribute to the literature where there is a lack of studies that focus on process-based illustrations of collaboration among faculty from different institutions, more importantly Historically Black Colleges and Universities (HBCUs) or other Minority Serving Institutions (MSIs) and Predominantly White Institutions (PWIs).

WHAT SHOULD I KNOW?

If you decide to participate in this study, your participation will involve completing a brief questionnaire, a virtual interview, and possible follow-up questions. Based on the data collected

through the survey, participants will be selected for an individual interview. The interview will be audio recorded for the accuracy of the transcript. The video recording is optional and you can opt-out if you choose to. After the interview, you may be contacted for follow-up questions for clarification. In addition, the proposals and reports submitted to ICTAS for the ICTAS D&I grant will be reviewed for information about research projects, activities, and their outcomes.

The study should take approximately 75-120 minutes of your time.

The risks associated with participating in this research are minimal. The risks are those associated with basic computer tasks, including boredom, fatigue, or mild stress.

Your participation in this study is voluntary. If you volunteer to be in this study, you may withdraw at any time without consequences of any kind. You may also refuse to answer any questions you don't want to answer and remain in the study.

CONFIDENTIALITY

I do my best to protect the confidentiality of the information collected in this study, but the study team cannot guarantee 100% confidentiality. In reporting the data, no personally identifiable information will be linked with your responses. When transcribing the interview recordings, pseudonyms will be used for your name and for the names of any other people who you mention. These pseudonyms will also be used in preparing all written reports of the research. Research records will be stored securely and only I will have access to the records. After the completion of the project, the data will be stored in a locked cabinet at Virginia Tech for two years. It is possible that the Institutional Review Board (IRB) at Virginia Tech will view this study's collected data for auditing purposes. The IRB is responsible for overseeing the protection of human subjects who are involved in research.

WHO CAN I TALK TO?

If you have any questions or concerns about the research, please feel free to contact me at yousef@vt.edu, 715-821-1644. You are not waiving any legal claims, rights or remedies because of your participation in this research study. If you have questions regarding your rights as a research participant, contact the Virginia Tech HRPP Office at 540-231-3732 (irb@vt.edu).

If you would like to participate in this study, please click "NEXT" to go to the survey.

Consent Information Sheet- Interview



Information Sheet for Participation in a Research Study

Principal Investigator: Dr. Vinod Lohani

Other Personnel: Yousef Jalali

IRB# and Title of Study: IRB# 20-417, Sustaining Faculty Collaboration: An Exploratory Process-Based Study of Research Collaboration Between HBCU/MSI and PWI

You are invited to participate in a virtual interview as part of the research study that explores different factors influencing sustainability of faculty research collaboration across institutions. This form includes information about the study and contact information if you have any questions.

This study is being conducted by Yousef Jalali, a PhD candidate in the Department of Engineering Education at Virginia Tech. The outcomes of this dissertation study will provide ICTAS with key findings and recommendations that can help improving the program and also inform development of similar programs at other institutions; and contribute to the literature where there is a lack of studies that focus on process-based illustrations of collaboration among faculty from different institutions, more importantly Historically Black Colleges and Universities (HBCUs) or other Minority Serving Institutions (MSIs) and Predominantly White Institutions (PWIs). The results of our findings may be published and shared with other educators and professionals.

WHAT SHOULD I KNOW?

You will be requested to participate in an individual interview via Zoom. I will be asking you about your experiences with research collaboration that initiated or fostered as a result of ICTAS Diversity and Inclusion Seed Investment Program.

The interview will be audio recorded for the accuracy of the transcript. The video recording is optional and you can opt-out if you choose to. After the interview, you may be contacted for follow-up questions for clarification. The individual interview will take between 60 to 90 minutes.

The risks associated with participating in this research are minimal. The risks are those associated with basic computer tasks, including boredom, fatigue, or mild stress. Your participation in this study is voluntary. If you volunteer to be in this study, you may withdraw at any time without consequences of any kind. You may also refuse to answer any questions you don't want to answer and remain in the study.

CONFIDENTIALITY

I do my best to protect the confidentiality of the information collected in this study, but the study team cannot guarantee 100% confidentiality. In reporting the data, no personally identifiable information will be linked with your responses. When transcribing the interview recordings, pseudonyms will be used for your name and for the names of any other people who you mention. These pseudonyms will also be used in preparing all written reports of the research. Any details in the interview recordings that could identify you, or anyone you mention, will also be masked during the transcription process. Any direct or indirect quote will not be attributed to you using your actual name, but rather using a pseudonym in order to maintain your anonymity to the best of our ability. Research records will be stored securely and only I will have access to the records. After the completion of the project, the data will be stored in a locked cabinet at Virginia Tech for two years. It is possible that the Institutional Review Board (IRB) at Virginia Tech will view this study's collected data for auditing purposes. The IRB is responsible for overseeing the protection of human subjects who are involved in research.

WHO CAN I TALK TO?

If you have any questions or concerns about the research, please feel free to contact me at yousef@vt.edu, 715-821-1644. You are not waiving any legal claims, rights or remedies because of your participation in this research study. If you have questions regarding your rights as a research participant, contact the Virginia Tech HRPP Office at 540-231-3732 (irb@vt.edu).

Appendix E. Interview Protocol

Introduction

Thank you for agreeing to participate in this research study! I am completing this study as part of the research leading to my doctoral dissertation. In the project, I explore the process of faculty partnerships across institutions in order to better understand some of the factors influencing sustained collaborations. The interview questions include three different sections. In the first part, I will ask you about your involvement with inter-institutional collaboration supported by ICTAS, your collaborative partner, and prior working relationship and collaboration experience. In the second part, I will ask you specifically about your first year collaboration through ICTAS Diversity and Inclusion Seed Investment (ICTAS D&I Investment) when you first received support from ICTAS. Finally, towards the end of interview, I will ask you a few questions about your experience after the first year and your reflection about the overall process of the collaboration.

I should mention that your collaborative partner will not have access to any of your responses. I will record the interview today and later transcribe the data. When transcribing the recording, I will remove all identifying information and assign pseudonyms for your name and for the names of any other people you mention. Do you have any questions before we begin?

1. How did you get first involved in this inter-institutional partnership supported by ICTAS? What motivated you to engage in this partnership?
2. Who was your primary collaborator at the partner institution?
3. Before your partnership through ICTAS D&I Investment, when and how did you get to know your primary collaborative partner?
4. Did you have working or any professional relationships with your partner before joining the collaborative project funded by ICTAS? For instance, were you and the primary collaborative partner involved in any mutual co-teaching, student mentorship, meeting at conferences or different events, or other projects?

Now I would like to ask you specifically about your experiences during your first year collaboration through the ICTAS D&I Investment.

5. How would you describe your roles and responsibilities in the process of the collaboration?
 - 5.1 How were different tasks and responsibilities assigned? Who was accountable for different outcomes?

6. How did you and your research collaborator negotiate and make decisions? Please describe the process?
7. Were there any other individuals who played a major role in this inter-institutional partnership? Can you describe their roles and responsibilities?
8. What were the major mechanisms of communication and interaction (such as in person meeting, by phone, online, etc.) between you and your primary partner?
 - 8.1 How do you evaluate the frequency of communications?
 - 8.2 How do you evaluate the quality of communications? How did you know when interactions were going well or going poorly?
9. Individual similarities and differences in personalities, working styles, or skills may have influence on collaboration. Have any of these similarities or differences influenced your collaboration?
10. To what extent did you encounter misunderstanding or conflict in your working relationship?
 - 10.1 Were you able to resolve those? Could you provide an example?
11. To what extent did you trust your collaborative partner in meeting obligations and fulfilling commitments?
 - 11.1 Has your perception changed throughout the collaboration? Why?
12. Before collaboration, what was your perception of the kind of relational dynamics you would have with your collaborative partner? In other words, how did you imagine the quality of your relation and communication?
 - 12.1 Has your perception of the relational dynamics (you described) changed throughout the working relationship?
13. How would you evaluate the success of your collaboration at the end of first year? What were the major benefits and outcomes resulted from your collaboration?
14. To what extent do you think the collaboration was mutually beneficial?
15. Sociodemographic factors such as ethnicity, gender, age, education, and status may have influence on formation and persistence of a collaborative relationship. Do you think these factors influenced your collaboration? and if so, in what ways?

16. How do you think institutional differences in terms of institutional structure and missions influenced your collaboration?
17. To what extent do you think your collaboration advanced relationships between HBCU/MSI and PWI at the institutional and systemic level?

We're coming to the last section of the interview, first I will ask you a couple questions about your experience after the first year collaboration through ICTAS D&I Investment.

18. Have you continued to collaborate after the first year? Why?
- 18.1 [Y.] How do you describe your overall experience with the partnership after the first year? Were there any changes?

Now, I will ask you a few general questions about the process of your collaboration.

19. Thinking about the overall process of your partnership, what were the main factors that influenced the continuity (or discontinuity) of your collaboration?
20. Which changes in ICTAS D&I Investment Program can you think of that could have helped your collaboration to be more beneficial to both partners?

Closure

1. Do you have any final thoughts about your experience that I have not yet discussed or have considered insufficiently?
2. Do you have any questions for me before concluding the interview?

I would like to thank you for participating in this interview! Thank you very much for your time! I may follow-up and request to answer additional questions, if necessary. Do you have any questions for me?