Managing Knowledge in a Changing Scientific Landscape: The Impact of Cyberinfrastructure

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Abstract
Motivating employees to share knowledge has been an ongoing challenge for organizations. In contrast, scientific and academic organizations have built reward systems around knowledge sharing. With the implementation of information and communication technologies and large-scale cyberinfrastructure initiatives, the nature of scientific knowledge sharing is evolving. Technology enables rapid dissemination of knowledge, yet institutions continue to build reward systems based on old models. The current paper describes research-in-progress to examine the skills, cultural shifts, and mindset changes necessary to capitalize on cyberinfrastructure for sharing scientific knowledge. Open-ended interview questions will be used to uncover the factors that are uniquely important in scientific knowledge sharing. While the research is focused on plant scientists who are involved with the iPlant collaborative, an NSF-funded project to build cyberinfrastructure to support research in the plant sciences, the results should be broadly applicable to large-scale technology-enabled science.

1. Introduction

Knowledge sharing has been an area of interest in organizations for quite some time [38, 47, 49, 58]. A number of studies have found that knowledge sharing is likely to occur when there is a perception that knowledge sharing enhances professional reputations and when there is a strong commitment to the community [2, 3, 58]. In an intra-organizational context it is possible to develop a set of rewards and increase commitment to encourage knowledge sharing. But, what happens when one desires that knowledge be exchanged across organizational boundaries? Such is the case in scientific inquiry.

The process for obtaining and sharing scientific knowledge has evolved over time. In the past, researchers have focused on presenting their work at conferences and sharing their knowledge via refereed journal publications. Recently, there has been a movement toward earlier and more open sharing of scientific knowledge, such as the NIH (National Institutes of Health) platform (http://www.nih.gov/). The NIH platform enables medical researchers to openly share relevant information necessary for conducting and supporting medical research before it is published or formally presented. This represents a significant shift in how scientists think about knowledge sharing.

Advances in information technology have enabled these shifts in knowledge sharing. Recently, implementations of large-scale cyberinfrastructure (CI) initiatives have been designed to further the evolution of scientific discovery and knowledge sharing in a variety of research fields [39]. CI can be thought of as a collection of technologies, people, and data that are interconnected via advanced networking capabilities [4]. Some believe that CI represents a second information technology (IT) revolution [10] that will change the way we engage in and share the results of scientific inquiry [45].

The current study asks the question: How do large-scale CI initiatives change the nature of knowledge sharing in scientific inquiry? The study is focused on the iPlant Collaborative, a $50M NSF-funded project to build CI to support plant science research. A key objective of the current study is to understand the skills, cultural shifts, and mindset changes that are necessary to help scientists embrace the changes brought about by CI.

2. Background

Previous studies have demonstrated a growing interest in treating knowledge as a significant organizational resource [1]. This is especially true in the scientific community. High-quality knowledge is important; once it is coded and stored in a knowledge repository, it can be reused [24]. Traditional knowledge management (KM) is the process of organizing, structuring, and sharing the knowledge or intellectual assets in an organization [34]. It attempts to maintain, locate, and apply the organization’s...
collective knowledge systematically [1]. Information technology (IT) assists KM by providing knowledge repositories and methods for capturing, retrieving, and sharing knowledge [34]. Successful KM is expected to have a positive impact on the organization through its improvement of organizational effectiveness. Understanding and defining the factors related to KM success is a difficult endeavor due to the dynamic nature of knowledge [35].

KM systems should be built and implemented to support KM success, however KM success is defined and measured [33]. The DeLone and McLean information systems (IS) Success Model [21, 22] is a generally accepted model for assessing success of an IS. Using the IS Success Model as a theoretical basis, Jennex and Olfman [34] derived a KM success model from observations generated through a longitudinal study of KM in an engineering organization. Knowledge quality is an important dimension of KM success. Knowledge quality is focused on ensuring that the right knowledge with sufficient context is captured and presented to the right users at the right time. Three constructs are included in the knowledge quality dimension: the KM strategy/process, knowledge richness, and linkages between components. The KM strategy/process construct is about knowledge capture, knowledge reuse, process planning, knowledge format and storage. The knowledge richness construct looks at the accuracy and timeliness of storing knowledge and the context needed to make knowledge useful. The linkages construct is about the availability of expertise to identify important knowledge resources. The model also includes a perceived benefit dimension, since the use of a KM system is typically voluntary.

These elements of KM success are important for evaluating the outcomes of KM initiatives. While they have been used for organizational KM success evaluation, many of the constructs are relevant in the broader realm of knowledge sharing.

2.1. Knowledge Sharing

Knowledge sharing refers to the coordinated exchange of knowledge and information among individuals. Garfield [28] suggested 10 explanations for why people do not share their knowledge in online communities. These 10 reasons can be grouped into four main categories: (a) people do not understand why knowledge sharing is important for the organization or for themselves; (b) they do not know the best ways to share knowledge; (c) they may not believe the recommended ways of knowledge sharing are effective; and (d) they are not motivated to share and do not see personal benefits of sharing (or even see potential negative consequences of sharing).

Figure 1 summarizes prior research that has examined the factors that motivate people to share (or not) their knowledge. Wasko and Faraj [58] conducted a longitudinal research to study knowledge sharing in an online virtual community supporting a professional legal association. Guided by social capital [43] and social exchange theories [11], they found that people tend to actively contribute to the online community when they perceive that this enhances their professional reputation, and when they feel strong commitment to the community. Meanwhile, contributions are made without immediate expectations of reciprocity from others. Wasko and Faraj [58]
measured the dependent variable, knowledge contribution, by examining both the helpfulness and the volume of the contribution. Content analysis was used to determine the helpfulness of each response message and the total number of messages posted by each individual was used to measure the volume of contribution during the experiment time period.

Leveraging social capital [43] and social cognitive [8] theories, Chiu, Hsu and Wang [14] examined individuals’ willingness to share their knowledge in online communities. They found that social ties, trust, norms of reciprocity, identification with the community and its goals, shared mission and vision, and shared language play a significant role in employees’ decision to share their knowledge in a professional virtual community. For the dependent variable, they also measured both the quality of knowledge sharing by analyzing the message content and the quantity of knowledge sharing based on the average volume of an individual’s knowledge sharing per month.

Finally, guided by social cognitive theory [8], Hsu, Ju, Yen, and Chang [31] found that self-efficacy, personal outcome expectations, and trust play important roles in determining the knowledge sharing behavior of online communities. The dependent variable in this study, knowledge sharing behavior, was measured by the frequency of sending or presenting knowledge to a potential recipient.

2.2. Cyberinfrastructure

Science depends on communication among researchers and on access to the wealth of scientific knowledge generated by the scientific community. Until recently, this function was provided by an infrastructure that was based on paper or face-to-face interactions. Knowledge was stored in journal articles and books which were accessible in libraries [30, 59] or exchanged during meetings and conferences. Now, this infrastructure is changing [54]. Many institutions are creating online knowledge infrastructures in the form of electronic journals [13], digital libraries [53], online encyclopedias [29] and collaboratories [60] which provide instant access to large amounts of scientific knowledge.

CI refers to infrastructure based upon distributed computer, information and communication technology [4]. As shown in Figure 2, a CI contains three layers. The bottom layer is the enabling technologies that are the integrated components of computation and storage that continue to advance in raw capacity at exponential rates [4]. The middle layer consists of enabling hardware, algorithms, software, communications, institutions, and personnel. This layer aims at providing an effective and efficient platform for the empowerment of specific communities of researchers to innovate and eventually revolutionize what they do, how they do it, and who participates [4]. The top layer consists of software programs, services, instruments, data, information, knowledge, and social practices applicable to specific projects, disciplines, and communities of practice [4].

Figure 2: The three-layer structure of CI

CI should be produced and managed in a way that enables research communities or projects to tailor efficient and effective application-specific, but interoperable, knowledge environments for research and education. Interoperability is important for facilitating multidisciplinary projects as the evolution of discovery dictates [4]. It is important to note, however, that CI is more than high-performance computing and connectivity. It assists and enables sharing, efficiency, and making greater capabilities available across research communities. It also serves to facilitate new applications, allow applications to interoperate across institutions and disciplines, ensure that data and software acquired at great expense are preserved for future generations and easily available to all, and empower enhanced collaboration over distance and across disciplines. CI enables individuals to have access to more information more rapidly. It is intended to provide a mechanism for data and knowledge sharing. While publications and conference
presentations represent the primary mechanism for knowledge sharing in science, institutions embarking on CI initiatives hope to encourage sharing earlier in the scientific process and across a broader group of people. By effectively bringing together a simultaneous focus on mission, organization, processes, and technology, CI offers the potential to conduct novel types of research in new ways. It creates the need to involve social scientists as well as natural scientists and technologists in a joint quest for better ways to conduct research [4].

As an example of a CI initiative, NCEAS (The National Center for Ecological Analysis and Synthesis; http://www.nceas.ucsb.edu/) supports cross-disciplinary research that uses existing data to address major fundamental issues in ecology and allied fields, and their application to management and policy. NCEAS has hosted over 4,000 individuals and supported more than 400 projects since its inception in 1995. The projects have produced a wide array of outcomes, from specific results to general knowledge about a discipline and its application to the management of resources. NCEAS public data repository contains information about the research data sets collected and collated as part of NCEAS’ funded activities. Data can be accessed through the Knowledge Network for Biocomplexity (KNB; http://knb.ecoinformatics.org/index.jsp), an international data repository. A set of KNB software is developed to provide an efficient way to “discover, access, interpret, integrate and analyze complex ecological data from a highly-distributed set of field stations, laboratories, research sites, and individual researchers”. In addition, NCEAS provides different tools to enable online collaborations, including private Web areas, archived email lists, and remote communication. Each working group in NCEAS has a dedicated Web area hosted on their servers. This service allows group members to download shared documents, references, data, and other files using a Web browser. Email lists can be set up to manage communication among working group members which makes it easier to ensure that all collaborators are receiving messages at their current addresses. In addition, a regular conferencing phone and a video conferencing system are available for remote communication.

An example of an emerging CI initiative is project Bamboo (http://projectbamboo.org/), a multi-institutional, interdisciplinary, and inter-organizational effort to bring together arts and humanities researchers, computer and information scientists, librarians, and campus information technologists. Project Bamboo hopes to encourage Participants to develop shared technology services that will enable them to collectively engage in the enhancement of arts and humanities research. The project plans to derive “a number of commonalities, scholarly primitives, and natural clusters of activity across disciplines, and develop a deep understanding of needs and services”. The major goal is to “create a strong, analytic framework and documented understanding of the humanities to guide the development of a common services development”. Small teams of collaborative researchers could focus on solving important and potentially transformational problems for humanities scholarship, and then transfer this knowledge to a lightly coordinated system of collaboration that helps to transition successful projects into long-term sustainable and shareable services.

The focus of the current study is the iPlant Collaborative (http://www.iplantcollaborative.org). The goal of iPlant is to build CI to advance plant science research. The project’s philosophy is that the CI is ‘by, for, and of the community.’ As a result, iPlant has adopted an ‘if they come, we will build it’ approach that encourages scientists to come together in grand challenge workshops to identify grand challenge questions and the CI needed to answer them. The grand challenge workshops and the grand challenge research projects that emerge from them include researchers from diverse disciplines, including biology, ecology, statistics, bio-informatics, and computer and information science. iPlant leverages cross-disciplinary teams to work collaboratively with iPlant staff to design and develop Discovery Environments -- “software platforms custom designed to help the team address a grand challenge question.” Discovery environments take the form of mashup applications that enable integration of diverse sets of data and tools. iPlant development is founded on an open source philosophy that will ultimately enable the CI to be expanded and maintained by the community.

In addition to the underlying core technologies, there is a consistent theme across these CI initiatives. Specifically, the goals associated with connecting individuals from multiple disciplines and multiple institutions lead to interesting challenges, particularly when the ultimate goal is to share and advance knowledge in a specific domain. While the ultimate outcome is to share knowledge, CI changes the way in which this sharing occurs. CI has a significant impact on the process of sharing scientific knowledge.

3. Research Model

In developing our research model, we draw on the theories that provide the foundation for the knowledge sharing research described above. Specifically, we focus on social cognitive, social exchange, and social
capital theories. In this section, we discuss those theories as our foundation and highlight the contextual issues that are particularly relevant for scientific knowledge sharing. We conclude with a set of propositions.

3.1 Social Cognitive Theory

Social cognitive theory argues that a person’s behavior is partially shaped and controlled by the influences of his or her social network (i.e., social systems) and his or her cognitions (e.g., expectations, beliefs) [8]. Bandura [8] advances two types of expectation beliefs as the major cognitive forces guiding behavior: self-efficacy and behavior outcome expectations.

Self-efficacy is a form of self-evaluation that influences decisions about what behaviors to undertake, the amount of effort and persistence to put forth when faced with obstacles, and finally, the mastery of the behavior. In general, the perceived self-efficacy plays an important role in influencing individuals’ motivation and behavior [6, 7, 32]. People who have high self-efficacy will be more likely to perform relevant behavior than those with low self-efficacy [31].

Outcome expectations refer to the expected consequences of one’s own behavior [9, 17]. Compeau and Higgins [16, 18] discussed the role of individuals’ beliefs and reactions about their ability to competently use computers in the determination of computer use. They identified two types of outcome expectations concerning individuals’ computer use: performance-related outcome expectations and personal outcome expectations. Performance-related outcome expectations are associated with improvements in job performance associated with using computers. Personal outcome expectations relate to change in image or status and to rewards, such as promotions, raises, or praise. Their study shows that both types of outcome expectations have a significant effect on computer usage.

According to Bandura [9], outcome results from actions and may be anticipated by people while judging how well they can perform in a given situation. In other words, people will judge their expected outcomes before taking actions. Thus, this relationship bridges the belief of personal efficacy and the outcome expectations. Prior IS studies have provided strong support for the significant relationship between self-efficacy and outcome expectations [16, 17, 18, 36]. Based on social cognitive theory and prior knowledge sharing research, we expect that:

\[ P1: \text{Outcome expectations will be positively associated with scientific knowledge sharing.} \]

3.2 Social Exchange Theory

Social exchange theory [11] posits that individuals engage in social interaction based on an expectation that it will lead in some way to social rewards such as approval, status, and respect. This suggests that one potential way an individual can benefit from active participation is the perception that participation enhances his or her personal reputation in the network [58]. Reputation is an important asset that an individual can leverage to achieve and maintain status within a collective [37].

Prior research has found that building a reputation is a strong motivating factor for participating in online networks [23]. Individual reputations in online settings can extend to the profession [52]. In addition, Constant [19] found that people will take part in a community action more often if they can improve their reputations. Individuals will continuously share their knowledge if they feel it enhances their reputation [40]. Thus, the perception that contributing will improve their status in their profession may motivate individuals to contribute their valuable, personal knowledge to others in a virtual community. Based on social exchange theory and prior knowledge sharing research, we expect:

\[ P2: \text{Social rewards will be positively associated with scientific knowledge sharing.} \]

3.3 Social Capital Theory

Social capital theory suggests that social capital, the network of relationships possessed by an individual or a social network and the set of resources embedded within it, strongly influence the extent to which interpersonal knowledge sharing occurs [43]. Nahapiet and Ghoshal [43] define social capital with three distinct dimensions: structural (the overall pattern of connections between actors), relational (the kind of personal relationships people have developed with each other through a history of interactions), and cognitive (those resources providing shared representation, interpretations, and systems of meaning among parties).

Among the most important facets of the structural dimension for knowledge sharing is the presence or absence of social interaction ties between actors [50, 51]. Tsai and Ghoshal [55] considered social interaction ties (network ties) as channels for information and resource flows.

Important facets of the relational dimension for knowledge sharing are trust [15, 27], norms of reciprocity [48], and identification [43]. Nonaka [44] indicated that inter-personal trust is important in teams and organizations for creating an atmosphere for
knowledge sharing. Likewise, Bouty [12] found that the exchange of resources among scientists across organizational boundaries was based on the mutual trust among these researchers. According to Blau [11], reciprocity implies “actions that are contingent on rewarding reactions from others and that cease when these expected reactions are not forthcoming.” Identification refers to how an individual thinks of him/herself in terms of relevant social categories [5], in this case, the virtual community. In a virtual community, identification refers to an individual's sense of belonging and positive feeling toward a virtual community, which is similar to emotional identification proposed by Ellemers et al. [25].

The most important aspects of the cognitive dimension for knowledge sharing are shared vision [15, 55] and shared language [43]. Shared language goes beyond the language itself; it also addresses language usage, such as people’s underlying assumptions and the nuances of acronyms [41]. Tsai and Ghoshal [55] noted that a shared vision represents the collective view of organizational members. Based on social capital theory and prior research in knowledge sharing we expect:

**P3: Structural, relational, and cognitive aspects of social capital will be positively associated with scientific knowledge sharing.**

### 3.4 CI and Scientific Knowledge Sharing

Social cognitive, social exchange, and social capital theories provide a solid foundation upon which to build our understanding of scientific knowledge sharing in a CI environment. In general, we propose that the theories supporting organizational knowledge sharing will behave in a similar fashion for scientific knowledge sharing. It is important to note that the results of prior research have, in some cases, been in conflict. This may be due to the dependent variable selected or the context under study. As Orlikowski and Iacono [46] propose, the context is an important part of theorizing. Thus, when trying to understand the nature of scientific knowledge sharing, it is important to acknowledge elements in the scientific context. Furthermore, specific challenges exist in a CI-enabled scientific collaborative. While people in different departments of an organization might have discipline-specific language, they do share a common frame of reference that is the organization. In a scientific collaborative, participants span disciplines and organizations. When considering scientific knowledge sharing in a CI-enabled environment, shared language is a critical component. Participants have significant challenges associated with differences in vocabulary, culture, reward systems, goals, and incentives [20].

Furthermore, although organizations often desire the results of multi-disciplinary scientific research there is often little support for multi-disciplinary research in the form of incentives. Researchers may also have a difficult time getting their findings acknowledged or accepted as there are few outlets for multi-disciplinary research.

The theories used to understand knowledge sharing in organizations can help to identify the factors that are relevant for influencing scientific knowledge sharing. In the models discussed earlier, three different sets of dependent variables are used. Specifically, Wasko and Faraj [58] measured helpfulness and volume of contributions. Chiu et al. [14] examined quantity of knowledge submission and knowledge quality. Hsu et al. [31] measured the frequency of knowledge submission. While quantity is clearly a theme in prior research, quality has received less attention. Further, timeliness of knowledge sharing has not been addressed. In scientific knowledge, timeliness is an important element [59]. Existing structures for knowledge sharing in science can impose significant time delays due to the review process and possible publication backlogs [59]. By the time knowledge reaches the broader community, researchers have typically moved on to newer topics. CI provides a mechanism for reducing the time to share knowledge. However, this could be at the cost of quality, which is enhanced by the review process. We expect that the relevant dimensions of scientific knowledge sharing success will be different than those for organizational knowledge sharing success.

Prior research in technology acceptance has identified important moderators of key relationships. While some of the moderators are based on individual characteristics (e.g., age, gender), others are based on personal experiences. In the scientific community, a number of elements could contribute to differences in the relationships proposed above. Similar to Venkatesh et al. [57], we expect that experience will moderate, some of, the relationships. Experience with the technology and/or the particular CI being used by the community can alter, for example, the importance of social exchange constructs on knowledge sharing. Status or rank in the academic community can also have a moderating effect, such that reputation (as an example) has a reduced effect on knowledge sharing. Thus, we propose:

**P4: Contextual factors affecting CI acceptance and use will moderate relationships between social cognitive, social exchange, and social capital factors and knowledge sharing.**

The contextual factors that we propose to investigate include age, gender, experience, rank, and
reputation. However, our research method is designed to enable further refinement of this list.

4. Research Method

The context of the study is the plant science community and the iPlant Collaborative. iPlant is in its second year of funding and is currently in the process of working with two different grand challenge teams to develop the initial components of the CI. During the past two years, iPlant has held workshops for plant and information scientists in order to educate the communities about the project. At this point in time, we expect that community members will have, at a minimum, a basic awareness of the project.

In order to generate a list of factors relevant to scientific knowledge sharing, we will conduct a series of interviews. The interviews will be targeted at researchers working in the area of plant science to understand the factors that motivate and hinder their participation in knowledge sharing activities. Interviews are appropriate for this research for a number of reasons. First, the context is sufficiently different from an organizational setting necessitating a focus on the specific population of interest. For example, Venkatesh and Brown [56] argued that the household context was sufficiently different from the organizational context of technology adoption. Through the use of open-ended interview questions, Venkatesh and Brown [56] were able to identify factors associated with household PC adoption that had not been previously identified in organizational adoption. Similar to the approach used by Venkatesh and Brown [56], we will conduct open-ended interviews to elicit the relevant beliefs in this context. Our initial sample size is 30 individuals; however, we will continue interviewing until we achieve convergence in the responses.

The interview script is presented in the Appendix. The questions are designed to tap into social cognitive, social exchange, and social capital theories. While we leverage the findings in prior research, the questions have been designed to elicit information that extends beyond prior work. Similar to Venkatesh and Brown [56], the interview responses will be coded based on the constructs defined in prior work, with the ability to identify new constructs based on interview responses.

We will rely on the guidelines presented by Miles and Huberman [42] for conducting our data coding and analysis. Specifically, an initial list of constructs and definitions will be provided to two coders. As they encounter comments that are outside the coding list, they will identify them and the researchers will examine the list to derive additional constructs as needed. Once this process is completed, the coders will go back through the data using the expanded list. Inter-rater reliability will be assessed and, where discrepancies exist, the coders will negotiate to consensus. Once the data is coded, response patterns will be examined to evaluate the degree to which they conform to or diverge from the propositions.

5. Expected Contribution

While some CI-related research is focused on evaluating the development of the CI itself (e.g., [26]), the current study focuses on the knowledge sharing communities that are impacted by the CIs. Some of the greatest scientific discoveries have occurred through multi-disciplinary awareness and interaction, making multi-disciplinary research a high-risk, high-reward venture. Organizations such as NSF are striving to utilize advance in IT to make multi-disciplinary scientific research less risky for individual researchers. One of our expected contributions is to encourage this effort.

More specifically, the results of this research will provide insights into the nuances of CI-enabled scientific knowledge sharing. First, the current research will identify the factors relevant for scientific knowledge sharing. Second, the current research will uncover the relevant qualities of knowledge sharing behavior. Finally, the current study will identify relevant context-related moderators. Thus, the current study can inform CI initiatives, such as iPlant, NCEAS, and Bamboo regarding the hurdles that will have to be overcome to enhance knowledge sharing, and the outcomes that are needed to evaluate it. The resulting model that emerges from this study can be tested in future work.

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7. References


[2] A. Ardichvili, "Learning and Knowledge Sharing in Virtual Communities of Practice: Motivators, Barriers, and


8. Appendix: Interview Script

Knowledge sharing is an important aspect of the scientific discovery process. I have a series of questions about how and why you currently share your knowledge and how it might change with the evolution of technology tools.

1. a. What sorts of things contribute to your personal reputation in the field?
   b. How important are the following for developing your personal reputation:
      1. Publishing
      2. Conference presentations
      3. Sharing early results of research
      4. Sharing data
      5. Participating in cyberinfrastructure projects
      6. Other (please explain)
   c. overall, how important is personal reputation to your success in the field?

2. a. How important is it to you to expand your social network – to work with other researchers
   1. in your field
   2. in other fields
   3. in other institutions
   b. What makes the expansion (un)important?

3. What things make it easier for you to share your research and results with others?
(Probe – is it a trusting relationship, a shared language (e.g., in the same discipline), shared goals, CI familiarity, academic rank, etc.)

4. What things inhibit your desire and ability to share your research results at:
   a. planning stage
   b. data collection
   c. after data collection
   d. pre-publication
   e. during the review process
   f. once published

5. How important for knowledge sharing are the following:
   a. technology readiness/comfort
   b. participating in development of the CI
   c. academic rank
   d. academic affiliation
   e. common academic discipline
   f. Age/experience
   g. common research goals
   h. other (please describe)

6. a. How should scientific knowledge sharing be evaluated? What are the important elements – quality, quantity, frequency, timeliness, other?
   b. With respect to the elements that are important in the evaluation of scientific knowledge sharing, how would you rank the items we just listed?

7. What are the important rewards you get from conducting and publishing your research?

Cyberinfrastructure initiatives, such as the iPlant Collaborative, are increasingly being developed to enable cross-disciplinary collaboration and rapid dissemination of research results.

8. Have you heard of iPlant? (if no, ask the remaining questions using a CI description). What do you understand about it?

9. Who would you consider to be the most influential members of your social network?
   a. with respect to your social network, what is the general attitude toward collaborating with iPlant?
   b. do members of your social network believe that iPlant can help you to achieve your research goals? (if yes, why; if no, why not)

10. Do you believe that participating in iPlant will enhance your research performance? (if yes, why; if no, why not)

11. Do you believe that participating in iPlant will alter your status in the field? (if yes, why; if no, why not)

12. What are the characteristics of people who are most likely to embrace the iPlant collaborative and share their knowledge, data, and research.

13. Do you have recommendations for other people we should interview?

14. Is there anything else you would like to discuss with respect to your field or iPlant that was not raised in the previous questions?