

The five themes introduced at the end of Chapter 2 frame an agenda for the research enterprise that reflects the concerns, insights, and experiences of a wide range of stakeholders. This chapter discusses the five themes and presents key research questions for each.

### Understanding the multiple-value propositions that stakeholders bring to the enterprise and how they are aligned, are complementary, or conflict.

Value propositions and interests are central to the way stakeholders and decision makers participate in and attempt to influence the grants-making process. These value propositions involve different priorities given to knowledge building, ethical behavior, financial accountability, relevance to societal needs, and inclusiveness in decisions. The enterprise must be sensitive to where stakeholders agree about these values and where they do not. It must recognize where conflicts must be resolved, avoided, or accepted, and where consensus forms a foundation for action. Moreover, individual stakeholder groups are seldom homogeneous in their views or priorities, so research on value propositions should include attention to value differences both within and across the relevant organizations and stakeholder groups.

Grants-making policies and award decisions involve a wide range of potentially competing value propositions and interests. These include propositions about what rules and priorities should govern the grants-making process; what questions, institutions, disciplines, or styles of research should receive more or less funding; who should participate in review and allocation decisions; and who should decide grant policies and priorities. Exploring the dimensions of seemingly competing values, for example, is a strategy for discovering real or perceived differences. Identifying and sharing these value propositions as part of joint problem solving can allow members of the enterprise to understand competing values in a multifaceted way. For example, in an effort to respond to its own need for budget accountability and grantee interest in budget flexibility, and a shared interest in reducing administrative burden NIH established a new policy that provides for budget blocks. NIH budgets are now submitted in blocks of \$25,000. Grantees report budget categories and aggregate amounts within those categories. Their policy enables the accountability that NIH is interested in, provides flexibility to grantees within budget categories, and frees both from the level of effort associated with line item budget preparation and review.

Better knowledge about stakeholder values and interests could also help us evaluate the benefits of research by identifying outcomes most highly valued by critical stakeholders. Better understanding of these interests and value propositions could also be useful in identifying the terms of discourse most likely to communicate effectively about the value of research to the range of relevant stakeholders. Information about the benefits of biomedical research, for example, can be framed to communicate effectively with patients and health care advocates, as well as with scientists or clinicians.

### Key research questions

- What values are held by the different stakeholders within the research enterprise?
- How are these values operationalized?
- How do values influence decision making in the research enterprise?
- How do values influence the cost and performance of the enterprise?
- What policy and practice alternatives might move the enterprise close to the ideal vision?

### Understanding how work is done by individuals, within and across groups, and within and across organizations

At its most basic level, grants making is a series of business processes made up of highly interdependent work flows. Many of these processes are performed in parallel, others play out in specific sequences. They range from very flexible to highly rigid. Some processes are carried out within single departments; others span multiple organizations across the enterprise. Understanding how work is done within and among the organizations in the enterprise is therefore a critical building block of the research agenda.

The essence of workflow is role-based routing that reflects complex organizational policies. The proposal preparation, submission, review, and management stages of the grants-making process (illustrated in highly simplified form in figure 2) are governed jointly by the policies and practices of many organizations. As the enterprise evolves from paper-based and manual workflow systems to sophisticated electronic work flow systems,

we need increasingly detailed and comprehensive models of how work is done.

Work-flow technologies deal with work processes as a collection of activities that support a specific business process. This overall business process is treated as consisting of two work-flow components, both of which are critical to smooth and effective operation. These are control flow and data flow. The mechanisms and sequences of events that determine the path and pace of the work are known as the control flow. Some activities in a process can be performed in parallel, while others must be done in sequence, thus there are multiple paths or flows possible for a business process. Data flow refers to the movements of data and documents that accompany or make up each activity in a business process.

For work-flow technologies to be effective in grants-making they must meet several criteria. They must enable researchers to focus on the content of a proposal, reduce overall human effort, minimize the number of steps in a process, and minimize the time to process a proposal. Although many current workflow systems meet some of the above criteria, none appears to address fully the complex interplay of organizational policies and interorganizational relationships involved in the grants-making process. Accordingly, future research should focus on the development of next generation workflow systems that include features such as a meta model or language for describing complex group activities and tasks. Further, they must capture complex organizational policies and handle the cross-organizational implications of policy or process changes. Research is also required to develop a framework for dynamic workflow schema changes that allow for changes to be made "on the fly" rather than necessitating wholesale upgrades or re-engineering of systems.

By its nature, the grants-making process is collaborative and hence needs to support collaboration tasks within and across organizations. Most current workflow technologies lack this support and therefore present another area for future research: the development of robust architecture and applications that facilitate seamless integration of interorganizational workflow and collaboration support systems.

### Key research questions

- What is the nature of work conducted by the various individual stakeholders within the grants-supported research enterprise and what are the most effective ways to model and analyze these work processes?
- How does this work change when conducted in an interorganizational arena?
- How can modeling tools capture sophisticated interorganizational group processes?
- Can complex organizational and interorganizational policies be adequately described and used effectively within workflow systems?
- How can workflow technologies support dynamic workflow changes?
- What technical architectures support collaboration and what applications are needed to integrate workflow across interacting, but separate, organizations?

### Understanding how knowledge is captured, managed, and used within the enterprise

The grants-making enterprise is both knowledge-intensive and multi-organizational. Thus, improved intra- and inter-organizational knowledge creation, sharing, and management are critically important in enhancing effectiveness and supporting the ideal vision for grants-supported research. At present, no single discipline or research frame is adequate to study how knowledge is acquired, used, and shared. These frames include the social construction of knowledge and the sociology of science, organizational theory and organizational learning, the knowledge-based theory of organizations, and the technologies and methods known as knowledge management. While none of these is comprehensive, they do share some general concepts that are useful to describe and analyze the knowledge issues involved in the grants-making enterprise, they are:

- **Explicit knowledge**--which can be expressed and communicated in formal ways (such as through language, symbols, or images)
- **Tacit knowledge**--which is possessed and applied by a person but not fully expressed or communicated in formal terms
- **Embedded knowledge**-- which is expressed or captured in artifacts, groups, processes, or structures

- **Knowing or knowledge-in-action**--which refers to knowledge that is part of and expressed or shared through practice or activity.

Developing, sharing, and managing these forms of knowledge requires distinctive strategies and methods that reflect the important differences among them. The formal grants-making processes are most appropriate for and are often supported by formal mechanisms for collecting and working with explicit knowledge about policies, regulations, scientific programs, proposals, investigators, institutions, and activities. However, there are several unanswered research questions regarding how best to handle these explicit knowledge assets. These include how to build or expand formal institutional memory and make it accessible and usable. Additional research is needed to explore what semantic and ontological resources or tools are needed to integrate explicit knowledge across programs and disciplines. This research should include attention to what forms of learning and which knowledge-sharing mechanisms are best suited to the social structures and cultures of grants-making organizations and to the various discipline or practice communities within them.

Along with this substantial body of explicit knowledge, grants making requires subtle judgments and considerable tacit knowledge. In any grants-making organization, program staff have difficulty in delineating and codifying the tacit knowledge that is created and used in making complex judgments when working with investigators and reviewers. Research related to tacit knowledge should include attention to the kinds of tacit knowledge employed in seeking grants, in the scientific review process, and in grants management. It would also be useful to study the role of organizational factors, such as trust and communities of practice, on tacit knowledge sharing and management.

Even though it is not generally recognized, embedded knowledge plays an important part in much of the grants-making enterprise. Knowledge is embedded in review procedures, information systems, and in many of the group processes that are characteristic of the enterprise. It would be useful for research related to embedded knowledge to explore how knowledge about grants making becomes embedded in organizational processes and cultures, and under what conditions or forms embedded knowledge acts as valuable institutional memory or as an impediment to innovation. The knowledge content of some activity may be formalized and explicit (e.g., how to solicit proposals) but others may be much less so (e.g., how to conduct a review panel, or how to evaluate the scientific merit of an idea).

### Key research questions

- How can the knowledge embodied in the grants-supported research enterprise be usefully classified by type (explicit, tacit, embedded, knowledge-in-action)?
- How, or in what way, can the interplay among these types be modeled? By what means can one type be transformed to another (e.g., can tacit knowledge be made explicit)?
- What role do organizational factors, such as trust and communities of practice, have in tacit knowledge sharing and management?
- What semantic and ontological resources or tools are needed to integrate explicit knowledge across programs and disciplines?
- How do the dynamics of critical knowledge-in-action processes affect the outcomes of grants-making decisions?
- To what degree is participation in these processes necessary for developing the knowledge required by agency staff or investigators?
- How does knowledge about grants making become embedded in organizational processes and cultures, and under what conditions and in what forms does embedded knowledge act either as valuable institutional memory or as an impediment to innovation?
- To what degree is the unequal distribution of knowledge about grants making throughout the enterprise an impediment to the development of proposals or a source of unfairness in grants making?
- What sorts of policy or procedural changes would reduce or eliminate these problems?

### Understanding how individuals, groups, and organizations collaborate across the boundaries of structure, time, and place

Grants making is a collaboration-intensive activity with collaborations in both the intra- and inter-organizational contexts. Since these activities cut across both time and space, collaborative technologies present attractive

possibilities for improved communication and performance. Over the years, electronic mail, workflow, and virtual meeting technologies have been deployed by organizations to enhance the effectiveness of their collaboration tasks. When used appropriately, these collaborative technologies can foster creativity, improve the quality of discussions, save time, and be satisfying to use. However, determining what constitutes appropriate use of these technologies is a nontrivial undertaking. These technologies appear to be most helpful for groups that experience communication problems due to their size, for groups that handle complex problems or tasks, and for virtual teams with members located in different places, all of which are found in the grants-making process.

The grants-supported research enterprise presents several excellent opportunities for studying collaboration and collaboration tools. Each opportunity includes a range of collaboration activities focused on different aspects of the enterprise. The development and definition of research initiatives, for example, which involve granting agencies, interested constituencies, potential investigators, and political leaders. Proposal preparation may involve investigators in different departments or different institutions. Proposal evaluation and selection often involves geographically distributed review panels.

Grants management involves collaboration among administrators and program officers in the granting agency along with research administrators and investigators in the grantee organizations. Successful deployment of collaboration technologies in grants making presents several research challenges. A salient feature of collaborative technologies is their ability to improve the exchange of both common and unique knowledge among the participants. However, mere exchange of knowledge does not enhance the quality of collaborative activity, which requires better understanding of the deeper structures and processes of collaboration. From a practical perspective, the challenge is to change the way people work by encouraging experimentation, enabling careful reflection and evaluation of ideas and action, adopting and inventing new best practices, and developing special purpose processes and tools. A related challenge is to identify best practices that can be extracted from one setting and adapted for use in others.

Too often organizations import beliefs and theories from the "old media" (i.e., paper-based work processes) and find that just automating the old ways does not bring significant benefit. New theories, new work processes, and new tools to reflect and inform emerging modes of group work are needed to advance collaboration initiatives and to guide the adoption of new work processes and structures engendered by technology use.

### Key research questions

- What is the nature of the critical collaborative processes in current efforts to develop research initiatives, prepare and review proposals, conduct research, and manage grants?
- What are the key factors that lead to successful collaboration in the research enterprise? What tools and techniques need to be developed for virtual collaboration to be successful?
- What kinds of incentives support collaborative work models? How can organizations provide incentives for collaboration?
- What advances are needed in technologies such as peer-to-peer networking?
- How do these technologies interact with group norms and functioning to produce effective collaboration?

### Understanding how to choose, use, manage, and support information technology investments

Modern organizations cannot operate without significant investments in information technology to support both routine operations and new innovations. However, the constantly changing aspect of technology and the risks of innovation pose dilemmas for organizations. All innovations have risks resulting from the interactions among innovation characteristics and organizational characteristics. Insufficient knowledge and understanding of these interactions leads to uncertainty about consequences, thus generating significant organizational and operational risks.

In IT applications, poor risk management often leads to failure. Recent research indicates that 50 to 80 percent of IT initiatives in both the public and private sectors fail completely or produce unsatisfactory results. Some of the risk factors that lead to such failures include misidentifying the problem, underestimating complexity, instituting inadequate controls and monitoring, a lack of champions and sponsors, overvaluing novelty, and unstable environments.

Some factors that contribute to the failure of IT projects are unique to public sector organizations. Unlike private sector firms, for example, public agencies are accountable to many more stakeholders who pursue divergent objectives, rather than a shared bottom line. This engenders problems in project valuation and measurement of effectiveness. In addition, the structural characteristics of a public agency that limit the discretion of any one decision maker also limit the ability to act quickly or creatively prevent project failures.

Regardless of the growing body of descriptive, theoretical, and practical knowledge about information technology, practitioners seem unable to sense early failure symptoms or even avoid well-known shortcuts to failure. The deeper causes of failure appear to be only partially known. A variety of new and emerging frameworks are moving away from the past dependence on purely technical models and introducing models that incorporate more social, behavioral, and organizational factors for understanding information technologies and their application and use in organizations. All of these factors are significant in systems that support the work of individual organizations, but they increase in importance - and difficulty - when systems must connect multiple organizations across time, geography, and functional roles.

Information technology selection, use, and management affect nearly every activity and responsibility in grants making. IT supports communication about research initiatives and opportunities to propose projects. Investigators use IT to communicate with program officers and each other in the process of developing proposals. IT is used to support the proposal review and selection process and to identify and manage subsequent awards. Investigators use IT to help support the research process and to communicate results. Sometimes separate systems are used for different activities. Some systems, such as National Science Foundation's FastLane, incorporate many functions into a more comprehensive system.

### Key research questions

- What are the salient predictors of success and failure in IT applications in organizations and how can they be made visible and actionable?
- How can organizations involved in grants-supported research best collaborate on the conceptualization, design, and testing of shared information systems?
- How should the costs of shared information systems be distributed across multiple organizations?
- What return-on-investment models are suitable for multi-organizational systems?
- What IT investment strategies allow both stable current operations and reasonably quick adoption of new tools to improve performance?