

International Research Collaborations:
An Analysis of Researchers' Perspectives in Japan and the United States

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DEDICATION

In dedication to my wife, Richiko, my partner through life.

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ABSTRACT

This study examines researchers' perspectives, responsibilities, roles, and views on challenges and opportunities influencing the development of Japanese–United States international research collaborations. In this study, eight factors related to international collaborative research are examined for their influences on international research collaborations. The study is based on semi-structured interviews with researchers who conducted international research collaborations supported by federal or national government funding agencies over multiple years in basic and applied research in Japan and the United States. The results indicate that a supportive research environment significantly impacts their work in international research collaborations. According to the researchers in this study, stakeholders need to work together and share knowledge to systemically improve policies and practices by addressing policy gaps and removing policy barriers, producing flexible options for research funding uses, and providing further support to all stakeholders across nations.

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Chapter 1

Introduction

The phenomenon of globalization has increased connectivity among individuals, communities, institutions, organizations, regions, and nations around the world.

Development of communication and information technology infrastructure has enabled individuals to engage increasingly in two types of international activities: knowledge transfer and physical mobility (Rostan, Ceravolo, & Metcalfe, 2014). Researchers and scholars are also able to engage more easily in research projects through travel and communication because of advances in engineering and technology.

Researchers and professionals are able to share diverse types of knowledge and data to study complex, interconnected issues, and their collaborations now yield new knowledge that can create innovations in society. The affiliations of researchers shape their organizations' research cultures. Each individual's academic, professional, and cultural experience determines and reflects the attitudes, behaviors, characteristics, objectives, and values of an organization or institution.

Stakeholders such as individual scholars, governments and funding organizations engage in international research collaborations. At the individual level, scholars and professionals share resources, participate in research projects, gain access to data, and apply for international research funds. At the organizational level, universities pursue research development opportunities and share facilities in research pooling initiatives, and they share in the recruitment of international faculty and students in particular research areas (Kitagawa, 2010). In academia, English has become the "global lingua franca" (Byun & Kim, 2011, p. 478). It is important for policymakers and leaders in

higher education to observe and eliminate potential challenges in promoting the international connections of academics. Individuals look for international research collaboration opportunities, and organizations encourage individual researchers to conduct research internationally.

Scholars, scientists and professionals engage in cross-border, large-scale research projects in many fields, such as aerospace engineering, climate change, computer science, genome science and technology, infectious disease, medical devices, traffic safety among others. One outcome of international research collaborations is the production of internationally coauthored articles. The rate of internationally coauthored articles in science and engineering has risen from 16 percent in 1997 to 22 percent in 2012 (National Science Board, 2014). In terms of coauthored articles, international research collaborations offer a significant opportunity for scholars and professionals to publish articles.

Many universities have developed collaborative research infrastructures and supported the establishment of research networks, which are required for international research collaboration. According to *Mapping Internationalization on US Campuses: 2012 Edition*, approximately 68 percent of surveyed institutions consider international background and experience in the faculty hiring phase for a variety of fields, which is more than double the 32 percent reported in 2006 (American Council of Education, 2012). Many individuals and organizations are eager to establish and develop partnerships to pursue research collaboration opportunities around the world.

Although nations differ in scientific research investments, many try to promote international research collaboration to enhance creativity and increase productivity.

Government policymakers have focused on promoting research in specific academic disciplines. For instance, China, Hong Kong, India, Japan, Malaysia, South Korea, and Singapore have been leaders in promoting and conducting international research collaboration in the fields of engineering, physics, astronomy, and material and computer science in Asia (UNESCO Institute for Statistics, 2014). These nations share a common national interest in promoting international research collaboration. Rafic Makki, Executive Director of the Office of Planning and Strategic Affairs, Abu Dhabi Education Council, explains that Abu Dhabi in the United Arab Emirates (UAE) has established unique research and education opportunities, attracting leading scholars and developing elite, higher education institutions (National Research Council, 2011). It is one of the priorities for policymakers to focus on promoting international research collaboration, because it raises instructional quality, producing talented graduates who can meet the demands of employers (National Research Council, 2011).

National governments, policymakers, health care providers, organizations, institutions, and universities encourage researchers and institutions to engage in research collaboration globally. Promoting international research collaboration has become paramount through higher education. The number of previous studies on internationalization in higher education curricula and instruction has increased; however, there is little research on internationalization in research. Many challenges and opportunities need to be considered when establishing and developing international research collaborations.

Importance of International Research Collaborations

Different education systems, structures, mechanisms, and organizational administrative authorities provide intellectual, cultural, linguistic, disciplinary, bureaucratic, organizational, and intercultural challenges for individuals who conduct collaborative research internationally. Researchers have different perspectives on their research collaborations, and they need to understand institutional support, educational backgrounds, cultural expectations, research practices, handling and managing data, academic calendar and vacations, sensitivity to deadline, legitimate national security demands, and policy issues (National Research Council, 2008). Scholars, scientists, and professionals in international research collaborations confront new challenges and issues during their research planning and implementation processes.

Understanding the education policies of other nations and respecting cultural diversity and norms is crucial to organizing research protocols in international research collaboration. Scholars recognize that imposing a particular nation's research procedures or policies on researchers from other nations or cultures does not necessarily yield successful outcomes. Individuals need to be aware of challenges such as developing an international research agenda; identifying potential collaborators; and communicating with institutions, government agencies, academic societies, professional associations, funding agencies, and other stakeholders.

Institutional administrators and leaders should develop research training programs, organize communication settings, develop data management policies, refine Institutional Review Board (IRB) policies for the international context, and commit necessary resources at the appropriate organizational level. They need to establish

organized research support infrastructure to develop interpersonal relationships among researchers across institutions in various fields and at various levels.

Government agencies and international organizations have different organizational structures. International organizations such as the World Bank or the Organisation for Economic Cooperation and Development (OECD) have multilateral structures, whereas there are more simplified structures in municipalities and tribal governments (National Research Council, 2011). Not only have the size of research investment and the phase of scientific research advancement or development increased, but cultural and historical factors also play crucial roles in international research collaboration (UNESCO Institute for Statistics, 2014). It is important for government policymakers to retain talented individuals by providing sufficient support to help them continue their international research collaborations.

History

Beaver and Rosen (1978) traced the foundations of international research collaboration back to the 17th century. According to the authors, the earliest collaborative research paper was published in 1665. In Europe, people wrote scientific papers, created scientific journals, and held science contests during the 17th and 18th centuries. Based on these scientific movements, “reporting investigation” became the foundation of new research (Beaver & Rosen, 1978, p. 72). Among European nations, France actively legitimized research-supporting mechanisms and created scientific institutions such as the École Polytechnique, the École Normal Supérieure, the Bureau des Longitudes, the Paris Observatory, the Museum d'Histoire Naturelle (Beaver &

Rosen, 1979). The development of research in France established the concepts of fundamental structured science training and science professionalization in the late 18th and early 19th centuries, and England and Germany followed France's lead (Beaver & Rosen, 1978).

Europe has been a leader in establishing and developing research collaborations. Studies indicate that numbers of research collaboration activities and co-authorships increased during the second half of the 20th century, and it has become more common for scholars to engage in co-authorship research activities than in single-authored research (Adams, Black, Clemmons, & Stephan, 2005; Fernandez, 1998; Hicks & Katz, 1996; Lee, 2000; Newman, 2004; Pontille, 2003; Shrum, Genuth, & Chompalov, 2007). During the 20th century, more nations started promoting research collaborations. In particular, during World War II, federal agencies and industries began promoting interdisciplinary research collaboration and encouraging researchers to engage in research at large-scale laboratories on the institutional, national, and international levels (Capshew & Rader, 1992; O'Brien, 2012).

Importance of Studying International Research Collaborations

In international research collaborations, stakeholders need to be aware of the importance of research support structures and mechanisms. Establishing systematic research support structures and improving current research procedures will be important to meeting the requirements of governments and funding agencies. Scholars, professionals, and policymakers are concerned about multiple issues surrounding international research collaboration (National Research Council, 2011). They have

expressed concerns over the barriers and challenges in international research collaboration. Anderson (2010) identified four dimensions of national research system, the organization of the research system, legal and regulatory systems, oversight related to research integrity, and the training of graduate students and postdoctoral fellows as potential challenges when promoting research and support in international research collaboration. Dealing with challenges at the appropriate organizational levels is key to pursuing successful international research collaboration.

Organization of the Education and Research System

There are many education and research systems around the world. Each nation has a different education system, and some government agencies and international organizations have more complex hierarchies than others. Organizations shape their education and research systems differently based on their cultural and social systems, and they influence researchers' engagement and involvement differently. For instance, doctoral education is not the same everywhere, and expectations for academic positions are different as well. Scholars recognize that many professors outside the United States tend to have very heavy teaching loads (National Research Council, 2011). It is essential for researchers to understand their potential collaborators' backgrounds and their education and research systems.

Legal and Regulatory Systems

Different legal and regulatory systems pose challenges for international research collaboration. Some nations and regions are strict on spending their public funds in

particular research fields. The European Union (EU) carefully observes how their financial contribution would be used in international research collaboration to create positive effects that rise above a single country's research investments. In the EU, there is the "state aid" understanding that governments will not provide support to entities that would deform their market advantage, and "if foreign support violates the state aid rules, a clawback provision of EU law may require repayment" (National Research Council, 2011, p. 68). In addition, in Europe, a group of university lawyers created a formal consortium with partner institutions to conduct international research and create operating procedures before the funding can be used (National Research Council, 2014). In international research collaborations, researchers must work with other professionals to understand government regulations, follow legal guidelines, spend allocated funds appropriately, and satisfy other requirements.

Oversight Related to Research Integrity

Educational structures, curricula, and instructional approaches differ among nations and provide different educational knowledge and experiences to scholars and professionals. A doctor of medicine (MD) or juris doctor (JD) program in one nation requires different training programs and learning experiences than in another nation. Researchers are familiar with their own national research systems and tend to take them for granted. Recognizing the differences in education systems helps create common understandings to prevent misconduct in international research collaborations (Anderson, 2010). It is crucial to recognize differences in trained individuals' knowledge, skills, research integrity and ethics, as well as other research-related training (National Research

Council, 2011). Respecting and understanding the educational contributions and responsibilities of individual scholars and professionals is crucial to the construction of good relationships in international research collaborations.

Training Graduate Students and Postdoctoral Fellows

The academic culture around research collaborations influences the research planning and implementation processes. Some nations do not have full academic freedom, and students' research and learning experiences are varied across nations. Nations have different perspectives and tolerances on corruption in higher education admission, examination, graduation, promotion, and other procedures that can yield misunderstandings among international research collaborators (National Research Council, 2011). Education systems shape scholars' norms and values, and thus it is critical to understand educational backgrounds and motivations for international research collaboration.

Benefits of International Research Collaborations

Scholars conclude that participants in international research collaborations are able to share and develop broader analytical perspectives and create conceptually advanced research questions. Research collaborators develop more organized solutions and comprehensive approaches to complex global issues. Government and organizations are able to share common interests and advance human and regional development through international research collaborations. Initiatives by governments or international

organizations are also sometimes important in promoting international research collaborations when adapting to new global conditions.

The United States and the International Science Foundation collaborated to promote international research during the 1990s. The United States supported the Nunn-Lugar program that redirected scientists and weapons from the former Soviet Union communities, preventing nuclear proliferation in the region (National Research Council, 2011). In addition, the International Science Foundation assisted in research and the provision of scientific literature to former Soviet scientists (National Research Council, 2011). These two collaborative research projects helped researchers and communities adapt to new global conditions. Sharing knowledge and resources enables researchers and professionals to expand their ability to conduct more comprehensive research into global issues.

Challenges of International Research Collaborations

There are many possible challenges and misunderstandings in promoting international research collaborations. Scholars are concerned about the lack of international research experience in terms of publication and dissemination opportunities, and they point out that journal editors with no international research experience may not recognize significant scholarship contributions (National Research Council, 2008). In addition, researchers face many practical challenges such as locating appropriate collaborators, receiving adequate funding, reaching material transfer agreements, understanding export controls on technology development, agreeing on intellectual property, developing research designs, integrating talented professionals, dealing with

positional authority and power, handling the protection of human subjects and other ethical issues, owning research data, deciding on authorship, and managing cultural traditions and institutional settings (National Research Council, 2014). Researchers and professionals who engage in international collaborations need to understand their differences and recognize their collaborators' cultural, educational, and training backgrounds (National Research Council, 2011).

Each nation has different perspectives on export controls related to the development of engineering, science, technology, and other fields. Scholars admit that export controls could be an impediment to international research collaboration. For instance, an American corporation brought an equipment piece from a European company, and the equipment did not work properly. The American corporation tried to send it back to the European company but could not do so because of US export controls (National Research Council, 2011). This case shows an export control issue in international research collaboration.

The Purpose of this Study

The purpose of this study is to explore the relations between Japanese government research funding and the structure and functioning of Japanese-U.S. international research collaborations that contributed to the development of international research collaboration in Japan. International research collaboration will be generally defined as the various kinds of joint research engagement activities and partnerships conducted by researchers of different nationalities. The study also investigates what opportunities and

challenges exist in the international research collaboration process by analyzing stakeholders' perspectives.

Context of the Study

The Japan Society for the Promotion of Science (JSPS) has established and developed research collaboration by promoting international joint research, forming international research support networks, providing international training opportunities for young researchers, and creating fellowships for excellent overseas researchers. This study focuses on the “Bilateral Collaborations (Joint Research Projects and Seminars)” which is one of the international collaborations organized by JSPS and the U.S. National Science Foundation (NSF) (Japan Society for the Promotion of Science, 2010; Japan Society for the Promotion of Science, 2013; Japan Society for the Promotion of Science, 2014). This study addresses the challenges, opportunities, and influences that shape researchers' experiences in international research collaborations.

Research Question

The question driving the analysis is: *In what ways do government policies, joint JSPS/NSF initiatives, funding structures and mechanisms, institutional factors, and prior connections affect international research collaborations jointly funded by the Japan Society for the Promotion of Science and the United States National Science Foundation?* International research collaborations are examined in terms of their process and outcomes.

Summary of the Dissertation

Chapter 2 examines the literature on international research collaborations. It reviews analyses regarding the definition of research collaboration, research collaboration types, the history of research collaboration, research collaboration trends, forces affecting research collaboration and stakeholders, motivations and citation effects in research collaboration, benefits and costs of research collaboration, and international research collaboration. Chapter 3 presents this study's conceptual framework, research methods, and the data collection and data analysis processes. Chapter 4 presents the data analysis for this study and the study's findings. Chapter 5 discusses the study's results, implications, limitations, conclusions, recommendations to promote international research collaboration, and implications for further research.

Chapter 2

Review of the Literature

The purpose of this paper is to review research and historical developments to provide an understanding of factors that have shaped research collaboration. I review seven dimensions of research collaboration: types of research collaboration, the history of research collaboration, trends in research collaboration, forces affecting research collaboration and stakeholders, motivations and citation impacts in research collaboration, benefits and costs of research collaboration, and international research collaboration.

Definition of Research Collaboration

Patel (1972) defines *research collaboration* as a process shared among individuals to create rewards or understanding in research. Anderson and Steneck (2011) define *international research collaboration* as “research projects that involve investigators whose primary employment affiliations are in different countries” (p. 3). This definition applies to research collaboration projects at the individual, organizational, regional, national, and other levels.

Over the last 350 years, the number of collaborative publications has increased, particularly after the middle of the eighteenth century (Luukkonen, Persson, & Sivertsen, 1992). Research collaboration provides knowledge-sharing and professional advancement opportunities to researchers, scientists, professionals, and other research participants. It also enables them to access intellectual and material resources, such as equipment, facilities, and information. Previous studies show that interdisciplinary

research collaboration has a positive influence on innovation and knowledge (Gibbons et al., 1994; Rhoten & Pfirman, 2007; Schmickl & Kieser, 2008).

Scholars have also analyzed and discussed different research collaboration practices across academic disciplines (Lewis, Ross, & Holden, 2012). They make an analytical distinction between *expressive* research collaboration and *instrumental* research collaboration from both academic and policy perspectives (Lewis et al., 2012). Expressive research collaboration indicates a project or networking status in which researchers conduct research and publish their results together. Instrumental research collaboration involves discussing research and receiving feedback or commentary on research or draft papers. Based on these two research collaboration types, Lewis et al. (2012) conducted two studies to examine how and why scholars collaborate in different disciplinary fields. They examined publication data in the faculty of arts and the faculty of science at the University of Melbourne between 2001 and 2005, and they collected data through structured interviews of 274 researchers in the humanities, sciences, and social sciences at the University of Auckland, the University of Birmingham, and the University of Melbourne between May 2008 and February 2009. The study results show that expressive research collaboration is least commonly found in the humanities and social sciences and that each academic discipline has distinct collaborative objectives and practices. The authors also recognize that governments, granting bodies, and institutions have promoted research funding policies focusing on research collaboration promotions.

From the faculty perspective, Eddy (2010) compares cases of research collaboration and clarifies the roles of research collaborators in successful research collaboration, finding particular factors that influence faculty behavior during research

collaboration. For instance, a variety of reasons such as academic disciplinary backgrounds, personal motivations in research, institutional characteristics, promotion and tenure review process, and organizational cultures may affect a faculty member's motivation to engage in research collaboration. Eddy (2010) points out that some academic disciplines value research collaboration engagement more than other disciplines. The sciences are likely to involve multiple researchers in a single project and publication, but a single author tends to conduct an entire research project in the humanities.

Types of Research Collaboration

Analyzing research collaboration patterns and types is important to understanding research collaboration. Previous studies find that different research collaboration patterns; research collaboration gaps in different regions; research methods; and researchers' locations, physical mobility and status influenced research collaboration. Gunawardena, Weber, and Agosto (2010) examine research collaboration types from four different perspectives to understand interdisciplinary research collaboration challenges. The authors examine collaborations and define *research collaboration* as studies covering more than one discipline. In the study, the authors specify four primary research collaboration types: multidisciplinary research, cross-disciplinary research, interdisciplinary research, and trans-disciplinary research (Gunawardena et al., 2010).

Another study examines research collaboration types and finds that multiple research collaborations taking place within specific regions around the world. Yarime, Takeda, and Kajikawa (2010) examine research collaboration patterns quantitatively in

the field of sustainability science across national boundaries, in particular, the degree to which nations specifically engage in publishing activities in the field of sustainability science. They then compare structural data from 1995, 2000, and 2007 on international research collaborations. Study results show that the number of nations engaged in international research collaboration increased, and collaborations are more often conducted between nations of close proximity. Among nations, the study finds that the sustainability science scholars' international research collaboration networks correspond to three primary regions: Asia Pacific, Europe and Africa, and North and South America. Study results indicate that scholars in the three areas tend to share diverse types of knowledge and data to conduct large-scale complex research, such as the study of climate change across regions.

Other scholars focus on the relationship between the location of research partners and the research field. Abramo, D'Angelo, and Solazzi (2010) apply an identification and disambiguation algorithm model to measure research performance within domestic industries among public research universities in the Italian higher education system between 2001 and 2003. The authors found that the location of research partners and the scientific field are important factors for promoting research collaboration in Italy. They use the Science Citation Index database and examine 1,983 collaborations that produced 1,534 publications co-authored by 58 Italian universities' scientists within the 19 regions and within such fields as agricultural and veterinary sciences, biology, chemistry, computer science and mathematics, earth sciences, industrial and information engineering, and medicine. The study results show that 42.35 percent of research

collaboration cases were held inter-regionally, and 34.79 percent involved partners within a single region.

The physical mobility of researchers has encouraged researchers to engage in research collaborations across states, nations, regions, and the world. Hoekman, Frenken, and Tijssen (2010) conducted a study to examine the physical distance between researchers and the intensity of research collaboration in Europe. They analyze the effects of European integration on research collaboration. They analyzed the co-publication activities and research collaboration patterns of 3,768,086 published research articles indexed by the Web of Science, in the fields of engineering, humanities, life sciences, medicine, physical sciences, and social sciences, in 33 European nations between 2000 and 2007. The authors consider the geography of research collaboration as a critical factor in conducting collaborative research, in terms of regional, national, and linguistic differences. The study results show that physical distance negatively affects co-publication activities, and the authors find that co-publication activities are likely to take place in the same sub-national region, within the same linguistic area and the same nation.

Previous studies examine research collaboration types, and scholars show methodological and perspective differences in the research. Outlining these research methods and perspectives and classifying these patterns into primary research collaboration categories will be significant to analyzing research collaboration cases across academic disciplines. McNicol (2003) states that understanding disciplinary integration is significant in understanding scholars' research types in applying theories, models, and methods in research collaboration. For the purpose of classifying research

collaboration types, four research types—multidisciplinary, cross-disciplinary, interdisciplinary, and trans-disciplinary—are introduced here. *Multidisciplinary research* applies methods and perspectives from more than two different disciplines to an issue, and there may be no integration of methods and theories of the disciplines (Gunawardena et al., 2010; Hattery, 1986; Newell, 2001). *Cross-disciplinary research* applies one discipline's methods and perspectives to those of another discipline, providing insights into common issues (Repko, 2008). In *interdisciplinary research*, researchers of one discipline apply methods and perspectives from another discipline, integrating the knowledge from both places and providing insights into shared issues (Hattery, 1986; Klein, 2004; Newell, 2001). *Transdisciplinary research* is problem-based; it does not consider disciplinary boundaries but instead promotes different disciplines working together to establish a broader framework of knowledge (Gunawardena et al., 2010; Klein, 2004).

Van Rijnsoever and Hessels (2011) examine the most rewarding research collaboration types associated with individual researchers' characteristics in their disciplinary or interdisciplinary research collaboration. In their study, basic and strategic disciplines, dynamics of the scientific field, and factors such as gender, global innovativeness, and work experience are used as independent variables. Scholars' academic status in terms of the path to a full professorship and research collaboration types are designated as dependent variables. The authors collected survey data from 303 scientific researchers in the faculty of science, the faculty of geosciences, and the academic biomedical cluster at Utrecht University in the Netherlands in June 2006. They analyzed survey participants' current employment status, global innovativeness, past

occupations, research collaborations, and the nature of their research. The results show that the number of years of work experience, the amount of previous work experience at other institutions, and scientific field dynamics are positively correlated with *disciplinary research* collaborations; however, previous work experience at firms have negative conditions. Years of work experience, the amount of previous working experience at other institutions and firms, female gender identification, and experience working in a strategic discipline are all positively related to *interdisciplinary research* collaboration.

The History of Research Collaboration

To gain an understanding of the brief history of research collaboration and literature, empirical analyses of research collaborations are reviewed. Previous studies describe researchers as having been engaged in research collaborations since the seventeenth century and note that they are likely to engage in research collaboration to pursue research opportunities worldwide.

Beaver and Rosen (1978) note that the first collaborative scientific paper was published in 1665, and that the number of collaborative papers in the sciences has increased since that time. Other studies note that co-authorship growth began at least a century ago (De Solla Price, 1986; Zuckerman & Merton, 1973). Fewer than 10 percent of all publications were coauthored at the beginning of the twentieth century, but the number of co-authored publications increased to over 50 percent of all publications by the end of the century (Wagner-Döbler, 2001).

Scientific co-authorship increased during the second half of the twentieth century (Adams et al., 2005; Hicks & Katz, 1996; Pontille, 2003; Shrum, Genuth, & Chompalov,

2007). Recent studies show that multiple-authored articles outnumber single-authored articles in many research fields (Adams et al., 2005; Fernandez, 1998; Lee, 2000; Newman, 2004). Jones, Wuchty, and Uzzi (2008) state that the proportion of single-author studies dropped by half from 1975 to 2005 in the fields of engineering and social sciences. Other scholars conclude that the proportion of co-authored studies increased in journals related to the social sciences and some humanities (Hicks & Katz, 1996; Wuchty, Jones, & Uzzi, 2007).

O'Brien (2012) conducted a study to analyze how co-authorship has shaped individual researchers' careers by comparing four different PhD cohort periods: 1953–1962, 1963–1972, 1973–1982, and 1983–1991. The study analyzed the co-authored publication records, comparing generational differences in scientific careers. The study presents a longitudinal, individual-level description of twentieth-century increases in scholarly co-authorship during the first 12 years of a scholar's career. The study results show that scholars who received their PhDs between 1983 and 1991 coauthored about one third more of their early-career articles than those who received their PhDs between 1953 and 1962. This comparative study of individual researchers' cross-generational co-authorship trends supports the growth phenomenon of research collaboration.

The results of these studies indicate that research collaboration cases have increased and created co-authorship opportunities for researchers. As research collaboration continues to expand, researchers need to understand more of their individual responsibilities and engage in research networking to become productive. To understand and analyze research collaboration growth comprehensively, the following

sections outline research collaboration trends, forces affecting research collaboration and stakeholders, motivations and citation impacts, networks, benefits, and costs.

Trends in Research Collaboration

This section examines previous research collaboration cases and collaborative practices around the world. Scholars find that many national governments, funding agencies, institutions, and other organizations encourage researchers and institutions to engage in research collaboration. A review of the body of international research collaboration literature allows one to gain an understanding of research collaboration trends.

Both individuals and organizations have promoted research collaboration as a means of sharing resources. Thirty years ago, Katz and Martin (1997) stated that most governments consider that international research collaboration can provide a cost savings and other benefits. The 2007 Translational Research Working Group report states that fostering coordination and collaboration and incorporating proactive goal-oriented management practices would be significant in confronting translational research challenges among individual projects and organizations (Provan, Leischow, Keagy, & Nodora, 2010).

Establishing interregional research collaboration linkages at the global level is significant for promoting research collaboration among institutions, states, regions, and nations. Universities have created and developed interregional research collaboration networks with their institutional partners. For instance, in the field of sustainability science, Chalmers University of Technology in Sweden, the Federal Institute of

Technology (ETH) in Switzerland, Massachusetts Institute of Technology (MIT) in the United States, and the University of Tokyo in Japan have joined to establish an interuniversity research collaboration named the Alliance for Global Sustainability (Yarime et al., 2010). This is one of the successful interregional research collaborations at the institutional level. In addition, the sustainability science community organized the International Conference on Sustainability Science (ICSS) to promote communication and knowledge integration among scholars at the international level.

In Europe, establishing a research and development program and network has been part of the European Union's primary research policies. Kuhlmann (2001) notes the emergence of the European Research Area (ERA) as a driving force of research collaboration in Europe. In the ERA, the Framework Programme for Research and Technological Development aims to promote research collaborations across disciplines, nationalities, and sectors (Bammer, 2008). In 2004, European Commission Communication 353 defined six significant objectives in promoting research collaboration in Europe, outlining the fundamental provisions for the full development of the ERA in the paper titled "New Perspectives for the European Research Area in 2007" (Abramo, D'Angelo, & Di Costa, 2009). The report emphasizes the importance of sharing instruments, knowledge, and resources among different states' public organizations, including public sectors and the private industry.

Trends in research collaboration promotion could emerge within a national research system. Hohn and Schimank (1990) discuss a national research system in Germany; the German Research System encompasses a large extra-university sector, including Helmholtz Research Centers, the Max-Planck Society, the Leibniz Association,

and the Fraunhofer Society. Although these organizations did not collaborate much with each other, they focused on particular research functions in the field, such as fundamental research, applied contract research, and big-science research facility management.

Some nations are eager to engage in establishing and developing research collaboration policies and practices with other nations. For instance, Australia and the United States established bilateral research collaboration networks. Australian Cooperative Research Centres and the United States National Science Foundation (NSF) collaborated to create particular funding programs to promote industry–science partnerships. As a result of this collaboration, the Australian Research Council Research Networks and the U.S. Transdisciplinary Tobacco Use Research Centers coordinated funding support arrangements to promote interdisciplinary and transdisciplinary research collaborations (Bammer, 2008). The literature suggests that institutions, states, nations, and regions have established and developed a variety of research collaboration policies and practices. The results of these studies indicate that institutions, states, nations, and regions have encouraged individual researchers to engage in research collaboration to share resources.

Forces Affecting Research Collaboration and Stakeholders

This section addresses stakeholders and forces affecting research collaboration, including government initiatives and policies, research impact factors, changes of funding patterns, institutional structure, size of institution, citation impact, and other possible causes. To gain an understanding of the influence of these forces on stakeholders, the literature on research collaboration and international research collaboration is reviewed.

Many national governments have considered that international research collaboration would yield benefits. In particular, the European commission and national governments established initiatives and policies to promote research collaboration between the universities and the industry (Katz & Hicks, 1997). These initiatives and policies encouraged individual researchers to engage in research collaboration. Katz (2000) states that the size of academic communities, the number of different types of collaboration, and the size of academic institutions influence research performance. Other scholars also examine the institutional and organizational factors that contributed to research collaboration over the last three decades (Gornitzka, Kyvik, & Larsen, 1998; Senker, 2006; Shapira & Kuhlmann, 2003). Technological advancements led the European Organization for Nuclear Research (CERN) and the EU's Framework Programme to promote research collaboration (Hicks & Katz, 1996; Melin, 2000; Ziman, 1994). In sum, technological advancements in telecommunication, especially the advent of the Internet, and more convenient travel infrastructure have enabled researchers to conduct research together to share their information, knowledge, facilities, equipment, and resources.

Didegah and Thelwall (2013) examine eleven research impact factors in the fields of biology and biochemistry, chemistry, and social sciences: individual collaboration, institutional collaboration, international collaboration, abstract readability, journal impacts, reference impacts, number of keywords, number of references, paper length, abstract length, and title length. The authors analyze citation impacts associated with these factors among biology and biochemistry (16,058 articles), chemistry (16,378 articles), and social sciences (15,932 articles) publications in the Thomson Reuter's Web

of Science database between 2000 and 2009. The study shows that individual collaborations and international research collaborations are considerably associated with increases in citation in the fields of biology, biochemistry, and chemistry. Researchers also find abstract length to increase with increases in citation, and increased title length and number of keywords are also associated with decreased citations.

One of the most influential forces affecting international research collaboration has been research funding structures and mechanisms. Changes in funding patterns affected the growth of co-authorship in the 20th century (O'Brien, 2012; Pestre & Krige, 1992; De Solla Price, 1986). Sa (2008), Lepori et al. (2007), and Bruce, Lyall, Tait, and Williams (2004) discuss funding structures and mechanisms that promoted interdisciplinary research collaboration at the institutional, national, and international levels. Government agencies and private sectors have supported large-scale laboratories since before World War II, and the wartime period yielded the "big science" model of research interest in federal agencies and industries (Capshew & Rader, 1992; O'Brien, 2012). For instance, in the United States, the NSF and the National Institutes of Health (NIH) have endorsed collaboration in cross-institutional and interdisciplinary research (Gunawardena et al., 2010; National Institutes of Health, 2005; National Science Foundation, 2006).

These changes in research funding patterns encouraged agencies and private sectors to establish large, centralized research centers and organize big research teams in the United States. As a result, scientists' dependence on high-level equipment and instruments in "big science" encouraged them to conduct research with other experts, professionals, and scientists (O'Brien, 2012; Pestre & Krige, 1992). As a result, many

funding agencies expect researchers to conduct research not only with their colleagues in the same lab but also experts and professionals from other scientific fields. These patterns provided more interdisciplinary research and co-authorship opportunities to researchers in particular during the second half of the 20th century.

Other scholars examine the roles of institutional structures in the formation of research collaboration in public research institutions and advocate for university research centers as part of research collaboration forces (Laudel & Gläser, 1998). University research centers help scholars to conduct research at an individual level (Boardman & Corley, 2008; Friedman & Friedman, 1982). Boardman and Corley (2008) study the roles and effects of university research centers in research collaboration at the individual level with foreign institutions, government agencies, industry laboratories, and other universities. They analyze how university research centers would affect individual research collaboration by determining how institutional variations are related to factors of research collaboration behavior. They use the data drawn from a national survey of university scientists between August 2003 and July 2004. The authors sent the survey to 4,916 scientists and had a survey response rate of 38 percent. The analysis of faculty research activity addressed career trajectory, collaboration, funding, institutional affiliation, and work-effort distribution. The study results show that stakeholders and participants in university research centers influence research collaboration at the individual level. The authors also found that affiliation with a center linked to a federal program is positively correlated with collaboration within the immediate work group.

The results of other studies indicate that the size of a research institution is a critical factor in promoting research collaboration. Abramo, D'Angelo, and Di Costa

(2011) examine 1,983 publications by all research institutions in Italy in the bibliometric database of the Observatory of Public Research between 2001 and 2003. They analyzed the research capability of an institution with industry in terms of university size, location, and research quality. The study shows that the most active universities to collaborate with the private sector are located in Northern Italy in particular, and the number of collaborations is correlated with university size. The study concludes that institutional research quality is the most influential factor in research collaboration between universities and industry.

Citation impact has been a force affecting the behaviors of individual scholars and professionals in research collaborations. Researchers have also recognized that research collaborations yield more successful research outcomes and stronger positive community impacts. Glänzel (2001) analyzes the citation impact in international publications and states that the multiauthored publication phenomena are observed worldwide in all science fields. Narin and Whitlow (1990) indicate that research publications involving multiple institutions are cited more frequently than publications by a single institution. They also state that publications including a foreign collaborator are more frequently cited than domestic publications.

Scholars have analyzed a variety of potential forces affecting research collaboration. Katz and Martin (1997) analyze several of these comprehensively and outline six reasons in particular to conduct research collaboration. The first reason is to minimize the rising costs of science research. It is difficult for funding agencies to cover all of the costs of research equipment and facilities, and researchers are expected to share their resources at the regional, national, and international levels. The second reason is to

decrease the cost of travel and communication. Travel infrastructure, communication development, and technological development enable researchers to reduce the time spent travelling or communicating their research. The third reason is the growth of networks and teams in research. Researchers exchange knowledge and information with their peers, and they establish research networks or teams to meet funding agencies' demands. The fourth reason is the demand for specialization in particular science fields. In some science fields, researchers need to have experts or professionals to maintain lab equipment, run experimental facilities, conduct computer analyses, analyze computer data, write and edit research processes results, promote fund-raising, and fulfill administrative responsibilities. These specialized professional fields require scholars and professionals with particular knowledge and skills. The fifth reason is to promote the growth of interdisciplinary research. The range of skills is limited in any one discipline, and researchers are eager to work with scientists from different research backgrounds to deal with issues in emerging interdisciplinary science fields, such as biosensors, optoelectronics, or chematronics (Martin & Irvine, 1989). The sixth reason is that political influences have accelerated research collaboration among scientists. Moed, De Bruin, Nederhof, and Tijssen (1991) and Narin, Stevens, and Whitlow (1991) studied political influences on research collaboration growth in Europe. They note that CERN, the European Southern Observation (ESO), the European Molecular Biology Organisation (EMBO), and the European Commission established research collaboration networks among nations. The scholars also point out that the political changes in Eastern European nations after 1992 encouraged scientists in Western European nations to conduct research with their colleagues in Eastern Europe.

Motivations and Citation Impacts in Research Collaboration

This section explores researchers' interest in research collaboration. One may examine the motivations of researchers who engage in research collaboration and the impact that the collaboration has on the number of citations such studies receive. Many organizations have encouraged scholars and teams to conduct research collaboration across disciplines. For instance, National Academy of Sciences, National Academy of Engineering, and Institute of Medicine of the National Academies (2005) have claimed that the importance of interdisciplinary research is to challenge complicated social issues. In addition, scholars advocate making institutional arrangements to facilitate interdisciplinary research collaboration (Metzger & Zare, 1999; Porter, Roessner, Cohen, & Perreault, 2006). Individual researchers and scholars have conducted collaborative research as a means of overcoming challenging research issues or networking with other researchers. Melin (2000) points out that pursuing publication opportunities, getting funding opportunities, and benefitting from peers' research recognition are motivations; however, some scholars argue that interdisciplinary research collaboration is less rewarding than disciplinary research collaboration (De Boer, De Gier, Verschuur, & De Wit, 2006; Levitt & Thelwall, 2008).

Understanding individual researchers' motivations is significant for institutional leaders to establish effective institutional policies and practices to promote research collaboration. Melin (2000) argues that a high degree of self-organization and strong pragmatism work together to shape successful research collaborations. The study regards co-authorship as a research collaboration indicator, and Melin (2000) examines the first-listed authors of institutionally co-authored journal articles listed in the 1994 CD-ROM of

the Science Citation Index. The study collects data from 195 researchers at Umea University in Sweden. The authors find various background causes of research collaboration, either structural or personal. Having access to technical facilities and using particular research equipment is considered the individual scholar's primary interest. The study concludes that a researcher's intellectual and scholarly background and environment are important to the pursuit of research collaboration opportunities.

Other scholars studied the relationship between an internationally collaborative research publication and its citation impacts. Over the last 60 years, studies have indicated the benefits of co-authorship. Nudelman and Landers (1972) argue that the scientific community recognizes and gives credit to co-authored publications more than to a publication by a single author. Lawani (1986) emphasizes that the number of authors per paper and the proportion of high-impact citations are positively correlated. Internationally coauthored publications are cited twice as often as publications authored by researchers working at a single institution in a single country (Narin et al., 1991).

To understand and measure collaborative research activities, scholars apply a bibliometric analysis of multiple-author publications (Bush & Hattery, 1956). Katz and Hicks (1997) apply a calibrated bibliometric model and compare the average impacts among different research types. They examine collaborations within institutions, between domestic intuitions, and between international institutions. To analyze the collaboration systems in the United Kingdom (UK), they created the Bibliometric Evaluation of Sectoral Scientific Trends database, which contains about a half million referred UK research and development (R&D) publications in the Science Citation Index (SCI) between 1981 and 1994. The authors found that collaborative research

publications with foreign institutions have the greatest impact and conclude that adding one author from a foreign institution led to an average gain of approximately 1.6 citations, compared to 0.75 citations for adding an author from the same institution or another domestic institution (Katz & Hicks, 1997).

Another study focuses on a single institution's research records and its citation patterns in research collaboration. This study limited its scope to an institution; however, the study shows the importance of citation impact in research collaboration. Beaver (2004) conducted a longitudinal study of 482 publications, published by 33 professors at Williams College for 10 or more years. Beaver (2004) used the faculty publication data from the Report of Science at Williams, annual research records in the natural sciences, psychology, and history of sciences. This study compares the citation frequencies of different authorship types, such as Williams professors, their professional research scientist peers, and undergraduate students. The author found that collaborative research publications with peers were cited 3 times more often than those by a single author. The study also shows that collaborative research produces more authoritative research via citations.

Rigby and Edler (2005) examine the effects of collaboration on academic research network quality. The authors collected data from 22 scientific research networks in the fields of agriculture for veterinary medicine, biomedicine, humanities, natural sciences, natural science and biomedicine, social sciences, and technical sciences in Austria. The authors analyzed the relationship between the level of interaction within research networks and the variability in quality. They compared the citation ratio of a specific paper with an average number of citations received in the Institute Scientific Information

citation database. The study shows that the quality of collaborative research is regarded as higher than that of studies conducted without research collaboration. The authors conclude that the higher the research collaboration level, the better the quality of the research as reflected in its value within the research network.

The number and percentage of institutionally co-authored articles increased in the UK science system between 1981 and 1991 (Hicks & Katz, 1996). Scholars argue that the citations of international research collaboration publications have increased faster than those conducted through domestic research collaborations (Narin et al., 1991). The study by Schmoch and Schubert (2008) comes to a similar conclusion, finding that internationally co-authored publications are more cited as compared to domestically co-authored publications. Glänzel and de Lange (2002) study multinational publications and citation patterns and conclude that participating in multinational projects yields benefits not only to individuals but also to nations. In addition, Abt (2007) conducted a study to examine the average number of authors per paper in 16 academic disciplines, and the results show that the number of authors per paper ranged from 2.83 in mathematics to 9.41 in physics. Despite differences in the number of authors across academic disciplines, these studies find that internationally co-authored publications are more likely to be cited by other researchers.

Gazni and Didegah (2011) conducted a study to analyze research collaboration patterns and their citation impacts, examining 124,937 published documents across 22 academic fields between 2000 and 2009 at Harvard University. The authors found that approximately 88 percent of publications at the university are authored by multiple persons, and about 12 percent were authored by a single person. The authors also found

that single-authored publications obtained one citation on average; multiple-authored publications, however, received an average of 2.12 citations per paper. The study supports the statements of previous studies, showing a positive correlation between the number of authors and the number of citations. The authors state that publications involving a greater number of institutions are more likely to be cited while publications involving a greater number of foreign collaborators are not more frequently cited.

Benefits and Costs of Research Collaboration

This section focuses on the benefits and costs of research collaboration. Apart from citation impacts, researchers recognize benefits and costs of research collaboration. On the one hand, previous studies find that expanding research capacity, improving research capability, enhancing researchers' visibility, and other effects are essential with research collaboration. On the other hand, scholars have also argued that research collaboration carries costs, such as unreasonable demands, a lack of sufficient financial compensation, inappropriate authorship placement in publications, and other effects. To gain an understanding of the benefits and costs of research collaboration, the collection of literature about international research collaboration benefits and costs will be reviewed.

In a study focusing on rationales for research collaboration, the authors analyze qualitative research data to determine the desired institutional settings in promoting research collaboration. Heinze and Kuhlmann (2008) conduct 32 semi-structured interviews with senior researchers, junior group leaders, institute directors at universities and extra-university institutions, and representatives of non-university research organizations and the German Ministry of Education and Research (BMBF) between

2004 and 2006. The authors conducted interviews and utilized the three governance dimensions of organizational dimension, resource endowment, and thematic interdependence to identify governance structures that support or obstruct scholars' engagement in research collaboration in nanoscience. They used these three components together and utilized a research collaboration governance dimension model in the study. The authors were interested in understanding desired institutional settings to promote research collaboration, and the study identifies institutional governance structures that support or impede researchers' collaboration efforts as they engage in research collaboration networks across institutional boundaries in Germany. The authors outline rationales for research collaboration, such as expanding research capacity, improving current research capability, realizing institutional complementarities, and boosting the visibility of scientists and companies in their research fields. The study concludes that research staff recruitment, job mobility support, research leadership, balanced funding from internal and external stakeholders, and flexible functions for funding allocation are significant factors in understanding inter-institutional research collaboration costs.

Scholars recognize the benefits of research collaboration for less-experienced researchers. In particular, graduate students gain research experience and skills through research collaboration. Lei and Chuang (2009) examine collaborative publications and outline their benefits and costs from a graduate student perspective. The students emphasize that engaging in research collaboration provides many benefits to graduate students, who understand the significant relationship between the number of authors and a publication's citation impact. Receiving valuable advice from faculty mentors advances students' research skills and experience, and students gain social,

organizational, and leadership skills needed to work as part of a research group. At the same time, trained graduate students would become future research collaborators with faculty scholars after graduation. Katz and Martin (1997) also state that these pragmatic research skills could not be taught in the classroom and there are some dilemmas among the graduate students. At the same time, graduate students are likely to gain less experience as researchers on a team and often face unreasonable demands for the amount of research work. There are also a fair number of costs to participate in collaborative research with experienced researchers. While graduate students do not receive direct financial compensation or obtain less recognizable authorship opportunities in publications, the benefits of collaborative experience need to be considered and recognized in the long run.

International Research Collaboration

Research on international research collaboration is limited as compared to the literature on research collaboration. The lack of research literature could result from the fact that existing collaborations are becoming complicated internationally and across academic disciplines; current scholars and professionals are thus establishing and developing the international research collaboration literature. This section examines international research collaboration cases and findings.

Many researchers, professionals, policy makers, practitioners, and stakeholders engage in international research collaboration. The World Weather Research Programme of the World Meteorological Organization, for instance, created the Observing System Research and Predictability Experiment (THORPEX) in 2004 (Chang, Peña, & Toth,

2013). According to the U.S. THORPEX Science Plan, THORPEX emphasized the coordination of the prediction science, process and phenomena, and socioeconomic research communities.

In addition, national and international organizations have recognized international scientific collaboration as improving national scientific research capabilities and as a valuable means of sharing research costs. In particular, experimental research projects involving expensive equipment and facilities call for international research collaboration networks in Europe (Luukkonen, Tijssen, Persson, & Siversten, 1993). CERN laboratories are leading representatives in international research collaboration. International organizations have advocated for funding for specific research conditions, and the EU Framework Programme has asked researchers to collaborate across organizations from different countries.

Networking opportunities are necessary for researchers, scholars, and professionals to begin international research collaborations. Stead and Harrington (2000) advocate the Internet and conferences as two primary networking opportunities for international communication in international psychological research. They mention national and international listservs as organized networking platforms to foster scholars' international research networks, learn other scholars' research activities, share research ideas, and identify scholars interested in similar research subjects. International conferences enable scholars to socialize with others. Allowing face-to-face communication, conferences yielded productive relationships among scholars. In addition, arranging interest groups led scholars to establish common research projects.

Other scholars outline potential reasons for the demand for international research collaborations. Scientific research costs have risen sharply, and researchers have had to pool resources across research organizations (Katz & Martin, 1997; Ponds, 2009). For instance, CERN has encouraged scholars to share resources to conduct international scientific research. The development of professional and scientific fields and subfields also requires interdisciplinary research collaboration (Ponds, 2009; Stichweh, 1996). Professionals in the new fields have gained special knowledge and learned how to use complex equipment, facilities, and instruments (Ponds, 2009). National governments have been found to be likely to support international research collaboration, and they expect scholars and professionals to engage with potential research collaborators worldwide.

A macro-trend analysis of international research collaboration examines how domestic and international research collaboration patterns and trends have shaped the connectivity of world science networks (Tijssen, Waltman, & Van Eck, 2012). The authors examined the geographical coordinates of authors' addresses between 2000 and 2010. Then the authors performed calculations for a number of selected nations and for the world as a whole based on five measures: the proportion of collaborative publications, the proportion of international collaborative relations, the mean geographical collaboration distance of all collaborative relations, the mean geographical collaboration distance of domestic collaboration relations only, and the mean geographical distance of international collaborative relations only. The study analyzed distances among domestic and international research collaborators and classified nations into four groups. Canada and France belong to the first group in which collaborators tend to work with colleagues

far away. China belongs to the second group that tends to have short distances between domestic research collaborators and large distances in international research collaborations. In the third group, research collaborators in Australia, Japan, and South Africa tend to have larger distances from international research collaborators and shorter distances in domestic research collaborations. India belongs to the fourth group in which collaborators are likely to work with colleagues at a short distance in both domestic and international research collaborations. These results show that domestic and international research patterns shaped scholars' networking dynamics.

International research relations could be analyzed by examining past and existing research focuses and topics. Examining international research collaboration patterns would improve the understanding of research links among nations and states. Luukkonen et al. (1992) examine country-to-country differences in the rates of international research co-authorship, international scientific collaboration networks among countries, and international scientific collaboration patterns. The authors examine social, intellectual, and linguistic factors that influenced international scientific collaboration networks. The authors analyzed the collaborative patterns of individual nations and provide their interpretations based on the concepts of intellectual dependence. They used the Computer Horizons/National Science Foundation Science Literature Indicators Database, which covers 6 years between 1981 and 1986 and eight academic disciplines: biology, biomedicine, chemistry, clinical medicine, earth and space science, engineering and technology, mathematics, and physics. To understand influential factors in establishing co-authorship linkages between countries, the authors examined the ratio of observed to expected co-authorship frequencies and produced an international institutional research

collaboration map. The authors found that countries that collaborated closely are likely to have similar academic field focuses. For instance, the focus for the Soviet Union is Eastern European nations, such as Bulgaria, Czechoslovakia, the German Democratic Republic, Hungary, and Poland. The study shows that mathematics is the field with the largest proportion of internationally coauthored publications. The authors state, “the less developed the scientific infrastructure of a given country, the higher the tendency for international co-authorship collaboration” (Luukkonen et al., 1992, p. 123). The authors also found that medical research fields have the highest rate of institutional collaboration with national laboratories, and they recognize that researchers collaborate as a means of exchanging data and skills as often as they collaborate to share research costs and research outcomes in medical research fields.

Wagner and Leydesdorff (2005) applied network analysis concepts to analyze the relationship between the researcher network system and international scientific collaboration. They used international co-authorship and test the hypothesis of international collaboration as a self-organizing network by examining 19,147 publications from 65 journals in the fields of astrophysics, geophysics, mathematics, polymer science, soil science, and virology. The study data were drawn from the Science Citation Index (SCI) CD-ROM version 2000 of the Institute for Scientific Information (ISI) for the six fields. Access to resources and solidity of reputation are thus especially attractive components for researchers on the hunt for collaborators. In other words, the selection of a collaborating researcher would be motivated by reward structures, such as co-authorship, citation impacts, science community recognition, and sharing resources. The study data indicate that productive researchers tend to gain opportunities to choose

their research collaborators and boost their research productivity. The study concludes that clarifying attractive research demands for potential research partners would be a key to joining international research collaboration networks.

Examining relationships and dynamics of international research collaborations at the individual level would be significant in understanding the factors that influence researchers' behaviors and motivations in establishing and developing international research collaborations. Hwang (2008) conducted a study to investigate international research collaboration in science and technology. The study focuses on understanding the factors that drive international collaboration and the reasons why researchers participated in international collaboration. Hwang (2008) collected interview data from ten Korean scientists and engineers and asked the same questions to one German, one Dutch, and six British scientists and engineers. The latter interview group members worked in the UK. The study compares the interview data from the Korean researcher community and the non-Korean researcher community. The study results showed a research labor division at a global scale between scientifically advanced research organizations and those less advanced. The UK research team indicated its strength in understanding the basic operating physics experiments and possessing the theoretical knowledge while the Korean team noted its advanced skills in the implementation process. The study further indicates that international collaboration did not essentially yield scientific knowledge equally to research participants. The study emphasizes that international collaboration is valuable as a means of exchanging resources. The author found that engineers and scientists engaged in international collaboration to receive recognition for their research activities and to acquire additional research resources.

Rationales and dynamics in international research collaboration are different in Korea and the United Kingdom, and this study describes how researchers in less advanced nations are eager to obtain core knowledge and participate in research conducted in advanced nations for career building objectives. This study is significant to the understanding of influential sociocultural factors and establishing international research collaborations among researchers. Finally, this study highlights the dynamics within international research collaboration between scientifically more advanced and less advanced nations.

This chapter has reviewed seven dimensions of research collaboration: types of research collaboration, the history of research collaboration, trends in research collaboration, forces affecting research collaboration and stakeholders, motivations and citation impacts in research collaboration, benefits and costs of research collaboration, and international research collaboration. I investigated the development of international research collaboration and reviewed previous studies that have analyzed factors that have shaped research collaboration. The next chapter describes the conceptual framework, the research question, the research methodology, and other related topics of the analytical approach.

Chapter 3

Conceptual Framework and Methods

This chapter presents this study's conceptual framework and methodology. The purpose of this study is to explore the relationship between Japanese and U.S. government research funding and the structure and functioning of Japanese-U.S. international research collaborations. This study explores individual researchers' perspectives and examines challenges and opportunities that emerge during international research collaborations.

The goal of this study is to identify forces that shape researchers' considerations, experiences, insights, knowledge, and perspectives on international research collaboration practices in establishing collaborative networks, developing international collaboration relationships, sharing leadership and decision-making processes, and other related research activities. Applying a qualitative semi-formal interview research methodology, this study focuses on the researchers in international research collaborations and their experiences, knowledge, and perspectives.

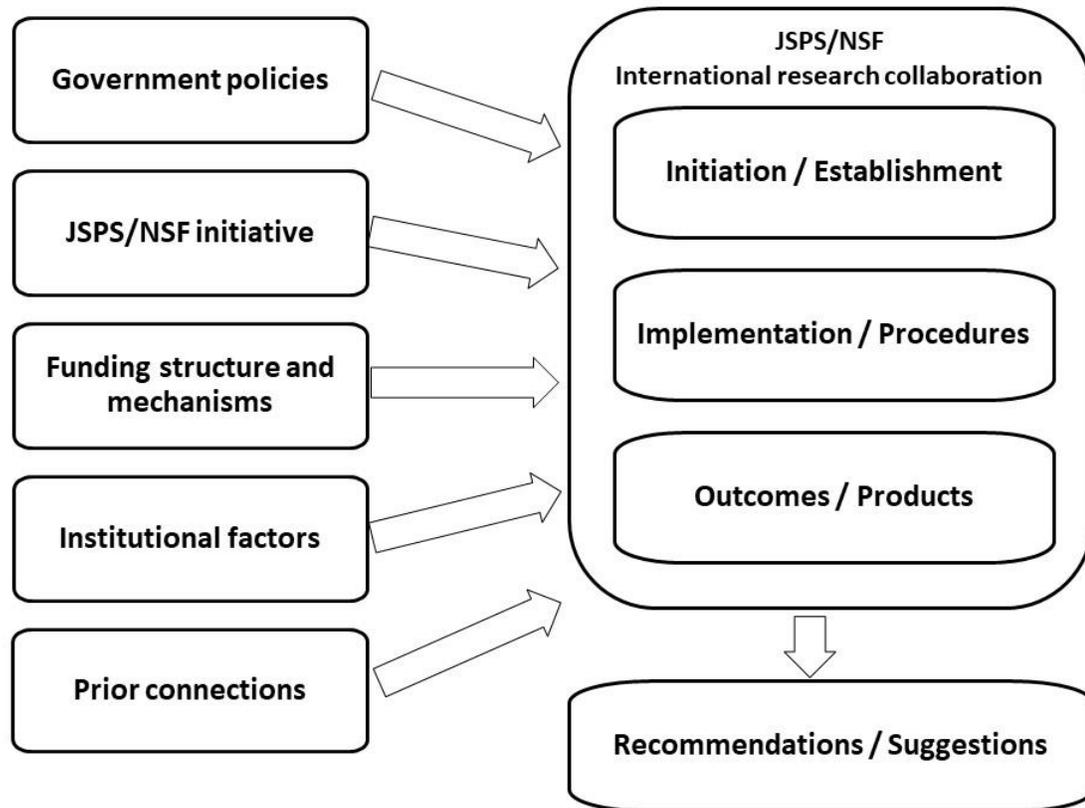
Conceptual Framework

This study focuses on examining the individual researcher's considerations, experiences, insights, knowledge, and perspectives in international research. The study analysis addresses the research question: *In what ways do government policies, joint JSPS/NSF initiatives, funding structures and mechanisms, institutional factors, and prior connections affect international research collaborations jointly funded by the Japan Society for the Promotion of Science and the United States National Science Foundation?*

The question is premised on the assumption that government policies, JSPS/NSF initiatives, funding structure and mechanisms, institutional factors, and prior connections may influence the aspects of international research collaborations, specifically, their initiation and establishment, implementation and procedures, and outcomes and products. In addition, recommendations and suggestions are also included as further outcomes of international research collaborations.

Five of the concepts—government policies, JSPS/NSF initiatives, funding structures and mechanisms, institutional factors, and prior connections—are considered the five influence factors. The other three concepts—initiation and establishment, implementation and procedures, and outcomes and products—are considered aspects of international collaborative research. Recommendations and suggestions are considered useful to advance cross-national collaborative research from the researchers' perspectives. Figure 1 presents the conceptual framework for this research.

Figure 1: Conceptual Framework: Key Factors Related to International Research Collaborations



Influences on international research collaborations

In this study, the perspectives of researchers on government policies, JSPS/NSF initiatives, funding structures and mechanisms, institutional factors, and prior connections are examined in relation to their influences on the aspects of international research collaborations. This study examines these five influential factors that may affect international research collaborations.

Government policies

In this study, the term *government policies* refers to actions, documents, guidelines, procedures, rules, and other means used by national governments to promote international research collaborations. National governments support international research collaboration and expect researchers and institutions to engage in research collaborations with their fellow researchers worldwide. Although the rate of international research coauthorship differs by country, the number of international scientific collaboration networks among countries has increased over a period of time (Luukkonen et al., 1992). Launching a research and development program has been one of the European Union's primary research supports in Europe, and the European Research Area (ERA) has taken the initiative to foster research collaborations across disciplines, nationalities, and sectors (Bammer, 2008; Kuhlmann, 2001). Governments understand that international research collaborations could provide cost savings and other benefits (Katz and Martin, 1997).

National and international organizations have recognized international scientific collaboration as improving national scientific research capabilities and as a valuable

means of sharing research costs. In particular, researchers in experimental research are expected to collaborate to share the costs of expensive equipment and facilities (Luukkonen et al., 1993). Their collaborations benefit both their own nations and others. *Government policies* have shaped the trends of international research collaborations across the globe and as such are a factor influencing researchers and shaping their international collaborations.

JSPS/NSF initiatives

In this study, the term *JSPS/NSF initiatives* refers to the Bilateral Collaborations (Joint Research Projects and Seminars), one of the international collaborations that the Japan Society for the Promotion of Science (JSPS) has organized. JSPS's international research collaboration objective was to promote "international scientific exchanges between Japan and counterpart countries in accordance with agreements or memoranda of understanding concluded with academies, research councils and other science-promotion organizations in those countries" (JSPS, 2010). JSPS and its partner agencies mutually examine research proposals, select research funding recipients, and support joint research projects for two to three years per agreement. The bilateral joint research collaboration supports the development of research relationships and inter-group networks and promotes research in all academic fields (JSPS, 2015g).

This study focuses on examining perspectives and experiences of researchers in international research collaborations supported by JSPS and the United States National Science Foundation (NSF). Between 2011 and 2014, 15 Japanese and 15 American researchers conducted joint research projects (JSPS, 2013; JSPS, 2014). The *JSPS/NSF*

initiative is one of the forces that has influenced researchers and shaped their international collaborations.

Funding structure and mechanisms

In this study, the term *funding structures and mechanisms* refers to structures and mechanisms of government agencies or funding organizations that encourage researchers and organizations to establish, develop, and engage in international research collaborations. One of the most influential forces affecting international research collaboration has been research funding structures and mechanisms, and changes in funding patterns have influenced research styles and the growth of coauthorship (O'Brien, 2012; Pestre & Krige, 1992; De Solla Price, 1986). In the United States, NSF and NIH have promoted collaboration in cross-institutional and interdisciplinary research (Gunawardena et al., 2010; National Institutes of Health, 2005; National Science Foundation, 2006).

In order to emphasize the importance of sharing instruments, knowledge, and resources among stakeholders, government agencies and funding organizations actively engage individual researchers, institutions, organizations, and government agencies (Abramo, D'Angelo, & Di Costa, 2009). For instance, the Australian Cooperative Research Centres and NSF established a successful bilateral research collaboration funding program to promote industry-science partnerships (Bammer, 2008).

Since before World War II, government agencies and the private sector have focused on supporting the "big science" model of research interest in federal agencies and industries (Capshew & Rader, 1992; O'Brien, 2012). Researchers have followed this

research paradigm and established research networks to share high-level equipment and instruments with other experts, professionals, and scientists (O'Brien, 2012; Pestre & Krige, 1992). Government agencies and funding organizations have created, developed, and shaped policies to foster international research collaborations. *Funding structures and mechanisms* are another factor influencing researchers and shaping their international research collaborations.

Institutional factors

In this study, the term *institutional factors* refers to institutional characteristics, research support structures, research networks, and other institutional attributes that comprehensively influence international research collaborations. Studies examining the institutional and organizational factors that contribute to research collaboration have identified the institution itself as an important influence on international research collaborations (Gornitzka et al., 1998; Senker, 2006; Shapira & Kuhlmann, 2003). For instance, scholars examined institutional structures and advocated the importance of university research centers in promoting research collaborations (Boardman & Corley, 2008; Friedman & Friedman, 1982; Laudel & Gläser, 1998). Boardman and Corley (2008) found that stakeholders and participants in university research centers influence research collaborations; they showed that affiliation with a center linked to a federal program is positively associated with collaboration.

Heinze and Kuhlmann (2008) found that institutional governance structures that support or impede researchers' collaboration efforts also show significant differences in recruiting research staff, supporting job mobility, promoting research leadership, and

conducting other support activities. Institutions that have organized interregional and inter-university research collaboration networks tend to promote research collaborations (Yarime et al., 2010). The size of a research institution is one of the institutional characteristics significant for promoting research collaboration (Katz, 2000). In addition, institutional characteristics, promotion and tenure review processes, and organizational cultures affect a faculty member's research interests and motivations in research collaborations (Eddy, 2010). *Institutional factors*, thus, have influenced and shaped international research collaborations.

Prior connections

In this study, the term *prior connections* refers to the academic and professional networks and relationships that researchers cultivated during their previous education and research experiences. The growth of networks and teams in research has been a primary influence on the exchange of knowledge and information among researchers (Katz & Martin, 1997). Well-networked scholars are likely to have more opportunities to select collaborators and enhance research productivity (Wagner & Leydesdorff, 2005). O'Brien (2012) analyzed the coauthored publication records of scientists of different generations and concludes that doctoral education shaped individual researchers' early research collaboration experience.

Other scholars also found that the amount and duration of previous work experience at other institutions and firms were positively related to interdisciplinary research collaboration (Van Rijnsouwer & Hessels, 2011). Stead and Harrington (2000) identified the Internet and conferences as two primary networking opportunities for

fostering international research networks. They emphasized that participating in international conferences provided researchers with face-to-face knowledge and information-sharing opportunities and enabled researchers to socialize with one another and identify potential research collaborators. Prior connections are essential for understanding the thought process of individual researchers engaged in international research collaborations. *Prior connections* are another factor that may influence researchers and shapes their international research collaborations.

Aspects of international research collaborations

In this study, initiation and establishment, implementation and procedures, and outcomes and products refer to aspects of international research collaborations. These aspects may have been influenced by the five influential factors: government policies, JSPS/NSF initiatives, funding structures and mechanisms, institutional factors, and prior connections. To understand the researchers' considerations, experiences, perspectives, thoughts, and other reflections throughout the research process from initiation to completion, I examine the five factors in relation to their influences on the three aspects of international research collaborations.

Initiation and establishment

In this study, the term *initiation and establishment* refers to the researchers' perspectives on the process in identifying research collaboration partners, establishing relationships among researchers, agreeing on research objectives and responsibilities, writing proposals together, submitting funding proposals to funding agencies, and other

related tasks at the start of an international research collaboration. Initiation and establishment are significant aspects of international collaborative research.

Implementation and procedures

In this study, the term *implementation and procedures* refers to the processes of decision-making, conducting research and other related tasks during the active stage of international research collaborations. Understanding researchers' considerations, insights, and observed challenges and opportunities is crucial to examining their international collaborative research experiences. Implementation and procedures are an important factor in examining the researchers' engaged experiences and insights on their international research collaborations.

Outcomes and products

In this study, the term *outcomes and products* refers to the benefits, costs, outcomes, products, results, and other related consequences at the end of the international research collaborations. Analyzing researchers' various perspectives, thoughts, and views on gained research opportunities and confronted challenges at the end of the research process is significant to understand their international collaborative research outcomes and products.

Recommendations and suggestions

Recommendations and suggestions are the researchers' broad considerations, reflections, suggestions, thoughts, and views on international collaborative research.

Individual researchers' recommendations and suggestions are based on their international research collaboration experiences, and analyzing their recommendations and suggestions is significant to understanding policies and support for international collaborative research.

Methodology

The literature focusing on international research collaborations is quite limited with regard to examining the processes and outcomes of international research collaborations. This study examines the researchers' considerations, experiences, insights, knowledge, and perspectives on international research collaborations. I explore researchers' past experiences and examine their interpretations of international research collaborations. In particular, I analyze their perspectives and ideas on international research with their collaborators. The goal of this study is to examine forces that shape researchers' considerations, experiences, insights, knowledge, and perspectives on international research collaborations. This study may also contribute to the understanding of challenges and opportunities in international research collaborations.

In this section, I detail the procedures I used to conduct my study. A research design is defined as "the arrangement of conditions for collection and analysis of data in a manner that aims to combine relevance to the research purpose with economy in procedure" (Selltiz, Jahoda, Deutsch, & Cook, 1963, p. 50). Research design refers to a "procedural-cum-operational plan" (Kumar, 2014, p. 122) by which researchers apply specified methods and procedures during the research process.

In this study, I used Skype or phone interviewing to collect data from individual researchers. The interviewing process is efficient for obtaining information from informants who have in-depth knowledge of particular subjects or phenomena and for questioning interview subjects about their particular actions, interpretations, motivations, perspectives, and thoughts (Singleton & Straits, 2010). To study phenomena that are not tied to specific geographical backgrounds or particular settings, intensive interviewing is effective for collecting data and understanding how informants form, maintain, and transform identities (Kleinman, Stenross, & McMahon, 1994; Lofland, Snow, Anderson, & Lofland, 2006; Singleton & Straits, 2010).

Singleton and Straits (2010) emphasize the importance of understanding the reactions of the interview participants as critical research validity checks on the researchers' inferences. Another strength of the interview method is that interview participants provide their considerations and share their experiences directly with researchers.

Semi-structured interviewing is the method of data collection I chose for this study. I collected qualitative interview data from December 2016 through January 2017 using semi-structured interviews either by Skype or by phone with JSPS/NSF funding recipients. Throughout the interview data-collection process, I followed an interview protocol as a research instrument to collect qualitative data to understand how the interview participants define, initiate, and structure international research collaborations. The advantage of the Skype or phone interview process is that it does not require the interviewer and the interviewee to be in the same geographic location, and I was able to

hold interactive interviews with the participants wherever they were located around the world.

Setting and Data Source

The Japan Society for the Promotion of Science (JSPS) was established as a nonprofit administrative foundation in 1932, and it became a quasi-governmental organization under the auspices of the Ministry of Education, Science, Sports, and Culture in 1967. Japanese national law states the purpose of the JSPS: “contributing to the advancement of science in all fields of the natural and social sciences and the humanities” (JSPS, 2015k). The Japanese government provides annual subsidies to JSPS, which works under government policies to promote academic and scientific advancement. In addition, JSPS implements programs to meet the demand of academic and scientific communities. In 2015, JSPS received direct funding of ¥259.5 billion and indirect funding of ¥45.8 billion, so its budget for the 2015 fiscal year was ¥305.3 billion (JSPS, 2015d).

In 2001, the JSPS became a government organization under the Ministry of Education, Culture, Sports, Science, and Technology (MEXT). Then, in 2003, JSPS became an independent administrative institution, promoting effective and efficient management in advancing the quality of support to research institutions, universities, and scholars and scientists. Approximately 99.8% of its budget is subsidized by the Japanese government. Throughout its entire organizational history, JSPS has developed and promoted domestic and international scientific research programs. The five primary roles of JSPS’s operation are (a) fostering young researchers, (b) promoting international

scientific cooperation, (c) awarding grants for scientific research, (d) supporting scientific cooperation between the academic community and industry, and (e) collecting and distributing information on scientific research activities (JSPS, 2015k).

JSPS has established and developed international bilateral programs in promoting international scientific exchanges by organizing joint research projects, joint seminars, and researcher exchanges with counterpart institutions around the world (JSPS, 2015c). JSPS specifies particular counterpart nations in each application round, and each applicant is able to submit one per counterpart nation. According to the list of JSPS' counterpart institutions (JSPS, 2015a, 2015b, 2015e, 2015f, 2015h, 2015i, 2015j, 2015l), as of 2016, there are 90 counterpart institutions in seven regions: Africa (4), Asia (20), Europe (46), international organizations (4), North America (9), Oceania (4), and South America (3).

The bilateral program proposals are openly recruited in each nation, and JSPS and the counterpart agency jointly select and support the programs. JSPS and counterpart organizations conduct reviewing processes separately, and they then make joint selections based on their own reviewing results. In the United States, five agencies—National Academy of Sciences (NAS), National Cancer Institute (NCI), National Institutes of Health (NIH), National Science Foundation (NSF), and Social Science Research Council (SSRC)—were named as the counterpart institutions (JSPS, 2015i).

According to the official announcement of the JSPS Bilateral Joint Research Projects/Seminars (JSPS, 2015h), JSPS utilized these criteria in the reviewing process:

scientific excellence of projects/seminars; necessity of cooperation, added value gained, and mutual research advancement through transfer of knowledge and expertise; impact of outcomes on improving the quality of life, contributing to socioeconomic development, and/or solving prevailing social issues; participation

of young researchers and contribution to fostering them; and feasibility and concreteness of the research plan and expectation of its advancing the research. (p. 5)

Through the program of the JSPS Bilateral Joint Research Projects/Seminars, JSPS provides financial support to individual scientists and promotes research exchange among research teams and through bilateral joint research projects and seminars based on 2–3 year research plans (JSPS, 2015c). The applicants must hold full-time researcher positions at universities or research institutes in Japan, and each researcher's affiliated institution must provide an appropriate research environment and support for the research projects. The researchers also must be eligible to receive *Kakenhi*, which refers to a Japanese grant for scientific research. In the JSPS Bilateral Joint Research projects, JSPS pays for international travel, domestic travel, and other related expenses of the international research collaborations.

In this study, my research subjects are the researchers who received research funding from Bilateral Joint Research Projects, a joint JSPS/NSF initiative, from 2011–2014 while collaborating and conducting international research across two nations, Japan and the United States. I obtained the list of the researchers who received funding support from the JSPS website. The expected interview participants were (a) 20 principal investigators who were affiliated with Japanese institutions and universities and (b) 20 principal investigators who were affiliated with U.S. institutions and universities.

Since the researchers of the Bilateral Joint Research Projects are a small group (JSPS, 2013; JSPS, 2014), I contacted all 40 researchers rather than employing a random sampling procedure. I considered the 40 interview subjects as informants about the international research collaborations in which they have been involved. The interview

questions do not address the subjects' own experiences except as background for understanding their collaborative work.

Institutional Review Board Approval Process

Before recruiting the interview participants and beginning the data collection process in this study, as the principal researcher of this study, I requested approval from the University of Minnesota Institutional Review Board (IRB) office for obtaining interview opportunities with researchers in international research collaborations. On May 13, 2016, I submitted my IRB forms and supplemental materials to the University of Minnesota IRB.

The IRB is a key section of the University of Minnesota's Human Research Protection Program (University of Minnesota, Office of the Vice President for Research, IRB, 2018), and it is responsible for checking proposed research methods that meet ethical standard and supporting investigators to confirm adequate protection and informed consent. The IRB is part of the Human Research Protection Program, which reports to the Office of the Vice President for Research at the university.

On May 25, 2016, the Institutional Review Board's Human Subjects Committee determined that the referenced study was exempt from review under federal guidelines 45 CFR Part 46.101(b) category #2, SURVEYS/INTERVIEWS; STANDARDIZED EDUCATIONAL TESTS; OBSERVATION OF PUBLIC BEHAVIOR. The approval is documented in the Appendix.

Interview Protocol

I sought to learn about the perspectives of the individual researchers and the particular contexts and settings of international research collaborations. I wanted to understand individual researchers' perspectives, examine challenges and opportunities during the international research collaboration procedures, and learn about research behaviors. Based on the conceptual framework, I posed questions to all interview participants to get their answers and responses to the research question: *In what ways do government policies, joint JSPS/NSF initiatives, funding structures and mechanisms, institutional factors, and prior connections affect international research collaborations jointly funded by the Japan Society for the Promotion of Science and the United States National Science Foundation?* I posed nine key questions to each researcher based on the study's conceptual framework. In addition, I used the prompts to understand details and specific aspects of their international research collaborations.

The conceptual framework describes five concepts as the influential factors—government policies, JSPS/NSF initiatives, funding structures and mechanisms, institutional factors, and prior connections—that may influence these three aspects—initiation and establishment, implementation and procedures, and outcomes and products—of international collaborative research. In addition, as an independent concept, I consider researchers' recommendations and suggestions related to advancing cross-national collaborative research.

The interview protocol is an important tool for researchers to organize interview questions and collect data from interview participants. Scholars have argued about the importance of the interview guideline, and Singleton and Straights (2010) defined it “as

an outline of topics in some logics order, or they may contain many specific questions, arranged thematically” (p. 368). I created and developed the interview protocol based on topics from the literature review and ideas that scholars and professionals in international research collaborations have considered to be key elements. I created the list of interview questions based on the conceptual framework. Table 1 presents this study’s interview protocol.

Table 1: Interview Protocol

Introduction:

Thank you for agreeing to participate in this interview.

The purpose of this interview today is to learn more about your international research collaboration experiences with your research collaborators and your recommendations to improve international research collaborations.

Please review and sign the Consent Form.

I would like to audio record our conversation.

Do I have your permission to record this interview?

Thank you.

Interview questions:*1. Prior connections*

Could you please tell me about your experience with international research collaborations?

Prompts:

- Could you tell me a bit about your past research experience as it relates to international research, if it was different from your current research?
- How did you first come to be involved in international research collaboration?

2. Initiation and establishment

Could you please tell me about your international research project funded through the funding agency's grant proposal?

Prompts:

- How did this project get started?
- How did you first connect with these collaborators?
- How did you write the grant proposal?
- What was the process through which it evolved?

Table 1: Interview Protocol (continued)

3. Implementation and procedures

How did you work with your international collaborators?

Prompts:

- How did you make decisions in the project?
- How did you share resources?
- How did you share facilities?
- How did you share data?

4. Outcomes and products

What have been the main outcomes of this research project?

Prompts:

- What opportunities have come from this project?
- What challenges have you encountered in this project?

5. JSPS/NSF initiatives

In what ways, have funding agency's initiatives affected your international collaborative research?

Prompts:

- Did any of your international research projects begin because of a funding agency's initiative?
- Have funding agency's initiatives supported your international research? In which stages? Start-up, advance, or finish-up?
- Have funding agency's initiatives supported your international research? In what ways?
- Have funding agency's rules constrained your international research in any ways? In what ways?

Table 1: Interview Protocol (continued)

6. *Funding structure and mechanisms*

In general, not just for the funding agency's projects, what have been your primary sources of financial support for your international research projects?

Prompts:

- How did you learn about the international research collaboration initiative?
- What are your primary resources to get information of the international research collaboration initiatives?

7. *Institutional factors*

How has your institution influenced your international research?

Prompts:

- In what ways, if any, has your institution supported your international research?
- In what ways, if any, has your institution constrained your international research?

8. *Government policies*

What influence, if any, do government policies have on your international research projects?

Prompts:

- In what ways, if any, have government policies supported your international research?
- In what ways, if any, have government policies constrained your international research?

9. *Recommendations and suggestions*

What recommendations do you have for funding agencies, your institution, governments, and other organizations to support international research collaborations?

Prompts:

- What would you recommend to address some of the challenges of international research projects?

Table 1: Interview Protocol (continued)

Closing question:

Is there anything else that you would like to add about any of the topics that we've discussed or other areas that we didn't discuss but you think are important?

The information that you provided to me will be extremely useful in this research project.

If you know of any information or resources that may be useful to added to this interview, could you please share them with me?

Thank you for your time and participation in this interview and for contributing to this study.

The protocol begins with opening questions that ask about researchers' current positions, responsibilities, and research projects. Then, I used the introductory questions to collect data about researchers' prior connections that influenced their recent Japan–U.S. research. I intended to learn the researchers' perspectives that related to prior connections and their initiation and establishment in this study's conceptual framework. To start the interviews, I asked the following questions to each interviewee:

- *“Could you please tell me about your experience with international research collaborations?”*
- *“Could you please tell me about your international research project funded through the funding agency's grant proposal?”*

Then, I moved to the next section of transition questions about JSPS/NSF initiatives, international research collaboration process, and outcomes. I intended to learn the researchers' perspectives that related to the key concepts of implementation and procedures, outcomes and products, and JSPS/NSF initiatives in this study's conceptual framework. I asked the following questions to each interviewee:

- *“How did you work with your international collaborators?”*
- *“What have been the main outcomes of this research project?”*
- *“In what ways, have funding agency's initiatives affected your international collaborative research?”*

The next section of questions examined funding structures and mechanism, institutional factors, and government policies. I intended to learn the researchers' perspectives that related to funding structure and mechanisms, institutional factors, and

government policies in this study's conceptual framework. I asked the following questions to each interviewee:

- *“In general, not just for the funding agency's projects, what have been your primary sources of financial support for your international research projects?”*
- *“How has your institution influenced your international research?”*
- *“What influence, if any, do government policies have on your international research projects?”*

Finally, I concluded the protocol by asking one question regarding researchers' recommendations concerning international research collaborations. I intended to learn the researchers' perspectives that related to recommendations and suggestions in this study's conceptual framework. I asked the following question to each interviewee:

- *“What recommendations do you have for funding agencies, your institution, governments, and other organizations to support international research collaborations?”*

Throughout the interview data collection process, I followed the interview protocol. My goal was to understand how their valued insights and viewpoints related to the nine concepts for the overall analysis of international research collaborations.

Pilot Interview Tests

The interview questions were pilot-tested on three scholars who have engaged in international collaborative research at the University of Minnesota. All pilot interview participants were recruited at the University of Minnesota, and the purpose of the pilot

interviews was to identify potential challenges and vague wording in the prospective interview questions so I could make revisions.

The interviews were conducted in English or Japanese, depending on the pilot interview participants' language preference. Obtaining pilot interview participants' feedback refined the quality of the interview questions and improved my interview skills. Their advice, feedback, and suggestions were valuable for me in preparing for the interviews with the researchers in the data collection process. Based on feedback and suggestions of the pilot interview participants, I modified the interview questions and refined wording for clarity. There were no changes to the content of the interview questions.

Recruitment and Data Collection

I collected interview data from December 2016 through January 2017. I scheduled the interviews based on the interview participants' schedule requests and conducted all the interviews by Skype or by phone. All participants completed the consent authorization process through the online service Adobe Sign and gave their permission for me to audio record the interview conversations.

In all, I contacted 40 researchers who conducted research in the 20 funded international research collaborations funded by the JSPS/NSF initiatives between Japan and the United States during the 2011–2014 period. There were 20 potential interview participants from U.S. institutions and universities and 20 potential interview participants from Japanese institutions and universities.

I contacted all 40 prospective interview participants three times: first, by invitation letter; second, with an email including the contents of the original invitation letter to the researchers; and third, by another email. The invitation letter and emails explained the study objective, the interview request, the interview time commitment, and potential considerations and risks for the study participants. In addition, the invitation letter and the emails clarified my motivation for this study and explained my research interest in international research collaborations.

I mailed the invitation letter to the 20 researchers who were potential interviewees at the U.S. institutions and universities on November 3, 2016. I then contacted the researchers via email to check my invitation arrivals and asked for interview opportunities to learn about their international research collaboration projects on November 14, 2016. Finally, I sent another email to the researchers followed by email communication to invite them to interview opportunities on November 21, 2016.

Regarding the 20 researchers who were affiliated with U.S. institutions and universities, eight researchers out of the initial 20 researchers replied with their willingness to do an interview with me; 12 researchers did not respond to my invitation. Of these eight, I scheduled seven interviews. One researcher was interested in sharing research information through email communication, but schedule conflicts prevented an interview with the researcher.

I mailed the invitation letter to the 20 potential interviewees at the Japanese institutions and universities on December 10, 2016. I then contacted the researchers via email to check my invitation arrivals and asked for interview opportunities to learn about their international research collaboration projects on December 19, 2016.

Regarding the 20 researchers who were affiliated with the Japanese institutions and universities, 10 researchers out of the initial 20 researchers replied with their willingness to do an interview with me; 10 researchers did not respond to my invitation. Of the 10 responses, I scheduled nine interviews. One individual researcher was interested in sharing research information through email communication, but schedule conflicts prevented an interview with this researcher as well.

I scheduled interviews of approximately one hour with individual researchers either by Skype or by phone, based on their requested preferences. The expected interview participants and I exchanged emails and confirmed the dates, times, and communication settings of the interviews via email. I also emailed the interview questions and the consent form to the participants before the interviews. I asked the interview participants to sign and date the consent form before the scheduled interviews, and I also asked them questions about the consent form before the interview. This process enabled them to understand my research purpose, fill out the consent form, and prepare for the interview. All interview participants completed the consent form and gained access to the copy of the form via the online service Adobe Sign.

I began each interview with a brief statement of my introduction and research interest. I clarified my data collection process and explained the confidentiality of the interview and the protection of the interview participants' identities. Through the data collection process, I used the interview protocol shown in Table 1 for each interview.

I recorded the interview with a digital audio application QuickTime Player, and I saved all digitally recorded files to my computer. By following the protocol of the IRB, I

stored data and information securely. After each interview, I sent a thank-you message to each interview participant.

After the interviews, I transcribed the recorded interview data into the document format in a Microsoft Excel sheet as a complete transcript of the interviews with participants. Regarding the interview data that I collected from the researchers who were affiliated with the U.S. institutions and universities, I transcribed the interviews from the recordings with the support of a professional transcribing service. Getting support from a professional American transcribing service enabled me to check and enhance the accuracy of the transcriptions against the audio recordings. Regarding the interview data that I collected from the researchers who were affiliated with the Japanese institutions and universities, I transcribed the interviews from the recordings myself, and I also translated them into English for the data analysis procedure. Then, I analyzed all interview participants' data through the transcript-based analysis.

Data Analysis Procedure

For this study's data analysis, I used a systematic analysis to ensure the interview data reflected what was shared in the interviews. In the data analysis process, researchers focus on summarizing and outlining the collected data; they then look for systematic patterns in the data that could help explain phenomena (Bernard, 2011; Singleton & Straits, 2010). The participants' explanations and ideas should provide concrete details about their views and perspectives on the international research collaboration settings and the actions that occur there. I created the full interview texts from the digital recordings and selected the key words that interview participants used repeatedly.

I used a coding process to classify and categorize the collected raw data and then classify the transcribed collected data into a sentence or paragraph (Miles & Huberman, 1994). Creswell (2014) and Tesch (1990) outline the coding process as organizing data, examining all transcripts, clustering similar topics, exploring descriptive wording relating to research, and conducting analysis. In this study, the coding process refers to finding themes across interview responses by their relevance to the five potential influences on international research collaborations, three aspects of international research collaborations, and an independent concept recommendation and suggestions through the coding process. I used coding to conduct the data analysis process and find key themes, and I interpreted the qualitative research data. Finally, I outlined the narrative outcomes and generated interpretations.

I reorganized the collected data in the data spreadsheets, using the theoretical concepts to examine each line of text by hand-coding and assigning codes. I developed the coding categories based on the commonly found themes and assigned coding to the themes. Regarding data privacy protection, during the data analysis, the interviews transcribed data and the transcriptions were de-identified. All identifiers such as name, title, or geographic identity were removed from the data. De-identified data were assigned a re-identification code.

I categorized the data by specific themes according to the coding presented as follows. For example, if a researcher explained his or her work as exploring common research interests across different academic fields in terms of international collaborative research outcomes, I categorized the data under the coding category of interest-based relationships, which signifies the researcher's desire to reach out to a leading professional

from a different academic field and conduct collaborative research. If a researcher stated that the research group needed to add some resources to their ongoing collaborate research, I categorized the data under the coding category of project-based relationships, which referred to the research team's objective to include other research groups and put extensive resources together. If a researcher said that a senior researcher recommended a particular researcher as a potential research collaborator in research collaborations, I categorized the data in the coding category of network-based relationships, which refers to the researcher's objective to maintain the network and conduct collaborative research. If a researcher noted that he and his collaborators shared ideas and specified research topics together during the grant writing process, I categorized the data in the coding category of sharing responsibilities, which relates to the researcher's objective to obtain funding from each site.

I outlined all collected data and work on moderating the entirety into meaningful units based on the concepts: prior connections, initiation and establishment, implementation and procedures, outcomes and products, JSPS/NSF initiatives, funding structure and mechanisms, institutional factors, government policies, and recommendations and suggestions on which the data analysis is based. The next chapter presents the data analysis for this study and the study's findings.

Chapter 4

Research Findings and Data Analysis

This chapter presents the results of the analysis. I outline the characteristics of the interview respondents and the findings related to the five factors of potential influence and the three aspects of international research collaborations considered in this study. I present the most noteworthy and related themes. I synthesize the findings of the researchers in their international research collaborations in Japan and the United States. The findings are presented using the conceptual framework to reveal the various aspects of international research collaborations from the researchers' perspectives.

The purpose of this study is to explore the relationship between Japanese and U.S. government research funding and the structure and functioning of Japanese-U.S. international research collaborations, and I will analyze individual researchers' perspectives and examines challenges and opportunities that emerge during their international research collaborations. I investigated the research question, "*In what ways do government policies, joint JSPS/NSF initiatives, funding structures and mechanisms, institutional factors, and prior connections affect international research collaborations jointly funded by the Japan Society for the Promotion of Science and the United States National Science Foundation?*"

The study findings are based on data I collected through interviews with researchers who received government funding support in their international research collaborations in Japan and the United States. I transcribed all the interview data, and I examined the experiences, knowledge, and perspectives of the researchers based on five

influences on international research collaboration: prior connections, JSPS/NSF initiatives, funding structures and mechanisms, institutional factors, government policies, and three aspects of international research collaborations: initiation and establishment, implementation and procedures, outcomes and products, and recommendations and suggestions.

I used a qualitative, semi-formal, interview research methodology and analyzed the experiences, knowledge, and perspectives of the researchers in their international research collaborations. The researchers' answers, information, and knowledge are classified by the model's nine primary elements.

During the data analysis process, I applied three measures—frequency, specificity, and extensiveness—to analyze the interview responses to the questions (Krueger & Casey, 2009). First, it is crucial to understand how frequently some subjects are mentioned during the interview, which shows commonality of considerations and perspectives among the researchers who conducted international collaborative research. Second, in-depth descriptions or explanations of comments, information, and other related stories are important for analyzing researchers' experiences and knowledge in international collaborative research. I thus gave more emphasis to specific or detailed researcher responses. Third, it is important to capture the principles of what the researchers explained to me during the interview process. To refocus my analysis on the responses of all the researchers, I extensively examined how many researchers provided specific recommendations and suggestions to improve international collaborative research throughout the interview process. I present the descriptions and themes in the qualitative narrative.

Characteristics of the Respondents

In this study, I conducted semi-structured interviews with researchers who engaged in international research collaborations between Japan and the United States during the 2011–2014 period. At the start, I contacted 40 researchers who engaged in international research collaboration projects between Japan and the United States during the 2011–2014 period. I sent an interview invitation letter to the researchers followed by email communication, and I asked for online interview opportunities to learn about their international research collaboration projects. There were 16 researchers who agreed to participate in the interviews with me. These 16 researchers conducted 13 international research collaboration projects. They responded with stories describing their experiences, knowledge, and perspectives in international research collaborations. The researchers who participated in the interviews were nine researchers currently conducting research in Japan and seven researchers now engaged in research in the United States.

Nine researchers had institutional affiliation with Japanese institutions, and seven researchers were affiliated with American institutions. Thirteen interviewees were faculty members associated with higher education institutions, two members worked at government research institutes, and one member was connected with a nonprofit research institute. When I conducted interviews with them, I found most researchers engaged in their own research at their current affiliated organizations.

All interviewees in this study were the primary investigators, and they led international research collaboration projects between Japan and the United States. They engaged in international research collaborations in the fields of applied biological science, astronomy, biomedical science, geophysics, engineering, environmental science,

medicine, pharmacology, physics, social science, surgical science, and veterinary medicine. Their international research collaborations were supported by federal or national government agency funding agencies over multiple years.

All interview participants answered all the interview questions; however, the amount of discussion by the participants varied widely. Some of them explained their prior connections in detail and others did not. Some participants provided specific recommendations and suggestions to refine the support mechanisms for international research collaborations, and others did not have particular comments.

Note that each quotation below is labelled according to the language in which it appears in the original transcript, Japanese or English. Also, quotations that document dialogue between the respondent and the interviewer indicate the interviewer's words with italics. In this chapter, quotations have been edited to protect the confidentiality of the interview participants. For example, names of the specific universities have been replaced by generic terms.

Findings Related to Potential Influences on and Aspects of International Research Collaborations

This study examines five influential factors that may affect international research collaborations throughout the research process from initiations to completions. In addition, I will outline aspects of international research collaborations. I present the findings and provide analyses particular to each interview question.

Prior connections

To understand the interviewees' experiences and knowledge, the first interview question related to the five factors was, "*Could you please tell me about your experience with international research collaborations?*" Most interview participants knew their research collaborators prior to the research collaboration. They explained that they had developed connections through established organizational network platforms, individual network platforms, and research development processes.

Most researchers had network connections with their research collaborators prior to their international research collaborations. Seven interviewees noted that established organizational network platforms provided opportunities for them to reach out to their research collaborators. Seven respondents said that their individual network platforms helped them get to know their collaborators beforehand. Three researchers also stated that they fostered connections with their research collaborators through research development processes. The researchers viewed their prior connections as the primary driving force for sharing common research interests and identifying possible subjects for their research collaborations.

Connections through established organizational network platforms

One common factor that researchers named as essential for establishing and developing connections was established organizational network platforms at their affiliated institutions, in their academic and professional societies, and through their related organizations. Researchers named the influence of established researchers, the influence of the word of mouth, references to individual or team research projects,

influences of institutions and academic disciplines, costs of sharing research devices, and incentives for institutional partnership attainments as primary elements for forming connections at the organizational level.

Established researchers influenced and shaped connections among some researchers. One interviewee reported that his employer's bilateral laboratory research affected the establishment and development of research connections. The researcher joined his employer's international collaborative laboratory research project, where he connected with a collaborator. Another interviewee stated that one leading scholar's leadership and efforts in creating a global research network through symposia helped him reach out to a research collaborator. One Japanese professor said,

“Well, there was a researcher, I had conducted research under a similar research topic together before. [A Japanese researcher] who was at [a Japanese university] had already retired. He collected researchers and organized symposia two times. He created a global research network and invited researchers to Japan with Japanese funding.”

“It was at the symposia.”

“Well, yeah, that's because I was doing it, well, I was familiar with the researcher whom I was also competing with. Well, I am not sure about the specific time, but I think it was around 2002. There was a program to send faculty members to other institutions for two months at [a Japanese university].” (Japanese)

Researchers often establish connections through word of mouth. One interviewee addressed the influence of word of mouth in institutional research programs in exploring collaborative research opportunities and expanding research connections. One U.S. researcher explained the process of establishing connections with research collaborators as the following:

“But, anyway, we had a lot of Japanese who came in the early 70s, and they tried to explore the opportunities. Then, of course, with their good experiences through

the word of the mouth. So, more and more Japanese come over. In the past 40 years, I trained probably around 350 fellows all over the world.” (English)

In another case, a member of an established organizational network platform expanded and created networking opportunities for researchers. Researchers share their colleagues’ contact information to build connections and organize research teams. One Japanese professor noted the network connection establishment process as follows:

“In particular in [a U.S. state], the research group at [a U.S. university] contacted us.”

“Uh-huh, I see.”

“Well, it was lucky. There were other famous research groups that studied [a research subject] at other institutions such as [a Japanese university], [a Japanese university], and others in Japan.”

“Uh-huh.”

“At that time, researchers were very busy, well, there was the occurrence of [an infectious disease] in Japan. [A U.S. state] group was not so famous at that time in [an infectious disease] research, and the group leader’s research focus was on a degeneration of [a research subject].”

“Uh-huh.”

“So, there was a group that did not conduct collaborative research with [a U.S. state] group in [a Japanese prefecture] and [a U.S. state], at that time. I started my laboratory and my colleague had conducted [an infectious disease] research.”

“Uh-huh.”

“So, somebody provided our research team information that [a Japanese university] group might do it to the team, and they contacted us. So I’m sorry that the story became long.” (Japanese)

Researchers also maintained and cultivated longtime relationships with their collaborators since the time they started working at their affiliated institutions. One U.S. researcher explained that the large research network of connections he had cultivated since the mid-1980s mainly consisted of researchers at European research institutions.

The researcher began conducting collaborative research with European researchers first, and he later expanded the size of his collaborative research to include other collaborators from Asia.

In some research studies, there is an integral need for access to special research devices, equipment, or facilities. One interviewee also provided perspective on the importance of sharing institutional research devices. In some particular academic fields, it is critical to share the costs of particular research equipment and facilities in collaborative research. One Japanese researcher emphasized the need to use particular devices to conduct international collaborative research:

“So, [a U.S. national laboratory] near [a U.S. city] in the United States, has the special device, dealing with the type of [a research subject], to [condition] [a research subject] which are [a research subject] to [condition].”

“Uh-huh.”

“We utilize the device, and the Japanese group and the American group conduct collaborative research, that kind of research.” (Japanese)

Institutional leaders also influence international collaborative research through their own networks. Another interviewee explained that institutional leaders encouraged researchers to create cross-institutional programs and conduct collaborative research through cross-institutional partnership agreements. The interviewee reported that institutional partnership development was one of the driving forces in establishing connections among researchers. One Japanese professor said,

“At the beginning, [a Japanese university] and [a U.S. university] had university exchange and university agreement. We tried to launch a new educational program between [a U.S. university] and [a Japanese university]. We studied [a research subject], and there were the researchers whom we are familiar with.”

“Uh-huh.”

“Well, there were the researchers who studied [a research subject] at [a U.S. university]. They are doing research on the same [a research subject], and we met at conferences. Then, at the beginning, we visited [a U.S. university] to create educational programs for students through the university partnership between [a Japanese university] and [a U.S. university].” (Japanese)

Connections through individual network platforms

Individual network platforms were an influential factor in establishing and developing connections among researchers. The interviewees listed individual connections established and developed through advisors, bosses, postdoctoral researchers, trainees, students, and study and work abroad experiences at the individual level as their primary influences. Possibilities to identify and reach out to potential collaborators often came from the opportunity to interact with established or emerging researchers.

Interviewees described connecting with potential research collaborators through their individual networks of established researchers. One U.S. professor explained that a leading Japanese scholar visited his lab approximately 30 years ago, and they conducted research together for several weeks. The researcher, the visiting Japanese scholar, and the Japanese scholar’s students developed long-standing relationships through international research. Another researcher referred to the influence of his boss’s individual connections on his research network. The Japanese researcher stated,

“Well, originally, the boss, the former boss, got to know the researcher during his study abroad, so, then, they continued collaborative research. Well, the former boss knew the researcher. Then, I got the opportunity to join the research.” (Japanese)

Similar to the cases with established researchers, academic advisors and faculty members were also influential stakeholders in the establishment of connections among

researchers. One professor stated that his academic advisor introduced a potential research collaborator to him.

Researchers connect with collaborators at conferences, forums, symposia, meetings, and other networking events. These events link researchers with others who have common interests. In addition, participating in these events provided researchers with opportunities to reach out to research collaborators. One Japanese researcher emphasized the influence of an established scholar by saying:

“Well, originally, my professor from [a Japanese university] introduced the researcher to me at a symposium or a small meeting, I am not sure that he is still at [a U.S. university] or not. I got to know [a U.S. researcher] who was at [a U.S. university] at that time.” (Japanese)

To advance their research and explore new opportunities, researchers often change organizations or work in other nations throughout their careers. The interviewees stated that their previous study or work abroad experiences provided them with opportunities to connect with their research collaborators. One Japanese professor explained that he developed his long-standing relationships while working abroad:

“Oh, yeah, it is, originally, I worked for a university for about 10 years in [a European country].”

“Uh-huh.”

“After that, well, I am currently at [a Japanese university]. When I was studying in [a European country], I conducted international collaborative research by using the [a research device]. Then, after that, at [a Japanese university], I use [a research device] and continue conducting international collaborative research.”

“Uh-huh.”

“At that time, there were a lot of people from European universities and research institutes. There were also researchers and research groups from the United States. They were my colleagues through the research in Europe, and they became my colleagues in the United States. When they started conducting

research in the United States, they were interested in conducting research together with the group of [a Japanese university].” (Japanese)

Researchers are likely to change locations and explore opportunities to advance their educations and research. The researchers’ mobility encouraged them to be flexible in maintaining and developing their connections with research colleagues. One Japanese professor described how his study abroad experience in Europe led to opportunities to connect with researchers in the United States:

“At the beginning of the 1990s, I studied at [a European university] in [a European country].”

“Uh-huh.”

“Then, after that, my professor moved to a university in the United States.”

“Uh-huh.”

“So, then, I started visiting the United States.”

“Uh-huh.”

“Well, I met with a variety of people. My professor recommended particular researchers to meet with. Then, I met one particular researcher who was a teacher of my research collaborator in the international collaborative research. So, there are connections from the beginning.” (Japanese)

In addition to the influence by established researchers, interviewees noted that they gained networking opportunities through emerging researchers. In particular, postdoctoral researchers played important roles in building connections among researchers. A professor U.S. established and developed connections with Japanese researchers through a postdoctoral researcher from Japan. He said the “Very first postdoc whom I hired happened to be a young woman from Japan. And, that sort of seemed to impress my Japanese colleagues.” Similar to this employment case, another U.S. professor established a connection with a Japanese postdoctoral researcher through

another Japanese colleague's suggestion. The interviewees indicated that their personal communications and efforts enabled them to establish and develop individual connections with their collaborators.

Connections through research development processes

The researchers' incentives to advance research led to opportunities to conduct research collaboratively. Their research connections were based on their desire to share common research interests, advance the research development process, and explore research advancement opportunities. Interviewees said that their connections were part of the research development process. One professor explained a previous research relationship with a collaborator by saying, "Ah, we had already collaborators in several things and we had published some papers together." Another professor described his research incentive by saying, "You know, I think, we had common interest in terms of scientific subjects."

Research support funding opportunities are strong motivations of researchers in international collaborations. One interviewee described how his strong incentive to find a collaborative research program led him to reach out to research collaborators. The following quote exemplifies how researchers specify research targets, find research grants, and conduct research. A Japanese professor said:

"Well, I thought that it would be nice to promote collaborative research, while, I traveled over the long term. At that time, as a researcher, when I was looking for research funds in many places, I found that kind of the bilateral cooperation. Well, I applied for it for a couple of times and got accepted."

"Uh-huh."

“Well, I was not able to get it on the first try. I applied for the funding to several times, and I finally got accepted.” (Japanese)

Conclusions related to Prior connections

Among the researchers at the American institutions, 71 percent (five researchers) responded that they had actively looked for and contacted collaborators in their international research, and 29 percent (two researchers) said they were contacted by their collaborators. Among the researchers at Japanese institutions, 44 percent (four researchers) responded that they had actively explored and contacted collaborators in their international research projects, 33 percent (three researchers) said they were contacted by their collaborators, 11 percent (one researcher) explained the researcher continued his supervisor’s research, and 11 percent (one researcher) said the researcher and his collaborator began international collaborative research under the initiatives of their affiliated institutions’ partnership.

To explore opportunities to advance research, researchers actively establish connections with other researchers and organize research teams around the world. Researchers understand that conducting international collaborative research enables them to access special research devices, equipment, facilities, and other important resources to which they would not normally have access. Participating in international conferences, forums, symposiums, and other events is crucial to sharing research outcomes and finding researchers who have common research interests. Researchers also acknowledge their institution’s leaders influence international collaborative research through their own institutional networks.

Established organizational network platforms, individual network platforms, and research development processes all influence research network connections. Established organizational network platforms at institutions, in societies, and through related organizations affect and shape researchers' network connections. Individual network platforms based on interactions with established or emerging researchers also influence network establishment and development processes. Furthermore, through research development processes, researchers can continuously create connections and explore collaborative research opportunities based on their incentives to advance research.

Initiation and establishment

To understand the interviewees' experiences and perspectives at the beginning of international collaborative research projects, I posed the following question to interviewees: "*Could you please tell me about your international research project funded through the funding agency's grant proposal?*" which was the first interview question associated with the three aspects of international collaborative research. *Initiation and establishment* were essential to recognizing mutual understanding in submitting funding proposals and clarifying responsibilities at the beginning of international collaborative research. Understanding the interests, motivations, and efforts of researchers is a crucial component in beginning international collaborative research projects across nations.

In this study, the term *initiation and establishment* refers to the engagement between researchers to agree on conducting international collaborative research, sharing responsibilities, and submitting funding proposals to funding agencies. To conduct international collaborative research, researchers need to identify their collaborators, and it

is crucial to establish good relationships among researchers to write proposals collectively. *Initiation and establishment* are also a key factor for enhancing relationships and clarifying responsibilities in international collaborative research.

Most interview participants claimed that their research initiation and establishment process was based on sharing responsibilities, and that the relationship was built on common research interests, research project interests, and researchers' networks. 11 interviewees reflected on the ways that they shared responsibilities at the research initiation and establishment stage. Five interviewees said they established research through interest-based relationships. Three noted they developed research through project-based relationships. Two interviewees indicated that their academic or professional network-based relationships helped them initiate and establish research.

Initiation and establishment through interest-based relationships

Researchers initiate collaborative work across nations by sharing common research interests. Two interviewees stated that sharing common interests enhanced their relationships at the research project initiation and establishment stages. One U.S. professor indicated that he got to know his potential collaborator through information from his colleague:

“One of the colleagues just brought up his name, as a well known specialist in the field, and I sent him an email introducing myself, and telling him a little bit about my work, yes.” (English)

Learning research skills and knowledge applications from established colleagues is valuable for advancing research. One U.S. researcher explained he was contacted by a professor in the same field who wanted to learn a particular equipment approach. The

professor was interested in the application of a particular research device and wanted to learn how to advance the research equipment application process:

“Because his interest is more in the same area of my interest. So, he liked to see the application, not just development, of equipment. So, I remember now, so, that was the project. He came here two times.” (English)

Three interviewees noted that they made gains in their research by exploring common interests and extensive knowledge across academic disciplines. Sharing knowledge and research techniques can enrich researchers’ experiences such as utilizing different research methods, testing extensive research approaches, understanding emerging research fields, and others. One U.S. professor explained the importance of sharing techniques in research, and he and his collaborator considered it necessary to share knowledge and techniques to enhance research:

“Yes. I think we, we actually have kind of different, different techniques that we specialize in, myself and my colleague in Japan, and so actually our methods are complementary, and we each need this collaboration to make progress. So it's quite natural. My Japanese counterpart is making new [research subjects] in [condition].” (English)

Incorporating the knowledge of colleagues from different academic disciplines into their own work helps researchers utilize a variety of perspectives that enhance their collaborative research. One Japanese professor acknowledged that it was difficult to find research collaborators interested in his research subjects in different academic fields, and he stated that he enhanced his relationship with his U.S. collaborator by holding discussions and sharing data in specifying common research interests:

“Well, he is a researcher who specialized in [a scientific discipline] and [a scientific discipline]. Well, there are a few researchers in the fields to be connected through the research keyword [a research subject].”

“Uh-huh.”

“Well, yes, after meeting at the seminar, we had discussions and shared my data. So, we have maintained our relationship and exchanged ideas through these interactive interactions.” (Japanese)

Integrating research interests and goals promotes international collaborative research. One Japanese professor explained that he and his collaborator shared common research interests in terms of international collaborative research outcomes:

“He was a researcher in [a scientific discipline], and I am a researcher in [a scientific discipline]. So, our academic fields are completely different. We shared common research interests on developing [a research device] by using a particular [a research subject] what I used in my research. So, I got to know him and filed the application.” (Japanese)

Initiation and establishment through project-based relationships

Key factors for enhancing researcher interactions at the initiation and establishment stages are the understanding of objectives and the sharing of responsibilities. Three interviewees reported they had conducted research continuously and shared responsibilities in groups or teams. They also indicated that their colleagues in academic and professional networks encouraged them to establish connections with researchers. One U.S. professor explained that his research team needed to put extensive resources together from other research teams to conduct research:

“And, at that point, that was primarily a U.S. collaboration. At that point, we still needed some more resources to carry out the experiment.”

“Uh-huh.”

“And, so, we went looking for groups, particularly in Asia, and got several groups from Japan, one group from [an Asian country] to join the experiment. So, the experiment would not have started without them. They assumed significant responsibility for building [a research device] for the experiment. One of the professors at [a Japanese university] is leading the analysis of the experiment. The experiment involves about [numbers] people, and let’s see, ..., [many] institutions.” (English)

When writing proposals for research projects and applying for international collaborative research grants, an investment of collective knowledge and time is essential to explain value of collaboration in research. One U.S. professor said it was essential to write proposals together and conduct international collaborative research on common research interests:

“So, my, my collaboration with [a Japanese researcher] has been going on previously. He was certainly named in my grant five years ago, so it must have been, you know, around that time, but the project itself has been going on for a long time trying to, you know, understand [a research subject].” (English)

Even at the implementation stage, adding team members and sharing resources can help researchers integrate their knowledge and increase funding for research projects. One Japanese professor stated that his collaborators needed additional resources to conduct research and contacted him:

“In fact, it was desirable to organize international collaborative research. After having our proposal accepted, when we began the research implementation stage, we recruited researchers from Japan.”

“Uh-huh.”

“Well, even in Japan, we had mainly conducted research in Europe. And the research subjects were very close to our research subject.” (Japanese)

Initiation and establishment through network-based relationships

Colleagues and established researchers are key to developing constructive relationships. Two interviewees stated that they got to know their research collaborators through their academic or professional network-based relationships. Colleagues or academic advisors took essential roles in connecting with other researchers. One U.S. professor described how a mutual friend of himself and his collaborator provided opportunities to meet and share common interests on research:

“. . . a Japanese colleague of mine was visiting our department, and he had, he had a former collaborator working in our department. So, that, he came to see that other person, but we also started talking, and we saw a grant solicitation by the National Science Foundation . . .” (English)

Strong recommendations from established researchers are likely to reflect researchers’ choices of partners for international collaborative research. One Japanese professor said that senior faculty members recommended researchers to him. Among researchers, the professor had an opportunity to meet the researcher and share research interests:

“Well, in short, originally, I mean, faculty members who took care of me recommended potential research collaborators to me. Among them, I had an opportunity to meet the researcher who later be the representative of the American research team. Since that time, I have engaged with them.” (Japanese)

Initiation and establishment through sharing responsibilities

There are a variety of responsibilities that individual researchers, teams, and institutions share through international collaborative research. Two interviewees noted that funding agencies guided researchers and research teams to share responsibilities through international collaborative research. In addition, the agencies promoted scholar and student exchanges through international collaborative research. One U.S. professor explained that funding agencies encouraged researchers to organize international collaborative research and share responsibilities with other research teams through research, and he stated all participating institutions in international collaboration were responsible for covering the operating costs and sharing responsibilities through research:

“And so, for example, at each, each institution is expected to contribute their initial responsibility which they got from their funding agencies, but then there are ongoing expenses for the collaborations. We use [a research device] to detect [research subjects]. And so, the [conditions] for [a research device] is ongoing expense. And we basically have a system to make sure that every institution

covers their fraction of those costs proportional to the number of collaborators they have.” (English)

Exchanges of researchers and students across nations enhance engagement among researchers and enrich researchers’ experiences in international collaborative research.

One U.S. researcher pointed out that the funding agencies encouraged scholar and student exchanges across nations:

“And it was the similar amount of money given by a Japanese funding agency, for the Japanese parties to come over to the U.S. So basically each funding agency was providing funding for their people to go to the other country.” (English)

Mutual trust among researchers is key to making progress through the various stages of research. Two interviewees mentioned that they did not articulate their responsibilities to others at the beginnings of their international collaborative research projects. One U.S. researcher described how he and his collaborator discussed and shared resources in research:

“So, this is, we're a small enough collaboration that we don't have a formal advisory council or decision-making council. We try to do everything by consensus.” (English)

Researchers are also more likely to share responsibilities and conduct research on an informal rather than formal basis. One U.S. professor also had a similar view on sharing resources. The professor stated there was no formal procedure to advance the research process:

“Right. I would say that everything was done in a very informal basis between, in the collaboration.” (English)

Research grants provide opportunities for researchers to combine expertise and knowledge in the planning stage of international collaborative research. Four interviewees noted that they communicated ideas with others and shared responsibilities

during the grant proposal writing process. One U.S. professor emphasized the importance of the international collaborative grant writing process. To obtain funding from each site, it is critical for researchers to write grant proposals collectively. The professor said that he and his collaborators shared ideas and specified research topics together:

“Oh, I mean, we first talked about the general idea for the proposal, and then we agreed on the specific aims, and each of us did some of the work of preparing the actual proposal. And then [a Japanese researcher] submitted it.” (English)

The degree to which researchers and collaborators integrate their knowledge, ideas, information, and other conditions varies across grant-proposal-writing cases. One Japanese professor shared brief information on the research-grant proposal-writing process. The professor stated that she was responsible for the writing process based on consensus with her collaborators:

“Well, our collaborators are not able to read it in Japanese. I explained the information, what I was going to write on the proposal based on consensus. Then, I explained how to advance the ongoing research. I wrote it as an additional part to the ongoing research without much trouble.” (Japanese)

Researchers also work independently regarding the grant proposal writing process and submit their work directly to funding agencies or organizations in each country. One U.S. professor explained that, although he and his collaborators did not write a particular grant proposal together, they still included all of the collaborators’ names on the proposal:

“As far as I remember, I did not write it.”

“I see.”

“I don’t remember writing anything of his grant. Now, I put him down on my grant.” (English)

Including leading researchers as principal investigators on a research project is an important strategy to increase the potential for acquiring collaborative research grants.

One interviewee discussed a particular norm that he and his colleagues shared during the research grant proposal writing process. One Japanese professor indicated that his colleagues frequently included his name on grant proposals for international research:

“Yeah, every year, the time of application is decided. So, with regard to the international exchange project, for example, if someone in my domestic research groups want to do projects, they use my name as a representative on the application. That kind of thing is something we are familiar with.” (Japanese)

Individual researchers are responsible for writing and submitting grant proposals to funding agencies that support international collaborative research. Three interviewees noted that the structure of the funding support was independently organized in each country. One Japanese professor shared that researchers needed to describe research objectives and procedures for the way they were conducting research in each country in the proposal:

“We are the only receiver of the funding support. I basically wrote about what we do and how to conduct research with American team.” (Japanese)

Individual researchers are significant contributors to the grant proposal writing process. One Japanese professor simply stated that he was responsible for the research grant proposal writing process:

“So, in order to make it happen, each team applies for various research funding opportunities and gets them. Well, there were consultations in our research group, and I organized the application document itself.” (Japanese)

One Japanese professor shared a similar view of each team’s responsibilities during the proposal writing process. Both individual researchers and research teams are responsible for submitting international collaborative research grant proposals. The

professor reported that each research team was in charge of submitting proposals to funding agencies in their nations:

“Yeah, well, the Japanese side wrote the Japanese one. The American side wrote the American one. Well, I was responsible for the Japanese one.” (Japanese)

Both individual researchers and institutional leaders are eager to promote collaborations at the institutional level across nations. Among the Japanese interviewees, one shared a unique process to initiate and establish international collaborative research, explaining that his institution’s leaders encouraged him to conduct international collaborative research as part of the institutional partnership establishment and development process:

“So, in order to start, after all, in terms of the institutional partnership agreement, there are many hurdles. To begin with, institutions mutually agreed to start collaborative research in the field of [a research subject] research. Well, I suggested conducting bilateral collaborative research by exchanging technologies and materials. Then, a faculty member at [a U.S. university] was responsible for accepting me as a visiting scholar. This was the beginning part of the research.” (Japanese)

Conclusions related to Initiation and establishment

Among the researchers at American institutions, 57 percent (four researchers) mentioned that they wrote the research grant proposal separately, and 43 percent (three researchers) explained they wrote the research grant proposal together with their collaborators. Among the researchers at Japanese institutions, 67 percent (six researchers) said they wrote the research grant proposal separately, and 33 percent (three researchers) explained they wrote the research grant proposal together with their research collaborators.

Sharing common research interests enforces their relationships at the research project initiation and establishment stages. Incorporating the experience and knowledge of collaborators from different academic fields into collaborative research projects can help researchers use different research methods and integrate a variety of ideas to enhance their international collaborative research projects. Understanding research objectives and sharing various responsibilities on either an informal or formal basis are key factors for enhancing interactions among researchers. Recommendations from established researchers can also influence researchers' selection of their research collaborators. To verify the combination of expertise and ideas, the research grant proposal writing process is crucial for all researchers. Researchers can work separately or together regarding the grant proposal writing process and submit their proposal to funding agencies or organizations in their nations.

Implementation and procedures

To understand the interviewees' experiences and considerations throughout their international collaborative research projects, I asked interviewees: "*How did you work with your international collaborators?*" *Implementation and procedures* are significant elements for making progress during international collaborative research. The researchers' efforts in regard to exchanging ideas and understanding collaborators' perspectives helped the researchers advance their international collaborative research.

In this study, the term *implementation and procedures* refers to the planning, decision-making, and implementation processes of international research collaborations. Experiencing international collaborative research processes throughout planning and

implementation can provide researchers with comprehensive insights and reflections on their international collaborative research. Considerations, insights, and reflections are crucial to examining the researchers' international collaborative research experiences.

The interview participants indicated that they conduct international collaborative research through sharing common interests regarding research advancement, sharing responsibilities, experiment styles based on their academic fields, sharing resources, sharing data, and exchanging scholars and students. Two interviewees mentioned they shared research interests through international collaborative research. Seven interviewees noted the responsibilities and roles of individual researchers in international collaborative research. Eight interviewees said their research styles were particular to their academic fields. Five interviewees explained how they gained access to particular resources or equipment. Six interviewees described the ways they share research data with their collaborators. Five interviewees stated that promoting scholar and student exchanges provided collective benefits to researchers.

Implementation and procedures through sharing common interests regarding research advancement

Two interviewees described their international collaborative research implementation and procedures. Research capabilities, interests, knowledge, and skills are essential criteria for those working to implement and advance procedures of international collaborative research. The interviewees said they shared research interests throughout their international collaborative research. One U.S. professor emphasized the importance of sharing common research curiosity and recognizing different perspectives in research:

“We really haven't done before, and so in that way, we begin to have some capabilities of expertise that was a little bit overlapping what our collaborators in Japan had, and, of course, this creates some possibilities to have some kind of competition or some differing viewpoints on the, actually, same, the same specific technical activity.” (English)

Sharing interests helps to advance international collaborative research and develop domestic research networks. One Japanese professor described how he was also interested in sharing common research interests with his colleagues and advancing the domestic research community through his international collaborative research project:

“Well, I think that there were about 20 people on the Japanese side. They were originally connected through my research network in the same academic field. Almost all of them conducted research from day to day together.” (Japanese)

Implementation and procedures through sharing responsibilities

Three interviewees mentioned the specific responsibilities and roles of individual researchers in their international collaborative research projects. Two interviewees shared their views on the structure of conducting independent research. Clarifying and recognizing the responsibilities of team members is important for conducting international collaborative research. One U.S. professor mentioned that leaders on the research teams were responsible for covering broader research topics and not limiting their research focus to particular research targets:

“Yes. In our experiment there are perhaps five different [a scientific discipline] topics we can address.” (English)

Team members are key contributors to international collaborative research, and the incorporation of their extensive knowledge and skills is essential. One U.S. researcher explained the importance of sharing researchers in the research process and recognizing their contributions to the research:

“When you have collaborators, you have to recognize them. For example, if someone from other laboratories, they help us resolve these problems, eventually, in the publication, we can consider them as coauthor, or we give acknowledgement. So you have to have mutual respect. You cannot just take advantage of other people without recognizing them, right?” (English)

Preparing research objectives, procedures, and results for publication is a significant collaboration process for sharing findings and outcomes. One Japanese professor credited the collaborator’s support during the scientific research paper editing process:

“After all, while my collaborator understands what I was thinking, I understand what he is thinking. It was very helpful to write an article together through editing and correcting my writing, understanding each other, writing an article together, making decisions, holding discussions on concluding thoughts on research.” (Japanese)

International collaborative research can be viewed as the integration of research projects conducted independently in different locations. Two interviewees noted that their research implementation and procedures were independent, and they had some exclusive, non-shared responsibilities. One U.S. professor pointed out that he and his collaborators conducted research independently in international collaborative research:

“So, in essence, we are both doing what's best for ourselves in our own environments, but in an informal way, agreeing to collaboration when it's useful for both of us.” (English)

Researchers share various resources with their collaborators through international collaborative research even though they cannot use research funds freely at their collaborators’ sites. One Japanese professor also described a similar story and said that the independent financial support from different funding agencies across the nations shaped their research styles independently:

“Well, basically, it was like a matching fund. So, there are funds over there, and there were funds here. So, our money cannot be used over there, and their money cannot be used here.”

“That is what you mean.”

“Yeah, so, in that sense, there was a valley between the research teams.”
(Japanese)

Two interviewees noted the significant roles of graduate students in international collaborative research. Graduate students and postdoc researchers cover extensive research topics and conduct analyses. One U.S. researcher stated that graduate and postdoc researchers took primary responsibilities during the data-collection and -analysis phases to cover essential research topics:

“And so, we don't want everyone focusing on one of those and having the other four being neglected. But that actually works out pretty well because most of the analysis is done by graduate students . . .”

“Uh-huh.”

“. . . who have to write a thesis. And so they want a thesis that's distinct from the other theses in the collaborations.”

“I see.”

“So again, it's done in a cooperative way, in a cooperation meeting. We always find out what each student or postdoc is working with in terms of analysis. And if there are too many working in one area, then we try to guide them to work in a different area that isn't being addressed at this time.” (English)

Research team leaders consider the contributions and efforts of graduate students important for successful international collaborative research. One Japanese professor shared a similar view and explained that graduate students' contributions were crucial to conducting research:

“Well, graduate students work practically as core members. They work full-time and play the most significant roles.” (Japanese)

Implementation and procedures through particular experiment styles

There are a variety of styles that researchers adopt in international collaborative research studies. Four interviewees stated their research styles were particular to their academic fields. One U.S. researcher described the nature of his research and explained the continuity of the research experiment:

“You know, we run the experiment, for example, running continuously for nine months at a time.”

“Yes.”

“And so, just to be in an experiment 24 hours a day . . .” (English)

Understanding research goals and choosing the appropriate research style is important for successful international collaborative research. One Japanese professor described two primary research approaches and compared the expected international collaborative styles with those of researchers from two countries:

“Ultimately, for example, when conducting research with researchers in India, the research focus is related to practical application in less-developing nations.”

“Does that mean that the practical part is large?”

“It is practical, it seems to be practical application. They are good at making models or theories into practical applications. So, we conduct collaborative research along with their research.”

“In the case of conducting research with researchers in the United States, it is not likely to be like that. Our collaborative research focuses on theoretical aspects.” (Japanese)

Some academic disciplines do not require experiments for research. Among 16 interviewees, 2 professors reported they did not conduct any experiments in their research. One U.S. professor said that their international collaborative research did not require experiments:

“Ok, so, first off, we are theory groups. So, we don't have experiments.”

“But we do [research activities], and we do [other research activities].” (English)

One group of the researchers also use secondary data collected by other researchers for analysis in addition to primary data. One Japanese professor also provided a similar comment and stated there was no experiment:

“Well, basically, this project is a [a research activity] project.”

“Uh-huh.”

“The data are also opened to the public. The data of each group were opened, and we are able to share the data of the [a research subject].”

“Uh-huh.”

“So, each group could do [a research activity] analysis.”

“Uh-huh.”

“Well, in that sense, we did not share equipment or conduct experiment jointly. There was no such thing.” (Japanese)

Good communication enhances relationships among researchers in international collaborative research studies. Four interviewees mentioned the aspects of communication in their international collaborative research. One U.S. professor emphasized the importance of communication among researchers to share ideas and make decisions:

“It was just a regular interaction, you know, when you work in the group. Everyone has specific goals, and usually they overlap with someone else's, so, you know, you have to work in the group, regular meetings, discussions, then joint decisions, on what steps should be taken next, and so on, yes.” (English)

Incorporating different perspectives benefits researchers who seek new research opportunities. One U.S. professor added another perspective and stated that recognizing cultural differences and diverse perspectives would be key to enhancing research:

“But, so the way to have some scientific discussion was, you know, you give out ideas that may or may not pan out, and may or may not be right, of course. That requires the communication of disagreement.” (English)

Working on a different research team or at a different site is helpful for recognizing the various communication styles and dynamics at play in international collaborative research. One U.S. professor observed the communication among researchers at the collaborator’s site and found intercultural differences regarding the research discussion process:

“And what I really noticed as being very distinct was that, it seems, you would have a group of people, and one person would then be trying to express their understanding of things, and the remainder of the group would leave this person to have the best possible expression of their, of their understandings, and then be kind not interrupting or kind of pushing the person, but just . . .”

--- (talking with an IT professional)

“So, so this was really, a very, I think, a helpful way of progressing, and so, then basically a person would be allowed to do the best they could, and it would be handed off to the next, almost like in a piece of music where the different instruments have the, you know, their passages, and the remainder becomes an accompanying part, and then each instrument can come to fruition and so on. This is quite different from the style that I’m used to, from having worked in the States for a while which is actually, which is also good, and we enjoyed it, but it’s quite different, which is a much more kind of combative, kind of much more, and not combative, but kind of, it’s a more vigorous kind of interchange.” (English)

There are a variety of ways that researchers share research data to make decisions during international collaborative research. One Japanese professor stated they organized group meetings for all members and smaller meetings for a few members, based on research themes in international collaborative research to share information and ideas among researchers:

“There was also a plenary meeting called a collaboration meeting.”

“Uh-huh.”

“Well, some members go to the meeting site. Other members participate in video conferences. There are also meetings to share research progress and other related topics.”

“Uh-huh.”

“Besides these meetings, as I said, well, there are teleconferences for researchers based on specific themes such as analysis, data analysis, and other topics by approximately 10 members. They share the latest information of the research progress of the past week and exchange information between the United States and Japan.” (Japanese)

Besides promoting international collaborative research, there are other opportunities for researchers to work together. One professor emphasized the importance of including emerging researchers in international collaborative research:

“So, although it was called collaborative research, we did not conduct research. For instance, we organized workshops in Japan and the United States respectively.”

“Uh-huh.”

“Well, getting involved with a lot of young researchers and giving a stimulus to the research community were the objectives of the bilateral research project.” (Japanese)

Implementation and procedures through sharing budget, resources, equipment, and facilities

The sharing of knowledge, skills, resources, and other benefits increases the collective resources of individual researchers. Three interviewees stated they had access to particular resources or equipment that they could not have used without international collaborative research. Other interviewees noted similar views on sharing resources. One U.S. professor noted the beneficial aspects of international collaborative research by sharing knowledge, techniques, and resources:

“So, when you say did we share resources, well, certainly. I mean, we had a [research activity] method that he didn't have at the time, but the [research

subjects] that I didn't have. So, he sent me samples, and we sent him back the results.” (English)

Researchers view the sharing of resources as the grounding for international collaborative research and its most significant benefit. Another U.S. professor shared a similar view and emphasized the importance of maintaining mutually beneficial relationships for gaining access to particular resources:

“And, they can provide what we don't have, but we need. So, I think, you know, that's the main thing, and this is really important, so that, you know, they generated, for example, like certain [research subjects], and we don't have to make it again because it's very expensive.”

“Oh, I see.”

“So, it could be kind of a win-win situation, right?” (English)

Research devices, equipment, and facilities are critical resources for researchers in international collaborative research. One Japanese professor described how he gained access to a particular device that he rarely gains access to through this international collaborative research:

“Yes, basically, this JSPS collaborative research was our Japanese side research. Our collaborative research based on the proposal conducted research by using the equipment at the collaborator's site. We negotiated on bringing our biomaterials to the collaborator's site and using the equipment, and agreeing to publish our research together.” (Japanese)

Receiving institutional support and sharing a common research support infrastructure are important factors for successful international collaborative research.

One U.S. professor said that his institution supported international collaborative research by providing a computer access account for his collaborator:

“My, all my Japanese colleagues with whom we work also have computer accounts on our computers here at [a U.S. university].” (English)

The outcome and results of previous international collaborative research reflects the need for resources or materials for further research. One Japanese researcher had a different experience regarding sharing resources and stated:

“Well, originally, my boss conducted collaborative research. So, basically, all materials were already shared between teams.” (Japanese)

Implementation and procedures through sharing data

The interviewees mentioned that they shared research data in different ways through emails, databases, and graduate students. Six interviewees communicated their experiences to share their research data, and four interviewees noted that they shared partial data with their collaborators. There are a variety of ways researchers share data in international collaborative research, depending on the protocols of their academic disciplines. One U.S. professor simply said that he shared data with his collaborator through emails.

“And we can provide all the data through email.” (English)

Individual researchers’ attitudes and practices are also influenced by the degree of data sharing among researchers in international collaborative research. One Japanese professor stated that he and his collaborator shared partial data:

“Well, basically, raw data, we did not share the raw data.”

“Uh-huh.”

“Yes, we shared organized results, only the results as figures.” (Japanese)

Researchers discussed the need for sharing data and making decisions on the data refining process in international collaborative research. One Japanese professor

explained the details of the data-management agreement among researchers to publish the research data:

“So, in the experimental group, yeah, when we are discussing various topics, before announcing it in scientific journals, we do not release our information to the public. It was supposed to make the announcement as an experiment group after cross-checking data by various researchers.” (Japanese)

Individual researchers are responsible for data ownership. When it comes to presenting or publishing research findings, they communicate with each other on how to best share it together. One Japanese professor said there was no formal agreement between researchers; however, the researchers shared mutual understanding of data ownership:

“Well, basically, altogether, we did not have particular arrangements for our data. Based on our mutual understandings, the ownership of the data collected under my collaborator’s initiative belongs to him.”

“Uh-huh, I see.”

“Well, well, when we do something with that data, I certainly do something and report to my collaborator. We publish it as the form of collaborative research outcomes.” (Japanese)

Researchers in the process of publishing are strongly motivated by data-sharing practices and influenced by academic disciplines. Researchers in natural sciences are likely to share partial data instead the research raw data. Another Japanese professor also described how he shared data through research and defined the data sharing as one particular part of the publication process in his international collaborative research:

“But, so, in the case of natural science, after all, we share subdivided data partially. It is not necessary, it refers to sharing, it stands for sharing data at the publishing stage.” (Japanese)

Although data sharing practices vary widely across fields, researchers responsible for data management agree on what data can be shared among researchers. One Japanese

professor said that he and his graduate students were responsible for storing data. Then, the professor stated that he shared responsibilities regarding the data-formatting process with his collaborator:

“Well, in the meaning of data sharing, well, in terms of the raw data, my student and I were responsible for storing the data. Then, we shared the organized and checked data through discussions. Then, we formatted the data together into the form applicable to publications.” (Japanese)

Implementation and procedures through promoting scholar and student exchanges

The exchanges of scholars and students are a significant contribution to research teams and international collaborative research. Five interviewees stated promoting scholar and student exchanges provided collective benefits to individual researchers. One U.S. professor mentioned that members of the ongoing international collaborative research team could be potential collaborators for upcoming research:

“And to this day, my Japanese collaborators fairly regularly come to visit, not as frequently as it used to be. They may come once a year.”

“I see.”

“But the connections are still there, so, for example, that Japanese postdoc of mine. And in later years, when we had the funding, she benefited also from being able to shuttle back and forth between Japan and us for work, and she's now, an associate professor at [a Japanese university].” (English)

Institutions, funding agencies, and support organizations expect individual researchers to train students through international collaborative research. One U.S. professor said that funding agencies and institutions encouraged researchers to conduct international collaborative research and create opportunities for students:

“So, we really have, I think, always been encouraged, and in general, I think, our agencies as well as our institution is welcoming these kinds of collaborations, and we also feel that it is a positive for our graduate students and our undergraduate students that we can develop opportunities for them to be able to become, you

know, scientific citizens of the world, that they're really collaborating, have had a broad network of collaborations.” (English)

Researchers acknowledge that training students and emerging researchers through international collaborative research includes providing practical research experience and training across nations. One U.S. professor noted that training students is part of his research collaboration:

“Yeah, and, then, I think he likes to train his ... students. So I think he actually has been sending his students to my lab for the past three to four years.” (English)

Students are key contributors to the inclusion of diverse backgrounds in international collaborative research. One Japanese professor noted that she intentionally included international students or postdocs from Asian nations to expand the international collaborative research:

“Yeah, so, we have [Asian] students as Ph.D. or Postdoctoral students. There are also students from [certain Asian countries], and other places.” (Japanese)

In addition to training, some students can gain pragmatic research experience and participate in experiments through international collaborative research. Students are also sometimes responsible for operating tasks and other duties. One Japanese professor explained that he sent his students to his collaborator’s site to do the research experiment:

“Well, decision making, so, practically, the student in my lab at that time, when we conducted research, visited my collaborator’s site. Well, as a result, my collaborator and I had already decided almost all general things. In the form of sending the graduate student to the lab, I expected my students to do the research experiment.” (Japanese)

Conclusions related to Implementation and procedures

Among the researchers at American institutions, 71 percent (five researchers) stated that they visited their collaborators’ research sites and conduct research together,

and 29 percent (two researchers) said they did not visit their collaborator's sites. Among the researchers at Japanese institutions, 56 percent (five researchers) said that they visited their collaborators' sites for research, and 44 percent (four researchers) said they did not visit their collaborator's sites.

All the researchers at American institutions explained they had shared their research data with their collaborators. One researcher emphasized that it was also important to translate outcomes into clinical practice during international collaborative research. All the researchers at the Japanese institutions said they shared their research data with collaborators; however, 33 percent (three researchers) emphasized that only formatted data were shared among researchers. These three researchers explained they did not share raw data with their collaborators during international collaborative research.

International collaborative research can be viewed as the integration of independent research projects conducted in different sites where researchers share a variety of resources throughout a study. This is the most significant benefit of international collaborative research. Setting research objectives, choosing appropriate research styles, defining research procedures, and analyzing research results are all important for sharing findings and outcomes within research communities and the public. On the one hand, some researchers need special research devices, equipment, and facilities to conduct research. On the other hand, some researchers, who do not conduct any experiments at all for research, use computer simulations or calculations and need secondary data collected by other researchers in their international collaborative research projects. Receiving institutional support and sharing a similar research support infrastructure are essential components for researchers. Researchers also recognize the

roles of graduate students and postdoc researchers because they are important for covering broad research topics and analyzing research data. Academic or professional disciplines influence and shape researchers' data sharing practices, and there are various attitudes regarding the degree of data sharing among the researchers. There are also expectations from institutions, funding agencies, and research support organizations regarding training students or emerging researchers, and researchers actively promote scholar and students exchanges through international collaborative research.

Outcomes and products

To understand the interviewees' overall experiences and views at the end of international collaborative research projects, I asked interviewees: "*What have been the main outcomes of this research project?*" The *outcomes and products* were crucial in assessing research and identifying emerging opportunities and unanticipated challenges throughout international collaborative research. The researchers had opportunities to advance research and deal with challenges throughout research, and it is crucial to understand their overall experiences by examining their research outcomes and projects.

In this study, the term *outcomes and products* refers to the benefits, costs, results, and other consequences of international collaborative research. The researchers gained and expanded research opportunities through international collaborations. In addition, they confronted challenges in terms of gaps among individual perceptions, research support environments, and so on. The perspectives, thoughts, and views of the researchers regarding international collaborative research are significant to analyzing their research outcomes and products.

The interview participants acknowledged that they had opportunities such as extending research to other advancement opportunities, promoting interdisciplinary research engagement, gaining credibility in research, and others. At the same time, they experienced challenges, such as organizing meetings among researchers in different locations, sharing knowledge in the publishing process, continuing research, recognizing gaps in researchers' preparation and support environments, and others. The interviewees observed that there were various opportunities for individual researchers, institutions, and other stakeholders to make progress in research. Six interviewees noted they faced challenges during their international collaborative research projects.

Opportunities in international collaborative research

Researchers share their findings in a variety of ways within research communities and with the public, and recognizing their contributions to research advancement is essential in international collaborative research. Three interviewees noted the importance of research outcomes and explained their research achievements. One U.S. researcher explained how the research achievements were recognized among researchers in the science community:

“And once you have those results, then, you write scientific papers. You give scientific talks, and that's what your reputation is based on. So, that's the prime focus in terms of the opportunities. There's certainly opportunities in the sense that you develop new technologies or something like that. You may be able to apply that to other experiments. This particular experiment is not pushing the state of the art in terms of new technology, so there's very little of that.” (English)

Research grants are credited for advancing research and achieving goals in international collaborative research. One U.S. professor emphasized the importance of

research support and claimed he could not have achieved his research results without international collaboration:

“Yes. We published ... [numbers] papers in scientific journals as a result of that collaboration.”

“Yes.”

“We showed results in [many] presentations.” (English)

Researchers have their own incentives to maximize the value of their research, and it is important to manage their incentives and set objectives for successful international collaborative research. One U.S. researcher described achieving three primary research outcomes: publications, device patents, and clinical applications. Among these results, he addressed the importance of authorship and stated that incentives are essential for researchers. He explained how he managed the authorship incentives of the researchers by publishing papers from two different aspects:

“So, eventually when they go home they can have a promotion. So, we understand that situation, but on the other hand, certain types of projects they do together. You and he all want to be the first author. Fortunately, nowadays, there are journals, they allow to have two first authors. But with many of them, they do not allow that. So, in that case, I would encourage them to be creative. It's not plagiarism or the duplication because our research is a cross between [a scientific discipline] and [another scientific discipline].” (English)

Researchers are also strongly interested in integrated research development and its application in expanding opportunities for further research. One U.S. researcher said that he was in the process of establishing a new company based on his international collaborative research project:

“Oh, certainly. We had submitted some patent applications, and we're thinking, currently we're thinking of starting a company that would continue development of this technology, the products based on the technology developed at a university.” (English)

Institutional leaders consider international collaborative research an opportunity to discover potential institutional partners. Three interviewees claimed that they expanded their collaborative opportunities through international collaborative research. One U.S. professor said that international collaborative research helped institutional leaders obtain opportunities for establishing and developing institutional partnerships with other institutions:

“He's had several students, and postdocs have come to visit, and he's still here now, and he's going to be here until, I think until ... [a month] of next year. He's been going back and forth quite a bit, but he's also been here for really extended periods of time. So, that has led to a collaboration, and, in fact, it happens, this is just a coincidence, but it happens that on Monday, we will have a visit from, from two leaders of institutes at [a Japanese university], and they will meet with our department chair, and we tried to establish a longer-term collaboration between the two, between the three institutions actually, in our department and Institute for [scientific disciplines] in Japan and the Institute for [a scientific discipline] in Japan. These three institutes are wanting to form a collaboration which will allow for more regular exchange of students, faculty, and postdocs in order to further the science.” (English)

Research findings can be important contributions to the continuous development of research. One U.S. professor indicated that his international collaborative research outcomes were essential components for the next step. The professor mentioned that he would apply the preliminary research outcomes for another upcoming research opportunity:

“Also, actually, right now, what we are doing is that, through, you know, through the outcome of the collaboration, we, we used that as a preliminary data, as the preliminary data for a future, ah, you know, grant application.” (English)

Funding provides insights to individual researchers and their affiliated organizations, motivating them to explore additional opportunities to advance their research. One Japanese professor had a similar view, and she stated that her research

team explored other bigger funding opportunities based on their international collaborative research achievements:

“In addition, even more, furthermore, in the place where it is continuing, as well as trying to target another funding opportunity [a scientific research grant] with [a U.S. researcher]. We applied for [a scientific research grant]; however, it was not accepted. We also applied for [another scientific research grant] which is the research funding was organized by the Ministry of Education, Culture, Sports, Science and Technology. Without being accepted by JSPS, I was not be able to maintain my motivation or be confident, so, at least, receiving small research funding opportunities is good for me to challenge to the next step.” (Japanese)

Participating in research at different locations enhances appreciation for the integration of collaborators from various academic disciplines as well as the organizational support structures and functions involved in advancing collaborative research. One U.S. professor explained that conducting research at his collaborator’s institution enabled him to learn about organizational structures and functions in advancing research:

“We try to have projects that are drawing on a range of different expertise, and we'd like people to be able to contribute with their different capabilities and different kind of viewpoints, but by kind of, by the breadth of experiences, and we make progress. So I think I've learned something about that mode of collaboration that I find very interesting. I think also we learned something about the way the Institute for [a scientific discipline] in Japan is organized. They are, again organized by ensuring a range of different expertise being present even though from an academic perspective they actually belong in different departments ... but by bringing these together, we can actually make more progress. And so we've adopted some of those elements in the way that we've organized our research efforts here. I think that's been good.” (English)

Researcher networks can be expanded through personal efforts at different sites in international collaborative research. The professor also added that he unexpectedly obtained a networking opportunity to meet one researcher from his home institution at the collaborator’s site:

“It has also happened that, you know, both in [a scientific discipline] with my collaboration, but at the same time, there was another gentleman who was collaborating with them in the area of [a scientific discipline].”

“And we were actually not quite aware of each other's interactions with essentially the same, you know, both of them at [a Japanese university]. And it was when I was in [another Japanese university], I met the other gentleman from my institution. I think, we also had talked about it previously, but, and he actually has a joint appointment at [a third Japanese university], and so we had in a sense, two instances of actual scientific collaborations that were just progressing because of the science.” (English)

Integrating researchers with different types of expertise on a project enhances the experiences of students and emerging researchers. Three interviewees noted that individual researchers can share knowledge and experience by working with others. Including researchers from different career development stages also supports students and emerging researchers in international collaborative research. One U.S. professor described that emerging researchers can have opportunities to visit the collaborator's site through international collaborative research:

“. . . outcomes that we are looking for, right? Now occasionally we would consider having, maybe a junior member of one lab go to the other.” (English)

Research grants also enable the exchange of researchers and students through international collaborative research. Another Japanese professor shared a similar view and stated that his students were able to visit the collaborator's site:

“At that time, well, regarding the question, I think the primary benefit was to send my students to my collaborator's site. In other words, well, in my case, I arrange meeting. It was great to make a student go to the research site for one or two months.” (Japanese)

Participating in collaborative research at the early stage of one's career helps one understand the importance of the exchanges and be involved continuously in promoting exchanges of researcher and students. One Japanese professor explained one positive

aspect of the results was that junior researchers could join study-abroad programs after their international collaborative research projects:

“I regard that participating in the bilateral research collaboration inspired younger researchers and gave lots of excitement to them. As a result, among the researchers, there are researchers who joined study aboard programs.” (Japanese)

Positive communication among researchers and the recognition of various research interpretations are significant contributions to international collaborative research. Three interviewees noted the crucial importance of sharing knowledge to advance research. One U.S. professor emphasized the importance of learning other perspectives and interpretations through research as an opportunity to make progress in research:

“Sometimes, this is a little bit difficult, but I think, I think we, we are always, because of the long nature of our collaboration, we are able to do that, to continue to have a fruitful collaboration. No need to be getting into, getting into arguments about it, and that we have slightly different interpretations, but I think in the end, we will make progress.” (English)

There are a variety of ways to utilize researcher experiences as a foundation for successful international collaborative research, such as the sharing of knowledge among experienced and inexperienced researchers. One Japanese professor credited international collaborative research as a great opportunity for researchers. For instance, he stated that less experienced researchers were able to learn from more experienced researchers through international collaborative research:

“While considering these things, also, researchers with good experiences teach other group members. As a whole, it could optimize efficiency. It is overall efficient, and there are more benefits as a whole. It is better than conducting research just at one university or just within one nation.” (Japanese)

Integrating knowledge among researchers enhances the understanding of different approaches and provides opportunities for researchers to find solutions through

international collaborative research. Sharing broad knowledge and extensive information among researchers from different academic and professional backgrounds is likely to yield creative approaches in exploring possible solutions. One Japanese professor addressed the significance of knowledge integration. He stated that sharing knowledge and research data would help individual researchers find potential solutions to particular research questions:

“For example, we could not figure out the phenomena, for a long time, without understanding the meaning of the contents. Then, we have a foundation as integrated knowledge and examination data of mine and my collaborator’s could be used to answer the life phenomena.” (Japanese)

There are various benefits of international collaborative research. Three interviewees defined international collaborative research as sharing exclusive knowledge and skills to advance research. One U.S. professor noted that he could utilize the knowledge of his collaborator, who specialized in a different academic field:

“The challenges, I mean, obviously, it offers tremendous opportunities, because, you know, I guess, you know, my collaborators have a kind of a certain expertise that we don't have, right?” (English)

Gaining access to extensive resources is crucial and could be an important factor in encouraging researchers to conduct research with their collaborators. The professor also added that conducting international collaborative research benefited him and his collaborators to share resources, and he could share what his collaborator did not have:

“So, I think, it's really synergistic, because, you know, we can provide what they don't have.” (English)

While acknowledging the difference between basic and applied research, researchers still recognize the benefits of integrating the two approaches, in particular,

across academic disciplines. One Japanese professor indicated that he gained new research experience in terms of combining basic and applied research:

“Originally, I have conducted research dealing with [a research subject] since my school days. I engage in conducting basic research which also refers not to making any profit. My research explores interesting opportunities, creating new [research subjects], and so on. The bilateral collaborative research was new to me. My collaborator is a professor in [a scientific discipline], and we designed our research approach and set our research results as creating the form of [a research device].” (Japanese)

Researchers believe funding distinguishes them because it suggests they are conducting valuable research, giving them external credibility and access to additional grants. One Japanese professor cited international collaborative research recognition as a source of gaining additional research funding opportunities for upcoming research:

“Well, in terms of a new challenge, well, even though doing good work, scholarly activities such as acquiring research grants or publishing papers are evaluated from the outside. I was lucky to acquire the bilateral research grant for the first entry. This recognition will be one of the footholds to the next stage, and I am confident to appeal my research for others. The outside place trust on me. As I explained, it supports for two years, and would be over soon. So, in order to lead to the next research, half year later, I submitted another bilateral research grant proposal conducting research with [an Asian country].” (Japanese)

Challenges in international collaborative research

There are a variety of challenges that researchers and their collaborators must confront when conducting international collaborative research. Six interviewees observed there were challenges during international collaborative research. One U.S. researcher said he experienced no research challenges; however, he acknowledged that the researchers were located in different places, and it was hard to find common time to hold meetings around the world:

“I would have said in this particular case, there were no challenges accompanying the fact there was international collaborations.”

“Uh-huh.”

“...but none of that was associated with international nature of the experiment.”

“Uh-huh.”

“I should say one of the, of course, one of the issues you always have in an experiment where you have people in different time zones is finding meeting times where everyone can participate.” (English)

Individual researchers have their own incentives to publish, and each has different goals in terms of publishing collaborative results. The researcher have different perspectives in terms of gaps among individual achievements at the end of their international research collaborations. One U.S. professor found that he had a conflict of interest with his collaborators at the publishing stage of their research:

“And, for example, I am not sure that the most recent thing, that he submitted the results for publication, it must have been six months ago, and it's been a long, long process trying to get it published in one of the top journals.” (English)

Both maintaining and enhancing the continuous efforts of research are critical challenges in international collaborative research. One U.S. professor pointed out one of the serious challenges in international collaborative research was continuity of research:

“So the continuity will be the biggest challenge in the research collaboration. I see.”

“Yeah.”

“With these things it's not like, yes, you can do a project over the course of a couple of years, but the real benefits are longer term, and then the really good research projects take longer.” (English)

Although researchers share objectives and responsibilities in collaborative research, there can be preparation gaps among research teams. One Japanese professor described that he faced a challenge in the research-preparation process. His

collaborator's team required a longer preparation period to launch their international collaborative research projects. The delay in the process of establishing the research team's structure meant that the Japanese and American researchers could not start research together as they originally planned.

In some cases, the academic tradition of the faculty promotion system could discourage a particular group of faculty members from conducting international collaborative research. One Japanese professor explained that promoting advanced-ranked faculty positions made it more difficult for faculty members to conduct international research:

“Well, especially, the older we get, well, when I visited my collaborator's site, it was a few years ago, now. I got promoted a few years later, and it became quite difficult to go overseas for a long term.” (Japanese)

Researchers are uncertain of the climate, weather, or other related environmental influences on research subjects at different research locations, and research outcomes might be different from what they predicted in international collaborative research. One Japanese professor noted that the different environment and other influences such as climate or other conditions at the collaborator's site were a challenge to obtaining the expected research results on the research subject:

“It was same; however, the environmental condition, temperature, humidity in the United States, for example, might had influenced the shapes of [a research subject] which was different from those in Japan. There were performance differences of the [research subjects], and so what say, we did not expect to see that. We did not anticipate it, and we were somehow confused, at first.” (Japanese)

Conclusions related to Outcomes and products

Researchers at American institutions regarded publishing scientific papers, applying for patents, exchanging researchers and students, enforcing research networks, acquiring new collaboration opportunities, learning different organizations' structures and functions, and gaining access to research resources as primary opportunities that emerge from international collaborative research projects. Some researchers noted the major challenges include conducting research in different time zones, advancing research with limited funding support, maintaining continuity of collaborative research, and acknowledging different viewpoints and interpretations.

Researchers at Japanese institutions considered gaining access to their collaborator's research skills and techniques, sharing knowledge, integrating basic and applied research components, and providing international collaborative research experience to graduate students and emerging researchers as crucial opportunities that emerge from their international collaborative research projects. Some researchers said that the longer time periods for a collaborative research preparation process and the different research environments were challenges to international research collaborations.

Researchers find emerging opportunities throughout international collaborative research. Sharing their research findings and recognizing their contribution to research communities are important outcomes of international collaborative research projects. During the research finishing stages, managing individual incentives and sharing publication opportunities are crucial to recognizing researchers' efforts and acknowledging individual contributions. Research applications are also strong incentives for researchers to expand opportunities for further studies. Including researchers from

different career development stages and promoting student and researcher exchanges create opportunities for students and emerging researchers to learn from more established ones. Researchers acknowledge the benefits of integrating basic and applied research approaches to advance research. There are also emerging challenges throughout international collaborative research. While sharing responsibilities among research teams, researchers still find preparation gaps among the teams. Maintaining and enhancing constant efforts are serious constraints in international collaborative research. Faculty promotion systems could discourage faculty members from conducting international collaborative research projects. Climate, weather, or other related environmental factors across different research sites were also instrumental in influencing research subjects.

JSPS/NSF initiatives

To understand the interviewees' perspectives and the influences of the *JSPS/NSF initiatives* on international research collaborations, I asked the interviewees, "*In what ways have funding agency's initiatives affected your international collaborative research?*" The *JSPS/NSF initiatives* created international collaborative research opportunities and encouraged researchers to set collaborative research objectives. Understanding the effects and consequences of the *JSPS/NSF initiatives* is needed to understand how the initiatives have influenced international research collaborations.

In the present study, the term *JSPS/NSF initiatives* refers to the collaborative research initiative called Bilateral Collaborations (Joint Research Projects and Seminars) organized by the Japan Society for the Promotion of Science (JSPS) and the U.S.

National Science Foundation (NSF). To promote international collaborative research, the *JSPS/NSF initiatives* support the development of collaborative research relationships and intergroup networks and promote collaborative research across academic fields between Japan and the United States. The *JSPS/NSF initiatives* are one of the factors that have influenced individual researchers and shaped their international collaborative research.

Researchers engaged in international collaborative research through the *JSPS/NSF initiatives*. The interview participants explained that the initiatives supported their research in many ways. In particular, the researchers stated that the initiatives supported the various stages of the research process entirely or partially. Three interviewees said that they received comprehensive support from the JSPS/NSF initiatives throughout the international collaborative research process. Nine interviewees mentioned that the initiatives supported international collaborative research at particular research stages, such as start-up, preparation, completion, and others. The interviewees also noted supportive and constrained elements of the JSPS/NSF initiatives in international collaborative research. Eleven interviewees explained the supportive elements of the initiatives, and six interviewees pointed out the constraining elements.

Influences of the JSPS/NSF initiatives on the various stages of research progress and advancement

The JSPS/NSF initiatives support research grant recipients in various ways. Nine interviewees stated that the JSPS/NSF initiatives supported international collaborative research from the start-up stage to the completion stage. Three interviewees explained that they received comprehensive support from the JSPS/NSF initiatives to establish,

develop, complete, and continue research. One U.S. professor explained the benefits of the initiatives and simply said,

“I mean, there is a specific stage I benefitted from the collaborations, but I think it could be, you know, it could contribute at any stages.” (English)

Research grants are critical resources for researchers and their collaborators to continuously advance their international collaborative research. One U.S. professor emphasized the importance of research continuity and described how the initiatives supported him and his collaborators throughout the research:

“All stages are equally important: the initial stage, and the work in the middle, and, I mean there's no final stage per se, and the work is ongoing. We're continuing to work on these things, so.” (English)

While recognizing the importance of research support, researchers have also emphasized the importance of continuity in international collaborative research. Another U.S. professor shared a similar view, stating that he and his collaborator had continuously developed research for more than a decade:

“I wouldn't describe it as helping it at different stages of the project. The project has been going on, but, developing for, yeah, at least 15 years.” (English)

There are a variety of research advancement stages during which research grants support researchers. Six interviewees reported that the JSPS/NSF initiatives supported specific stages of their international collaborative research. Two interviewees stated that the JSPS/NSF initiatives supported the start-up stage of their collaborative research. Researchers have credited research grants for the stages of establishment and initiation of international collaborative research. One Japanese professor explained that he and his collaborator received benefits from the initiatives in establishing and developing international collaborative research:

“Yes, as you may understand, in my research, the initiative exactly supported the promotion of research. The research was established between Japan and the United States, and it is still continuing now. Well, it fits to the stage when we were establishing and advancing collaborative research.” (Japanese)

Researchers need support to establish and initiate new international collaborative research. One Japanese professor also cited the initiatives as the critical support for the establishment of his international collaborative research:

“So, in other words, because of the initiatives by Japan Society for the Promotion of Science (JSPS), I applied for the research initiative grant. In terms of establishing and initiating research, yeah, the initiatives supported the start-up stage.” (Japanese)

The research initiatives support researchers and influence stages of advancement in international collaborative research. Two interviewees stated that the JSPS/NSF initiatives were helpful for them in advancing their research. Research grants are vital contributions to various objectives, such as organizing meetings, preparing for meetings, and exchanging researchers and students, to support operating procedures in international collaborative research. One Japanese professor stated that the initiatives covered the cost of the travel and meeting arrangements. The professor used the research funds to invite researchers and hold a large meeting at his institution in Japan:

“Well, then, once in a while, yeah, I organized a ‘[a research project]’ meeting for the whole experiment team members in Japan. So, approximately ten American members came and held meetings at [a Japanese university]. So, we utilized the research funding grant for the meeting preparation process and others.” (Japanese)

Advancement of research sometimes requires the integration of new ideas and new techniques. One Japanese professor explained that he and his collaborator wanted to advance their research by testing their budding research ideas through international collaborative research:

“Well, I wanted to break through a little. There are a variety of techniques that my collaborator could use, with [a research device]. I organized the plan with my collaborator, asking my collaborator to work together. Then, we collected a few budding research evidences through the research. In that sense, well, it was the development stage, the advancement stage, well, conducting a little preliminary, budding research, I mean.” (Japanese)

Researchers have also credited the research initiatives for supporting them in completing their international collaborative research. Two interviewees shared a common view in terms of focusing on the research completion stage in the JSPS/NSF initiatives. They mentioned that the initiatives particularly supported the completion stage of their international collaborative research. One Japanese professor simply said that she benefitted from the initiatives to complete her collaborative research:

“In my collaborative research, I think the initiative supported the finish-up stage.” (Japanese)

The research initiatives enabled researchers to incorporate students and postdocs in international collaborative research from preliminary stages to completion. Also, another Japanese professor stated that the initiatives helped them obtain research results after the preliminary research:

“In short, well, probably, it was just about the middle stage. Well, establishing the research project itself. I am sorry, I am not sure when it was, might be the fiscal year Heisei 23. Well, I met him. Master or undergraduate students of mine conducted preliminary research for two to three years. And, an international postdoc student joined my lab just before or after this collaborative research. Then, I think we got research results and completed the research project.” (Japanese)

Influences of the JSPS/NSF initiatives as supportive elements in various circumstances

The forms and policies of JSPS/NSF initiatives have changed and increased in flexibility over time to support researchers in various ways in international collaborative research. Eleven interviewees addressed the supportive elements of the JSPS/NSF

initiatives. Six interviewees mentioned that the JSPS/NSF initiatives encouraged researchers to conduct research with their international collaborators. One Japanese professor noted the historical development of the policies and stated that the policies of the initiatives had become more flexible for research expenditures:

“Yeah, well, in that sense, very much, it has become more open, because we were not able to invite people from overseas through the *Kakenhi* [Grants-in-Aid for Scientific Research] in the past.” (Japanese)

The JSPS/NSF initiatives have had numerous impacts on the attitudes and behaviors of researchers and the ways they conduct international collaborative research. One U.S. professor described the contributory roles of the initiatives in international collaborative research:

“Yes, so, so, the funding agency definitely was instrumental in trading this new research collaboration, when they had the money.” (English)

Researchers have also credited the JSPS initiatives for promoting exchanges of researchers and students, who are the foundations for finding solutions in international collaborative research. Another Japanese professor emphasized the importance of pursuing breakthrough opportunities in collaborative research:

“That is a just story. So, so, that is, yeah, it enables me to do what I could not do on my side. So, anyway, that is, yeah, it is the biggest benefit to visit the collaborator’s site.” (Japanese)

Regardless of the monetary values of the grants, researchers believe receiving them adds value to their international collaborative research. Another Japanese researcher said the JSPS/NSF initiatives added value to his research regardless of the size of the financial assistance:

“So, so, so, that is the point, adding value makes sense. That, what you say often, people say the funding amount is insufficient. I hear lots of similar stories. It

means the research project itself does not have enough money to conduct research.” (Japanese)

A U.S. professor explained that the initiatives have created opportunities for researchers to establish and maintain effective international collaborative relationships in advancing their research:

“So, so, it, it really acted as an incubator for, for the research.” (English)

Conducting collaborative research with particular colleagues appears to be an important criterion for researchers to define the research validity and claim the uniqueness of their collaborative research. Another U.S. interviewee acknowledged that sharing the particular resources of his collaborators helped him explain the exceptional aspect of his collaborative research and the benefits of the collaborations to the funding agency in his nation:

“Well, it's very helpful to me to have this collaboration because I could tell my granting agency that I had these very special resources that, mainly the [research subjects], that [a Japanese researcher] had developed that nobody else has.” (English)

The JSPS initiatives provide significant contributions to researchers in terms of financial and value-added aspects. Researchers also regard the initiatives as providers of significant research support in the cultivation of ideas and the formation of research. Three interviewees shared their views of how researchers managed research funds from the JSPS/NSF initiatives for international collaborative research. Researchers handle resources and enhance their approaches in international collaborative research in a variety of ways. One U.S. professor noted that the combination of multiple funding sources was essential to manage his expenditures on international travel and conference participation:

“ . . . in a sense that I normally do not receive extra money for these international collaborations. It just has to somehow make them work in the context of my normal funding.” (English)

The integration of multiple funding sources and international efforts enables researchers to create flexible research plans to manage their funds. Another Japanese researcher provided a similar view and explained the importance of the combination of initiative funds with other research funds:

“Well, research is not to be completed by the bilateral research project itself.”

“Uh-huh.”

“Yes, well, research will be advanced together with other projects. At last, all would be combined as an article. Yes.” (Japanese)

Recruiting researchers with various areas of expertise is important for the team-building process. Integrating resources, researchers’ knowledge and experience, research objectives, and significant contributions is essential for successful international collaborative research. One U.S. researcher described how to incorporate research collaborators in an international collaborative research project supported by government agency research funds:

“ . . . because we do have government grant funding. We cannot use our government funding to support foreign fellows, but we can use the government funding to support a project.” (English)

Face-to-face, interactive communication in person appears to be the most significant communication channel for sharing experiences for research and education advancement purposes. Two interviewees observed that the JSPS/NSF initiatives encouraged researchers to visit their collaborators’ sites and promoted researcher and student exchanges across nations. Researchers have credited interactive communication for enhancing relationships among researchers and collectively advancing research. One

Japanese professor stated that researchers and graduate students received face-to-face interactive communication opportunities with their collaborators at the collaborators' site. She explained that interactive research experience with collaborators and sharing common research experience are crucial:

“I could discuss with my collaborators via Skype or emails; however, I still believe holding face-to-face meetings, holding discussions across tables, you do experiments together with collaborators through establishing and enforcing relationships were significant. Also, holding workshops, taking graduate students to the collaborator's site are significances. So, I engaged in these activities, and I certainly think it was good. We are likely to be busy on daily talks, and it could happen that researchers might purchase things one after another in the case that the research expenses are enormously increasing. So, regarding one concern reducing travel expenses and transferring it to for research expenses, perhaps, it is understandable to set the restrictions on research expenditures.” (Japanese)

Experiments benefit from being conducted collectively, aiding research engagement and the advancement of international collaborative research. Another U.S. professor shared a similar perspective and stated that the initiatives provided essential financial resources for researchers to make travel arrangements and stay at the research site during collaborative research:

“Well, it certainly made it much easier for the Japanese scientists to spend time at [a U.S. national laboratory], which was critical.”

“Ah, is that, is that your project started because of this initiative or is that what kind of stages did it help your research start-up.”

“So, this, this, I would have said, once the, once the memorandum of understanding of the experiment was completed, so we could see that we had all the pieces necessary to do the experiment, that's when the JSPS grant became very important to allow the Japanese scientists funding to come here.” (English)

Influences of the JSPS/NSF initiatives as constraining elements in various circumstances

Enhanced relationships among funding agencies is one of the important criteria in providing collective support to researchers and promoting international collaborative

research. Six interviewees noted the constraining elements of the JSPS/NSF initiatives. Two interviewees mentioned that funding agencies did not share information on the research grant applications in the JSPS/NSF initiatives across nations. Providing collaborative support to grant recipients requires the integration of information and resources as well as objectives. One U.S. professor discussed the reviewing process for the research grant applications, and he did not encounter organized communication between funding agencies across two nations:

“It was not a hard link. So, it was not like each party applies at the same time, and then the funding agencies talk about joint approval and all of that. I don't think it happened in that way.” (English)

To identify collaborative research objectives and efforts, funding agencies could enhance their extensive relationships with partner agencies in other nations that also support international collaborative research. Another Japanese professor explained that he could not observe interinstitutional or interagency collaborations during the process to check the research grant applications to support international collaborative research:

“Well, when we conduct research in the United States, my collaborator basically applies the National Science Foundation. We mutually understand that each side is responsible for the application process in each nation, but we did not go along with. Well, after all, there are two research institutes, universities, Ministry of Education, Culture, Sports, Science and Technology, National Science Foundation, and other ministries and agencies also in other nations. Well, at that time, I observed that there was no collaboration among them. Yes, well, I am not sure, but it would be nice to guarantee that research funding acceptance on one side will be also endorsed by another side.” (Japanese)

Individual researchers must be able to arrange international travel options for international collaborative research. Two interviewees observed that there were some travel restrictions in the JSPS/NSF initiatives to limit researchers' international travel in collaborative research. One Japanese professor pointed out that the funding policies of

the initiatives limited researchers' international travel to nations other than the research collaborator's nation within the international collaborative research:

“Well, there is an important [an infectious disease] meeting now in [a South American country]. When my collaborator and I planned to present our research achievement at the conference in [the same South American country], it was not allowed to use the research fund for my travel at that time.”

“I see.”

“So, the first thing, I felt, well, something, well, if it proves to be part of the research exchange project, I wish I could use it for covering the cost of travel expenses to any place.” (Japanese)

Researchers have credited the JSPS/NSF initiatives for supporting their international research travel; however, some regulations and rules in the initiatives limited their research activities. Another Japanese professor provided a similar opinion on the policies on international research travel, and he explained the limited support of the research funding for international travel:

“Well, that, because it is bilateral, it focuses on collaborative research with a particular location. So, I would say, my research was with the United States and I can only use it for covering the travel expenses to the United States.” (Japanese)

In addition, the policies on research funding use could limit researchers' engagement in sharing resources across nations. Two interviewees discussed policies on the research funding uses in the JSPS/NSF initiatives, stating that the policies could be flexible enough for spending for themselves and their collaborators. One Japanese professor observed the constraints in covering the cost of collaborative research across nations. The professor stated it would be helpful for him and his collaborators if he could use the research funds cross-nationally:

“Well, as it is collaborative research, of course, my collaborator should be responsible for covering the cost of his research. Well, yeah, I thought that it

would be better, when it relates to payment topics, it could be flexible to pay across the countries.” (Japanese)

The personal incentives of researchers come from opportunities to share and exchange resources with their collaborators across institutions and nations. One side of the research group has research funding, while the other side might not have research funding in another country. Another Japanese professor emphasized the importance of flexibility in how researchers spend research funds for their international collaborative research. The professor claimed that policies mandating only domestic use would limit researchers in finding collaborators and continuing to advance research with their international collaborators:

“Well, it is right to be called as international collaborative research. It is right. But, it is not necessary that 100 percent all the time, everybody, anybody wants to conduct international collaborate research with Japanese on the research subject.”

“Uh-huh, that's right.”

“As the Japanese side, we choose overseas sites as research fields. We want to exchange information with researchers at the sites. So, well, my collaborators might not have funding on the collaborator’s side. Then, so, we are asked to be strict on the independent spending policies at each site. It could be a complicated conversation that is a matter of talking whether it really is collaborative research, and it can be also said that you are doing a project for what. If there are too many instructions, it would be painful to conduct research in order to get results of international collaborative research.” (Japanese)

Conclusions related to JSPS/NSF initiatives

Among the researchers at American institutions, 57 percent (four researchers) mentioned that the research initiatives supported no particular research stage or all stages throughout studies, 29 percent (two researchers) explained the initiative was helpful for their ongoing research, and 14 percent (one researcher) said the initiative supported the research advancement or implementation stage.

Among the researchers at Japanese institutions, 44 percent (four researchers) stated that the initiative helped their research advancement or implementation stage, 11 percent (one researcher) said the initiative supported them during the research start-up stage, and 11 percent (one researcher) explained the initiative supported the research finish-up stage. In addition, 33 percent (three researchers) did not provide their responses to the questions, and one of them emphasized the importance of combining multiple research funds for international collaborative research projects.

The JSPS/NSF initiatives support researchers and their collaborators in various ways. The initiatives help the stages of establishment and initiation, advancement, and completion in international collaborative research. Through them, researchers can advance their research by organizing meetings, exchanging researchers and students, arranging travels plans, and supporting various operating procedures. In particular, the initiatives help researchers incorporate students and postdocs throughout the international collaborative research process. The policies of the JSPS/NSF initiatives support the researchers and increases their flexibility over time. It is necessary for the researchers to receive multiple funding sources to develop flexible research plans regarding managing international collaborative research funds. Interactive, face-to-face communication positively enhances relationships among researchers. There are also some regulations and constrained policies that limit research activities and resource exchanges across nations.

Funding structure and mechanisms

To understand the interviewees' perspectives and the influences of the *funding structure and mechanisms* on international research collaborations, I asked the interviewees: “*In general, not just for the funding agency's projects, what have been your primary sources of financial support for your international research projects?*” The *funding structure and mechanisms* provided fundamental research support infrastructure for researchers to organize their research plans, find possible financial support opportunities, and conduct research continuously. Understanding the various aspects of the *funding structure and mechanisms* is essential to analyze how researchers gained research funding opportunities and conducted international collaborative research.

In the current study, the term *funding structures and mechanisms* refers to structures and mechanisms of government agencies or funding organizations that provide funding support to researchers, encourage individual researchers, and guide organizations to establish, develop, and engage in cross-national collaborative research. To promote international collaborative research, government agencies and funding organizations have created and developed policies to promote engagement among scholars and foster research collaborations.

The researchers explored funding support extensively from government agencies, funding organizations, foundations, and other organizations in international collaborative research. The interview participants stated that the funding structure and mechanisms are the foundation of research support across nations, and they agreed that it is essential to receive a set of various supports through the funding structure and mechanisms in each nation. Five interviewees explained how they obtained information about international

collaborative research funds through their networks. Six interviewees noted that funding agencies were responsible for multiple responsibilities, such as research priority and regulation criteria settings, research support sovereignty governance, travel approvals and arrangements, researcher exchange promotions, and others responsibilities regarding international collaborative research.

Information on research funding structures and mechanisms

Five interviewees reported that they obtained information about international collaborative research funds through scientific communities, institutions, colleagues, and websites. Among the five interviewees, 3 interviewees noted that emails and websites are their primary information resources. Colleagues in research communities and the websites of funding agencies are important information sources for research funding opportunities. One U.S. professor named his colleagues and funding agencies as the significant information providers regarding research funds:

“All of the above. Yes, sometimes we learn from my colleagues; sometimes we learn from solicitations from funding agencies.”

“Yes.”

“Sometimes, we, actually, actively go looking on the websites of the funding agencies to see whether they have any programs.” (English)

Researchers discover research funding opportunities in many ways. University administrators support international collaborative research by proactively providing information on research funding through institutional newsletters. One U.S. professor cited emails as a common information source regarding research funding opportunities at his institution:

“So, our Provost Office at the university, sometimes they send around some sort of synopsis of funding opportunities, and sometimes I hear about these opportunities through this channel. And sometimes it's because we're already collaborating, and then we look around ourselves, and we notice things on the websites of the foundations.” (English)

Experts and professionals who support international collaborative research share information related to the work and provide assistance to researchers. Another Japanese professor explained that the university administration forwarded information about funding opportunities to faculty members and provided administrative support to the faculty:

“So, well, there is a specialized staff who are familiar with supporting the application process in the division of research support. Well, they deliver relevant information such as research application information and others to us immediately. So, we also get application information from the bulletin board designed for faculty members. There are faculty members who are actively look for research application information, but I am fine with this information.” (Japanese)

Two interviewees named specific funding agencies as their primary research funding providers and explained basic mechanisms of the research grants. There are many research funding opportunities, and researchers acknowledge that particular research funding initiatives and funding agencies are significant contributors to successful international collaborative research. One Japanese professor simply mentioned *Kakenhi* [Grants-in-Aid for Scientific Research] as the primary research funding source for him and his colleagues:

“Oh, well, I think that *Kakenhi* [Grants-in-Aid for Scientific Research] is the primary one.” (Japanese)

Funding agencies and funding organizations are the primary research funding providers for researchers. Another U.S. professor described the structure and functions

of his research funding and how they supported his research at his institution in the form of research grants:

“But, most of the support comes from NIH. For example, if everything was perfect, I would have 98 or 90 percent of my old salary coming from NIH grants.”
(English)

Support through the funding structure and mechanisms

Funding agencies are responsible for making investments in possible emerging research fields and setting objectives for international collaborative research. Six interviewees reported that funding agencies had multiple responsibilities, such as setting priorities and regulatory criteria in research, maintaining independent authority over research support functions, supporting travel approval and arrangements, promoting engagement among researchers, and other aspects of international collaborative research.

Funding agencies are important contributors to international collaborative research, and they support researchers by developing and providing grants based on organizational missions, visions, and objectives. One U.S. researcher said that funding agencies set priorities in distributing the research funds to researchers and institutions:

“And then, individual groups of scientists get together and try to form collaborations. Occasionally, DOE or NSF will have targeted funding opportunity announcements to direct research in a particular area, but in most cases, they respond to proposals and clearly topics that are highlighted in the long-range plan are considered prime topics for funding.” (English)

According to the policies on the use of research funding, the funding agencies must articulate that researchers cannot transfer their received research grants to collaborators in other nations. Another U.S. professor described the independent authority of the research funding structure in each nation and acknowledged that it would be difficult to swap financial resources across nations:

“. . . such as Japan, but probably, hesitate or, at least would think twice about providing direct financial support for the foreign collaborator. They will support me as part of the collaboration. They certainly would not, or would think twice, or would it would need a heck of lot of justification before they'd be sending money to the foreign collaborator.” (English)

Under the JSPS/NSF initiatives, researchers are expected to have their own financial resources in international collaborative research. In addition to the previous statement, the professor discussed his international collaborative research experience and explained that researchers share resources but did not transfer money in international collaborative research:

“Usually the foreign collaborator in Japan has their own funding, and I have my own funding.”

“Uh-huh.”

“And, we could swap resources, but don't, you know, they do not give me money. I don't get that money.” (English)

Successful international collaborative research requires excellent communication among researchers and effective management of multiple research grants. Another Japanese respondent also explained the independent functions of research funding structures across nations and emphasized the importance of additional financial support options to conduct research continuously:

“So, my collaborator conducts his own research. So, what it is, in a sense, to be called, so, it means we conduct research independently.”

“I see.”

“That is, that, for example, unless there is a request to advance research analysis relating to our primary research on my side, yeah, what in the end, nothing happens. So, that means, in terms of the financial aspect, getting one international collaborative research grant can't cover the whole amount of spending, from the beginning.” (Japanese)

There are various research funding providers, and the integration of research grants from multiple funding sources is essential for researchers to conduct international collaborative research. One Japanese professor described the structure of his research funds and stated that there was no distinction in terms of financial resources between international and domestic research funds. He explained how he managed his research grants collectively to conduct international collaborative research:

“In that case, so, there is no distinction among international research, collaborative research, or domestic research. Well, it is important to conduct research as part of global training. So, in Japan, in our field, with [a research device], well, there are researchers who conduct research with [research devices] in Japan.” (Japanese)

Research grants contribute to the credibility of researchers’ efforts and practices in international collaboration. Another Japanese professor added an important element of research funding grants, stating that it enabled him to make administrative arrangements for visiting scholars and students. The professor explained that authenticating a particular endorsement for individual researchers under the research funds was significant for both visiting researchers and receiving institutions:

“First of all, recently, well, *Kakenhi* [Grant-in-Aid for Scientific Research] has been quite flexible over the last ten years, and various things can be done. For example, the American side accepts visiting Japanese researchers, the researchers are named as JSPS fellow, JSPS scholar, research fellow, or any suitable name.”

“Yes, yes.”

“Then, for example, it is easier for Japanese researchers to register over at the American site. For example, students stay at hotels, for example, students have no status at [a U.S. university], visiting the American site without an endorsement. If there is no real arrangement, people at the American site would start discussing why we accept students from places where we have no inter-university agreement at all.” (Japanese)

Researchers search for international collaborators in many ways, including using current collaborations to find candidates for future collaborative opportunities. A Japanese respondent shared his previous experience and acknowledged that visiting researchers involved in current international collaborative research could lead to potential research collaborators for upcoming research:

“Well, yeah, yes, yes, there is a researcher who just became a faculty member among researchers who joined this international collaborative research in the American side. This researcher used to be a sponsored researcher endorsed by the Japan Society for the Promotion of Science at my place. Well, I would say, that, these researcher exchanges could lead to creating bilateral exchange projects. So, well, a visiting researcher who stays at my place for a while. Then, later, I would say it would be possible to have bilateral exchange projects with the researcher.”
(Japanese)

Conclusions related to Funding structure and mechanisms

Researchers at American institutions named the Department of Energy, Japan Society for the Promotion of Science (JSPS), National Institutes of Health, National Science Foundation (NSF), and private foundations as their primary research funding providers. They obtained information on international collaborative research funding opportunities from their colleagues, through their research network or communities, from the websites of funding agencies or organizations, and through emails from their affiliated institutions.

Researchers at Japanese institutions mentioned the JSPS; Japan Science and Technology Agency (JST); Ministry of Education, Culture, Sports, Science and Technology (MEXT); and private foundations were their primary research funding providers. They obtained information about international collaborative research funding opportunities through their affiliated institutions' emails, from the research support staff

members at their institutions, through their research networks, and the websites or emails of funding agencies or organizations.

Researchers acknowledge particular research funding agencies and organizations are important research funding providers for them. These organizations can help with obtaining information about research funding opportunities, and colleagues in research communities, emails, university administrators, experts and professionals at institutions, and funding agencies and organization websites are also main information resources. It is essential to make proactive investments in possible emerging research fields and define research objectives across countries. In addition, the integration of research grants from multiple funding sources can help researchers organize more flexible plans and procedures throughout international research collaborations. Research grants contribute to the reliability of researchers' efforts and help them connect with researchers who are likely to become potential research collaborators for upcoming research.

Institutional factors

To understand the interviewees' perspectives and the influences of the *funding structure and mechanisms* on international research collaborations, I asked the interviewees, "*How has your institution influenced your international research?*" The *institutional factors* were crucial influences for researchers in understanding potential incentives in academic and professional career advancement opportunities and setting the level of their research engagement. Institutions have influenced and encouraged researchers to engage in cross-national collaborative research. Examining the various

aspects of *institutional factors* is necessary to analyze how the researchers' affiliated institutions influenced their international collaborative research.

In the current study, the term *institutional factors* refers to institutional identity, institutional characteristics, research support structures, administrative support in research, and other institutional attributes that comprehensively influence individual researchers in cross-national collaborative research. To promote international collaborative research, the *institutional factors* support the development of collaborative research relationships in terms of research support environment and administrative support arrangements. The *institutional factors* are a primary influence in creating research opportunities and promoting research and institutional advancement that can move researchers and their collaborators collectively toward cross-national collaborative research. It is crucial for researchers to obtain institutional support in advancing research with their collaborators at other institutions.

The researchers explained that their affiliated institutions provided a supportive research environment and administrative support to them in international collaborative research. The interview participants stated that the funding structure and mechanisms are the foundation of research support across nations, and they agreed that it is essential to receive a set of various supports through the funding structure and mechanisms in each nation. Eight interviewees expressed diverse views on supportive and constraining aspects of institutional support in their research. Three interviewees noted institutional identity, interests, and objectives as essential elements encouraging researchers to conduct international collaborative research. Four interviewees indicated that their institutions had no influence on their international collaborative research.

Influences of the institutions on administrative and research support

Eight interviewees reported that their institutions provided administrative and research support for researchers involved in international collaborative research. They shared diverse views on supportive and constraining aspects of institutional support in their research. Researchers have credited their affiliated institutions for providing them with extensive research support. Two interviewees noted that institutional support was essential for international collaborative research. Research support experts and professionals are foundations for advancing successful international collaborative research. One U.S. professor stated that the experts and professionals at his institution were essential resources for him because they allowed him to use their research equipment in his international collaborative research:

“Right, right. So, I mean, of course, they support the environment here, strongly by producing, by putting together strong resources to help with our research. I shouldn't omit that. I mean, I said that we've got a group of strong, [a research subject] researchers.”

“Uh-huh.”

“But we're in an environment where we've got all the resources to do it: the technical resources like [research subjects] for, you know, producing [research subjects], you name it.” (English)

There are a variety of experts and professionals available from various academic disciplines and institutions, and the integration of researchers from different areas of expertise aids successful international collaborative research. Another Japanese professor shared a similar view and explained the organizational research support structure at the institution. She stated that there were professionals and experts who supported the process for applying for research grants for international collaborative research:

“Yes, as I said, there is a division called the Research Support Division. This division supports our research, including the acquisition of the research grants very much. Well, I would say, this college is a small college and there are many good and weak aspects. But, it is great to communicate closely with the staff members who are very supportive, and it is very powerful. In addition, regarding international exchanges, there is another division called the International Planning Division.”

“It is the International Planning Division, I see.”

“Well, there are staff members who can work in English in the division. Well, as I said, the Research Support Division supports me when I apply for the science research grants, and the International Planning Division supports me in the cases like JSPS' international exchange project and others that applied through the staff members of the International Planning Division.” (Japanese)

Some administrative support is critical for researchers, and university administrations and departments appear to be important contributors in providing additional assistance to researchers and their collaborators on many occasions. Two interviewees shared a common view on valuable aspects of administrative support in international collaborative research. One U.S. professor said it was essential to obtain administrative support from his institution to accept visiting scholars:

“The university helps by providing good administrative support that helps us, you know, support the application of J-1 Visas and or . . .”

“Yes, J-1 Visa for visiting scholars, yes.”

“Yes, that kind of thing. Yes, and J-1 Visa applications these days are getting rather involved.” (English)

Institutional support from different offices, colleges, departments, and divisions enables researchers and their collaborators to enhance their relationships and explore collaborative opportunities in international research and education. Another U.S. professor offered a similar view on administration support and stated that his department arranged special financial support by creating a lectureship to accept a visiting scholar.

In his case, his institution also intended to expand individual international collaborative research to institutional international collaborative partnerships:

“Yes, and so that was helpful, and now in the context of the visit of [a Japanese researcher], he, that was actually supported by our department. They were very enthusiastic about it, and they provided some funding through a lectureship we have here which is called the [a name] Professorship.”

“Yes.”

“And so this provided some help for the funding of the visit of [a Japanese researcher]. So, I've had very good support and actually in this, I mentioned that we would try to put it to an institutional level, and we're now discussing with each of our institutions that they would provide some initial kind of seed money to allow the project to start immediately, and then this may be for three or four years, and then in that period we will develop, we have the intention of developing a foundation or agency funding to let it continue.” (English)

There are various standard operating procedures to support researchers across institutions, and each institution has a different organizational structure to support international collaborative research. One interviewee provided his unique comparative perspective on research support structures between Japan and the United States. One Japanese professor compared his research experience at an American institution with another in Japan, stating that the research support structures and functions in the United States are better organized for researchers:

“Well, then, so, I am not sure how to answer to your question. For example, recently, I was in [a U.S. university] in the United States. In experiments, I was doing an experiment. When I needed [a research substance], I could send an email to a staff member on the first floor to purchase it. Then, the package would arrive around the next day. It never happens at my site.” (Japanese)

Better understanding of the influence of researchers' affiliated institutions on researchers and their collaborators in international collaborative research needs an understanding of the challenging aspects of receiving institutional support. Three interviewees shared diverse views on constraining aspects of the administrative and

research support at their institutions in international collaborative research.

Understanding the mindsets of researchers and their collaborators contributes to international collaborative research advancement and the addition of researchers to international projects. One Japanese professor stated that when he conducted collaborative research at his collaborator's site, his institution hired temporary teaching specialists who were responsible for his classes. The professor also discussed permanent complexities of the research support structure and administrative support. According to him, there are many possible constraints that prevent researchers from focusing on research:

“Before the leave of absence, for a long-time travel, well, yeah, at that time, the university hired temporary lectures to cover my classes when I was on the leave.”

“Uh-huh, in practice, during your collaborative research, I asked you earlier, well, was there something restricted or constrained. It could be part of university system or structure, or a university culture. Did you observe anything?”

“Yeah, well, from the perspective of a researcher egoism, well, when we have research abroad opportunity, well, it would be like leave of absence. That, well, I would also pursue the opportunity by reducing obligations.”

“Uh-huh, I see.”

“After all, so, various, so, so called burdens, could be called burden, my tasks such as teaching, participating in meetings, operating campus management are all inevitable for me.”

“I see.”

“After all, this, yeah, when I consider all these.”

“I see.”

“Well, there are many travel opportunities, for example, even if there are subsidies and supports, I barely take these opportunities. Well, I hesitate to consider these opportunities.” (Japanese)

Designating time spent on research might provide extensive opportunities for researchers to engage in international collaborative research. One Japanese professor said that faculty members were responsible for almost all operating tasks and procedures regarding documents, accounting, and other administrative tasks. The professor also pointed out that there was no common structure to support sabbatical leaves across colleges or departments at his institution and other national universities:

“Well, it is a quite difficult question. There is almost nothing at institutions. Most administrative tasks such as accounting and paper work are faculty’s tasks at Japanese universities. Of course, it can be done by hiring a secretary. Sabbatical systems are not institutionalized at Japanese national universities. There are some sabbatical systems in colleges or departments at the local level. In the case of [a Japanese university], there is no sabbatical system.” (Japanese)

Faculty promotion systems could influence faculty members and researchers in active and passive positions to conduct international collaborative research. The incentives given to individual researchers are closely linked to the research assessment structures of their affiliated institutions or organizations. Another Japanese professor stated that the faculty promotion system made it more difficult for faculty members to engage in international collaborative research because additional tasks and responsibilities would be assigned to associate professors. Then, the professor claimed that faculty members would not have time to conduct collaborative research:

“Well, yeah, I think, at the university, so, associate professors, associate professors are likely to engage in international collaborative research.”

“Assistant professor, I see.”

“After becoming an associate professor, after all, by all means, there are also additional commitments on classes, committees, and others at the university.”

“Uh-huh, I see.”

“These tasks will be added, for example, I am currently a member of the accounting committee and a member of management committee in the selection process. There is one meeting once a month.” (Japanese)

Influences of the institutions in terms of identity, interests, and objectives

Institutional influence can be based on an institution’s reputation, mission, vision, value, and priorities across academic disciplines. Three interviewees mentioned the importance of institutional identity, interests, and objectives for researchers to conduct international collaborative research. Recognition of individual researchers’ work is sometimes linked to the reputations of their affiliated groups, institutions, or organizations. One U.S. professor noted that being part of a group of leading scholars and having an institutional reputation for excellent research in an international arena are both essential:

“Well, the main thing is that, it happens to be that at [a U.S. university] there is a very strong group of faculty working in the general areas of [a scientific discipline].”

“Uh-huh.”

“So, all together, we are very supportive among ourselves, and we've got a very good, strong reputation internationally.”

“Uh-huh.”

“Not specifically me, but I would be say one of six people, people would name, that were, you know, the strong group at [a U.S. university].” (English)

Institutional missions contribute to the foundation of academic and professional identities of researchers, other institutions, and other stakeholders in international collaborative research. One U.S. professor said that his institution encouraged individual researchers to engage in international collaborative research for the sake of science advancement:

“I think, you know, if you want to, for promotion purpose, you need to be recognized internationally.”

“Oh, I see.”

“But, so, I think, it's very important to have, kind of have, you know, collaboration with, you know, international investigators or researchers.”

“Uh-huh.”

“And, that could be one thing, but I think in my place, actually, they really encourage for, like, you know, collaboration with anyone, anybody in the world, as long as it's really important for the science.” (English)

The roles of the institutional leadership teams have changed in international collaborative research, and institutional leaders exert influence on researchers through a variety of institutional policies and practices. Another Japanese professor shared a unique perspective and described interests and efforts of the institutional leaders at his institution. The professor explained how these interests had influenced individual researchers and claimed that institutional support was temporarily provided to individual researchers at his institution and that it does not support research continuously in the long run:

“Yeah, yeah, so, the university executive team set priorities and made an institutional agreement by themselves. They might be upset to hear my story. I would say the executive team made the deal without consultation, and they asked researchers to start conducting research. We did not have such a kind of decision making at a university in the old days.” (Japanese)

No institutional influence

Four interviewees noted that their institutions had no influence on their international collaborative research. Researchers organize and conduct international collaborative research with their collaborators through various means. There are also many kinds of support researchers receive from their institutions or other research-

supporting organizations. Some researchers conduct research independently of their affiliated institutions or organizations. One Japanese researcher stated that there was no support from his institution in his international collaborative research. The researcher also mentioned that he worked in a research division that was independent from the university structure and functions:

“So, if you conduct research, it was fine to do any research. Yes, yeah, there was absolutely nothing directed by [a Japanese university]. So, it was ok, as long as I conducted my research.” (Japanese)

Another Japanese professor simply stated,

“No, there is no particular support from the university.” (Japanese)

Researchers receive support from their institutions in many ways. Institutions sometimes do not make special arrangements for researchers to spend additional time on international collaborative research. One Japanese professor explained that receiving external research funds would not reduce his duties or responsibilities in teaching or other administrative commitments at his institution:

“Well, basically, so, university, [a Japanese university] might be upset, if I say something like this. Basically, acquiring research grants does not affect me. For instance, reducing my responsibilities in teaching or committees. There is no such thing.” (Japanese)

Researchers are key contributors to research advancement and the publication of their findings. Institutions regard the research activities of their affiliated researchers as significant contributions to institutional advancement. In particular, they encourage researchers to publish their knowledge in academic journals. Another Japanese professor said that there was no internal support for him in international collaborative research; however, he stated that his institution expected him to bring external research funds to his institution to conduct research and run experiments:

“Well, yeah, my collaborative research is, basically, I do it individually. Well, so, university is not directly relating to my research. Rather than that, for example, university expects on me not to miss teaching classes or so.”

“*Oh, I see, yes.*”

“Well, from then on, well, the university regulates that, for example, when I publish my research articles based on my collaborative research. When, I receive a large *Kakenhi* [Grants-in-Aid for Scientific Research], and the research grants are indirectly transferred to my institution.” (Japanese)

Conclusions related to Institutional factors

Researchers at American institutions explained that their institutions had supported their international collaborative research by helping with visa application procedures for their collaborators to come to the United States, providing sabbatical support to visit other institutions, and affording administrative support for visiting researchers. During their international collaborative research projects, almost no researchers faced challenges that constrained their international collaborative research at the institutional level.

A few members in the group of the researchers at the Japanese institutions said they did not have support from their institutions in their international collaborative research projects. Some members mentioned that their institutions helped their international collaborative research by hiring temporary staff members to cover their teaching commitments during their sabbatical leaves. One researcher said there were experts and professionals who supported two primary aspects such as advancing research and promoting internationalization in international collaborative research.

Maintaining institutional administrative support and having a variety of research support professionals are important contributors in providing various support to

researchers and their collaborators. Although each institution has a different organizational structure to support international collaborative researcher, researchers acknowledge that research support staff members and experts are foundations for successful international collaborative research. Getting administrative support is crucial for researchers to make travel arrangements, and it helps promoting exchanges between researchers and students throughout the international collaborative research projects. The researchers also acknowledge faculty promotion systems could have negative effects on faculty members who engage in international research collaborations. Mission, vision, value, reputation, and other related criteria of researchers' groups, institutions, and organizations can also influence researchers' attitudes and efforts in international collaborative research. Some researchers do not receive institutional support, and they conduct research independently of their affiliation institutions or organizations.

Government policies

To understand the interviewees' perspectives and the influences of *government policies* on international research collaborations, I asked the interviewees, "*What influence, if any, do government policies have on your international research projects?*" *Government policies* are one of the most significant factors because they influence almost all stakeholders in international collaborative research at the individual, national, and international levels. Understanding basic roles and responsibilities, examining the influence of government policies on institutional leaders, and identifying regulations and policies are essential to analyze how *government policies* guide researchers to advance collaborative research in the international arena.

In the present study, the term *government policies* refers to guidelines, procedures, regulations, and rules set by national governments to promote collaborative research across nations. To promote international collaborative research, *government policies* support the development of collaborative research relationships and intergroup networks and promote collaborative research across academic fields between Japan and the United States. *Government policies* are a primary influence in putting high expectations on researchers and institutions to lead collaborative research by providing funding support to them.

The respondents stated that national government policies influenced their research by setting interests and priorities through government funding agencies. The interviewees noted that government policies affected national interests and priorities in international collaborative research, setting guidance and regulations for research and education, and shaping institutional leadership and management. Eight interviewees explained various perspectives on the influences of government policies on international collaborative research. Six interviewees described valuable and disagreeable aspects of government policies in international collaborative research. Three interviewees explained emerging institutional challenges as influences of government policies on international collaborative research.

Influences of government policies on setting interests and priorities

Eight interviewees provided various views on the influences of government policies on international collaborative research. In addition, one interviewee described his international collaborative experience and stated that a funding organization holds a

specific focus on particular regions to promote international collaborative research. Researchers regard national interests as important influences on setting objectives and priorities in international collaborative research. Two interviewees stated that national governments' political interests influence government policies in international collaborative research. Intellectual property, patents, product inventions, outcomes, and other results related to research are all considered benefits of the investments of national governments. One U.S. researcher said that the interests of the national governments sometimes were reflected in international collaborative research and limited opportunities or options to conduct collaborative research with collaborators from particular nations:

“And that comes and goes depending on the government's policies. We have tried to have--the Chinese, for example, would like our laboratory to do some work for them, and the government decided that was not appropriate. They didn't want that technology necessarily to be given away to China.”

“I see.”

“And so, issues like that can come up. It usually does not affect, other than the overall funding, it typically does not affect basic research. It's more, that's more a question of intellectual property, and most basic research, there are no intellectual property rights. Nothing you can patent of something like that.” (English)

Interests and priorities of national governments influence how funding agencies support individual researchers, research teams, institutions, and other organizations in international collaborative research. One U.S. professor emphasized the impact of political leaders' influences on research budgets at the national level, and he argued that budget cuts in research would adversely affect international collaborative research:

“Any budget crunch will have an oversize impact on the type of funding that facilitated our international research collaborations.” (English)

Researchers regard government agencies as primary constituents for research grants related to international collaborative research. Two interviewees agreed that

researchers obtained more opportunities for research funding grants; however, one of them pointed out that the opportunities are still limited to researchers in specific academic disciplines. Proactive approaches by governments in promoting international collaborative research could be observed an increased number of research grant opportunities and options. One Japanese professor observed that researchers had gained more research grant opportunities for international collaborative research:

“Public opened project. The number of research projects that could be collaborated internationally has increased.” (Japanese)

Some funding agencies and organizations support researchers in broad academic disciplines, whereas others support researchers in specific academic disciplines. One Japanese researcher agreed that there has been an increase in research grant opportunities; however, he reported almost the reverse, describing the funding opportunities as limited to specific research targets:

“Regarding the Ministry of Education, Culture, Sports, Science and Technology, well, it is, it is widely, distributed the research funds widely to many people; however, Japan Agency for Medical Research and Development focuses on one specific target.” (Japanese)

Two interviewees emphasized the importance of researcher engagement and mentioned the influences of government policies promoting exchanges of researchers and students in international collaborative research. Some particular research support initiatives are quite valuable in promoting exchanges of researchers and students in international collaborative research. One Japanese professor noted that government policies had created research funding opportunities for researchers and extensively supported exchanges of researchers and students, and she introduced one specific

research initiative and explained that her research team benefited from the so-called “Abe Initiative” in accepting researchers from other nations:

“For example, perhaps, I think that it may not have been such an international exchange project in the past. As a policy, I observed that many policy reforms such as promoting researcher exchanges, creating large networks with overseas researchers, educating researchers, enhancing international competition, and others. I could find emerging funding support during the process to advance these objectives.” (Japanese)

“Well, I think the considerable amount of money is invested through the Abe Initiative. I think this is part of international contribution. This is, well, we accepted an excellent scholar from [another continent] through the initiative. Well, having the visiting scholar is a very good vitalization for my lab. I do believe it is great that our nation promotes internationalization which is relatively related to my research and other policies.” (Japanese)

There is an integral need for providing continuous research support to individual researchers. Terminating research support initiatives exerts a strong influence on all stakeholders and leads to the discontinuity of research engagement. Another Japanese professor emphasized the importance of scholar exchanges and claimed that researchers did not have enough opportunities to visit their international collaborators’ sites for a certain period of time and conduct research together. The professor explained that there had been research-abroad programs for researchers; however, they were terminated by elected officials:

“The Japan Society for the Promotion of Science created the research abroad project by its fund.”

“Uh-huh, is that so?”

“It aimed for sending 2000 people to research abroad through the project.”

“I see, so, that was the time of Prime Minister Aso.”

“Yes, at the end, Japan Society for the Promotion of Science made it funded, then, sending researchers to overseas for half a year to a year or so. Well, the previous research abroad project covers two thirds of the main payment as covering for

travel expenses. Well, this research abroad project provided for approximately ¥150,000 to each researcher.”

“*Uh-huh.*”

“It was approximately ¥150,000, well, combining with the project for special researchers by Japan Society for the Promotion of Science, it would be approximately ¥300,000 in total. Then, it also provided approximately ¥150,000 in addition to the main salary. But, the Democratic Party of Japan terminated the project.”

“*Was it Jigyo Shiwake [a screening process to review government programs and cut their budgets]?*”

“Yes, the administration did *Jigyo Shiwake* [a screening process to review government programs and cut their budgets], and the research abroad project recruited only once.”

“*Uh-huh, that was so.*”

“Well, that's why, after all, many of the researchers in their 40s currently have not had research abroad experiences.” (Japanese)

Two interviewees shared a common view that there were challenges regarding the influences of government policies on international collaborative research. The global perspectives of researchers in international collaboration might not be fully used to advance international collaborative research. Researchers have stated the selection process for international collaborative research applications might not include a variety of perspectives from internationally engaged researchers. One Japanese professor claimed that the selection process for international research collaboration applications was uncertain. The professor argued that the international knowledge and experience of experienced researchers might not be reflected during the process of selecting the recipients of international collaborative research grants:

“That said, in that sense, yeah, it is easy to use, but, not sure, in the case of the open partner, that is, there are interests of the stakeholders who selected the recipients; however, I question that the selection members have international

collaborative researcher experiences or not, and their experiences are properly reflected in the selection process.” (Japanese)

Government policies differ regarding international collaborative research across nations. The gaps among the policies sometimes discourage researchers from participating in research engagement practices or networking opportunities. One Japanese professor said that the guidelines and rules for the research funding uses were sometimes too strict to cover the expenses of the researchers’ participation in particular events at international conferences:

“Well, yes, I see, holding symposium, inviting people, arranging my visit to my collaborator’s site, we can organize them in our research. But, strangely enough, we have issues now, well, there are strict policies in terms of travel expenses in Japan. For example, we sometimes join international conferences. People say that the cost of the conference banquets needs to be deducted.” (Japanese)

Funding agencies and organizations influence individual researchers by specifying particular research targets, focusing on specific geographical regions, and setting other objectives. In addition to the perspectives of the seven interviewees, one U.S. professor learned about the particular interests of the funding organization and explained its geographical focus in international collaborative research:

“I, as I said, in my case, because we're doing really fundamental research, I think that, that thus far we've had very, generally we feel that there's kind of a wind in our backs, that they do encourage this kind of collaboration. Particularly in my case the National Science Foundation and [a U.S. Foundation], both of these have very expressed interests in the extending and strengthening collaborations. And the NSF has a very broad program connecting to JSPS and the corresponding agencies in other countries, and when I speak to people at the science foundation, they, they raise the topic of whether we have collaborations, and they make us aware of these efforts to strengthen that. And also, in [the same U.S. Foundation] which I am very fortunate, I have some funding from, they also have specifically when I meet the program manager, is they actually talk to me about their interests in making, strengthening our collaborations, actually particularly in Asia generally talking about Japan and China, and that they have specific funds to try to encourage that. So I feel I has always been supported in these efforts.” (English)

Influences of government policies on research and education

Six interviewees shared various perspectives on the influences of government policies on research and education, and they referred to both valuable and disagreeable aspects of government policies in international collaborative research. Government policies exert influence on institutional management and operating procedures in promoting internationalization. Two interviewees shared valuable aspects of government policies, which set specific objectives in education and research. The objectives provide incentives to individual researchers, institutions, and other stakeholders to promote international collaborative research. One Japanese professor explained that the national government's interests and priorities in promoting internationalization in higher education were valuable and made the institution recognized internationally:

“Well, as part of the national policy, our university is selected as one of the prioritized universities to get the international certification of so-called [a disciplinary] license. We are lucky to be part of it.”

“Uh-huh, I see.”

“To do so, in order to be qualified as the international certification, well, what to say, we engage in various things to improve to be qualified.” (Japanese)

Enhancing understanding of the integration of government guidelines and various regulations across nations is useful for researchers to explore possible options for conducting international collaborative research. Another U.S. researcher analyzed multiple aspects of government regulations and stated that understanding various types of government guidelines and regulations across nations would help researchers conduct collaborative research collectively:

“So, people can use it, then, America, internationally, they all use it. So, I should not say it's probably difficult if you are creative enough, you will be able to take

advantage of the government guidance of government regulations around the globe and take advantage of that.” (English)

Four interviewees shared a common view on disagreeable aspects of government policies. Two noted concerns about human resources in relation to the organizational structure of universities. The number of emerging researchers has become smaller, and it will be a serious challenge to incorporate emerging researchers in international collaborative research. One Japanese professor introduced a specific concern regarding human resource issues and argued that there is an insufficient number of young researchers in academic research:

“There is another thing. Yeah, this is an essential problem, and I do not say it as international collaborative research. Yeah, well, there are few younger researchers.” (Japanese)

Attracting and accepting internationally experienced researchers is a prioritized goal to advance the research community and promote international collaborative research. Universities and research organizations must restructure their systems to attract and accept researchers who engage in international collaborative research. One Japanese professor identified the current dilemma at the national level. The professor explained that it is important not only to encourage Japanese researchers to join research abroad but also to create an organizational structure and functions to bring them back to institutions in their nation.

“Well, that kind of system is fine. Well, even the number of the special researchers joining research abroad increases within the system and spend time at overseas sites, the main concern is, truly, are we able to welcome them to get back into Japan properly.”

“It is the places of their returning home.”

“Yes, living after the research aboard projects, for example my students are also, so, taking a tenured position will be happy, but well, as my own personal opinion,

well, it would be also nice to bring them back to Japan and utilize their research abroad experience to vitalize education in Japan.” (Japanese)

The duties, responsibilities, and tasks of faculty members may need to be examined and assessed to encourage them to conduct international collaborative research. Two interviewees mentioned that reducing the duties of faculty members would enable them to be involved in international collaborative research. Refined policies and extensive options must support researchers and promote international collaborative research. One Japanese professor described the gap between government and institutional policies in encouraging researchers to conduct international collaborative research. The professor said that introducing new national government policies to support cross-national collaborative research would be welcomed; however, the amount of researchers’ responsibilities and tasks at their institutions need to be reconsidered and reduced so they can spare more time for international collaborative research:

“Well, well, the various plans with ideas by the governments are fine; however, each faculty member’s capacity to afford conducting research needs to be guaranteed.” (Japanese)

Faculty members and researchers make various demands for greater institutional understanding of international collaborative research, and they consider it is essential to enhance an understanding of the options for devoting more time to international collaborative research. Another Japanese professor shared a similar view and said that faculty members were overwhelmed by their daily duties and responsibilities. The professor said it might be crucial to reconsider the burden of responsibilities on faculty members to promote international collaborative research:

“If, well, in order to support bilateral collaborative research, well, financial support will be fine. But, what it is, yeah, as I stated, I would consider reducing

the burden associated with duties or responsibilities of the faculty rather than providing financial supports.” (Japanese)

Influences of government policies on institutional leadership and management

Three interviewees observed the influence of government policies on international collaborative research and found organizational challenges under centralized leadership at higher education institutions. In higher education, a strong influence of institutional leadership stems from government policy reforms. One Japanese professor explained that the leadership of the university administration had become centralized and strong. The professor asserted that the priorities or decisions of the institutional leaders influenced individual researchers at his institution:

“Basically, university consists of individual researchers. Researchers could have conducted research based on their preferences. Under the administrative guidance by Ministry of Education, Culture, Sports, Science and Technology, the university executive team had to be responsible for taking strong institutional leadership, after becoming independent corporation.” (Japanese)

Setting different objectives in internationalization across university offices and reorganizing multiple standards in counting transfer credits are important in training students and promoting international collaborative research. The professor also mentioned an organizational structure issue in transferring the credits of graduate students at his institution. The professor claimed that there are conflicts of interest among individuals, offices, and divisions in promoting internationalization and recognizing transfer of credit problems:

“Well, there is conflict of interests between the division to promote international presence, such as international relations, international collaborative research and the division that is responsible for ordinary education. There are also gaps among individual and divisions as well. We promote international collaborative research by encouraging graduate students to join study-abroad programs or short study-abroad programs. They follow the guidance by the researchers, get research

results, and work master thesis papers at the study abroad sites. Then, they come back to our home institution. Although we have the system to recognize the compatibility in counting and transferring course credits at the national level, we do not utilize it in practice, and their gained credits at the overseas institution are only recognized half at the institutional level.” (Japanese)

Faculty members contribute to education and research, yet government policies can influence institutions to reduce faculty across institutions. One Japanese professor stated that faculty will be downsized at higher education institutions in the near future. The professor said that more duties and responsibilities will be put on individual faculty members, and it will make it more difficult for them to focus on international collaborative research:

“Yes, in terms of the burden to responsibilities, well, if it does not change, the burden per person would be bigger.” (Japanese)

Universities need to refine their administrative structures and accept more international graduate students. Another Japanese professor addressed a dilemma in accepting international students to a graduate education program at his institution. Although international students contacted the professor to join the graduate program at his institution, there was no formal organizational structure to accept international students at the institutional level:

“Well, there is one, yeah, as I said earlier, in the case of establishing an admission system to accept international students, so, the Ministry of Education, Culture, Sports, Science and Technology has put more efforts and become the supportive. So, the number of admission requests to me from outside has certainly increased.” (Japanese)

Conclusions related to Government policies

Among the researchers at American institutions, 43 percent (three researchers) said government policies had influenced their research. The first researcher explained

understanding the gaps and differences among government policies was helpful for researchers to conduct collaborative research across nations. The second researcher stated political leaders' discussions and priorities strongly influenced international research policies. The third researcher stated that leaders of funding agencies or organizations had geographic focus when it came to investing their funds in international collaborative research projects. Other researchers at American institutions stated separate structures and functions of research findings and some research funding restrictions were challenges they faced when sharing resources in their international collaborative research projects.

Among the researchers at Japanese institutions, 33 percent (three researchers) commonly said government policies needed to be focused on reducing faculty tasks and promoting research, 22 percent (two researchers) suggested refining the structure of Japanese higher education institutions to adopt a transfer credit system, accept international graduate students, and hire Japanese researchers with experience conducting research abroad, 22 percent (two researchers) argued over the importance of the international protocol, the Convention of Biological Diversity, and they argued over the importance of research support systems across research institutions, and 11 percent (one researcher) complained that the regulations and rules were too strict, and he was not allowed to spend his research funds to participate in banquets at international conferences.

Researchers at Japanese institutions said government polices helped their international collaborative research by creating new research support initiatives, refining research programs, and promoting scholar and students exchanges. One researcher

explained her institution received special support to attain international accreditation status. In addition, the researcher was able to invite a visiting researcher from Africa through one of the government initiatives. Two researchers had different perspectives on the research grant reviewing process. Although one researcher explained researchers' opinions were taken into account during the research grant application process, another researcher argued the international research experience and knowledge of the reviewers were not taken into account during the research grant reviewing process.

Researchers understand that interests and priorities of national government influence how funding agencies or organizations support international research collaborations. Governments actively promote international collaborative research and have increased the number of research grant opportunities and programs. In fact, an increased number of researcher and student exchanges have taken place in international collaborative research. The selection process for international collaborative research applications has taken into account the perspectives of researchers from different backgrounds; however, one professor argued that the standpoints of internationally experienced researchers are not taken into account during the selection process. Researchers are also concern that gaps among national policies might discourage researchers from conducting international collaborative research projects. Researchers might be able to find possible options to organize flexible research plans by understanding guidelines and relations across nations. Government policies can also influence the operating procedures at the institutional level. It will thus be crucial for universities and research institutions or organizations to attract and accept internationally

experienced researchers, and it will be essential to set common goals and objectives for promoting international research collaborations at the institutional and national levels.

Recommendations and suggestions

To better understand the interviewees' perspectives and considerations for the advancement of international collaborative research, I posed the following question: "*What recommendations do you have for funding agencies, your institution, governments, and other organizations to support international research collaborations?*" This was the final question used to review the interviewees' experiences and perspectives. Guidelines, policies, procedures, regulations, and rules are fundamental principles for researchers to follow for the advancement of their research. The researchers reviewed their collaborative research experiences, providing various recommendations and suggestions to advance international collaborative research.

In this study, the term *recommendations and suggestions* refers to the researchers' comprehensive considerations, reflections, suggestions, thoughts, and views on international collaborative research. Collaborative researchers viewed several primary suggestions and recommendations, such as advancing and reviewing policies, refining legal procedures, improving administrative structures and policies, setting English as the primary language, enhancing interagency relationships, understanding challenges, and creating opportunities. *Recommendations and suggestions* are crucial ways to identify the lack of consistency in policies and support for international collaborative research at the individual, institutional, and national levels across nations.

The interview participants described their international research collaborations and shared diverse insights. They indicated there was room to improve various aspects of research structures and mechanisms. Their recommendations and suggestions captured the challenges of advancing international research collaborations beyond the issues of individuals and institutions. Three interviewees noted the need to create a variety of research funding support and arrangements. Three interviewees viewed legal procedures as potential challenges. Four interviewees said administrative structures and policies could be improved. Six interviewees emphasized English as the primary language to communicate with their colleagues. Three interviewees said government agencies needed to communicate closely with each other. Six interviewees said stakeholders in international collaborative research needed to understand the challenges and create opportunities throughout international collaborative research.

Advancing and reviewing policies on international collaborative research

Researchers pointed to challenges and described the need to refine policies of funding agencies for the advancement of international collaborative research. The influence of funding agencies comes from research funding initiatives to support researchers and research teams. Three interviewees addressed the importance of creating research funding support forums and arrangements. Researchers set different research objectives and there is an inherent need for various research funding opportunities for them in international collaborative research. It is important to maintain a variety of research styles to best advance research. One U.S. researcher stated it would be

necessary to consider the different types of demands on diverse research projects and provide opportunities for researchers who also conduct medium-scale research projects:

“And so, people had a number of good ideas for mid-scale instrumentation projects, and they just couldn’t. So, again, one of the recommendations of the long-range plan is they need to include in their planning and their future budgeting that there's always some of these mid-scale projects able to go on, or else you just, you lose opportunities.”

“So, this is like forecasting upcoming research or supporting emerging research.”

“Well, it's, it's you clearly want to do, but you also want to make sure you haven't locked in all the funding for several years to come.” (English)

Research funding agencies and organizations need to understand the demands of various researchers at different career and research advancement stages and coordinate research support opportunities for them. One Japanese professor provided a similar view on creating a variety of funding support opportunities and suggested creating additional funding forms and chances for mid-career researchers to advance their research:

“Conversely, this is probably a kind of opportunity. Probably, well, I need to advance to the next stage by continuing international exchanges. At this moment, for me, as I explained, there are several research grant options. But, there is no research grant opportunity which fit to my current research status. So, I do not have anything fitting to advance my research based on my recent research, if there is a research grant opportunity, for researchers at the medium level, for researchers in the process of development, that researchers can apply for and pursue support for several years in finishing up research to publish research.” (Japanese)

Creating more research support opportunities should have numerous and beneficial impacts on the incentives and efforts of researchers in international collaborative research. One Japanese professor suggested that increasing the number of funding request acceptances with lower amounts of awarded financial support could help more researchers:

“Well, it may be good to increase the number of the accepted cases by reducing the amount of each grant.” (Japanese)

Organizing networking opportunities for former recipients of research funding support could enhance relationships and promote further engagement among researchers and research communities. One interviewee emphasized the importance of post-international collaborative research. One U.S. researcher noted funding agencies would be able to help researchers continue their research and enhance relationships by organizing follow-up meetings or networking opportunities for the former recipients of the collaborative research finding:

“Well, I mean, one thing that I was thinking about is that there are many, many international visitors. They are all geographically located in different places. So, somehow it would be nice maybe to arrange the meetings for, I don't know, former, former research fellows who had JSPS support.”

“I see.”

“Maybe, to, to arrange some kind of the exchange there, you know.”

“Yes.”

“Not ideas, but, you know, what kind of project thing. Well, maybe, maybe there is something they can do together.” (English)

Funding agencies can influence research engagement and international concepts in initiatives, policies, and programs. One U.S. interviewee described a specific faculty grant program called the Fogarty International Research Collaboration Award (FIRCA) organized by the National Science Foundation (NSF). As a former recipient of FIRCA, the professor said international collaborative research opportunities provided scholars with effective ways to exchange ideas across nations:

“I think, I don't know what their current policies are, but, they all of a sudden will give small grants, but they're specifically, to, to foster international collaborations,

and about 20 years ago, I had [a scientific research grant]. It was called [a scientific research grant] International Research Collaboration.” (English)

Evaluating research outcomes needs to be accomplished from multiple perspectives, and the outcomes should be analyzed and synthesized to understand impacts created through international collaborative research. One U.S. interviewee highlighted the importance of cost-effective analysis in reviewing and assessing international collaborative research. The professor described the effectiveness of his international collaborative research and mentioned his achievements.

“Yes, on the U.S. side we got \$60,000 for this research collaboration, in the grant scheme of things, \$60,000 is not a big number. Yes, if I would get \$60,000 for my base support, yes, that, that would pay for one grad student for one year.”

“I see.”

“Yes, now one grad student one year would not be able to do XX publications, contribute to XX presentations and all that.”

“Yes, indeed.”

“So, so, the cost benefits on many levels is really, really good.” (English)

Refining legal procedures for international collaborative research

Researchers raised concerns about legal procedures as potential barriers for researchers to conduct international collaborative research. Working with experts and professionals to make international travel arrangements and coordinate alternative travel options is crucial in international collaborative research. Three interviewees noted that legal procedures were potential challenges to advance collaborative research across nations. One U.S. interviewee mentioned his concerns about regulations and restrictions on international travel. The professor said he had confronted challenges in relation to travel arrangements for a collaborator who had planned to visit his institution:

“So, now, if my collaborators want to come for more than 10 days, we need to plan this like four months in advance, and then if something goes wrong, and they need to shift the dates, then it's, you know, go back to Square One, you know, start a new application.”

“I see, so, the only one time J-1 VISA is valid to one visit, so, it has to be, wow, it is very strict on the policies.”

“It's very strict, and that really puts a damper on the research exchange, yes, because it is so much more difficult for my international collaborators to come visit.”

“I see, it is also applied to your visit to Japan, or this is only, you know, scholars coming to the US side.”

“It's only on the U.S. side.” (English)

Exchanging biomaterials and resources is also valuable for international collaborative research. Two interviewees explained the barriers and challenges to exchanging and shipping biomaterials across nations. One U.S. professor indicated the procedure to ship animals took time:

“It's a long process, you know. There's a lot of paper work to be done, and then, you know, and also, you know, so, I think it's not really easy to kind of move animals.” (English)

In terms of exchanging biomaterials in collaborative research, international agreements or protocols play critical roles and influence individual researchers, institutions, funding agencies and organizations, and other stakeholders in international collaborative research. One professor explained the international agreement “Convention on Biological Diversity” in relation to emerging challenges among individual researchers to exchange biomaterials in international collaborative research. Under such an international agreement, one Japanese professor discussed being responsible for all procedures in exchanging biomaterials with his collaborators:

“The point is, when dealing with genetic resources and genetic information, we have to make an arrangement. The United States does not ratify this convention. For example, when I conduct collaborative research with Mexican researchers. When I receive the materials from the Mexican researchers, individual researchers have to deal with the whole Material Transfer Agreement process.” (Japanese)

Improving administrative structures and policies in education and research

Researchers called for the demands on restructuring academic governance, advancing research support systems, and refining policies for the advancement of international collaborative research. Institutional policies and practices regarding international collaborative research influence researchers and research teams throughout collaboration. Four interviewees said administrative structures and policies needed to be improved to advance international collaborative research. Institutions and organizations could create options for securing more time for research, spending more time on collaborative research, and enhancing relationships with other researchers. One U.S. interviewee compared sabbatical policies at higher education institutions in the United States and Japan. The professor found spending time abroad was not a common practice among faculty members in Japan, at least in his academic discipline, and he suggested researchers would get a broader research experience if scholar exchanges were promoted through sabbatical systems:

“And part of it I think, as far as I understand when I speak to my colleagues is that they don't seem to have a sabbatical leave policy.”

“I am not sure that this is true, but my impression has been that, that, you know, the system we have is that every, I think it's every seven years, we take half year as a sabbatical leave. This gives quite a nice flexibility, and that means that typically people do travel, and it's not always abroad, but a lot of people do stay half year abroad, every, you know, they'll do that three or four times during the career.”

“Uh-huh.”

“But, it's less common in the case of a Japanese scientists. I think it would be nice to, I think that would probably be a very powerful way of making it a bit easier for Japanese scientists to visit abroad, and we would certainly welcome that. Actually, it's actually a very good thing for an institution to have someone who arrives. They tend to be supported already in terms of salary and those types of things, but really is, almost always you will find welcoming institutions, when scholar is saying that I'd like to take a sabbatical leave. They can always go wherever they would like, and so, it becomes a quite a good method for strengthening the interactions.” (English)

Faculty members, professionals, and administrators are important contributors to international engagement. The integration of their international knowledge into institutional policies and practices promoting internationalization in research and education is essential. From the human resource management perspective, one Japanese interviewee emphasized promoting internationalization at higher education institutions by hiring professionals who have completed study or research abroad:

“Well, after all, I am not sure of your position in this case. For instance, it is necessary to set a certain target with the particular percentage to hire professionals with overseas experiences in advancing internationalization.” (Japanese)

Advancing international collaborative research requires the integration of researchers from different career advancement stages. Established researchers have emphasized the importance of incorporating emerging researchers into their international collaborative research and setting administrative structure and policies to support them. Another Japanese professor provided a similar view and said it was important for emerging researchers to experience research abroad. The professor compared his current research environment with his past research environment and argued for the necessity of creating more opportunities for emerging researchers to conduct research abroad:

“After all, I believe training young people is the first priority. So, for example, when start working at a university, I suggest to create a mechanism to engage in collaborative research in foreign nation for a year or two.”

“Uh-huh, I see.”

“When I was a student, it was common to study abroad. But, now, it is not common among emerging Japanese researchers. There are young faculty members who have no experiences of studying abroad in my university.”

“I see.”

“After all, after all, at the early stage of the career, for a certain period of time, I think it would be better to support young research to conduct research at other nations.” (Japanese)

There are a variety of ways to support the continuity of international collaborative research. Post-primary research experiments during the process to analyze data and publish research require continuous administrative and institutional support. One Japanese interviewee addressed the development and continuity of research. One professor said research support structures could be an essential way to continue collaborative research in the long run. The professor mentioned the importance of establishing a research follow-up system, and he stated that his nation could also support international collaborative research during the data analysis process:

“Yeah, after conducting research experiment, it takes a few years to analyze various data and others. So, during that time period, it could be done in Japan. It is important to support the data analysis process, publishing articles, and announcing research achievements. In addition, after completing the main part of the research experiment, data analysis continues several years. So, it will be essential to have an organized research support system to bring it to Japan.” (Japanese)

Institutional constraints could be identified in the process to accept international students' applications to graduate programs. Administrative structures and policies have been identified as constraints at the institutional level during the admission of international graduate students. One Japanese interviewee highlighted issues with the admission structure and policies to accept international students in one master program at

his institution. The professor explained that the graduate program was designed for Japanese students; however, the university administrative structure was not ready to receive the students:

“Well, actually, this year, there were international applicants who consider completing the program for five years at [a Japanese university]; however, our organization system is not in place to accept the applicants. Well, even though universities establish exchange systems to some extent, there are issues at the local level. I think that it is actually a problem, I regard this is a problem.”
(Japanese)

Setting English as the primary language in education and research

Interviewees referenced communication challenges in international collaborative research. Linguistic skills are influential factors for successful international collaborative research. Researchers argued that English is the primary language for teaching, research, and other academic occasions. The researchers argued that English needed to be the primary language in teaching, research, and other occasions. Six interviewees addressed the importance of English as the primary communication tool among researchers in international collaborative research. One interviewee stated English was important for all researchers in science research. One U.S. professor emphasized the significance of linguistic skills:

“So, the ability for the scientific research, for the Japanese scientists to be able to communicate in English is extremely important.” (English)

Interviewees often strongly emphasized the value of English in research and education, and they were realistic about its adoption in academia. One interviewee highlighted the significance of English in academia. One Japanese professor recognized the current dilemma in education and research, and he stated that higher education institutions had to adopt English as the standard language in education and research:

Well, well, there are many, individually, there are many matters. I am not sure what is the best solution. To be like being strangled in this case, I would say and it may be irresponsible remarks, research including exchanges of researchers and students should be international collaborative research. Japanese universities have to do it all in English.” (Japanese)

Some researchers have changed their views on academic publications, and some of them regard publishing in English to be the only one option left in academia. Two interviewees held a common view on linguistic issues in international research. They considered English to be the primary language in which to publish research and communicate with colleagues. There is an inherent need for publishing in English among researchers in international research. One Japanese professor addressed issues in redundant publications and argued that scholars had no choice but to publish research in English:

“If you think about that, you only have one choice. In order to internationalize, university faculty members have no choice but to publish only in English.”

“So, you mean publishing in English.”

“It means do not publish articles in Japan. Previously, it was acceptable to publish the Japanese articles by translating it into English. Now, people call for stopping it and say it is sort of duplicate publication. Although it published in different languages, the content is same. So, it is getting stricter. Based on these ideas, there is no meaning to publish articles in Japanese anymore. I ask my students to publish articles in Japanese; however, I do not write articles in Japanese by myself.” (Japanese)

A deeper understanding of language and communication issues could help researchers and their collaborators work together more effectively. Researchers acknowledge that knowledge of English is an important contribution to research engagement. Refining linguistic and communication skills would help researchers deepen interactions with their collaborators in international collaborative research. One Japanese researcher pointed out language proficiency issues among Japanese researchers

and found Japanese researchers were not able to communicate well with their collaborators in English. The researcher said English was the primary tool in international collaborative research and explained common communication challenges:

“But, well, after all, as a Japanese, I consider it is all about language.”

“Uh-huh, that means language.”

“Language. Researchers use English, and research articles are written in English. When it goes abroad, English is the primary communication tool in discussion. So, I feel that we are taking such a delay.”

“After all, when it comes to international collaborative research, I somehow understand what they say, but I am not sure what it means in detail. Also, I am not sure what would be appropriate and how to respond to it. Well, so, after all, I feel it is very inconvenient.”

“I see.”

“So, in terms of language, after all, Japan took a delay in research. It would be better to have more people to go abroad from the early stage.” (Japanese)

In addition, a few interviewees also shared a common concern about linguistic issues in teaching and learning. A few interviewees also shared a common concern about linguistic issues in teaching and learning. There have been a variety of occasions when English played a critical role in higher education teaching and learning. There is an inherent demand for English in both research and education. One Japanese professor said faculty members had to utilize English on many occasions in teaching. He also said English was crucial when communicating with researchers and students.

“Quite often, there are so many people who can’t speak English. Among researchers, it is common that Japanese researchers are not be able to get inside easily. By all means, it is to improve English proficiency skills of the faculty members.”

“You mean English skills of faculty members.”

“It is the English proficiency skills of the faculty. Improving English proficiency skills. People say that students need to improve English proficiency skills. I strongly believe it is absolutely necessary to enhance English proficiency skills of the faculty.”

“Well, I just came up with an idea. You studied and conducted research in the United States. According to your observation, do you think the English proficiency issue of the faculty is a common challenge to all generations, or do you observe that young researchers are able to use English? From your perspective, in order to refine English skills or improve English proficiency, how should we start working on this challenge?”

“Well, that, really, perhaps, now, English education is changing a lot. It now starts at the elementary school. My [a family member] learns English in [a Japanese school], and I believe it needs to be taught from the infant time.”

“It is from a young age, I see.”

“I think it is difficult to start practicing and utilizing English after 20 or 30.”

“It is very difficult for me sometimes, and there are some linguistic barriers.”

“It means promoting English education. It is important that English language education for faculty members to refine their language skills since they are young.”

“In particular, it is vital for university faculty members to use English. University faculty members definitely use English.”

“Do you mean using English in all academic disciplines?”

“We use English. It is impossible not to use English in classes. There are international students. We use English, and we communicate with international students in English. Using English is absolutely necessary.”

“Uh-huh.”

“So, if we do not improve the English proficiency skills of the faculty members, we would be excluded. For example, when it comes to negotiations, we Japanese absolutely have to use English to communicate with English speakers. I think that it must be done.” (Japanese)

Although researchers cited English as the most important language in research and education, they have different perspectives on how to incorporate it into their

teaching practices. One Japanese professor explained that faculty members had a conflict of interest in adopting English as the primary language in teaching and learning at his institution. On the one hand, there were faculty members who were eager to using English in teaching and faculty meetings. On the other hand, there are faculty members who wanted to maintain Japanese as the primary language in teaching and other occasions. This dilemma made it difficult for faculty members to utilize English as the primary language in their teaching:

“Well, in short, well, I hope to hold lectures all in English. But, yeah, there are also faculty members who stated that teaching in English would not appropriate in education as well. Well, both sides have trouble.” (Japanese)

Enhancing interagency relationships among government agencies

Researchers addressed the importance of enhanced relationships and arrangements among government agencies. Funding agencies, funding organizations, and government agencies are important contributors to successful international collaborative research, and researchers acknowledge that they and their collaborators need to acknowledge the interests and priorities of these agencies or organizations. Three interviewees noted that government agencies need to communicate more closely to share information and promote engagement in international collaborative research. Research grant funders and receivers also need to understand the various influences of internal and external stakeholders across nations. One U.S. researcher said the cost increase of the research would be a critical issue to keep supporting research and advance international collaborative research:

“. . . that it's just almost impossible for any funding agency to fit in their budget envelope.”

“I see.”

“And so, people have to be realistic about how much could the U.S.--so that happened recently in the case of the long baseline neutrino experiment.”
(English)

Government agencies must gain knowledge and promote information management of national interests through international collaborations. To best integrate the knowledge and experiences of academic communities and industries, government agencies must enhance an understanding of collaborative solutions to address complex global challenges. One interviewee observed the complex communication challenges among domestic agencies to select and send participating representatives to international meetings. One Japanese professor observed the communication challenges among domestic agencies and said that agencies did not share information with other agencies to select appropriate individual representatives from academia to the international meetings. The professor said it would not be beneficial to pursue national interests in the international arena in the long run:

“So, that story, for example, [A Japanese government agency] is responsible for measurement standards and design standards.”

“Uh-huh.”

“So, [a Japanese government agency] official holds such information. They usually do not ask the officials of [the Japanese government agency] to send [an agency] officials to the committee. There are officials who do so; however, the officials basically do not do so.”

“So, you mean these two ministries hold separate jurisdictions.”

“Yeah, so, [A Japanese government agency] has jurisdiction over the university faculty members. But, even if [the Japanese government agency] requests [another Japanese government agency] to send the officials to international committees or so, the requests will be forwarded to [the third Japanese government agency], depending on the theme.”

“Uh-huh, I see.”

“... Most professionals asked by [a Japanese government agency] are not responsible for covering Japanese research, and they are less likely to eager to explain Japanese research.” (Japanese)

Funding agencies and organizations should share information and specify research targets across nations to provide research support funding for emerging research topics in international collaborative research. One interviewee held a similar view on setting a common international research agenda at the international level. One Japanese professor stated that funding agencies across nations could work collectively to discuss and set priorities in emerging international research fields:

“To some extent, when a particular research field has become matured, people start saying it would be better to conduct international collaborative research when a particular research field has become matured. To a certain extent, I think it is flexible to define international collaborative research from the beginning stage in a certain field with the seed funding support and expand international collaborative research. As part of the applicant side, I would have more broad options.” (Japanese)

Understanding challenges and creating opportunities in research

Researchers reviewed their international research collaborations, analyzed various influences and results, and shared diverse insights to advance international collaborative research. Six interviewees reported challenges and opportunities throughout international collaborative research. In terms of opportunities, five interviewees shared their perspectives on challenges in international collaborative research. The practice of international collaborative research includes institutions, funding organizations, and other organizations. Funding agencies and organizations exert influence on individual researchers and institutions through the provision of research grants. In terms of understanding the entire research funding structure, it is important to realize that funding

agencies and organizations are also under the auspices of government agencies and other organizations. These institutions must understand the influences of internal and external stakeholders on international collaborative research. One interviewee stated that researchers would need to understand the challenges faced by funding agencies. One U.S. researcher shared his insight on emerging challenges for funding agencies. The researcher said good communication and building trust were essential to advance international collaborative research:

“And so one of the things we do is every two years we have a symposium where we try to get people from the funding agencies of different countries together, talk about what are the general priorities of the fields. The priorities are typically very similar in the different countries, and to let them talk privately, so they can get some feeling for can they count on, you know.”

“Uh-huh.”

“So, for example, we had an issue a few years ago where I said there was a potential real shortfall on funding. There was a talk about U.S. closing one of its major facilities. That caused lots of distress from international funding agencies that were funding research at that facility, and so there's a real need for increased communication in funding agencies. So, people get to know the priorities, get to know the places where there are potential policy differences that one has to worry about, and basically get, gain trust in each other. So, that is a very important thing that needs to be continually improved.”

“Not only scientists but also funding agencies they should communicate each other.”

“Because if, you know, sometimes the scientists don't understand the pressures the funding agencies are under. They say, you know, they say, ‘Oh, I need just \$5 million dollars to do an extra project. But if the funding agency needs to give as a project, that's, say you're starting a construction project, and they have to keep increasing the funding, then suddenly they have considerable less money, so it makes it much harder to start some other new projects. So, again appreciating quite often scientists have very grandiose ideas . . .” (English)

An organized research infrastructure and research support opportunities are significant contributions to the advancement of international collaborative research. One

U.S. interviewee highlighted a common bias on research and development at the national level and said many people did not understand the essential components of research. The researcher analyzed research support infrastructure and emphasized the importance of equipment and facility conditions:

“I treat them equally. I think all the people there are equally smart. America is not smarter than anybody else. We are fortunate here. We have better, more advanced equipment because the sciences is a little bit more advanced throughout the past years. But, on the other hand, everyone, include Japanese, include those from Europe, from Eastern Europe, they are all smart. They all have good ideas. Simply they just do not have the right equipment to do right things.” (English)

Researchers have also identified new challenges in international collaborative research. Emerging issues in international affairs influence attitudes and behaviors of researchers and their collaborators in international collaborative research. One interviewee said concerns have emerged about international travel. One Japanese professor said terrorist activities had become a threat to the faculty and students, leading to hesitation about bringing students to certain international research sites because of potential safety threats:

“That's right. So, now, considering the United States and others. There is no restriction on travel spending, and the scientific research expenses can be used freely. I took young people to my counterpart site for several times, of course, in [an Asian country] and other nations. I've written a research grant application based on my ideas to visit [an African country] or other nations. As you may know, the issue of terrorism in recent years is very troublesome for me. I do not want to make an excuse; however, it has been always my concern regardless of where I go to research, in a sense, I concern there may be an explosion in high school. Any person has this idea.” (Japanese)

In some academic and professional disciplines, researchers are also interested in leading a conversation on setting international standards in research and development in international collaborations. One interviewee's statement pointed out another critical element in considering international collaborative research. One Japanese professor

argued for the importance of setting standard criteria in relation to the International Organization for Standardization (ISO). The professor stated that researchers are eager to be leaders in setting standard criteria in research and development across the world:

“Well, so, well, it is not international collaborative research, but it is a global competition that we are facing now.”

“I see.”

“So, Europe, originally, holding the mentality in terms of global competition, has been hold International Organization for Standardization (ISO).”

“It is Europe, I see.”

“Yeah, they were good at creating standard criteria.”

“It's a standard, I see.”

“Yeah, setting international standard criteria. The United States has not engaged in setting the standard criteria until recently, and the United States and Europe currently engage in hegemony competitions. It is extremely bad for Japan not to be able to properly participate in the competitions setting international standard criteria. It is important to promote it.” (Japanese)

Positive relationships among researchers found research communities, and individual efforts lead to opportunities to join international collaborative research. One interviewee found dealing with politics was one of the critical factors researchers had to face when participating in international research collaborations. One Japanese professor observed that politics play important roles in academic communities, and he noted developing good relationships is a key criterion to getting opportunities to participate in international collaborative research:

“Well, well, I think international collaborative research is probably becoming tremendously important, quite possibly, because there is no border and it is the abundance of information. In particular, indeed, in research, there are lots of things influenced by politics.”

“You mean politics?”

“It influences. For example, I am not engaged in this case. When it comes to establish a large international project, it matters whether Japanese researchers are asked to join the project or not.”

“Uh-huh.”

“Well, it is pretty much. This is secret. Japan was part of the international project of [a research subject]; however, Japan is not included in the project, because there was a bit of trouble.”

“Uh-huh, I see.”

“So, researchers conduct research and make arrangements at the individual level.”
(Japanese)

In terms of opportunities, one interviewee said face-to-face opportunities were essential for researchers to learn the interests of other researchers, exchange ideas, and look for collaborators. For researchers, opportunities to interact with colleagues and share the latest research are invaluable in presenting their work and finding future international collaborators. One U.S. professor confirmed conferences could present great opportunities for researchers:

“Yeah, generally speaking. Well, international conferences are a huge plus in terms of simply getting to meet the people, getting to hear their presentations, or see their presentations, and just generally bonding, if you like.” (English)

Conclusions related to Recommendations and suggestions

There are various kinds of research support demands among researchers who are at different career advancement stages, and it is essential for funding agencies or organizations to promote more research support options to researchers in international collaborative research projects. To promote advanced engagement among researchers, funding agencies could also create networking opportunities for former research funding recipients. Understanding the impacts created through international collaborative

research is crucial to analyzing the accomplishments of researchers. In terms of sharing resources, exchanging biomaterials, and making travel arrangements, it is essential to have institutional support throughout the international collaborative research process. There are many ways that institutions or organizations can provide administrative support during the data analysis process after the main research experiments. Linguistic skills are especially important in international research collaborations, and there is an integral demand for publishing English among researchers across the world. Sharing information and specifying research targets are also important parts of funding agencies and organizations' agendas. It is crucial to understand the influences of various stakeholders in international collaborative research projects. The advancement of international research collaboration requires the collective efforts of individual researchers, institutions, funding agencies or organizations, private foundations, academic communities, national governments, and other stakeholders across nations.

Summary

In this chapter, I described and analyzed the experiences, knowledge, and perspectives by the 16 researchers based on the proposed conceptual framework, which consists of the prior connections, JSPS/NSF initiatives, funding structures and mechanisms, institutional factors, government policies, initiation and establishment, implementation and procedures, outcomes and products, and recommendations and suggestions.

Understanding and examining respondents' reflections and views on influential factors can contribute to analyzing the effects of their collaborative research. I identified

several common themes across the responses. In the next chapter, I will discuss the research results, present my research conclusions based on my data analysis, present implications for policy, and define implications for practice.

Chapter 5

Discussion and Implications

This study focuses on the relationship between Japanese government research funding and the development of international research collaboration between Japan and the U.S. It is driven by the following research question: *In what ways do government policies, joint JSPS/NSF initiatives, funding structures and mechanisms, institutional factors, and prior connections affect international research collaborations jointly funded by the Japan Society for the Promotion of Science and the United States National Science Foundation?*

In this study, I focused on the perspectives and views of researchers who conduct international collaborative research between Japan and the United States. I conducted interviews with 16 researches representing applied biological sciences, astronomy, biomedical science, engineering, environmental sciences, geophysics, medicine, pharmacology, physics, social sciences, surgical science, and veterinary medicine at higher education institutions or research institutes in Japan and the United States. I asked the 16 interviewees about their experience and knowledge of international collaborative research.

This study provides insight into international collaborative research between Japan and the United States based on nine international research collaboration concepts: prior connections, JSPS/NSF initiatives, funding structures and mechanisms, institutional factors, government policies, initiation and establishment, implementation and procedures, outcomes and products, and recommendations and suggestions.

Discussion

This study provides better insight into international research collaboration by researchers who were funded by government agencies in Japan and the United States. The results of this study indicate that interview participants observed significant influences of JSPS/NSF initiatives, funding structure and mechanisms, institutional factors, and prior connections for researchers who engaged in international collaborative research projects. The researchers at Japanese and American institutions suggest that these four concepts strongly influenced the aspects of international research collaboration, regardless of the nation in which their international research collaborations took place.

Researchers at Japanese and American institutions observed similar effects of the JSPS/NSF initiatives. Scholars discuss the importance of research grants in gaining access to critical resources such as complex equipment, facilities, instruments, and professionals who specialize in using them (Katz & Martin, 1997; Ponds, 2009). The JSPS/NSF initiatives supported research grant-recipients in various ways, and the research grants were critical resources for the researchers who were at different research and development stages to advance their international collaborative research. Funding agencies expect researchers to share resources and conduct studies with experts from various fields (O'Brien, 2012; Pestre & Krige, 1992). Receiving research grants added credibility to their international collaborative research, and it had positive effects on researchers' attitudes and behaviors, regardless of the amount of the grant. In international collaborative research, researchers intend to receive recognition and gain access to resources for additional research and other related activities (Hwang, 2008).

Getting benefits from multiple funding sources was important for researchers in their collaborative research operating procedures, such as organizing meetings, exchanging researchers and students, and arranging travel plans. Pooling multiple funding sources is critical for individual researchers to share the costs of international collaborative research, and funding agencies coordinate international funding support arrangements and establish bilateral research collaboration networks across academic fields (Bammer, 2008; JSPS, 2015g).

Researchers at Japanese and American institutions observed similar effects of the funding structure and mechanisms. Funding agencies and organizations were the primary funding providers for researchers, and the researchers agreed that particular funding agencies and organizations were important funding providers. Funding agencies and international organizations expect researchers to integrate multiple funding sources to conduct international collaborative research (Luukkonen et al., 1993). The integration of multiple funding sources and effective grant management through excellent communication among researchers were crucial for successful international collaborative research. Scholar introduce that government agencies and funding organizations established and developed bilateral research collaboration funding programs across countries to share equipment, knowledge, and other resources (Abramo et al., 2009; Bammer, 2008; JSPS, 2015g). Receiving research funding supports gave these researchers external credibility as well as access to additional research funding opportunities. Funding structures and mechanisms focus on promoting interdisciplinary research collaboration at the institutional, national, and international levels, and researchers have followed this paradigm and share resources with other stakeholders

(Bruce et al., 2004; Lepori et al., 2007; O'Brien, 2012; Sa, 2008). The research funding structures functioned independently in each nation, and researchers could not transfer research grants they received to collaborators across nations.

Researchers at Japanese and American institutions observed similar effects of institutional factors. Pursuing institutional support from their affiliated institutions or organizations enabled researchers and their collaborators to enhance relationships between individuals and explore collaborative opportunities in international research and education. Institutions and their governance structures influence individual researchers in terms of recruiting staff, promoting leadership, and organizing other support activities within international research collaborations (Gornitzka et al., 1998; Heinze & Kuhlmann, 2008; Senker, 2006; Shapira & Kuhlmann, 2003). Some administrative support members were significant contributors of additional assistance to researchers and their collaborators. Institutional leaders who share interests agreed to establish an interuniversity research collaboration network to promote international research collaboration (Yarime et al., 2010). In addition, scholars find that international organization leaders set common objectives in research and established national research collaboration networks (Moed et al., 1991; Narin et al., 1991). Faculty promotion systems and research assessment structures of affiliated institutions or organizations could influence researchers in active and passive ways to conduct international collaborative research. Eddy (2010) argues that promotion and tenure review processes, institutional characteristics, and organizational cultures affect a faculty member's research motivations within research collaborations. Some researchers also conducted research independently of their affiliated institutions or organizations.

Researchers at Japanese and American institutions observed similar effects of prior connections. The interview participants cultivated their relationships with their research collaborators prior to their international research collaborations. Scholars recognize the impact and significance of networking in international research collaboration, and they argue that well-networked scholars are likely to have more opportunities to select collaborators and enhance their research productivity (Wagner & Leydesdorff, 2005). The researchers developed their own networks through established organizational network platforms, individual network platforms, and research development processes. The increase of mobility and growth of networks in research encourage researchers to exchange knowledge and information (Katz & Martin, 1997). The researchers' mobility encouraged them to be flexible in maintaining and developing their connections with their colleagues. Holding face-to-face knowledge- and information-sharing opportunities at international conferences and other networking events is critical for individual researchers to foster international research networks and identify potential research collaborators (Stead & Harrington, 2000). Their research connections were based on the researchers' incentives to create connections, share common research interests, advance the research development process, and explore research advancement opportunities.

Government policies and their effects on international research collaborations

In this study, I determined that the most significant difference of the researchers' perspectives at Japanese and American institutions is in government policies. The results of my data analysis indicate that interview participants observed different effects of the

influences of government policies, and they defined several different subjects that had influenced their international collaborative research. On one hand, researchers affiliated with Japanese institutions shared extensive perspectives and brought up several considerations regarding existing challenges to advance international education and research. On the other hand, researchers affiliated with American institutions shared focused perspectives and discussed the pragmatic reflections for the advancement of international collaborative research.

Researchers at Japanese institutions provided extensive considerations, perspectives, and views on government policies in international collaborative research. They discussed the influences of government policies and six possible improvements: refining research guidelines and regulations, improving research grant proposal review processes, increasing the number of research opportunities and options, advancing internationalization in higher education, utilizing English as the primary language in teaching and research, and setting standard criteria in international research and development.

Regarding research guidelines and regulations, researchers at Japanese institutions argued that government policies need to clarify support for exchanges of biomaterials among researchers in international collaborative research. National governments have recognized the beneficial aspects of international research collaboration such as saving costs and other related benefits (Katz & Martin, 1997). International agreements and protocols play critical roles and influence individual researchers, institutions, funding agencies and organizations, and other stakeholders in international collaborative research. Scholars argue the significance of the benefits of these networks to stakeholders, and they

also state the significance of the benefits not only to individuals but also to nations (Glänzel & de Lange, 2002; Luukkonen et al., 1992; Luukkonen et al., 1993). Under such international agreements, researchers at Japanese institutions were responsible for the procedures in exchanging biomaterials with their overseas collaborators, and the researchers considered that government policies could redefine the responsibilities of stakeholders and ease the burdens on individual researchers.

Researchers at Japanese institutions also explained the importance of improving research grant proposal review processes. The global perspectives of experienced researchers in international collaboration may not be put to full use in advancing international collaborative research. In particular, the international knowledge and experience of the experienced researchers might not be reflected during the process of selecting the recipients of international collaborative research grants, and the selection process for international research collaboration applications might not include a variety of perspectives from internationally engaged researchers.

Researchers at Japanese institutions observed increases in the number of research opportunities and options. Scholars state that organizing goal-oriented management practices and fostering coordination are critical to solving challenges in promoting international research collaboration at the individual and organizational levels (Provan et al., 2010). Government policies created specific research initiatives and research funding opportunities for researchers and extensively supported exchanges of researchers and students. Political leaders also sometimes influenced research budgets and controlled the number of international collaborative research opportunities in Japan. These initiatives

and opportunities encouraged Japanese researchers to develop large networks with overseas researchers and accept researchers from other nations.

Researchers at Japanese institutions noted that one influence of government policies was the creation of strong, centralized institutional leadership teams at Japanese higher education institutions as part of the internationalization of higher education. Scholars argue the significance of research supports across disciplines, nationalities, and sectors in international research collaboration (Bammer, 2008; Kuhlmann, 2001). This centralized leadership set objectives and goals for internationalization across university offices, reorganizing multiple standards in counting transfer credits, training students, and promoting international collaborative research. Scholars discuss the political influences of research collaboration networks on international research collaborations (Moed et al., 1991; Narin et al., 1991). Conflicts of interest exist among individuals, offices, and divisions in promoting internationalization and recognizing transfer credits, and the organizational structure itself constrains the promotion of many internationalization practices, such as accepting graduate students from other nations, transferring graduate course credits, teaching in English, and organizing institutional research support.

Researchers at Japanese institutions argued that utilizing English as the primary language in teaching and research is necessary, particularly in education and research at Japanese higher education institutions. Although disagreements exist among Japanese faculty members in utilizing English as the primary language in teaching and learning, it is necessary to incorporate it into their teaching practices because, in academia, English is the primary language in which to publish research and communicate with colleagues. In

Japan, researchers addressed issues in redundant publications and argued that scholars had no choice but to publish research in English.

Finally, researchers at Japanese institutions shared their extensive perspectives on setting standard criteria for international research and development beyond international research collaborations. Some researchers are also interested in leading a conversation regarding setting standard criteria in relation to the International Organization for Standardization (ISO) in research and development in international collaborations, which is considered a critical element in advancing international collaborative research. Participating in global competitions to set international standard criteria will be important for researchers, academic societies, academies, and national governments.

By contrast, researchers at American institutions pointed out the influences of government policies from the practical aspect of international research collaboration and three potential improvements: utilizing knowledge of research guidelines and regulations, assessing international collaborative research outcomes and achievements, and understanding national governments' interests and priorities. In comparison with the researchers at Japanese institutions, the researchers at American institutions were more likely to focus on pragmatic aspects of advancing international research collaboration.

Researchers at American institutions discussed the importance of understanding and utilizing various types of research guidelines and regulations across nations, stating it would be helpful for researchers and their collaborators to explore possible options for conducting international collaborative research collectively. Researchers at American institutions thought the integration of government guidelines and various regulations

across nations would lead researchers to take advantage of them to conduct international research collaborations.

Researchers at American institutions emphasized the significance of assessing international collaborative research outcomes and achievements. Reviewing and assessing international collaborative research outcomes and achievements from multiple perspectives through cost-effective analysis needs to be accomplished to demonstrate better the effectiveness of international collaborative research. The results of analyzing research outcomes and synthesizing the effects of international collaborative research need to be discussed broadly.

Researchers at American institutions explained the implication of understanding national governments' interests and priorities. To reflect these interests and priorities, political leaders sometimes influence research budgets and control the number of international collaborative research opportunities or options because the outcomes of international collaborative research projects, intellectual property, patents, product inventions, and other related results are considered the benefits of the investments of national governments.

Government policies influence research practices of individual researchers, scholars, and professionals. Each nation's government includes various guidelines and regulations situated in its policies in international collaborative research. The gaps among the research policies could encourage or discourage researchers from participating in networking opportunities and research engagement practices. Thus, refining government policies to set comparable research support guidelines and regulations across nations is necessary to support researchers in international research collaborations.

The more engaged in collaborative research projects at the early stage of their career development, the more likely researchers are to be proactive in exploring possible options for conducting international collaborative research. It is critical to refine the structure of research education systems to attract international researchers and accept international graduate students who would be likely to become the core foundation for promoting international collaborative research.

Government policies exert broad influences on research support organizations' organizational management and operating procedures. Government policies encourage government oversight agencies to articulate the different types of demands on diverse research projects and create opportunities for researchers. Government oversight agencies need to promote the integration of research guidelines and various regulations across agencies for the advancement of international research collaboration.

Funding agencies should not terminate research support initiatives because doing so significantly affects all stakeholders and can lead to the discontinuity of research engagement. Funding agencies and government oversight agencies need to work together in maintaining the number of research funding opportunities and setting research targets based on national interests for advancing international collaborative research across academic disciplines.

Universities need to refine their administrative structures to promote international education and research. It is necessary to reconsider the demand of refined supportive research education for graduate students and postdoctoral researchers. Refining research assessment and faculty promotion systems at the institutional level could encourage faculty members and researchers to become involved in international research. Refining

institutional policies regarding exchanging students across nations and recognizing transfer credits between higher education institutions could enhance student mobility in gaining such international experiences.

It is crucial to incorporate established researchers' experience and knowledge into government policies to continuously refine government policies on international collaborative research. I conclude that government policies were the most critical factors that affected research practices of individual researchers, and these policies also influenced research support policies and the practices of government oversight agencies, funding agencies, research institutions, and universities.

Recommendations and suggestions

The interview participants reviewed their collaborative research experiences and shared their various recommendations and suggestions that beyond the eight international research collaboration concepts: prior connections, JSPS/NSF initiatives, funding structures and mechanisms, institutional factors, government policies, initiation and establishment, implementation and procedures, outcomes and products, and recommendations and suggestions.

Their important recommendations and suggestions are outlined and described. In this study, the term recommendations and suggestions refers to the researchers' comprehensive reflections and suggestions regarding international collaborative research. Recommendations and suggestions are crucial ways of identifying the lack of consistency in policies and support for international collaborative research projects.

The interview participants argued in favor of refining funding agency policies to advance international collaborative research. They acknowledged that the influence of funding agencies came from research funding initiatives. It is crucial to understand the demands of various researchers at different career and research advancement stages and to coordinate research support opportunities for them. Creating more research support opportunities and evaluating research outcomes from multiple perspectives would have numerous positive effects on the incentives and efforts of researchers.

In international collaborative research, it is critical to make international travel arrangements and manage alternative travel options with legal experts and professionals in the field of international education and research. In addition, understanding international agreements and protocols regarding exchanging biomaterials and resources is enormously important for individual researchers, institutions, funding agencies and organizations, and other stakeholders to conduct international collaborative research projects.

Institutional policies and practices can influence researchers' collaboration and create more options for securing extra time for conducting collaborative research. Encouraging the integration of the knowledge of established researchers and emerging researchers can positively affect all members, and improving administrative support structures and policies is necessary for successful international collaborative research projects and the continuity of international collaborative research. The integration of international concepts and initiatives into institutional policies and practices in research and education is extremely important in the process of accepting more international graduate students.

The interview participants argued that linguistics skills are influential factors for successful international collaborative research, and there was an inherent demand for English in both research and education. In particular, they stated English was the primary language for research, teaching, and other academic settings. The interview participants acknowledged English is the primary language in international collaborative research projects and is often the only accepted publishing language. Refining researchers' linguistic and communication skills can help researchers deepen interactions with their collaborators and work together more effectively during international research collaboration.

Funding agencies, funding organizations, and government agencies are important contributors to successful international collaborative research. The interview participants acknowledged that funding agencies, funding organizations, and government agencies are important contributors to successful international collaborative research. Understanding the interests and priorities of these agencies and organizations across nations can increase international collaborative solutions to address complex global challenges. In addition, sharing information and specifying research targets across nations can help funding agencies and organizations construct research support structures and mechanisms for emerging research topics in international collaborative research.

Organized research infrastructures and research support opportunities are important contributors to the advancement of international collaborative research. The interview participants stated it was important to understand that funding agencies and organizations are under the auspices of government agencies and other organizations, and that emerging issues in international affairs can influence the policies and practices of

international collaborative research projects. The researchers were interested in leading a conversation on setting international standards in research and development. Maintaining individual efforts and cultivating positive relationships among researchers can lead to opportunities to join extensive international collaborative research opportunities.

Implications for Policy

Implications for policy focus on three primary stakeholder groups: higher education institutions and research institutes, funding agencies and organizations, and national governments and government agencies. This study examined researchers' considerations, experiences, insights, knowledge, and perspectives on international research collaborations. The study, therefore, focused on individual researchers as primary stakeholders within an academic or research institution. The interview participants described numerous factors that influence their international collaborative research, and they acknowledged that the policies acted as both driving forces and challenges in both Japan and the United States. They commonly mentioned the need for policy reforms at higher education institutions and research institutes, funding agencies and organizations, and national governments and government agencies.

Higher Education Institutions and Research Institutes

The interview participants stated that refining institutional policies and support would aid them and their collaborators in conducting and continuing international collaborative research. Higher education institutions and research institutes could support international collaborative research by sharing common research policies and

research support policies at the institutional level, which would help individual researchers and research teams advance research effectively together with their collaborators at other institutions. For individual researchers and their collaborators, it is crucial to have similar research support at the individual and institutional levels from their affiliated institutions and to share responsibilities in international collaborative research. Higher education institutions and research institutes should ease policy gaps and remove cross-institutional research policy barriers to promoting international collaborative research.

Funding Agencies and Organizations

The interview participants mentioned that funding agencies and organizations need to refine policies related to international research collaborations. Funding agencies and organizations should create more flexible research support policies, incorporate multiple perspectives in the policies to review research grant applications, and design more comprehensive research evaluating policies for the advancement of international collaborative research. Implementing these changes would have numerous positive effects on the incentives of various individual researchers at a variety of career and research advancement stages. In particular, funding agencies and organizations should refine policies on research funding uses and provide more flexible options to researchers and their collaborators to make international travel arrangements and become involved in international conferences, forums, symposiums, meetings, and other networking events across nations.

National Governments and Government Agencies

The interview participants expressed concerns regarding the gaps between the policies of national governments and those of government agencies. International collaborative research policies are different across nations, and gaps in the policies play a critical role in how researchers advance their research. In international collaborative research, some nations have strict guidelines, policies, and rules in regard to research practices, research funding uses, travel arrangements, and so on, whereas other nations have less formal rules regarding these criteria. Individual researchers have to work with experts and professionals in the fields of international education, law, and research to deal with emerging challenges and manage alternative options. In particular, policies regarding exchanging biomaterials and resources have been enormously important for individual researchers under recent international agreements and protocols; national governments and their government agencies should create supportive policies and provide additional support to individual researchers, institutions, funding agencies and organizations, and other stakeholders across nations.

Implications for Practice

This study also contributes to practice related to international collaborative research. Implications for practice focus on five primary propositions: integrating multiple funding sources and various stakeholders, training students and emerging researchers, promoting research collaborations for more extensive collaborations, enhancing relationships among funding agencies and organizations, and refining language skills for effective communication. The interview participants shared broad

perspectives and considerations on their international collaborative research projects, and they found commonly observed, principal lessons for the continuous advancement of their collaborative research. In international collaborative research, all stakeholders need to understand these features.

Researchers should ensure that they will consider and utilize these propositions throughout international collaborative research. Primary stakeholders such as institutional leaders, policy makers, and government officials who provide research support to researchers and their collaborators also need to reconsider their responsibilities and roles for the advancement of international collaborative research. They should encourage, develop, and support international collaborative research by introducing policies at various organizational levels. A greater understanding of these propositions will lead to enhanced and comprehensive processes to advance international collaborative research across nations.

Benefits of Integrating Multiple Funding Sources and Various Stakeholders

The interview participants identified the integration of multiple funding sources and effective grant management through good communication among researchers as essential elements for successful international collaborative research. Operating multiple funding sources encourages researchers to organize flexible research plans and conduct research. To build connections among researchers, established researchers, academic advisors, and emerging researchers should interact positively with individual researchers because their recommendations and suggestions are extremely influential to select research collaborators. In addition, it is essential for individual researchers and their

collaborators to network with experts and professionals from various academic disciplines and institutions to receive extensive research support. The information, knowledge, skills, and supports of these experts and professionals are invaluable for dealing with challenges, rules, and regulations throughout international collaborative research projects. In particular, changes and updates in visa regulations and rules can be critical constraints on exchanging scholars and students across nations. Pursuing administrative support from experts and professionals would make researchers' international travel arrangements much easier. Researchers and their collaborators should include all possible resources and construct networks with experts and professionals to advance their international collaborative research projects together.

Benefits of Training Students and Emerging Researchers

The interview participants stressed the importance of student and postdoctoral coordination when conducting international collaborative research. Not only individual researchers but also funding agencies, research support organizations, and institutions consider training students and emerging researchers an important part of international collaborative research. Throughout international collaborative projects, students and postdoctoral researchers play important roles in establishing, initiating, advancing, and completing international collaborative research projects. In particular, in large international collaborative research projects, they are responsible for major aspects of the research collaboration and data analyses. Almost all interviewed researchers stated that they included their students in international collaborative research, and they emphasized the importance of researcher and student exchanges across nations. Joining different

research teams or participating in research projects at a variety of sites enabled them to recognize different communication forms and intercultural challenges. The researchers acknowledged that previous study or work abroad experiences led them to participate in international collaborative research. Researchers and their collaborators should recognize that the students' current involvements in research will likely encourage them to increase their future involvement and engagements in international collaborative research.

Benefits of Enhancing Funding Organizations' International Relationships

The interview participants argued the importance of enhanced relationships among funding agencies in sharing mutual understandings and providing collective support to all stakeholders in international collaborative research. National interests and priorities likely influence how funding agencies and organizations support individual researchers, research teams, institutions, and other stakeholders in international collaborative research. The researchers expressed concerns about priority gaps and research target differences among funding agencies and organizations across nations. Funding agencies and organizations can identify priorities, specify research targets, share financial responsibilities, and set common research objectives across nations. Building research support structures and mechanisms across funding agencies and organizations enables researchers to understand research priorities, define their research objectives, and find potential collaborators for international collaborative research. In addition, enhancing relationships among funding agencies and organizations across nations can help with identifying emerging global challenges and issues. In addition to individual researchers, funding agencies and organizations need to cultivate relationships with their

partner agencies and organizations and collectively refine their research funding initiatives to support researchers, research teams, institutions, and other stakeholders across nations.

Promoting Research Collaborations Promotes Collaboration

The interview participants pointed out that their international research collaborations can lead to extensive collaborations at the department, college, or institutional levels. Institutional leaders can utilize international collaborative research opportunities to attain partnerships with other institutions. Individual researchers can share an institution's mission, vision, value, and priorities in their academic and professional identities; institutional influences need to be considered as driving forces and strong incentives among individual researchers in international collaborative research. Institutional leaders need to acknowledge that refining research support structures and functions is an important contribution to advancing international collaborative research. In addition, providing institution-wide administrative support to researchers can be done by sending researchers and professionals to other institutions, accepting visiting researchers and professionals, and creating new positions for hiring experts and professionals in international research and education. Institutional leaders should identify how to refine administrative procedures to support international collaborative research, and they should understand it will also benefit their partnership development practices.

Refining Language Skills Leads to Effective Communication

The interview participants, especially Japanese researchers, emphasized language skills as critical communication skills in both international collaborative research projects and international education. They stated that English is the only option accepted by researchers to communicate with their collaborators and publish their international collaborative research. In addition, they argued there was an inherent demand for English in both research and education in Japan; however, some faculty members wanted to keep Japanese as the primary language in teaching and other situations at Japanese higher education institutions. Although there is a conflict of interest in adopting English as the primary language in teaching among academic disciplines, English should be utilized as the primary language in international research. When it comes to international collaborative research, all the interview participants agreed that English should be the primary language for communicating with their collaborators. In international collaborative research, refining language and communication skills in English is vital to holding engaged discussion and working with collaborators effectively. Many Japanese researchers have yet to refine their skills, and this is important, because Japanese researchers need to refine their English communication skills and publish their international collaborative research with their collaborators in English to advance international collaborative research together.

Limitations

This study has some limitations. First, this study's findings represent only the perspectives of the international research collaborations in the bilateral programs

organized by JSPS and NSF. There are many other nations that have established partnerships to promote international collaborative research with Japan and the United States, and these partnerships are beyond the scope of this study.

Second, this study relies on the data from individual researchers and details of particular collaborative research experiences as described by the researchers. Organizing an interview of one hour was a reasonable request; however, the time necessary to get their responses varied because of the scope of their international collaborative research, the number of researchers and stakeholders involved in their international collaborative research, and the language used in the interviews. Through the interviews, in a few cases, I was not able to comprehend fully the perspectives and views of the researchers because of the tremendous scope of their international collaborative research and extensive engagement.

Directions for Future Research

My study provides a strong foundation for advancing additional research in the field of international research collaboration. The number of international collaborative research projects continues to increase around the world. Future research could identify aspects of international research collaboration. Future research related to my study, and in the area of international research collaboration, could be advanced through the following potential studies.

The first potential research project could analyze challenges in and constraining factors on the sustainability of international research collaboration. Further research could identify capability challenges and constraining factors that influence international

collaborative research. The researchers who participated in interviews in my study briefly mentioned that research sustainability was one of the primary issues among individual researchers. Insufficient support from their institutions and funding agencies or organizations could have an influence on individual researchers. In addition, the emergence of new research fields or extensive collaborative research involvement could affect researchers' priorities in international collaborative research. To what extent do broader challenges influence the sustainability of international collaborative research? To what extent does extensive collaborative research involvement influence the sustainability of international collaborative research? Understanding the challenges and benefits of research continuity and the continuous development of research over time would provide an overall understanding of potential obstacles or factors hindering stakeholders in their promotion of international collaborative research.

The second potential research project could analyze international collaborative research projects through observations and assessments of the impact of research support for international research collaboration. Further research could identify challenges and complications that influence the productivity of international collaborative researchers in comparison to their research plans. The researchers who participated in interviews in my study stated that a supportive environment for their research had significant impacts on their international collaborative research. Observing international collaborative research projects and tracking researchers' time and experience at their collaborators' sites would be valuable in terms of understanding challenges and complications relating to productivity in their research. In addition, new policies on international collaborative research or new international agreements affect the standard operating procedures of

international collaborative research. To what extent do challenges and complications influence the productivity of international collaborative research? How do researchers and their collaborators work with research support experts and professionals in dealing with challenges and complications? Understanding challenges and complications that influence the productivity of individual researchers would provide an overall understanding of needed improvements in research support structure and functions across educational institutions, funding agencies, and government agencies.

The third potential research project could compare a group of researchers who received research support grants and a group of researchers who did not receive research support grants. This further research could add value to my current study regarding the impact of government funding support on international collaborative research. The researchers who participated in interviews in my study briefly mentioned that the area of research, the qualification of the funding applicants, the researchers' career stage, and other factors would have a significant impact on receiving funds and advancing their collaborative research. Receiving grants provided credibility for the recipients, and it enabled them to reach out to potential research collaborators. In addition, this potential research would help to show how researchers and their collaborators begin new cutting-edge international collaborative research projects in the emerging research fields that are not recognized as established research fields by governments, funding agencies, and other related organizations. To what extent do government research support grants influence the planning and implementation of international collaborative research? To what extent do government research support grants influence the planning and implementation of international collaborative research? An overall analysis of international collaborative

research projects conducted without government research support grants will help us understand how researchers manage their funds and conduct their studies.

Conclusion

Japan and the United States have much to gain by maintaining sustainable development through cultivating institutional and organizational partnerships, promoting exchanges of students and scholars, integrating international and intercultural education programs, and sharing responsibilities in education, research, and services. Researchers, institutions, funding agencies, academic and professional societies, academies, governments, and other stakeholders in both nations have influenced and shaped the development of research systems in all fields of study. The international mobility of researchers has shaped the behaviors and attitudes of researchers and influenced international collaborative research. Differences in national research funding systems, research policies, and various responsible agencies influence international research collaborations. Understanding the differences between research and education systems is the first important step to identifying and addressing emerging challenges for the advancement of a more productive and responsible global research community.

To build strong foundations and expand research collaboration in a global setting in the future, researchers and all stakeholders need to be aware of priorities to promote international research collaborations and include students and emerging researchers to foster a sustainable research capacity. As this study has indicated, researchers who become involved in international collaborative research at an early stage of their careers are likely to engage in international research collaborations going forward. For the

advancement of international collaborative research, it is a shared responsibility among researchers to include students and emerging researchers in their research. All researchers need to understand how to conduct effective collaborative research with other stakeholders through their associated networks to help generate research that will result in visible benefits and positive outcomes for society.

Stakeholders need to work together and refine policies and practices regarding international collaborative research. Individuals, institutions, funding agencies and organizations, and governments can work together and share knowledge to systemically improve policies and practices of international collaborative research. They can ease policy gaps and get rid of policy barriers, deliver additional flexible options on research funding uses, and provide further support to all stakeholders across nations.

By understanding the challenges and complications that influence the productivity of researchers, we can recommend improvements in research support structures and functions. In particular, researchers, institutional officials, research administration personnel, funding agency staff, and other stakeholders need to work together to create more coordinated systems to effectively implement international research collaborations. We will be able to transform international research collaborations into more productive and responsible research environments by including multiple perspectives of relevant stakeholders. Modifying existing structures to respond to the needs of the research community will significantly influence how emerging researchers are trained and will facilitate more productive international research collaborations.

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APPENDIX

**University of Minnesota Institutional Review Board Study Confirmation
PI Kamata - IRB - Exempt Study Notification**



Takehito Kamata <kamata@umn.edu>

1605E87723 - PI Kamata - IRB - Exempt Study Notification

1 message

irb@umn.edu <irb@umn.edu>
To: kama0086@umn.edu

Wed, May 25, 2016 at 8:31 AM

TO : mand@umn.edu, kama0086@umn.edu,

The IRB: Human Subjects Committee determined that the referenced study is exempt from review under federal guidelines 45 CFR Part 46.101(b) category #2 SURVEYS/INTERVIEWS; STANDARDIZED EDUCATIONAL TESTS; OBSERVATION OF PUBLIC BEHAVIOR.

Study Number: 1605E87723

Principal Investigator: Takehito Kamata

Title(s):
International Research Collaborations

This e-mail confirmation is your official University of Minnesota HRPP notification of exemption from full committee review. You will not receive a hard copy or letter.

This secure electronic notification between password protected authentications has been deemed by the University of Minnesota to constitute a legal signature.

The study number above is assigned to your research. That number and the title of your study must be used in all communication with the IRB office.

Research that involves observation can be approved under this category without obtaining consent.

SURVEY OR INTERVIEW RESEARCH APPROVED AS EXEMPT UNDER THIS CATEGORY IS LIMITED TO ADULT SUBJECTS.

This exemption is valid for five years from the date of this correspondence and will be filed inactive at that time. You will receive a notification prior to inactivation. If this research will extend beyond five years, you must submit a new application to the IRB before the study's expiration date. Please inform the IRB when you intend to close this study.

Upon receipt of this email, you may begin your research. If you have questions, please call the IRB office at (612) 626-5654.

You may go to the View Completed section of eResearch Central at <http://eresearch.umn.edu/> to view further details on your study.

The IRB wishes you success with this research.

We value your feedback. We have created a short survey that will only take a couple of minutes to complete. The questions are basic, but your responses will provide us with insight regarding what we do well and areas that may need improvement. Thanks in advance for completing the survey. <http://tinyurl.com/exempt-survey>