From "Need to Know" to "Need to Share":
Tangled Problems, Information Boundaries, and the Building of Public Sector Knowledge Networks

The importance and challenges of networking and knowledge sharing for attacking wicked problems recently has been aptly described in Weber and Kham dien's (2008) provocative PAR essay, "Wicked Problems, Knowledge Challenges, and Collaborative Capacity Builders in Network Settings." We argue in this essay, however, that a broader category of equally challenging but more commonplace "tangled" problems lies in a vast middle ground between routine and wicked problems. Think, for example, of the tangle of actors involved in operating a public school or a military base or the tangle of programs that a social worker must navigate in order to help the families she serves. Success in coping with these kinds of challenges ultimately depends on finding ways to overcome the "need-to-know" default option in most organizations and moving to a "need-to-share" network culture.

One way to do so involves the creation of what we call "public sector knowledge networks" (PSKNs). Unlike other types of networks, PSKNs treat information and knowledge sharing across traditional organizational boundaries as a primary purpose as they try to address public needs that no single organization or jurisdiction can handle alone. PSKNs are socio-technical systems in which human, organizational, and institutional considerations exist in a mutually influential relationship with processes, practices, software, and other information technologies. They have emerged in tandem with the adoption of advanced networking technologies and the development of e-government.

Examples of PSKNs include efforts to share geospatial information and expertise, such as the National Spatial Data Infrastructure initiative in the U.S. federal government; net-
works to support the sharing of public health data, such as the BioSense system supported by the Centers for Disease Control and Prevention and the Department of Health and Human Services; and networks to share environmental data, such as the Environmental Protection Agency’s AirNow program. Other efforts support communities of practice (CoPs) with information systems, communication tools, and data resources that improve professional practice. Such networks also gather, analyze, and share information about program performance among participating agencies in such fields as human services or establish monitoring and communications functions for public health, government financial management, or national security.

But building and nurturing PSKNs is no easy matter. In this essay, we draw on existing literature on collaboration and networking along with our own 15 years of action research and theory building involving public management projects in New York state and elsewhere. Our argument is threefold. First, while problems in starting and sustaining PSKNs are formidable, they are not beyond the capabilities of astute, strategic, and tactically adept network builders. Second, a variety of lessons from our experiences can help them in this endeavor. The upshot of these lessons is that it is misguided to conceive of information-intensive public management problems as mainly information technology (IT) problems, and therefore it is useless to focus on IT as a silver bullet. Instead, IT considerations must be appreciated as nested within a variety of organizational, sociological, ideological, and political contexts that all need considerable attention. Third, we argue that political leaders and public managers need to invest in developing as fundamental public management skills a broad and deep understanding of and capability for engaging with the realpolitik of sharing knowledge and information in networks. We conclude the essay with a variety of avenues for future research.

**Types of Public Sector Networks**

The division of labor and compartmentalization of expertise in traditional hierarchical bureaucracies inhibit easy knowledge sharing. Professional identities and organizational cultures may be barriers to trust and risk taking in forming new relationships. These structures separate and often isolate practice domains, knowledge resources, and routines. The lines of authority, formal reporting relationships, and policy frameworks usually do not encourage and may even prohibit many forms of information sharing and cross-agency collaboration. To deal with complex challenges, something other than a traditional bureaucratic structure is needed.

What often emerges to meet these new demands is a network form of organization. In this form, the hierarchical pyramids do not disappear, but they are penetrated by both formal and informal information sharing and work relationships that cut across jurisdictions and program structures. Decisions and control are matters of both exercising formal authority and negotiating and collaborating. New groupings of persons and units must learn to work together and share information, exchange knowledge, and respond to demands in new ways that transcend traditional constraints or operate with newer, more appropriate controls. These may be ad hoc networks that emerge in unexpected situations or more permanent networks that can meet the knowledge demands of a new program or long-term project.

The concepts and challenges of network forms of organization are important to understanding the operation of the public sector and the role of knowledge in these networks. Network concepts have a fairly long history in public affairs scholarship (Agra-
noff and McGuire 2001; Ostrom 1990; O'Toole 1997; Provan and Milward 2001). In political science, interorganizational policy networks have long been recognized as an important feature of political influence and action (Heclo 1978; Laumann and Knoke 1987; Raab 2002). Policy networks are usually informal; they have no fixed organizational or management structure. Their main purpose is to exert influence on the political process in order to shape policy and resource allocation decisions that affect various constituencies. Regulation of the financial services industry, rules for the use of public lands, mechanisms for school choice, or protection of personal privacy in healthcare are just a few of the hundreds of concerns that give rise to policy networks.

Service delivery networks are the most widely recognized and studied form of public sector networks. These networks are a common method for implementing public policies, whether through traditional intergovernmental arrangements or through networks of nonprofit (or even for-profit) service providers linked by contract to a government agency (Provan and Milward 1995). Service delivery networks have been devised to achieve broad geographic coverage, economy, and flexibility in service systems. In these networks, the main purpose is to deliver specific services to a client population with high quality and reasonable cost. Many publicly-funded human services, such as mental health services, daycare, and employment readiness training, use this network service delivery model.

CoPs (Wenger 1998) represent a different kind of network—one that works mainly at the individual rather than the organizational level. They are "groups of people who share a concern, a set of problems, or a passion about a topic, and who deepen their knowledge and expertise in this area by interacting on an ongoing basis" (Wenger, McDermott, and Snyder 2003, 4). They consist of self-selected members, aim to develop members' capabilities to exchange knowledge, and are held together by commitment and identification with the group's expertise. CoPs operate as "social learning systems" where practitioners connect to solve problems, share ideas, set standards, build tools, and develop relationships with peers and stakeholders. Because they are inherently boundary-crossing entities, CoPs are a particularly appropriate model for understanding cross-agency and cross-sector collaborations (Wenger and Snyder 2000).

Different CoPs can be interconnected by boundary objects (Wenger 1998) (i.e., shared artifacts, documents, tools, concepts, and other objects around which CoPs can organize their interconnections). Connection across CoPs can be provided by people with membership in multiple communities who can introduce elements of one practice into another. When the connection between different CoPs becomes established and provides an ongoing forum for mutual engagement, it can produce a CoP in its own right. Many CoPs, including new scientific disciplines, have been established in this way.

Information and knowledge, of course, are crucial to all the foregoing concepts of networks. In the policy network, members use their specialized knowledge of a situation to try to influence decision makers with data, analysis, and stories that favor one position or another. In service delivery networks, information must flow among the various organizations in order to support and document the service delivery process, and successful information flow depends in large part on knowledge about the processes and practices in place in the different participating organizations. In CoPs, knowledge of the practice domain is widely and freely
shared to cement relationships and enhance the value of the community to its members. Our work has focused on one more type of network, the PSKN, which has information and knowledge sharing as a primary purpose.

PSKNs have emerged mostly with the growth and adoption of advanced networking technologies and the development of e-government. Other efforts support CoPs with information systems, communication tools, and data resources that improve professional practice. Such networks also gather, analyze, and share information about program performance among participating agencies in such fields as human services, or establish monitoring and communications functions for public health, government financial management, or national security.

PSKNs involve sharing knowledge and information across traditional boundaries in order to address public needs that no single organization or jurisdiction can handle alone. Such networks are complex and ever-evolving socio-technical systems involving relationships, policies, information, knowledge, processes, and technologies. Their formation, operation, and character reflect the characteristics of the participants, including their habits, resources, constraints, expectations and experiences (Zhang and Dawes 2006). These networks are also influenced by the participants' organizational missions, IT capabilities and infrastructure, legal and policy frameworks, and organizational structures and management practices. In short, PSKNs are deeply embedded in the contexts, practices, and experiences of the individual participants and their organizations.

PSKNs potentially offer substantial benefits. They constitute communication channels that give participants access to others' information and knowledge with the expectation that better quality, more timely, and more complete information will be available to those who need it at the time that it is most useful. From an organizational learning perspective, they provide a connection to others' knowledge and experiences (Galaskiewicz 1985; Hall 1999; Powell 1998), which can help public organizations improve their ability to react to uncertainty and complexity in the environment. In addition, interorganizational knowledge sharing is a major resource of professional and organizational innovation (Powell, Koput, and Smith-Doerr 1996).

Shared knowledge and information integration can help agencies better define and solve joint problems; coordinate programs, policies, and services; and prompt improvements in both IT infrastructure and information content (Dawes 1995). Sharing also facilitates integrated functions (Landsbergen and Wolken 2001) that provide citizens with convenient access to diverse information and services. Furthermore, positive sharing experiences can help government professionals build and reinforce professional networks and CoPs, which can be valuable resources of information about programs, best practices, politics, and environmental conditions (Kraatz 1998; Powell 1998; Zucker et al. 1996).

Types of PSKNs
Importantly, however, PSKNs are not all alike. One way to understand their variety is to see them as varying substantially across two salient dimensions: focus and extensiveness. As table 1 illustrates, two kinds of foci are prevalent: (1) a narrower focus that uses knowledge networking to help meet a specific need or solve a specific problem, and (2) a broader focus that aims to create systemic capacity to share knowledge and information whenever it is needed within a
domain of action. The interaction of these two factors produces six different types of PSKNs.

Narrower focus in PSKNs has the advantage of clarity: regardless of their organizational home or professional background, the actors involved are pursuing a particular goal that presumably has a desired end point. However, this type of focus lacks staying power. The knowledge and information-sharing network formed to solve a specific problem generally is considered a temporary necessity rather than a permanent resource. By contrast, more broadly-focused PSKNs offer more permanence and versatility. However, they are more difficult to design and implement, require more fundamental capability, and face different challenges to sustain operations, including finding an appropriate and acceptable permanent organizational home for the network.

In terms of network extensiveness, three levels are common in PSKNs: (1) an intraorganizational network, where sharing takes place across different units of the same organization; (2) an interorganizational network that lies within a single government jurisdiction; and (3) an interorganizational network that crosses jurisdictions, sectors, or levels of government. Typically, more extensive and varied organizational networks have greater depth and breadth of knowledge to share, but the greater number and variety of stakeholders and contexts present more risks, costs, and barriers to overcome.

Thus, as we move toward more extensive and complex networks and from problem-oriented to capability-oriented PSKNs, the costs and risks increase but arguably so do the potential benefits and overall public value. Specific problem-oriented initiatives have the potential to meet a particular need and perhaps to generate learning that can be applied in similar settings at other times. By contrast, systemic initiatives have the potential to create ready capability to not only address current problems but to tackle new problems as they emerge. These systemic knowledge and information-sharing capabilities also can support ongoing innovation and value creation within their policy or problem domains.

**Getting Our Networking Bearings:**

**PSKNs in Analytical Perspective**

Tangled problems may involve large numbers of diverse organizations and thus entail their respective organizational, institutional,
and technological situations, as well as any existing cross-boundary relationships. When these factors are intertwined with the tacit, elusive, and embedded nature of knowledge, information sharing can be a formidable challenge. Prior research and our 15 years of action research in New York state suggest important lessons for those contemplating or trying to sustain PSKNs. We present these lessons after first summarizing our experiences with six PSKNs that we worked with extensively in our research program; each entailed groups of public managers wrestling with an information-intensive problem. And when combined with prior research, each of these experiences helps inform lessons for those using or contemplating PSKNs in their own policy domains.

As table 1 illustrates, the cases summarized demonstrate that knowledge sharing takes a variety of forms and often initiates new understandings and working practices across organizational boundaries. The homeless services project is an example of an effort to share knowledge and work across many organizations and levels, all focused on a specific need to understand better the effects of services to homeless people (see table 1, top left cell). In the annual real-property assessment project, which was the same type, state and local participants held very different views of the definition of tax equity, the practices and processes of assessment, and the costs and benefits of relying on sales information instead of direct observation of real-property characteristics to set assessments. The GIS case aimed at building systemic capacity (table 1, top right cell) for a state-local coordination program, including a shared governance structure involving representatives of all stakeholder groups and related tools and policies that promote the sharing of spatial datasets.

The accounting case is an example of problem-oriented sharing within the same jurisdiction (table 1, middle left cell) with implications for the accounting, budgeting, and financial management needs of every state agency, all municipalities, and hundreds of private organizations. In turn, the initial goal of the justice information-sharing initiative (table 1, middle right cell) was a systemic one involving a set of state-level justice agencies in joint development of an interagency IT framework meant to give users of criminal justice data and systems "one-stop" access to the information needed to accomplish their missions. Finally, the municipal affairs project (table 1, bottom left cell) sought to improve a particular kind of performance within one agency responsible for promoting and overseeing the financial health of municipalities in different regions.

**Information to manage and evaluate homeless shelters and services.** Many public service programs suffer from an inability to assess their effectiveness and impact on a target population or societal problem. The Homeless Information Management System (HIMS) project involved efforts to share and consolidate information about homeless families and adults, shelters, and related service programs across several dozen organizations. The goal was to create a shared ability to conduct ongoing performance evaluations, identify best practices, and refine service programs for this population. The organizations involved included several state agencies, three local governments, and scores of shelter programs operated by nonprofit service organizations. HIMS was intended to fill a serious knowledge gap in program management by linking and comparing information on individuals and services to information about outcomes. In the course of defining and prototyping the sys-
tem, the participants came to understand that they needed to share not only defined data but also several different kinds of expert knowledge—and come to grips with different perspectives on practices, policies, and service effectiveness (CTG 2000).

**Annual reassessment program.** Real-property assessments are the basis for crucial financial decisions in the public sector, including setting property and school taxes and distributing some kinds of state aid to localities. This effort involved motivating and assisting town and county assessors to make a transition to a new method of assessment. Because physical assessments are rarely conducted across all properties at the same time but rather occur sporadically at the point of sale or major renovation, most localities are criticized for having unequal and outdated information that results in unequal treatment of property owners. The new program would move away from exclusive use of physical assessments of land parcels to establish property values. In the new process, a sample of physical assessments would supplement and verify annual statistical adjustments based on a market analysis system. This new system, intended to improve equity, relies on the sharing of up-to-date valuation and sales data across jurisdictions as well as more standard definitions and processes. As the initiative unfolded, it became clear that state and local participants held very different views on the definition of equity, the practices and processes of assessment, and the costs and benefits of relying on sales information instead of direct observation of real-property characteristics (LaVigne et al. 2000).

**Geographic Information System (GIS) Coordination Program.** Geospatial data is an expensive but versatile information resource that can be put to a wide variety of public and private uses. In view of these characteristics, governments encourage information sharing among producers and users. The statewide GIS Coordination Program supports this approach through a shared governance structure involving representatives of all stakeholder groups and a Web-based clearinghouse of metadata, datasets, and related information tools and policies that promote the sharing of spatial datasets statewide. This program involves a broad community of practice that includes a highly professional core staff team as well as working groups and hundreds of members that cross state, local, federal, academic, and private sectors. It encompasses the sharing of expertise, existing geospatial data, and the cost and work of creating new data resources, producing the benefits of reduced costs, increased analytical use, and better decision support in many domains of state and local government. Despite its many successes, the program also faces conflicting views on the questions of fees for access to data, sharing across sectors, and the different needs and practices of state agencies and local governments (Dawes and Oskam 1999).

**Revitalization of the state central accounting system.** Like many legacy information-processing systems, the aging statewide central accounting system, the backbone of state government financial management, needs to be replaced to take advantage of modern technologies and keep up with changing financial management standards. This redesign has implications for the accounting, budgeting, and financial management needs of all stakeholders, including every state agency, all municipalities, and hundreds of private organizations. This project explored the commonalities and differences in stakeholder information needs and business processes so they could be taken into account in the design of the new system and its associated policies and practices. Across more than a dozen working sessions
involving hundreds of system users, the contexts of use for the system and the information it contains were described and elaborated, sometimes for the first time. Intensive business process analyses documented the need for both common and specialized system features as well as related knowledge and information needs (CTG 2001).

Transition from regulation to service in municipal affairs. The State Division of Municipal Affairs oversees the financial health of 3,000 local governments through a constellation of six field offices loosely managed by a central office unit. Each field office, and sometimes each worker, had developed idiosyncratic knowledge and information resources pertaining to the localities in the region. None of this information was shared with other regions and little with the central office, making it impossible to discern statewide patterns or to transfer knowledge across administrations. The diversity of data sources, uses, and users made information management difficult and service delivery inconsistent. The goals of this effort were twofold: first, to generate consistent and readily shareable information and knowledge about local finances, local political and economic conditions, and state interventions in local government practices; and second, to advance the state’s transition from a regulatory approach to one based on technical assistance and advisory services that were believed to be more effective in avoiding problems or catching them in the early stages when they were more amenable to correction. The expected benefits included enhanced ability to recognize and target problem areas, provide relevant and timely technical assistance, reduce duplication of information, fill gaps in standard information and historical knowledge, and prevent or ameliorate local financial crises (Zhang, Faerman, and Cresswell 2006).

Justice information-sharing and coordination program. The justice enterprise faces many performance challenges that can be addressed more successfully through better information-sharing initiatives. The initial goal of e-JusticeNY was for a set of justice agencies (including, among others, police, corrections, parole, and a central coordinating agency) collectively to develop an interagency technology framework and portal to give users of criminal justice data and information systems "one-stop" access to the information needed to accomplish their missions. The effort evolved into a process for defining and implementing principles and practices for governance of the collective IT and information resources of the participating agencies. The critical first step was the establishment of an advisory body and governance process that would produce an integrated strategic plan that considers both agency-specific and statewide initiatives, as well as an integrated budget process, identification and engagement of cross-agency stakeholders, and integrated planning across the justice agencies. Work is carried out by both permanent and temporary committees and task forces to address such matters as standards and grant applications (Pardo, Gil-Garcia, and Burke 2008).

The Tough News First
While PSKNs like these offer significant potential benefits for dealing with both wicked and tangled problems, our research suggests that they also face two sets of challenges which make them difficult to develop and sustain. One has to do with the nature of knowledge and the other with the complexities of the boundaries to be navigated. Taken together, these knowledge and boundary challenges help explain why structured IT systems are often ineffective in transferring knowledge and information from one organization to another. Such systems rely on relatively rigid definitions and rules that are
at odds with the dynamic flow and use of information in practice.

**Lesson 1: The elusive nature of knowledge can cause considerable difficulty for PSKNs—it is dangerous to assume meanings are clear, context is understood, and quality is acceptable to all participants.** Effective knowledge sharing depends heavily on shared understandings, and these must be actively developed. That development almost always involves social interaction over time. Assuming that language is "clear" or that meanings are "obvious" usually leads to confusion, wasted effort, or costly errors. The social processes necessary to develop shared understandings and standard definitions of key terms and concepts require at least minimal levels of trust and support if open dialogue and compromise are to result.

The ease of knowledge sharing or the best ways to propagate it through a PSKN will depend on the nature of the knowledge itself. Some elements of knowledge are explicit, formal, and embodied in easily accessible media or artifacts, such as written policies, procedures, standards, and databases. This kind of knowledge is readily conveyed to others by language, images, or structured data and information systems. Other elements of knowledge are likely to be more tacit, embedded in social context and practices, and conveyed through "learning by doing" rather than through explicit means (Cohen and Bacdayan 1994; Wenger 1998). Knowledge also may be viewed as an organization-level phenomenon, embedded in organizational forms, expertise, and historical, social, material, and cultural contexts (Gherardi and Nicolini 2000).

Knowledge management studies also show that what is information to some is knowledge to others. Information forms the basis for knowledge development on the one hand, and knowledge often is required to assimilate and interpret information on the other (Davenport, DeLong, and Beers 1998). Finally, important aspects of knowledge sharing go beyond simple information or data exchange to focus on knowledge as knowing, implying the ability to use knowledge to accomplish some task or reach some level of performance (Brown and Duguid 2001). All these kinds of knowledge are likely to coexist in any given setting, and the same sharing strategies will not work for all kinds.

Data quality is a further challenge. Quality most often is characterized as simple accuracy, but research shows that high-quality data should be not only intrinsically good but also contextually appropriate for the task, clearly represented, and accessible to users. In other words, it needs to be "fit for use" (Wang and Strong 1996). The same information may be fit for some uses but completely inappropriate for others that have different temporal, security, granularity, or other requirements. Moreover, unrealistic assumptions about the quality and usability of information are common problems, including the common beliefs that information is objective, neutral, and readily available (Radin 2006).

In the annual reassessment project, for example, the basic argument for making annual statistical adjustments based on real-property sales data presumed that there were enough sales in each town every year to comprise a reasonable body of evidence for adjusting all property values in the town. Where this assumption did not hold, assessors refused to even consider the new process. When the state argued that sales data from "similar" towns might be used instead, assessors rejected the idea as politically untenable.
Lesson 2: As a potentially sharable resource, knowledge varies in several essential respects—codifiability, embeddedness, and dynamics—and each variation demands substantially different treatment within a PSKN. Variations in the nature of information and knowledge resources can be summarized in terms of three dimensions. One is codifiability—the ease with which knowledge is expressed in language, numbers, formal procedures, and explicit techniques. A second is practice embeddedness—the degree to which knowledge is situated in or generated by ongoing practice and learning by doing (Cohen and Bacdayan 1994). Information and knowledge are also very much embedded in changing temporal, physical, and programmatic contexts that need to be conveyed along with the information if someone working in a different context is to understand it. The third dimension is dynamics—the degree to which knowledge is constantly recreated and transformed by use, including the development of new knowledge.

The GIS cooperative faced all these challenges when it sought to make geospatial datasets widely available for sharing. Because this data had seldom been intended for use outside the programs that collected it, there was almost no metadata to help new users understand its context, how it had changed over time, its known weaknesses, or how key elements were defined and used in practice. Before the cooperative could become operational, significant investments had to be made in developing and adopting a common metadata standard to describe data resources in some detail. The logical first implementation focus was then to share the metadata, rather than the data itself.

Lesson 3: PSKNs are a form of cross-boundary exchange. The boundaries of organizations, jurisdictions, and sectors present the most obvious challenges, but more subtle boundaries related to ideology, professional norms, and institutional divisions can be equally problematic. While networks of information systems may be relatively new to the public sector, the historical and institutional relationships among agencies are often many generations, even centuries, old. The American political system is designed to prevent the consolidation of power that can flow from information and knowledge sharing. Sharp lines of authority divide branches of government as well as local, state, and federal levels. These may comprise the most deeply embedded and pervasive boundaries to be crossed by PSKNs and thus constitute serious barriers to information and knowledge sharing.

These barriers include widely different roles and functions at the federal, state, and local levels; enormous variation in local conditions and capabilities; inconsistent physical and technical infrastructure; and diverse and competing missions. These all contribute to misunderstandings and approaches that are ill-suited to collaborative work (Dawes et al. 1997).

Here, again, the annual reassessment case is instructive. Real-property assessment is mainly a municipal function in New York. Assessments are conducted by more than 1,000 cities and towns ranging in size and sophistication from New York City, to diverse suburban areas, to towns of only a few hundred people. Accordingly, their ability to finance and manage the assessment process, handle the data management and analysis responsibilities, and interact with and educate the public varies in every possible way. Combine this diversity with the fact that state-level authority over this function is quite limited, and the prospects for a uniform statewide approach rapidly fade.
Boundaries typically occur in complex combinations. Policy and legal constraints on collaboration and knowledge sharing may involve program boundaries and goals (LaPorte and Metlay 1996; Milward and Rainey 1983) in addition to matters of cost allocation and authority across jurisdictions. Agencies also will have different policy agendas and competing priorities that flow from their different missions. Other boundary concerns include control of collaboration activities and rules about participation and decision making.

Consider the knowledge exchanges necessary to establish new data-sharing relationships: data policies and standards, timing and methods of data collection, and access to information can all vary widely across organizations (Landsbergen and Wolken 2001). Unless knowledge about these differences can be effectively shared, they cannot be reconciled. Once made explicit, however, issues of privacy, proprietary content, and economic and political impacts can be taken into account in the kinds of sharing that are allowed.

In the homeless services case, for instance, the state agency and homeless shelter providers worked for months to agree on policies and practices to protect the confidentiality of shelter residents. The agreement rested on hard-won common understanding about how to shield individual identity. All were surprised later by the objections of a late-joining domestic violence shelter director who pointed out that the location of the shelter, not the identity of the individual, was their overriding confidentiality concern.

Experience with and attitudes toward the kinds of collaboration needed for knowledge and data sharing may vary widely across organizational boundaries. Innovative capacity (Pardo et al. 2006), or the attitudes, resources, and skills necessary to organize and facilitate collaboration and knowledge sharing, may differ widely as well. Key elements of innovative and collaborative capacity building for PSKNs include managerial support and leadership (Eglene, Dawes, and Schneider 2007), facilitative skills (Bryson 2004), participant attitudes toward power and trust (Huxham 2003), and available resources and infrastructure. Innovative capacity also reflects a willingness to change attitudes and master new managerial and technical tools, as well as a willingness to serve collective as well as individual agency missions and goals.

Crossing boundaries also means interaction with "alien" business processes and practices. As with information systems, the logic and full interpretation of a process may be poorly documented causing, at best, a fragmented understanding of the complete process. The knowledge necessary to interpret many kinds of information is also intricately linked to the business processes from which it arises and where it is used. Thus, effective data sharing and integration across boundaries often requires cross-boundary examination and understanding of diverse business processes and practices.

In the justice case, an important requirement was to assure secure access to all the justice information systems to be connected through a single portal. A new joint-management arrangement was needed to supersede multiple agency-based processes that issued and maintained user authentication and access permissions for thousands of workers. This impacted not only the costs but also the longstanding internal business practices of each participating organization. This shift to a unified system required difficult negotiations, including crafting a formal interagency contract to deal with costs, processes, and authority relationships.
Organizational and professional cultures pose other kinds of boundaries. Knowledge often is embedded in these cultures and thus is not easily extracted or transferred (De-Long and Fahey 2000). The way a police officer, say, interprets criminal history data will likely not be consistent with or easily transferred to someone without that particular training and experience. For information systems, the knowledge wrapper that holds the logic of data structures, definitions, collection methods, processes, and interpretive schemes is unique to the organizational setting in which it was created. This knowledge may be poorly documented and distributed in ways that make it difficult to aggregate and share. Without sharing this knowledge, however, the transfer of data across organizations is unlikely to produce meaningful results.

In the municipal affairs case, for example, regional staff used the general term "technical assistance" to mean a wide variety of activities under quite diverse circumstances. Only by actively engaging in comparisons and debates were they able to come to a common definition and set of services that could be deployed (and understood) consistently in every region. A similar process took place in the homeless services and annual reassessment cases where critical concepts like "recidivism" and "tax equity" were understood differently by different actors and had to be explained, debated, and harmonized before the networks could really begin to work.

Simple physical distance poses a final boundary challenge. Despite great expectations for network technologies to allow remote collaboration, face-to-face contact is often important, even indispensable, for many forms of collaboration and knowledge sharing. This is especially true in the early stages of network exploration and formation. This necessary personal engagement, however, often is inhibited by the costs or complexity of travel or lack of access to synchronous telecommunications, such as video conferencing, and incorrect assumptions about the nature and meaning of the knowledge and information to be shared.

As is probably true in most states, there is a common expectation in New York that local and regional officials will come to the state capital to be involved in discussions of statewide programs. As a consequence, however, only those with enough discretionary money and full-time staff, or those in close proximity to the capital, actually participate. In five of our six cases, it was necessary to physically go out "on the road" in order to engage these critical stakeholders in an evenhanded way.

Lesson 4: Trust, like knowledge, comes in different forms that work best under different conditions. Lack of sufficient trust and of the right kind of trust can be powerful inhibitors to PSKNs. Trust influences how culture, values, and personal and organizational relations influence the processes and outcomes of knowledge sharing (Cresswell et al. 2006). Trust is necessary in the face of the dynamic risks and interdependence inherent in knowledge sharing (Rousseau et al. 1998). When trust is low, transaction costs rise as a result of efforts to implement management and oversight controls that prevent exploitation (Jones, Hesterly, and Borgatti 1997).

Prior research and our experiences with PSKNs indicate that three kinds of trust are salient in knowledge networks. Calculus-based trust (Williamson 1993) rests on information-based rational decisions about the organization or person to be trusted. Identity-based trust (Coleman 1990) stems from familiarity and repeated interactions among
the participants. Identity-based trust also emerges from joint membership in a profession, a team, a work group, or a social group. Institution-based trust (Gulati 1995; Ring and Van de Ven 1992) rests on social structures and norms, such as laws and contracts, that define and limit acceptable behavior.

Importantly, different kinds of interactions demand different sorts of trust, and the lack of trust, as well as active distrust (Lewicki, McAllister, and Bies 1998), sharply limits what can be attempted and achieved. The sharing of codifiable information (such as in the GIS cooperative) may need only calculus-based trust or some combination of institutional and calculated trust. However, sharing practice-embedded knowledge (such as among the assessors and shelter providers) requires at least some identity-based trust, and building this type of trust takes considerable time and interaction.

The quality of preexisting personal and professional relationships makes a big difference in reducing (or extending) how long it takes to build sufficient trust for new undertakings. In the homeless services case, the relationships between the state agency and the nonprofit shelters had not always been smooth. However, they were consistently respectful. The shelter providers approached the project with healthy skepticism, but they also had many past experiences of fair dealings that gave them some confidence to try new ways of working. By contrast, the annual reassessment project started from a basis of long mutual distrust across state and local levels. It took longer to achieve less because past history had to be overcome. Many tentative steps were taken, withdrawn, and taken again as a long mutual adjustment process played out. Financial incentives, training programs, and grant-funded demonstrations all helped to encourage small but positive engagements that eventually moved the program forward.

Lesson 5: Risk is inevitable in PSKNs, and it is perceived and handled differently by different players. Substantial risks inherent in knowledge sharing and collaboration can greatly interfere with effective knowledge networks. Parties may not share the same understandings of risk and thus disagree over what may or may not be shared (Pardo et al. 2006). Common areas of disagreement include privacy, confidentiality, and security concerns; ambiguity about statutory authority to collect, share, or release information; and different degrees of openness to public access. In some contexts, information that is ordinarily public can pose unexpected risks, such as our earlier example of sharing the street address of a shelter for victims of domestic violence.

Moreover, agencies that compete for budget, control of scarce resources or infrastructure, or dominance in a policy domain may be reluctant to reveal any knowledge assets that reduce or threaten their discretion and autonomy (Rourke 1978) or their ability to compete for power and influence (Provan and Sebastian 1996). Revealing information to outsiders also may pose a threat of embarrassment or sanction, or invite invidious comparisons of one agency or jurisdiction against another (Dawes 1995). Knowledge also may constitute highly-valued organizational or personal assets. Loss of exclusive control of that knowledge can inhibit open dialogue and collaboration.

Even if there is no financial or tangible value at risk, some may resent another person or agency getting a "free ride" on their own hard-won knowledge. If the benefits of sharing are not clear, or if the exchange appears too one-sided, barriers go up. Strategies to address these perceptions of risk explicitly
are therefore critical to the success of knowledge-based collaboration. In the municipal affairs case, the regional staff were initially reluctant to share knowledge about how they advised local governments, fearing they would be criticized for giving bad advice. The agency’s leaders personally reassured them that the information gathered would not be used for personal evaluation and, in fact, that good regional practices would be highlighted and replicated. Putting these assurances into practice gradually built trust between management and staff.

But There's Also Good News
Despite the tough problems they must face, prior research, and especially our action research-based experiences with PSKNs, also suggest that all is not lost for those seeking to develop, nurture, and sustain these information-sharing entities.

Lesson 6: The processes of PSKN engagement build professional networks, organizational connections, and reusable capabilities regardless of the level of substantive network success. PSKN success is clearly not a unified concept. Our research suggests that substantive project success seems to depend on leadership and management practices, good quality data and appropriate infrastructure, and a culture that provides incentives and rewards for knowledge and information sharing. In contrast, successful processes and relationships—what we call "networking success"—appear to rest on a combination of reputation, trust, competence, and supportive culture.

In all the cases we studied, networking success was achieved more often and to a greater degree than substantive project success. All the initiatives achieved greater success with organizational and individual networking than substantive achievement of their program or administrative goals. We conclude from this pattern that trusted networks among individuals and organizations are an explicit positive outcome as well as a precondition for eventual long-term substantive success. In addition, organizational and individual networking success can outlive a particular project and go on to strengthen and deepen working relationships that can pay off in later projects. The homeless services project is a case in point. The project achieved a high level of networking success yet was not implemented because of a lack of political and financial support. Nevertheless, the project leaders from both the government and nonprofit shelter groups continued to work together successfully on new program initiatives.

It is important to recognize that networking success is much less visible to external constituencies and political leaders than project success. It is a challenge to gain the time and support to work past early difficulties that are an inevitable part of the PSKN maturation process. However, persistence and focus on the ultimate goal can pay off. The GIS project, arguably the most substantively successful of the knowledge networks in our research, actually failed several times over nearly ten years to garner political support and legal legitimacy before it eventually succeeded in achieving both its networking and substantive goals. Over this time, the professional GIS community persisted in building a case and demonstrating the practical value of its ideas until the political and managerial climate of state government was ripe for acceptance.

Lesson 7: Acquiring legal authority for a PSKN is a necessity, but there is no one-size-fits-all approach to structuring formal authority. Regardless of structure, mobilizing political support really helps. Some legal basis for a knowledge network is necessary for legitimacy, but no particular
structure of formal authority seems best. We have studied successful networks created specifically in law or by executive order, or formed under the general authority of an existing statute. None of the PSKNs we have studied over the years would have survived without this legitimating authority. In the annual reassessment project, for example, statutory authority was essential just to get started. Local government assessors are independently appointed or elected officials and very few would consider a radically different way of working without a legal foundation to stand on when working with their own constituencies.

However, while formal legal authority appears to be necessary to launch a knowledge network, it may not be sufficient to sustain it through implementation. In the projects we worked with, legal authority bolstered by political support provided a more conducive environment for project development. These political linkages, usually associated with the explicit support of an elected official such as the governor or mayor, were especially useful in bringing reluctant parties to the table, clarifying leadership responsibilities, and negotiating powerful bureaucratic processes such as budget formulation. In the justice network, difficult negotiations over authority relationships and resource allocations depended on the direct and ongoing involvement of the governor's criminal justice coordinator. In the municipal affairs project, internal agency conflicts could be confronted by the project leaders because they were carrying out their elected chief executive's call to change the agency's culture from one based on audits and compliance to one that emphasized prevention and assistance.

Lesson 8: Policy barriers are the greatest obstacles to substantive success in building PSKNs, but they often can be navigated by early intervention, focused action, and consistent attention. Policy and legal barriers, especially the lack of formal support mechanisms, appear to present the greatest obstacles to achieving the expressed program or policy goals of these networks. These barriers are not so much restrictions on sharing as they are failures to support collaboration with appropriate resource allocations and policy mechanisms. In our research, general lack of legislative support, misallocated funding, and simple lack of funding were perceived as more severe barriers than laws that specifically restricted knowledge and information sharing. This is troubling because so much of the promise associated with public sector innovation depends on the ability of agencies to share information about clients and services and to share knowledge about their professions and practices. Without an enabling policy framework, the risk-averse culture of government is likely to dominate decisions and actions. The result is seen in missed opportunities and half measures that achieve little.

Astute PSKN leaders found ways to deal with these challenges. In the statewide accounting system case, the project leader built a policy cabinet of "strategic partners" (representing both houses of the legislature, the state budget office, and the statewide IT agency) into the governance structure of the project. This ensured their ongoing attention, created a venue for policy discussions, and prevented surprises from derailing the effort. The GIS cooperative shows how formal policies can work to not only allow but encourage information sharing. Through the creation of a formal standardized data-sharing agreement, the cooperative members established the rules, responsibilities, and benefits of sharing geospatial data across state and local governments. The agreements assured access to data holdings, established primary data custodians for all datasets, and
specified practices to enhance data use and quality for all members. By contrast, the annual assessment project was stymied by a lack of specific statutory and regulatory authorization to use market information to assess property values. The few local assessors who agreed to try it did so at their own political risk.

Lesson 9: Organizational barriers are serious but amenable to innovation and creative management. Organizational barriers negatively affect both substantive and networking success, but in our research, participants were resourceful in dealing effectively with many of them. Perceived barriers may well reflect organizational realities that include diverse organizations with different missions and priorities, as well as organizational and individual resistance to change. Couple these difficulties with goals that often seem too ambitious or divergent and it is not surprising that knowledge networking does not easily flourish. Our observations and interviews over the years, however, also reveal how certain managerial practices and individual initiatives can mitigate organizational barriers.

These include enduring relationships and close association among key individuals with a shared vision, as was the case with the CoP that advocated for and eventually launched the GIS cooperative program. Professional commitments to innovative programs carried the annual reassessment project through a long period of negotiation and learning until it finally was adopted by a significant number of local governments. Likewise, long experience in working in and with certain organizations, and skills in negotiating familiar bureaucratic constraints, were instrumental in planning to replace the statewide accounting system. In that instance, veteran state officials designed the project in phases to coincide with budget and legislative cycles, ensuring that they would have the evidence necessary for decisions that would move the project forward and keep it visible to those with approval and budget authority.

Lesson 10: Multiple leadership behaviors are associated with success, including mission focus, emphasis on people and communication, willingness to experiment, and nurturing a culture of joint responsibility for success. The leaders of knowledge networks need a repertoire of behaviors and skills that support collaboration and trust. In a multi-case evaluation study (Zhang and Dawes 2006), we found that these personal qualities of leadership were much more important than the network leader's expertise in the program or policy domain. Leaders who inspired trust, commitment, adaptation, and mutuality set a positive tone for behavior throughout the network. The most successful projects were led by people who emphasized the mission value of the effort and who focused first on the people involved rather than on the rules of engagement, the information content, or material resources. They engaged in open communication with all players and used example and persuasion to convince participants of the collective and self-interest benefits of the effort. Successful leaders were candid and realistic about the costs and risks to all concerned.

In the statewide accounting system and homeless services projects, for example, we saw that leaders refrained from using the formal authority of their positions to compel participation by others. Instead, they sought practical solutions through wide consultation and experimentation. Moreover they encouraged informal leaders to step forward and
take responsibility for parts of the effort, especially when certain kinds of expertise or resources were needed.

**Lesson 11:** Early experience sets the tone and direction of cross-boundary relationships—unrealistic, incorrect, or misaligned expectations, processes, incentives, and assumptions are hard to change once set. Unrealistic expectations and unexamined assumptions plague knowledge networking projects. To avoid serious mistakes and control the risks of such undertakings, the early planning process needs to facilitate candid discussions that explicitly identify and engage stakeholders; fully describe benefits, barriers, and risks; and state underlying assumptions about the problem, the participants, and how they will make decisions and work together.

Furthermore, the cases we have followed over the years highlight the importance of aligning goals and incentives through careful stakeholder analysis. This kind of analysis produces an early understanding of history, policy constraints, organizational capabilities, and technological limitations that can help participants plan projects wisely and manage interorganizational dynamics and implementation processes more effectively.

In the justice project, for instance, participants initially thought they needed a common portal to link their information systems together. Through weeks of difficult and mostly unproductive early discussion, however, they learned that their most pressing need was not for a technological tool but for a governance process to evaluate alternatives, consider divergent views, and make decisions about their joint responsibility for the justice enterprise.

Because different stakeholders perceive benefits and barriers differently, they need to be able to express their concerns directly. No one view is entirely complete or correct but all are legitimate and need to be expressed and discussed openly from the start. Our findings indicate that in intergovernmental initiatives, higher levels of government tend to oversimplify and underestimate the needs of lower levels. In fact, local government stakeholders are considerably less optimistic about achieving goals and more concerned about a variety of organizational, technological, and financial barriers than their state-level counterparts. State officials often wanted to rely on their own assumptions about what "locals" think, need, and do, but when local officials spoke for themselves, the picture of risks, benefits, and capabilities was much more accurate, diverse, and authentic.

**Lesson 12:** Learning and adaptation are essential to PSKN development and survival. Knowledge networks are inherently learning organizations. They exist in a dynamic environment where changing economic conditions, political priorities, and social trends have a strong effect on their status and operation. These conditions require not only learning but ongoing adaptation. The interactions among individuals, organizations, and communities are the channels by which knowledge is exchanged, examined, and integrated.

In the central accounting system project, for example, the lead agency staff thought they were well versed in all the uses made of accounting information. Thirteen stakeholder workshops later, they recognized how little they had appreciated the myriad of cross-boundary business processes that linked their agency to all the other government and
private sector organizations that receive, handle, or disperse state funds. The next steps in the system design process were therefore refocused on detailing and accommodating these critical linking processes.

PSKN participants certainly should expect to adjust their sights based on learning and experience. In our research, when participants entered new projects, they generally had quite optimistic expectations about the possible benefits, giving all proposed benefits (such as better quality and more comprehensive information, improved infrastructure, and better accountability) good chances of being achieved. At the same time, they expected to face moderately severe barriers, including lack of funding, overly ambitious goals, and competing organizational priorities.

After acquiring substantial experience (typically about two years in our studies), participants reported that both benefits and barriers were lower than they initially expected. In addition, the top benefits that participants believed had actually been achieved were somewhat different from their predictions at the beginning. The number one predicted benefit was better quality information; the top achieved benefit was wider professional networks. The participants were very accurate, however, in predicting the top barriers. Lack of funding, overly ambitious goals, and different organizational priorities were the most expected—and the most commonly experienced—barriers.

**Lesson 13: Technology is necessary but not sufficient for success.** Collectively, the preceding lessons we have offered lead to one simple yet profound final lesson: appropriate technology is a necessary but insufficient ingredient in developing, nurturing, and sustaining PSKNs. In our view, for IT tools to be appropriate, they must be suited and scaled to the network structure and goals and be usable by all the participants at reasonable cost and effort. However, participants often believe that having appropriate technology is the essential key to success. Their mistake comes in thinking that making different systems "talk" to each other is readily doable and that, once this is done, the knowledge-sharing problem will be solved. As we saw in the justice and annual reassessment cases, no information system—no matter how powerful, sophisticated, or intuitive—can solve political, organizational, or managerial problems, or problems associated with conflicting or competing goals or professional practices. In the municipal affairs case, the early effort to specify an information system was soon replaced by an effort to specify policies, business rules, and associated work processes that could be implemented in all the regional offices. With that done, the technology implementation to support the new practices was fairly straightforward. In short, IT should be part of the effort to deal with these kinds of problems, but no particular method, and certainly no unexamined IT "solution," will untangle them.

**Future Research Directions**

We believe these evidence-based lessons are useful, but there is still much to learn. Our own prior research has identified several areas for further investigation. For example, the typology of PSKNs could be elaborated to identify key characteristics of the different types that represent various combinations of network extensiveness and problem-solving versus capacity-building purposes. A key research question is how PSKNs that are formed to address a particular problem differ in structure, cost, benefits, risks, leadership needs, and other characteristics compared to PSKNs that are formed to provide broad-ranging and long-lasting infor-
formation-sharing capability to a policy domain. Such work might generate both conceptual and practical results that could guide future investments in and evaluations of different types of PSKNs for different conditions. Our own current work includes exploration of a variety of capabilities and capability measurement approaches to understand better the array of skills, knowledge, policies, data, and organizational resources that combine to make information and knowledge sharing feasible, affordable, and effective under different circumstances.

The effects of time on PSKN development and performance have only begun to be explored and at least two time-oriented questions are salient: how does maturation affect networks and network relationships as they unfold over a span of time, and can network development be described in terms of predictable stages in which certain variables are more important, even essential, to sustainability, longevity, and success than at other stages? Substantive focus represents another framework for future work that might explain how different policy domains differ in their use of PSKNs and the extent to which these networks are effective in addressing domain-specific problems. Some of our current work is looking at these questions with regard to public health and public safety.

Leadership represents a fourth area for future research, including questions related to the role and value of informal and episodic leadership in contrast to formal leadership.

Methodologically, case studies have laid a foundation for understanding the structure and dynamics of PSKNs. However, quantitative analyses of survey data as well as a variety of modeling techniques hold promise for a deeper understanding of the ways in which these networks emerge, operate, and perform. In addition, comparative studies that look at information sharing and PSKN-like structures in other nations and cultures are also needed, especially as we begin to appreciate better the international and global reach of public policies (such as those regarding air quality and financial markets) and processes (such as transportation and safety of imported and exported goods) that extend beyond our national borders.

Finally, a rigorous approach to understanding the relationship of knowledge exchange in public administration to practice in public administration requires a good theory, or at least a useful theory, of how knowledge and practice are linked. One approach would follow on the work of Pierre Bourdieu (1980) in theorizing about practice from a social and anthropological perspective. Bourdieu's theory integrates attention to both historical and emergent aspects of work practices along with the importance of context and organizational resources, such as knowledge.

This integrative frame is based on four main concepts: practice, habitus, field, and resources. The emergent and historical aspects of a practice are captured in the concept of habitus, which is any set of practices rooted in history, which in turn produce more history. Habitus "ensures the active presence of past experiences…” (54), including the knowledge content of this experience base. Practices, shaped by habitus, take place in a field that represents the logical and objectified context of those practices, just as the chessboard and its rules make up the field in which the practice of chess occurs.

In organizational terms, a field includes the institutional and formal elements of an organization's environment. The rules and logic of a field shape the interactions among actors and their available economic, social, and cultural resources, thus establishing actors' positions in that field. Knowledge is an
important component in each of these kinds of resources. In this perspective, practices are not deterministically driven by the other elements, but they dynamically shape and are shaped by them.

This practice perspective has been taken in some research related to public administration (Ahonen and Virtanen 2008) and particularly in research on information systems (Orlikowski 2002; Schultze and Orlikowski 2004), but it does not appear to be widely used. It is not difficult to see, however, how these concepts might inform inquiry into the relationship of knowledge exchange to other elements of practice. For example, resistance to acceptance and use of new knowledge flowing in a network may be rooted in deep habitus developed over many years. Research on the nature of the public administration habitus and its relationship to knowledge bases and exchanges may be very useful in advancing practice in general and understanding the dynamics of knowledge exchange in particular.

Conclusion
We have argued in this essay that public managers confront tangled problems every day across all policy domains and levels of government, and they need to be ready to deal with them through networked forms of engagement and action. Knowledge networking—the ability to create PSKNs suitable for addressing these problems—requires a certain set of skills and attitudes, as well as interpersonal and other kinds of trust. Network development processes that emphasize early, open dialogue and examination of assumptions and expectations do better than those that rush forward with a fixed IT solution in mind. Those that adapt and learn from experience are more likely to succeed in achieving their substantive project and networking goals. Finally, to be sustainable as organizational forms, knowledge networks need some legal foundation, access to resources, supportive policies, and innovative forms of leadership.

Thus, the challenge to public managers is not so much a matter of successfully carrying out any particular networking project well. Rather, it is one of building institutional, managerial, and professional capabilities to engage cross-boundary, knowledge-intensive problems whenever they appear. As such, PSKNs work best when information- and knowledge-sharing capabilities are woven deliberately into the fabric of organizational and partnering work practices.

Sharing and integrating knowledge and information in multiorganizational settings clearly involves complex socio-technical interactions embodied in work processes, organizational forms, and institutional contexts. These are challenges of governance as well as issues for administration. They have implications for efficiency, performance, and public value that are ripe for multidisciplinary investigation, as well as for usefully linking research and practice. Sorting out these implications empirically affords a robust research agenda for the future. In the process, public administration schools and public agencies need to invest in developing as fundamental public management skills a broad and deep understanding of and capability for engaging in the realpolitik of sharing knowledge and information in networks. The increasingly wicked and tangled problems of the future will require no less.

References


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