Records Appraisal in Network Organizations*

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RÉSUMÉ Cet article explore le besoin de nouvelles approches de tri des documents au sein des organisations fonctionnant en réseau, lesquelles mettent l'emphase sur des processus informels de travail et de collaboration. De plus en plus de documents, et cela en nombre croissant sous forme informatique, sont créés dans le cadre de ces processus plus ou moins structurés. Les archivistes devront évaluer ces documents et les processus administratifs dans le cadre desquels ils sont créés. De plus, comme les archivistes sont confrontés à un changement rapide du monde du travail et à une plus grande panoplie de documents, il serait peut-être nécessaire d'élargir le concept traditionnel de provenance dans le but de tenir compte des effets des nouvelles technologies et des formes d'organisations sur la signification sociale des documents et de leurs différents types. L'article, étayé par une étude de cas, présente un cadre possible pour l'évaluation des documents faisant partie de l'infrastructure, ou qui servent d'outils à la réalisation des tâches, dans un environnement de travail basé sur la collaboration.

ABSTRACT This article explores the need for new approaches to the appraisal of records in so-called network organizations, which emphasize informal, collaborative work processes. More and more records, increasingly in digital form, are created as part of unstructured or less-structured processes; archivists will have to appraise both the records and the administrative processes whereby such records are created. Also, as archivists confront a rapidly changing workplace and an increasingly diverse body of records, it may be necessary to broaden the traditional concept of provenance to account for the impact of new information technologies and organizational forms on the social meaning of records and record types. This article, buttressed by a case study, presents one possible framework for the appraisal of records which are part of the infrastructure, or which serve as tools for accomplishing tasks, in a collaborative work environment.

In the past two decades, digital information technologies have inspired many changes in the way people work and create records. Archivists have been concerned with records in electronic form for some time, of course. But now they must contend with new organizational forms – in particular, so-called network organizations – which use information in new ways and, as they do so, create new types of records. Lately, network organizations have been the subject of intense scrutiny within the multidisciplinary field of organization studies, with

the result that a great variety of examples have been identified.[1] Network organizations are often described as teams, or ad hoc working groups, that are created to permit people from different administrative units to collaborate on particular projects. In manufacturing, for example, teams have long been recognized as effective means for coordinating different production activities and for solving problems efficiently. In recent times, some high technology industries, including software engineering, have come to depend on networks of various kinds for much of their productive capacity. For this study, I focussed on the problems involved in appraising the records of collaborative projects of employees organized as informal networks and located within larger, more permanent organizations. (See the **Appendix** for a definition of collaboration.)

The organizational role of collaborations is necessarily shaped by their impermanent and rapidly changing structures and functions. These characteristics naturally make records appraisal of collaborations more difficult than for more stable organizations. Yet anecdotal evidence suggests that a broad range of organizations, from government agencies to software development companies, are relying more and more on collaborative work as a source of innovation in a quickly changing social and economic landscape.

For archivists, the job of appraising the records of collaborations is complicated by the fleeting and often ambiguous institutional role of records creators in these organizations. In such an environment, it is necessary to consider changes over time in the meanings, and hence the appraisal values, of the records produced and retained by collaborations. In this respect, I was influenced by the postmodern line of argument in the archives literature which emphasizes the active role archives play in shaping the potential meaning of records through selection, description, and preservation. As Brien Brothman has argued, "archival appraisal ... is not merely a process of value identification, but of value creation or destruction."[2] This is especially true in a collaborative work setting in which records creators are expected to focus on short-term objectives and not consider the long-, and even medium-term, value of records they create. Thus, in appraising the records of collaborations, the archivist may find it impossible to not act as an "autonomous creator," to be a "mere instrument of the real creators of our memory of the past,"[3] as Robert McIntosh has written. In any case, the records of network organizations present a challenge to the traditional view of the archives as an agency that preserves not only records but also the original meaning and intent defined by the creators.

This article presents my observations on records appraisal in collaborative work settings, based on my participation in a two-year research project sponsored by the (U.S.) National Historical Publications and Records Commission (NHPRC) and the University of Michigan School of Information.[4] The project, entitled "Expanding the Options: Strategies for Preserving Electronic Records of Collaborative Processes," has addressed a wide range of problems

that archives are likely to face in appraising, describing, and preserving digital records. My particular involvement has focussed on records appraisal as the necessary first step in the process of identifying and describing valuable records in collaborations.

The initial motivation for Expanding the Options came from a 1996 NHPRC conference on electronic records, held in Ann Arbor, Michigan, which underscored the need for further research on digital record-keeping. The conference participants agreed that the creation of true digital archives – as analogues of established print and manuscript archives – would entail significant changes in organizational behaviour on the part of records creators and archival institutions as well. At the same time, it was widely believed, and has since been confirmed, that the runaway growth of computer networks would result in the production and distribution of large volumes of digital information by new types of organizations that may face fundamentally different record-keeping issues than has been the case in established organizations. Hence, the need arose to study digital records in emerging organizational forms, which became the basis for Expanding the Options.

Most importantly, by the mid-1990s there was a consensus (strongly echoed by the Ann Arbor conference) within the archives field that, in order to properly appraise, accession, and preserve electronic records, archivists would have to be directly involved in managing records at all stages of the traditional life cycle, including systems design, system implementation, and records creation. This view is widely held today, yet it is still not clear what strategies archivists can use to gain a voice in management decisions which in the past have usually been considered outside the expertise and political jurisdiction of the archives.

Thus far, efforts to bridge the gap between systems designers, records creators, and archivists have tended to focus on records generated by large, mature organizations with longstanding commitments to records management and archival programmes. Many established institutions are now concerned with the long-term preservation of digital information resources and are willing to invest in the design of effective digital record-keeping systems. Nevertheless, research on the appraisal and preservation of digital records has not yet taken into account the historic problem of changes in organizations that are currently being inspired by the use of electronic communications and digital information systems. In this context, Expanding the Options was conceived as an initial step towards bringing archival concerns into the world of emerging organizational forms, particularly collaborative work groups, or informal networks, which cannot be expected to have well-defined records management policies and which often lack the resources to implement formal record-keeping systems or routines.

Coming directly in the wake of large digital record-keeping projects at the universities of Pittsburgh and British Columbia, Expanding the Options was

designed to test the central assumption of both projects; namely, that the building of true digital archives requires a formal design process leading to standardized systems which will ultimately allow for the algorithmic capture of all digital documents that are appraised as archival records.[5] This is not to argue that the Pitt and UBC approaches were wrong, or that their conclusions were somehow flawed.[6] On the contrary, Expanding the Options began with the assumption that the Pitt and UBC approaches were likely to succeed in certain environments, particularly in large, mature, knowledge-intensive organizations.[7] Indeed, the principal investigators at Michigan have been directly involved in implementation projects stemming from the list of functional requirements set by the Pitt researchers, including work at the University of Indiana, the City of Philadelphia, and the Center for Technology and Government at the State University of New York (Albany).[8] In this context, Expanding the Options was designed to build upon the Pitt and UBC projects by addressing more directly the role of record-keeping policies in the emerging world of network organizations whose management structures and work processes are constantly changing.

In setting the research agenda for Expanding the Options, our major goal was to study record-keeping in informal, collaborative work groups in an effort to develop methods and tools for appraising digital records created by network organizations that lack the resources or market incentives, or both, to implement formal digital records management systems. In keeping with this objective, the natural focus of the project was not on information technology or record-keeping systems per se, but rather on the social process of translation whereby organizational memory gives rise to records that can be appraised and preserved by an archivist. Thus, a salient feature of this project was my dual concern from the outset with records-creating processes and with the actual *content* of digital documents.

The decision to examine both records and records-creating processes was in keeping with the notion that recordness, both in the evidential and informational senses identified by Schellenberg, depends overwhelmingly on the social context in which records are created and used.[9] This assumption is fairly well established in the archival literature, but it is also strongly reflected in a line of interdisciplinary research (which is well represented at the University of Michigan School of Information) on computer-supported cooperative work, or CSCW. This field is concerned with the social and organizational dynamics whereby records are produced and used within "communities of practice."[10] Under the leadership of former dean Daniel Atkins, the School of Information has heavily invested in research on "collaboratories," or "laboratories without walls," in which geographically distributed groups of researchers can interact over a network. Atkins describes collaboratories as having three main elements: a social network, a physical and technological environment, and a structured, managed collection or repository of information,

which Atkins calls a "digital library" but which one might also describe as an archives containing both static (e.g., text files) and dynamic (e.g., database reports) digital information artifacts.[11]

Informed by several ongoing lines of research on digital information systems and collections, we decided to produce a series of case studies on record-keeping practices and the larger role of records in collaborations. In keeping with this agenda, we chose sites that would highlight the flexible and informal (ad hoc) roles networks can play inside more formal institutions such as universities and other knowledge-intensive institutions. By observing collaborations in the field, we hoped to understand whether such organizations could be expected to document their work according to the kinds of standards put forth by the Pittsburgh and UBC projects, or whether new guidelines and management approaches are needed to enable effective archiving of digital records in network organizations. In this regard, we were particularly interested in studying organizations with tight limits on overhead costs and organizations which were already highly dependent on existing digital information systems that did not meet accepted archival standards for record-keeping.

Once we began to observe the role of records and record-keeping in our sites, it became clear that our case studies would present major challenges for archival appraisal. The research methodology outlined in the grant proposal included survey data, work process analysis, and documentation analysis of the record types created and retained by each organization, along with semi-structured interviews with project participants. This agenda evolved significantly over time. Initially, we had considered using a process modelling approach to decompose work functions in a way that would enable us to analyse (that is, to appraise) the records creation process.[12] But we encountered serious practical and conceptual difficulties in carrying out process analyses on the work teams in the study. We found that the technological and organizational complexity of collaborative work in our research sites made this approach both impractical and unlikely to capture a rich understanding of the meanings and uses of records for people working in a network environment. Indeed, the lack of formal documentation of work practices we found in our sites made it difficult, and in many cases impossible, to gather sufficient data to construct workable models for the functions we were examining. At the same time, our target population proved too small and heterogeneous to be studied effectively through conventional (quantitative) survey techniques.

By contrast, we were impressed by the volume and richness of qualitative data we were able to gather in our interviews. As we learned more about our sites, it became apparent that project participants tended to have a profound knowledge of their own work and the immediate collaborations in which they were engaged. But in many cases they had only a weak understanding of the larger organizations – especially with respect to administrative structures, rules, and standard operating procedures – in which their work was situated.

We found it interesting, to say the least, that project members could often work effectively together with little or no formal management supervision, and also (in many cases) with widely varying individual perspectives on the strategies and tactics used to complete a project. We gradually reached the conclusion that it was necessary for us, as archivists, to uncover some of the social and technological factors that were enabling collaborations to function and which were not immediately visible in the formal types of documents we were able to observe through a traditional archival lens. In other words, we needed to find some way to reconcile the widely varying accounts of changing perspectives over time, put forth by our subjects, as a basis upon which to evaluate the potential meanings of, and uses for, the records they create.

Working as I did within the tradition of qualitative or "grounded" ethnographic research, over time the data I gathered led me towards a distinctly qualitative method for situating records in their organizational context.[13] As we will see below, this study has sought to explore new approaches to appraisal that might take us beyond Schellenberg's modern, structural-functional approach, as well as the postmodern macro-appraisal approach developed in Canada. Given the fact that each of these approaches depends on the archivist creating, or in most cases reifying, some kind of model for the organization and its established functions, I encountered a serious obstacle when I found that the available data did not fit readily into an abstract, static model of structures and functions, for example, an organization chart.[14] It became clear that the available data called for a new method of representing structures and functions, in a way that would be qualitatively richer and more dynamic (more sensitive to changes over time) than has generally been used before in archival appraisal. To find such a method, I had to rethink the basic principle of provenance as it applies to network organizations. I also had to consider more deeply the status of records in collaborations, and to develop a framework for evaluating the changing context of records as they are created and used by creators as well as archival users. The following sections address these issues in turn.

Appraisal by Provenance in Network Environments

From the perspective of appraisal theory and practice, the researchers involved with Expanding the Options have been deeply concerned with the provenance of digital records, as well as the evidential and informational values carried by particular records. In our attempts to appraise records in collaborative work environments, it has become clear that existing appraisal methods need to be more closely tailored to the changing organizational environment in which digital information is created and used. Of course, archivists should not be expected to forecast the evolution of new organizational forms (an impossible task for anyone) or impose their own understanding of records on creators or

users. Nonetheless, in developing appraisal strategies, I would argue that archivists would be well served to consider Paul DiMaggio's claim that our collective knowledge about organizations is derived more from theory than empirical observation.[15] This is not to suggest that archivists should follow current trends in organization theory, especially seeing as most organization theorists today have strong incentives to constantly reinvent old theories.[16] Indeed, historically, theories of appraisal have been shaped more by practical considerations in the handling of records than by abstract thinking about the appraisal process. Actually, changes in the composition of record memories have occurred alongside the rise of new organizational forms, leading archivists to redefine their terms and adopt new appraisal techniques. My argument here is simply that archivists seeking to appraise digital records should consider how organizations are adapting to the perceived demands of new information resources and technologies.[17]

For instance, consider the works of Theodore Schellenberg and business historian Alfred Chandler in the 1950s, working in parallel fashion on different aspects of organizations. At this time, the organization was commonly viewed as an administrative structure, usually represented as an organization chart, with particular offices assigned a functional responsibility, such as production, marketing, or research and development.[18] In the 1950s, few people questioned the idea that organizations could be managed effectively by representing them as an amalgamation of groups of free-standing units in a supervisor-and-staff hierarchy; in effect, the organization chart *was* the organization, even though no one as yet had produced convincing evidence that organizations could be effectively controlled by using this kind of information. Alfred Chandler effectively filled this gap with his classic book, *Strategy and Structure*, first published in 1962.[19] Through exhaustive research, Chandler showed that the strategies adopted by top management directly affected the structure of firms (which one might expect intuitively) and, more importantly, that the presence of existing structures sharply limited a firm's range of functions or activities the organization could expect to perform in the future.

Chandler's key insight was that by taking a structural-functional view, managers at the top can effectively design organizations to perform functions without themselves having to examine in any detail *how* those functions will be carried out in reality. This was an insight archivists had long understood, as a theory, and which had led Schellenberg to argue (in the mid-1950s) that records created at or near the top of an administrative hierarchy were likely to provide the best historical evidence for why a government agency evolved in a particular way. Thus, Schellenberg argued that in carrying out records appraisal, archivists should concentrate on: "(1) the position of each office in the administrative hierarchy ... (2) the functions performed ... and (3) the activities carried on by each office in executing a given function."[20] Properly applied, these categories would point the archivist to records that were likely

to provide the most compelling account for the development of the organization as a whole.[21]

Apart from the theoretical elegance of Schellenberg's method, there was a distinct practical advantage in using this top-down strategy for appraisal. By focussing on records created at the top of the administrative hierarchy, archivists were able to effectively manage organizational memories that were growing exponentially larger and more complex by the 1940s. There was an important trade-off, of course, in using this approach, as it meant that the archival fonds would privilege one view of the organization – the top management view – at the expense of not documenting the operational processes whereby organizations carried out particular functions, as well as the dynamic interactions that take place between the organization and society.

Since the 1940s, the essentially static view of organizations put forward by the structural-functional approach has led researchers in a number of fields to search for a new view of organizations that would provide a dynamic representation of organizational behaviour as it unfolds over time.[22] Organizational behaviour research began during World War II, as part of a broad interdisciplinary research effort that led to modern computer science. Originally, the U.S. military recruited psychologists and other social scientists to study the decision-making processes in combat situations. The goal was to enable soldiers to use advanced weapons technologies in ways that were both effective and predictable.[23] This work originally focussed on the potential of computers and electronic communications systems as tools for management decision making. This emphasis led organizational behaviour researchers to treat decision making as a function of programming, in much the same way that computers are programmed to make decisions based on predetermined conditions.[24] From this perspective, organizations are said to function according to sets of "routines" (just as computer programmes have routines and subroutines) which are consciously designed to guide decision making in the face of uncertainty.[25] Hence, in this view, the basic unit of analysis for organizations is not the administrative structure and its assigned functions, but the routines whereby organizations process information and make decisions.

For our purposes, the most important aspect of organizational behavior research is that, by the 1960s, it led many records creators to think of organizations not as static entities, with structures and functions assigned to boxes on an organization chart, but as sets of dynamic routines for processing information and making decisions at all levels of the organization. By the 1980s, researchers in organizational behavior had begun to consider routines as formal learning mechanisms that enable firms to produce, retain, and recall knowledge in ways that were likely to have a major impact on the strategy and structure of an organization.[26] This line of thought is still being explored today, but it has important implications for archives as organizations that preserve records and, more importantly, facilitate access to our social memory.[27]

From the archives point of view, the search for a dynamic model of the organization is partly reflected by the theory and practice of macro-appraisal, which was developed in Canada as a way to overcome some of the limitations of Schellenberg's structural-functional approach for dealing with highly complex and constantly evolving institutions. Where Schellenberg advised archivists to focus on records created at the top of the administrative pyramid, macro-appraisal focuses on records created at any administrative level that best document the critical functions or routines that define an organization's role in society. Writing from the perspective of a public records archivist, Terry Cook argues that appraisal should focus on the ways records describe, as well as influence, the interactions that take place between government and society.

By focussing records appraisal on organizational behaviour more than on administrative structure, the macro-appraisal approach represents a second important, if subtle, extension of the archival concept of provenance in the past hundred years or so. In the 1950s, Theodore Schellenberg successfully adapted the concept of provenance in response to the practical problem of selecting records in an environment in which archives could expect to preserve only a small percentage of a given fonds. More recently, the concept of macro-appraisal (which starts with the appraisal of the records-creating functions) has emerged as a tool for appraising record series in an organizational environment that is growing increasingly complex and vastly richer in information resources. For Terry Cook, the critical difference between macro-appraisal and the traditional approach (which he terms "micro-appraisal") is that macro-appraisal starts with the functions and structures whereby records are created in a particular social context before moving on to the content and structure of the records themselves.[28] Each of these shifts in the way archivists apply the concept of provenance was motivated both by changes in how we view organizations and by practical problems that arose for archivists in carrying out records appraisal.

At the close of the twentieth century, it appears that the concept of provenance may be called into question once again, this time by the emergence of digital media and network organizations.[29] As yet, there is no consensus on this point or on how the concept of provenance may be altered to fit the digital records-creating environment.[30] Some archivists have argued that digital records need not be treated differently than print records, given that both have the same underlying (Schellenbergian) purpose of supplying information and evidence, as they have long been defined in the print environment.[31] Others in the profession have argued that digital information systems present a historic opportunity to move beyond the naive objectivism implied by the assignment of provenance by an archivist who is culturally and physically isolated from both records creators and users.[32] In keeping with macro-appraisal, for instance, Terry Cook argues that, in the digital age, provenance should

describe not records per se, but "a world of relationships, of interconnections, of context" in which archivists themselves are considered an integral part of the social context where records, and therefore archives, are created.[33] Indeed, Tom Nesmith goes so far as to argue that the archives itself should be viewed as part of the provenance of records, for "when archivists debate and refine the record's provenance, they interpret or shape it. They construct it from the knowledge available to them."[34] This last point is crucial, as archivists cannot hope to judiciously appraise records in highly complex organizational environments without consciously taking into account the specialized knowledge and institutional perspective they bring with them to the appraisal process.

The first step in macro-appraisal can generically be described as "functional decomposition," in which the archivist analyzes the routines themselves rather than the offices that comprise the organization's formal structure. In planning our research for Expanding the Options, we originally hoped to use a functional decomposition of work routines in our sites as the basis for appraising whatever records were at hand. However, the highly informal networks we chose to study made it difficult to begin with an analysis of functions. First, the work routines we found were generally too complex and ill-defined (from the traditional perspective of a management hierarchy) to be modeled in a straightforward manner, as work flows with clear inputs and outputs. A key issue was the tight coupling we observed between human actions and the variety of technological artifacts (including records) used, which made for highly complex interactions that constantly affected the status of human and machine agents in the system.[35]

Another problem I discovered in my attempt to apply macro-appraisal principles was the high degree of variability in the routines I observed. As Terry Cook and his Canadian colleagues who actively use macro-appraisal have observed, the practicality of functional analysis in appraisal depends in part on the stability of functions over time.[36] For service organizations, such as government agencies, experience has shown that functions are often more stable than the administrative structures which are responsible for work. I found a different pattern in our research sites, however, in part because I focussed on product-centred teams that were organized to meet the demands of a single project. In such environments, rapid changes in technology, combined with fluid organizational structures that are highly dependent on individuals and small groups, make it difficult to identify work functions that are likely to persist over even short periods of time. Such problems were not unexpected, as all of the research sites chosen for Expanding the Options were intended to push the limits of macro-appraisal, not so much as a theory but as a routine for carrying out appraisal in the field.[37]

In fact, I found the theory of macro-appraisal indispensable for the *view* it provides of the organization as a dynamic organism (rather than a static set of administrative relationships), in which the meaning, and hence appraisal

value, of a record is highly contingent on the pattern of social interaction between actors.[38] I found this to be a critical insight in examining both the functions of the organization as a whole and also the dynamic role of "communities of practice" – in this case, networks – that act within and between organizations, and whose work is often transparent in relation to the mission of the organization as a whole. Above all, my field research convinced me that appraisal practices, more so than theory, must be highly flexible in order to gather the vital information one needs *about* the organization as the locus of provenance to enable the archives to capture the most valuable records available. For example, in another of my cases (which will be reported in a future work), I had to effectively reverse the appraisal process; rather than beginning with functions and communities of practice, I had to begin with the actual records because the organization itself had ceased to exist.

Appraising Records in Network Environments

In fact, in all our attempts to carry out functional analyses of work in the research sites, we found it impractical to appraise functions, or technologies for that matter, in isolation from actual records. This is not to say that functional decomposition cannot be undertaken in such settings, although it would likely be a costly undertaking for many archives. The problem we encountered is that appraisal of the function by itself will not necessarily yield coherent, useful collections of digital records. In other words, in the digital environment one needs both the records and knowledge of the organizational context, the functions in which records are created. This has also been the case for paper archives, of course, but in the digital environment the archives has to play a much more active role in preserving and even creating "linkages between context and content" because such dynamic links can be expected to change substantially over time.[39]

In carrying out records appraisal, archivists have to manage the inherent tension between the archives' traditional mission of preserving the record as an object and the record as evidence of the intent and meaning imparted to the record by its creator. Many archivists have approached this problem by treating the record as a kind of "black box," as a container whose contents are to be interpreted by researchers (who are often presumed to be experts having a rich understanding of the context in which the records were created) rather than by the archivists themselves.[40] This approach is perhaps best reflected in the practice of diplomatics.[41] In response to the proliferation of digital records, in particular, many diplomatists have argued that the archives should cling all the more tightly to its historic role as guardian of records as physical and conceptual artifacts. Luciana Duranti, for one, argues forcefully that archivists should consciously avoid "attributing externally imposed values" to records in the selection process. In carrying out appraisal, archivists should focus on their

historical role as "mediators and facilitators, custodians and preservers of societal evidence" as opposed to "documenters and interpreters, or even judges, of societal deeds."[42]

For digital records, diplomatics promises to standardize record types and to clarify the role of records within contemporary organizations. However, one limitation of this approach is that it does not offer a method for collecting and preserving the large body of digital records whose value as evidence has yet to be determined by the judicial system, or by society in general. This is a distinct problem today, as many established organizational structures and processes are being undermined by the introduction of digital information technology. In a climate of organizational ambiguity and rapid change, archivists may need to expand their view of what constitutes an archival record if they are to maintain Hilary Jenkinson's concept of "archives" as an organic entity that necessarily reflects the particular social values and historical context in which records are created.[43]

To understand the context of records in technologically dependent network organizations, we need to pursue Tora Bikson's call for a "sociotechnical systems theory" that would promote a "'mutual adaptation' view of the implementation of new technologies in organizations, treating the social system of work and the technical system of work as inherently interdependent." In her view, technological systems and human social groups are "open system[s] susceptible to independent sources of influence, but changes in one cannot help but result in changes in the other." Consequently, the process of technological innovation is "inherently incomplete and unpredictable...[and] changes in one of these systems affects the other – they are reciprocally influential."[44] We need to include records as one of the technologies present in the system.

For the investigators involved in Expanding the Options, it was telling that David Bearman and his colleagues on the Pittsburgh project chose to limit their investigation to record-keeping systems designed to produce "evidence," in the juridical sense, and not "information" in the broad sense. Indeed, for Bearman, the archives faced a big challenge in dealing with digital records because computing systems have nearly always been designed to free "data from the form in which it was created, for use in other ways," making it useless as evidence. He thus argued that formal record-keeping rules had to be incorporated directly into the design of information systems. In other words, archivists should appraise the record-keeping *system* and not the record itself, as the natural "locus of provenance" in the digital environment, in which records are naturally unstable and dynamic but which nonetheless contain "evidence" of transactions that can and should be preserved for the long term.[45]

The obvious problem with the Pittsburgh approach, and this became the key issue for Expanding the Options, is that it excludes from the archives the huge mass of digital information that is unlikely to ever meet the rules for evidence,

because the creators do not want to limit their own use of such records to strict criteria based on legal rules of evidence or, for that matter, on current digital preservation standards.[46] Of course, the larger question is "whether archives can transcend a fundamental transformation in the nature of records from the stable world of static media to the dynamic world of electronic communications."[47] Since no one research project could hope to answer this question, my focus has been on the appraisal issue, on deciding what records we would like to preserve, before we address the issue of how we might go about actually preserving them as archives.

As I sought to move beyond the Pitt project's emphasis on record-keeping systems as the locus of provenance, I found the Australian continuum approach helpful in forming my research agenda. The continuum model put forth by Frank Upward, for example, led me to consider records as continuously active entities that have meaning only in a social and historical context.[48] Thus, as I sought to appraise records alongside the records-creating processes in my research sites, I consciously sought to examine both the creator and the chain of events whereby a record was created and used. In doing so, I treated the appraisal process itself as one of the events that determines the meaning or content of records, in order to avoid treating the records as static "relics" to be preserved like flies in some kind of archival amber, waiting for future users to recontextualize them through research.[49] In appraising the records of collaborations, the continuum approach suggests appraising records-keeping systems rather than existing records. The "web of relations" among record, creator, and user "cannot be encompassed through a single, hierarchical path," such as one would institute through a formal systems design process, because these relations are continuously in the process of being formed and renegotiated as records move from one point in the social system to another.[50] In general, the nature of network organizations strongly suggests that we consider appraisal as an open-ended process, one that begins with the formal design of record-keeping systems and then goes on to monitor and adapt to the evolving structures and functions of the creating organization.

Conceptualizing Records as Infrastructure

Having determined that records and records-creating functions need to be appraised together, I now sought a practical framework for carrying out appraisal at this level of analysis. Indeed, it became apparent that I faced serious obstacles in appraising the record value of digital documents and information systems produced by collaborations. Ultimately, the task of appraising digital records forced me to think strategically about records as both actual and potential sources of information.[51] In this respect, I chose to view records appraisal as a process for distinguishing valuable "information" from the huge quantity of "noise" one encounters in dealing with the flow of electronic information.[52]

In searching for a way to appraise records as sources of information in an organizational context, I decided to conceptualize records as a form of technological infrastructure. By treating records as part of the technical environment or background in which organizations carry out their activities, I sought to appraise records in a way that avoids the practical impossibility of appraising every record on a case-by-case basis. As archivists have known intuitively for a century or more, and psychologists since the 1940s, organizations depend on routines to distinguish information from background noise. Organizational structures, including hierarchies as well as networks, are thus critical tools in the decision-making process.[53] Likewise, routines within organizational structures serve as both formal and informal mechanisms for making decisions in the face of complex and uncertain sources of information.[54]

Given what we know about the ways in which organizations can process information, I would suggest that we can appraise records by treating them as a class of technological artifacts in a socio-technical system, or what Bruno Latour and other historians of science and technology have labeled "actor networks."[55] In this view, records should be considered actors within an organization in the same way that humans and machines can act, or have some effect on, the state of a system. This is not to argue that records act in the same way humans do, especially given that the content of records always depends on some action or decision on system design made by humans.[56] Nonetheless, records can be said to act by limiting, or expanding, the contents of human social memory, either by forcing us to recall something, using text to jog our memory, or by helping us to forget something, as when records are lost or destroyed.[57] This view of the record as an active rather than a passive force in organizational behaviour echoes Hugh Taylor's call for archivists to reorient the profession towards a more dynamic understanding of how changing media and forms of organization affect our understanding of the content and form of a record. For Taylor, the assembly-line or life-cycle model of records creation and retention tends to obscure the constantly shifting value of records, both for creators and users, in the digital environment. Thus, to ensure that future archives will be "of maximum value to the administrator and, where appropriate, to the general public as user, ... archivists must be far closer to the point of creation and original use." His rationale is that new technologies are pushing the "act or decision which informs the conduct of affairs ... closer in time to the document that records it."[58]

This view of records is in stark contrast to the traditional Schellenbergian and Jenkinsonian view of records as inactive by-products of administrative activity which are supposed to be appraised *as records* (as physical objects, or digital objects for that matter) and not as documents, whose meaning depends on an emergent or dynamic social order and is subject to continual renegotiation. Of course, the macro-appraisal approach was explicitly formulated to

permit archivists to appraise records in their social context by focussing specifically on the functions that result in the creation of records. Hence, what I am calling for, based on my field research in network settings, is an extension of macro-appraisal to treat digital memories (defined simply as the total mass of digital information which is current in an organization) as entities that can actively affect the range of actions available to any actor, human or non-human, in the system. Thus, records should be appraised as infrastructure to the extent to which one can observe them acting as information sources in a social or organizational setting. For records to be valuable, they clearly must do more than represent the social functions whereby they were created. As information sources, the value of records is necessarily linked to the set of shared, *tacit* meanings that bind together communities of practice. Of course, as much as we rely on tacit knowledge in doing our work, we still need knowledge contained in *explicit* forms (records in the conventional sense) to facilitate efficient search and retrieval in the process of learning.[59]

Indeed, the investigative group involved in Expanding the Options was greatly impressed by the dependence of work teams on a highly complex technological infrastructure, including records. Following cognitive psychologist Edwin Hutchins, one can study the linkages between actors and the embedded memories found in technical artifacts and organizational routines; in a sense, one can appraise technologies as sources of tacit learning.[60] However, we found this approach problematic in dealing with records because, as anthropologist Lucy Suchman has pointed out, information in the broad sense is often rendered invisible, or taken for granted, in the day-to-day interactions that take place between the machine-as-infrastructure and humans in many kinds of work environments.[61] In fact, as computer scientists Terry Winograd and Fernando Flores have persuasively argued, all types of technological infrastructure are transparent by nature except when the system breaks down, in which case the actors in a system generally work to make infrastructural elements become invisible again, in turn making them harder for an archivist to appraise.[62] In this light, the social context of records, that is, their appraisal value, is always dependent on highly complex interactions that occur between tools, information sources, and work activities.[63]

In viewing records as elements of technological infrastructure, it is especially important to note the political role of records, both as sources of content and by their presence and availability as infrastructure. Sociologist Marc Berg stresses the extent to which the field of participatory design, the original basis for research in Computer Supported Cooperative Work, was motivated by the political tension between communications technologies and information forms, or records in our terms.[64] Likewise, sociologist Leigh Star and others emphasize the degree to which a complex organization is necessarily a negotiated order rather than a static structure. In other words, organizations are con-

stantly engaged in a process of adapting to unforeseen circumstances with the resulting "articulation work" itself leading to changes not only in the "substance" of work but also in the formal language (or, for our purposes, records) used to explain and justify work activities.[65] As will be shown, we found a narrative approach useful in identifying events affecting the composition and creation of records in the organizations we were studying.

Appraising Records as Infrastructure

In developing a framework for appraising records as infrastructure, we are fortunate to have an extensive theoretical literature on the development and social influences of large-scale technological systems.[66] I would point especially to four characteristics of technological infrastructures identified by Geoffrey Bowker and Leigh Star, which in future research I would like to recast as appraisal categories for records. In their view, technologies become infrastructure when they are embedded in socio-technical systems, transparent to the user, and conventional – in the sense that they are generated in a way that is usually consistent with established routines. Finally, and most important for our purposes, to act as infrastructure, records must serve as effective "boundary objects; which is to say, they must carry multiple meanings, across multiple communities of practice."[67] A prime example of a boundary object, discussed at length by Star and Bowker in their recent book, *Sorting Things Out*, is the International Classification of Diseases (ICD). The ICD is a tool whereby nurses, doctors, and health care administrators – as distinct communities of practice having rather different perspectives on patient care, and who often work in isolation from one another – describe and preserve information about individual cases. Star and Bowker explore in detail the often subtle, yet powerful, ways in which the ICD classifications affect the social and political context of modern health care. From an appraisal point of view, the records using ICD classifications are obviously important, but they are also problematic because, as Star and Bowker indicate, the descriptors tend to have different meanings within each of the communities of practice that use the system. In this respect, by conceptualizing records as agents embedded in actor-networks, I am looking for an approach that will enable us to make deep inferences about the *potential* value of records for multiple communities of practice in a way that is theoretically consistent and equally valid for both creators and users of records.[68]

In traditional appraisal practice, the value of records is measured in part by the degree to which they appear to be embedded within a particular socio-technical environment, which we label as the record's provenance. My framework goes a step further by emphasizing the need to examine the ways in which records serve as actors within an organization. The easiest way to

measure the two-way interrelationship between human and technological actors is to observe how events or narratives within a collaborative project affect the state of records and the use of records. This approach helps us to address the problem of appraising records in a highly complex environment, such as a high technology, research and development project. Helen Samuels and her colleagues at the Massachusetts Institute of Technology (MIT) have observed that, despite the abstract nature of their work, "scientists and engineers do not work in isolation; they rely on and communicate with networks of peers and administrators."[69] Indeed, these social connections play a vital role in shaping the outcome of a research project as well as the way it is described to people inside and outside the team doing the work.

From the appraisal point of view, I found that the narrative accounts put forth by my interview subjects were remarkably useful in linking the project's plans, the actions of team members, and the records they have created over the course of the project.[70] By presenting our data in the form of case studies, it became apparent that two classes of narratives were of prime importance for records appraisal.[71] The first concerned events affecting the selection and retention of records. In effect, I decided to construct a record narrative for each research site, based on patterns I identified in the flow of work in projects that had some effect on the composition of the project's record memory over time, and based on the evidential and informational values assigned to the project's records. The second narrative accounted for events which affected the value of records as viewed by the human actors as they were involved in some collaborative work. In this case I tried to identify situations or problems in the course of the project that led actors to create records or to make use of existing records.

The second component of my proposed framework, transparency, directly concerns the value of records as information sources, both to the creators and to potential users. If one accepts that records are one set of actors that affect the status of an organization, as a negotiated order, it follows that records which are more tightly linked to the web of tacit knowledge within a community of practice will have more power, or, in our terms, a higher appraisal value. This is especially true in dealing with records as dynamic, digital artifacts rather than static, physical objects. In this view, records have to be appraised as they are being used, based on observable patterns of interaction between records, creators, and users. This means that by carrying out the act of appraisal, the archivist is taking records that are deeply embedded in an organization, and which are therefore transparent, and making them visible by placing a value on them. Thus, in carrying out appraisal, the archivist becomes another actor in the organization's actor network by deliberately making visible the memory traces generated by the generally invisible work of communicating valuable information. At a theoretical level, one can say that archivists,

as social actors, cannot appraise inactive records because the act of taking records out of storage and placing some value on them reintroduces them into the social life of documents in their organizational context.[72]

The more closely records are linked to the web of tacit knowledge in a collaboration, the more invisible they become – not in the literal sense, of course, but in the way they are used. As records are used more extensively, they are more likely to change over time, without leaving a documentary trail noting the changes. Digital records are especially transparent because they are designed to be dynamic components in information systems.

The third component of my framework is what I call the conventional meaning of records. By placing records into a narrative account of organizational or social behavior, records can be appraised according to how well they act as a reflection of important functions, activities, or routines; this is the basis of the macro-appraisal approach. Also, within a collaboration (as a community of practice), records often act as tools whereby novice or peripheral members of the organization can access the organization's memory without having to fully share in the tacit knowledge of the group.[73] Thus, in appraising records, the archivist should consider both the functions and the specialist knowledge represented by records as they are used in an organizational context.

The final component of my framework is the recognition that records – those documents appraised as having archival value – have multiple meanings and uses, in several (or many) communities of practice. In other words, valuable records effectively serve as boundary objects that translate information across social boundaries as well as across time and space, in this case, among the communities represented by records creators, archivists, and users.[74] This characteristic of records is especially important in dealing with complex digital records, the contents of which are routinely altered to meet the needs of a particular user, as in the case of a database report. The proliferation of online databases offers an especially compelling reason for evaluating digital records as boundary objects, as the overall value of a database depends on the cumulative set of values attributed over time to reports generated by the user community.

To sum up, my efforts to appraise records in network organizations have led me to develop a conceptual framework that calls for two basic steps in the appraisal process. First (as indicated in the left column below), the archivist seeks to appraise the creators of records by examining the values they place on particular types of records and by observing the pattern of events, that is, the routines, whereby they create records. The archivist then uses the information gained from this investigation to locate existing records as well as information sources that might be captured as records. Second, the archivist appraises actual records according to the four characteristics of infrastructure described above and listed below in the right column:

Organization:	Records:
Human Actors	Embedded
Events (Narratives)	Transparent
Records	Conventional
	Multiple Meanings

Case Study: The UARC Project

In the early 1990s, the University of Michigan Upper Atmospheric Research Collaboratory (UARC) became a working prototype for what Daniel Atkins, the project director, calls a "distributed knowledge work environment."[75] With substantial financial support from the National Science Foundation (NSF) and the University of Michigan, UARC produced an influential body of research over a six-year period. (It has evolved to become the Space Physics and Aeronomy Research Collaboratory today.) Its size and status relative to other grant projects on the University of Michigan campus made it a logical candidate for us to appraise its records and record-keeping functions. As a grant project, UARC carried out research and development on tools and methods for facilitating collaborative work across scientific disciplines.[76] It has since grown into a large on-line clearing house for scientific data.[77]

I found UARC to be a particularly rich site for our investigation because it consisted of a collaboration whose mandate was to design and test methods and tools for use by other collaborations.[78] As a test bed for collaborations, UARC was intended to stretch the idea of a network organization to its natural limit. By studying this project, I hoped to understand not only the functions whereby records are created in networks, but also the roles records can play in shaping the design of a network organization as it seeks to translate complex knowledge across multiple communities of practice. In short, I hoped to appraise the work of UARC both by function and by actual records produced.

I began the research by examining the project's formal record-keeping requirements, as dictated by the University of Michigan and NSF. I then examined the official documents produced and retained by the project staff. These consisted mainly of annual financial reports and progress reports submitted to the project's NSF review committee. I then examined public documents generated by the project, including pages from the project's Web site. Published articles about the project also helped put the organization into context.[79] I then conducted sixteen semi-structured interviews with project members and administrative staff; my colleague, Sarah Naasko, conducted two more. Seven interviews involved current principal investigators, including the project director. The rest involved administrative and technical staff members, including

programmers and systems administrators. In drafting interview questions, our main objectives were to identify the key actors at different stages of the work, the plans they set, the technologies and processes they used, and the records (both archival and non-archival) they created in carrying out particular tasks.

Although I found the public records on UARC valuable, I also discovered that they provided a rather narrow and fragmentary account of the project. They did not adequately document the functions and institutional responsibilities that shaped the day-to-day activities of project team members. Nor did they document interactions between the project team and the scientists who made up the collaboratory's user group. What the official records did provide was a high-level view of the project's plans and objectives at particular moments, but they revealed almost nothing about the human and technological factors shaping those plans or the organizational process whereby objectives were allowed to evolve over time. In practice, I found that I could not appraise functions and records separately, as the meaning of each was highly contingent on the tacit knowledge (that is to say, the organizational context) upon which the project participants depended to carry out their work.

For example, the final grant proposal called for a relatively ambitious and costly project, involving an unusual mix of space scientists, social scientists, and computer scientists. The stated goal was to build an electronic network linking scientists and data sources located around the world, enabling them to collaborate without having to travel. The proposal also called for social and cognitive research on collaboration itself, in order to build a knowledge base that would permit useful collaboratories to be built in other scientific domains using the same technologies as UARC. One thing the proposal did not indicate was that the original idea for the project had been much more limited at first, involving little more than building a satellite link that would enable researchers to gather data from a radar facility in Greenland.

As it happened, the plan for UARC grew dramatically after it was brought to the attention of a group of computer scientists and social scientists at University of Michigan who were already involved in building and testing distributed work environments. This group, many of whom would become principal investigators for UARC, was a robust social network, but it was an organization that tended to operate very informally and without much regard for the traditional institutional boundaries that separate academic fields within most universities. Many individuals within UARC's social network preferred to communicate face-to-face or over the telephone, rather than through letters and e-mail. Group meetings were an important feature of the project, and yet the most sensitive negotiations often took place in closed door conversations that generally did not lead to the creation of a record, but the results of which were well understood by the project participants after decisions were made. In effect, the grant proposal had only limited value as infrastructure, both in the work of the project team and as an archival record. As a document, the pro-

posal reflected a process whereby the team members consciously sought to make visible a set of assumptions about the work they had yet to undertake, or even to fully understand. In this respect, the grant proposal did not, and could not, represent the tacit knowledge that individual group members would use to design the actual system that the project was intended to build. Also, the proposal by itself does not reveal much about the process whereby the granting agency approved the proposal and funded the collaboration.

Indeed, our interviews suggested that the proposal itself was mostly a formality in the complex negotiations that took place between UARC's leaders and the granting agency. As such, it has archival value, but only if the user is able to gain some access to the contextual knowledge underpinning the collaborative process. As a record, the proposal's appraisal value depends, at least in part, on other records that might be collected alongside it. And yet, the grant proposal was the only official, institutional record I found relating to the early evolution of the project. So, to capture the valuable context of the project's origin, I clearly saw the need for projects like UARC to have some kind of "documentation strategy" according to Helen Samuels's approach, which seeks to locate and appraise valuable records by analyzing functions that cut across institutional boundaries.[80]

However, given the general absence of supporting documentation for records like the UARC grant proposal, it became apparent that I first had to search for potentially valuable sources of information, including some types of digital documents that are often not appraised as archival records because they are considered difficult to preserve, or because they do not contain sufficient identifying metadata to permit a conventional arrangement and description. For example, I found that the group often used PowerPoint presentations at academic conferences; they regarded these documents as valuable records and made considerable effort to preserve them. And yet, as an archivist who was not part of the project team, I found that their slides often had little informational value without a recording or transcription of the accompanying lecture.

Once I identified potentially valuable sources of information for appraisal, I next had to consider how patterns of work and communication affected the value placed by team members on the types of documents they created in the course of their day-to-day activities. In this regard, I found the narrative accounts I obtained through interviews especially helpful in making sense of the project's complex social and technological environment.[81] Besides helping us locate valuable documents, the narratives constructed by our subjects proved remarkably effective in identifying important events that they, and I as an archivist, considered worthy of being documented. I also found narrative accounts helpful in identifying events that directly affected the composition of the project's social and record memories, adding much to our understanding of the dynamic role of records in the collaboration.

Perhaps the most valuable records I found in UARC were the text files containing the computer code written for successive versions of the UARC system. These documents were the most basic products of the collaboration, and they strongly reflect the processes whereby they were created and used. As such, the code files are a clear example of records acting as part of the project's infrastructure. In fact, like all computer programmes, they were designed to act as boundary objects, translating important information from the programmers to the users and other stakeholders. To the programmers, the code files embodied the capabilities and limitations of the technology, along with the overarching goals set by the project team. For users, the code files were all but completely transparent, as they only saw the results displayed on their monitors. Likewise, the social scientists viewed the code as a set of features and functions that they wished to test with the user group. So the code had changing meanings for the different groups involved in the collaboration, meanings that changed over time as the project evolved.

In the early days of UARC, the system was developed through a process that is commonly known as rapid prototyping. For UARC, this meant a routine of writing and releasing code in quick, six-month iterations that enabled the programmers to incorporate user feedback directly into the design of successive versions. The first two iterations of the code were written largely by two people, who worked closely together and who also had much direct contact with users. This highly informal approach was made feasible because the project's initial goal was to build a working system with a limited set of functions, instead of incorporating all of the desired features at once. In such an environment, the programmers themselves required little or no formal documentation and, since the number of users was relatively small (generally less than a dozen at one time), the programmers could take time to answer questions if users encountered problems. Thus, it was apparent that the code files were very deeply embedded in the socio-technical network linking the UARC programmers and the space scientists who used the system.

Indeed, the code files for early iterations of the UARC system were so transparent and deeply embedded in the project's tacit knowledge that they lacked a good deal of important contextual information I clearly needed to assess their value as records. It was only by interviewing members of the project team, and thereby creating a set of archival records in the form of interview recordings, that I was able to construct a workable narrative that would enable us to appraise records, including the code files, within the organizational context of UARC's early system development efforts.

In general, I found that the records and record-keeping practices in UARC followed a similar pattern as found in our other research sites. In each case, I observed a puzzling relationship between records and records creators. On the

one hand, records creators uniformly placed a high value on their records and wanted many of them to be preserved for the long term. On the other hand, as participants in temporary and constantly shifting collaborative networks, records creators did not have the authority or access to institutional resources needed to establish formal record-keeping systems.[82]

Moreover, our subjects felt that informal patterns of communication and loose institutional controls were essential to effective project management in a collaboration that cuts across institutional and disciplinary boundaries. All of the networks I examined had very flat hierarchies that permitted individuals, such as the UARC programmers, to make fast decisions in response to rapid technological changes. As I observed these contradictory views – that records were valuable but formal record-keeping systems were too costly to implement – it became clear that to appraise records properly, I needed to explain how a network organization can depend heavily on records but not exert a high degree of control over their records. As noted above, my proposed solution is to reconceptualize the record as part of an organization's infrastructure. According to this approach, records should be appraised according to how effectively they transfer information between actors with *minimal human intervention*. In other words, records should be appraised as actors in their own right, alongside the human and technological actors that are all tightly interconnected in contemporary network organizations. The UARC code files, for example, served as critical actors in the organization by automatically conveying (and even producing, in some instances) different information to multiple sets of actors, making them a vital, if transparent, part of the infrastructure for each set of actors involved in the project.

In this context, our efforts to appraise the information sources (both records and non-records) found in UARC and our other sites led us to move beyond the practice of appraising functions and the practice of appraising records as self-contained artifacts. In essence, by conceptualizing records as infrastructure, I was appraising both the records creators and the records as part of a complete actor network. By examining collaborative work through a narrative lens, I sought to identify records that were closely linked not only to work processes but to the tacit knowledge that exists within communities of practice, and which were effective in transferring information across the social and institutional boundaries that divide participants within collaborations. Also, in carrying out appraisal in a network organization like UARC, I found it necessary to locate the archivist as records appraiser inside the social network that creates and uses archival records. In this respect, I found that the job of appraisal in the digital environment involves the translation of transparent, "invisible" information sources into visible record artifacts that are able to convey a rich understanding of the organizational context in which information is used and collaboration takes place.

Conclusion

The aim of this article was not to try to solve the fundamental problems facing archivists charged with appraising the records of network organizations. Rather, I have tried to add to healthy tension that already exists between the theory and practice of appraisal. Recent archival literature reveals a burgeoning debate in archival theory, mainly concerning the proper role of the archives in society, either as an impartial guardian of records or as an active participant in documenting our social and cultural heritage. My aim has been to show that the increasingly complex organizational environment poses a threat to the established practice of appraisal, making it necessary for us to explore and use theory in new ways that will help solve the immediate problem of identifying and capturing records of enduring value.

In appraising the records of collaborations, I found provenance to be a vital concept, but one that is also fluid and necessarily ambiguous with regard to many records creators in network settings. Second, I found it essential to consider not only the changing structures and functions of the records-creating organization, but also the values of records as they change over time. Third, the difficulty of appraising records in a network organization made it necessary to search for a conceptual view of the organization that would reveal the active role records play in shaping the highly complex strategies, structures, and functions underlying work processes in technologically advanced collaborations.

A great deal of further research is needed to enhance our understanding of the role of collaborative work and the impact of new technologies on the creation and content of records. Forthcoming reports from Expanding the Options will explore in greater detail the opportunities and limitations facing archivists in their efforts to appraise records in a rapidly changing organizational landscape. But more, and still larger, projects will certainly have to be undertaken before the archives profession is able to effectively adapt its existing appraisal standards and procedures to the task of collecting digital information resources created by emerging organizational forms. In the future, the cost of research to keep up with changes in the record may be high, but a failure to invest in new knowledge to support the work of appraisal may be disastrous for archives.

Appendix

Collaboration: A Working Definition

1. Structure

Collaborations are knowledge work processes involving more than one per-

son. They usually involve the coordination of tasks among a small- to medium-sized group – a team. Collaborations are informal, decentralized associations which act independently from existing lines of authority. They are central to network structures in which responsibility for completing tasks is widely distributed across organizational boundaries. Within networks and collaborations, strong interdependencies exist across different functions and among the different tasks or subroutines in the work process.

2. Strategy

A collaboration requires flexible and varying work routines, inherent to the knowledge work carried out in collaborations. Strategies for collaborative work require problem formulation and research rather than implementation of set practices. Collaborations typically arise in response to complex problems that call for expertise in several functional specialties. More broadly, collaborations can be seen as organizational responses to uncertainty, in which decision making is constrained by a lack of relevant knowledge. Thus, collaborations are normally motivated by a specific goal, as in the case of ad hoc projects intended to have only a short-term role within an organization.

3. Role of Information

Collaborations require an efficient and consistent flow of information. They are highly dependent on information technology (IT) systems and on effective record-keeping to document the results of each step in the work process. IT systems enable team members to maintain working relationships in spite of geographical and institutional barriers. Record-keeping systems and policies are needed to ensure effective feedback in the work process as well as to preserve the knowledge generated by collaborative work, a substantial portion of which could be lost when the collaboration is finished and teams are disbanded.

Notes

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1 In a recent lecture, eminent sociologist Paul DiMaggio highlighted the problem of building

conceptual models for networks, given the institutional diversity one finds within this category of organization. See Paul DiMaggio, ed., *The Twenty-First-Century Firm: Changing Economic Organization in International Perspective* (Princeton, forthcoming). See also Manuel Castells, *The Rise of the Network Society. Vol. 1, The Information Age: Economy, Society and Culture* (Cambridge, 1996).

2 Brien Brothman, "Orders of Value: Probing the Theoretical Terms of Archival Practice," *Archivaria* 32 (Summer 1991), p. 81.

3 Robert McIntosh, "The Great War, Archives, and Modern Memory," *Archivaria* 46 (Fall 1998), p. 2.

4 I should emphasize that the analysis and conclusions offered here are those of the author and do not necessarily represent the views of the principal investigators and other project team members.

5 Paul Marsden, "When is the Future: Comparative Notes on the Electronic Record-Keeping Projects of the University of Pittsburgh and the University of British Columbia," *Archivaria* 43 (Spring 1997), pp. 158–73.

6 In fact, both principal investigators at the University of Michigan were directly involved in drafting the list of functional requirements produced by the Pitt project.

7 A notable example being the U.S. Department of Defense, which was recently involved in a records management collaboration with researchers at the University of British Columbia. See: <http://www.slais.ubc.ca/users/duranti/intro.htm#COLLABORATION> (last visited 16 May 2000).

8 See the Models for Action report: <http://www.ctg.albany.edu/projects/er/ermn.html> (last visited 22 May 2000).

9 See John Seely Brown and Paul Duguid, "Organizational Learning and Communities of Practice: Toward a Unified View of Working, Learning, and Innovation," *Organization Science* 2, no. 1 (1991), pp. 40–57. See also Theodore Schellenberg, *Modern Archives: Principles and Techniques* (Chicago, 1956), pp. 139–60.

10 This concept has been most fully developed by Jean Lave. See Jean Lave and Seth Chaiklin, eds., *Understanding Practice: Perspectives on Activity and Context* (Cambridge, 1993).

11 See Daniel Atkins, "The Collaboratory Concept," <http://act.ummu.umich.edu/future_files/v3_document.htm> (last visited 22 May 2000).

12 See the work of Thomas Malone and his colleagues in the Center for Coordination Science at Sloan School of Management, Massachusetts Institute of Technology, <http://ccs.mit.edu> (last visited 5 May 2000).

13 The tradition of "grounded" research grew out of early work in sociology and anthropology, which focused on empirical observation as the basis for developing a theory to explain complex social behavior. As an ethnographer, Anselm Strauss and his collaborators have been particularly receptive to the use of narrative to structure their field accounts of work practices. On Strauss's pioneering study of doctor-patient interactions, see Barney Glaser and Anselm Strauss, *Awareness of Dying* (Chicago, 1965).

14 See JoAnne Yates for a discussion of the limits of a static view of information flows in an organization. JoAnne Yates, *Control Through Communication: The Rise of System in American Management* (Baltimore, 1989). A grand, if ultimately unsuccessful, attempt to model information in a dynamic way can be found in Jay Forrester, *Industrial Dynamics* (Cambridge, 1961).

15 This point has been made most convincingly by sociologist Paul DiMaggio and his colleagues. See Paul DiMaggio and Walter Powell, eds., *The New Institutionalism in Organizational Analysis* (Chicago, 1991).

16 The study of informal or ad hoc organizational forms, for example, is often described as an emerging area of scholarly interest, and yet it has been a visible feature of the literature of organization studies for decades. See Chester Barnard, *The Functions of the Executive* (Cam-

bridge, 1962). Also see Peter Blau and W. Richard Scott, *Formal Organizations: A Comparative Approach* (San Francisco, 1962), and Henry Mintzberg, *The Structuring of Organizations: A Synthesis of the Research* (Englewood Cliffs, N.J., 1979).

17 This view is strongly reflected in JoAnne Yates, *Control Through Communication* (Baltimore, 1989), and Alfred D. Chandler, Jr., *The Visible Hand* (Cambridge, 1977).

18 This is a highly simplified account of the theory of structural-functional view of organizations, which stems from ideas developed in great depth by Max Weber and Emile Durkheim, among others, at the turn of the twentieth century. See Emile Durkheim, *The Division of Labor in Society,* W.D. Halls, trans. (New York, 1984); and Guenther Roth and Claus Wittich, eds., *Max Weber, Economy and Society: An Outline of Interpretive Sociology*, Ephraim Fischoff, et. al., trans. (New York, 1968). By the middle of the twentieth century, Talcott Parsons had produced a synthesis of these ideas, which directly influenced Alfred Chandler's pioneering approach to business history which he learned as one of Parsons's students. See Talcott Parsons, *The Structure of Social Action* (New York, 1937).

19 Alfred D. Chandler, Jr., *Strategy and Structure: Chapters in the History of the Industrial Enterprise* (Cambridge, 1962).

20 Theodore R. Schellenberg, *Modern Archives: Principles and Techniques* (Chicago, 1956), p. 142.

21 The practicality of this method for analysing the production of records in large organizations continues to lead many in the archives world to seek ways to update and maintain its relevance. See, for instance, Victoria Lemieux, "Applying Mintzberg's Theories on Organizational Configuration to Archival Appraisal," *Archivaria* 46 (Fall 1998), pp. 32–85.

22 Thus far the most influential theorist in organizational behavior is Herbert Simon. His essential works are: *Administrative Behavior: A Study of Decision-making Processes in Administrative Organization* (New York, 1947) and *Sciences of the Artificial* (Cambridge, 1969).

23 See Paul Edwards, *The Closed World: Computers and the Politics of Discourse in Cold War America* (Cambridge, 1996). See also Donald MacKenzie, *Inventing Accuracy: A Historical Sociology of Nuclear Missile Guidance* (Cambridge, 1990).

24 Herbert Simon, "Will the Corporation be Managed by Machines?" in *The Shape of Automation: For Men and Management* (New York, 1965; essay first published in 1960), pp. 46–47.

25 On the definition and analysis of organizational routines, see Richard Cyert and James March, *A Behavioral Theory of the Firm* (Englewood Cliffs, N.J., 1963), and Richard Nelson and Sidney Winter, *An Evolutionary Theory of Economic Change* (Cambridge, 1982).

26 For a review of this literature, see Barbara Levitt and James March, "Organizational Learning," *Annual Review of Sociology* 14 (1988), pp. 319–40.

27 Recent years have seen a renewed interest in the social mechanisms affecting the composition and recall of social memory. See David Lowenthal, *The Past is a Foreign Country* (Cambridge, 1985).

28 Terry Cook, "Mind Over Matter: Towards a New Theory of Archival Appraisal," in Barbara L. Craig, ed., *The Canadian Archival Imagination: Essays in Honour of Hugh A. Taylor* (Ottawa, 1992), p. 46.

29 One sign that provenance is under scrutiny is the recent willingness of some in the profession to explore the epistemological problems raised by assigning agency to records creators. Richard Brown thus situates the problem of defining a records creator within the pragmatist tradition, as reflected in modern hermeneutics. Richard Brown, "Macro-Appraisal Theory and the Context of the Public Records Creator," *Archivaria* 40 (Fall 1995), pp. 121–72. In the context of Expanding the Options, I have been mainly concerned with the practical, or organizational, implications of the records appraisal process, as opposed to the more academic pursuit of a coherent appraisal philosophy.

30 Terry Cook, "Electronic Records, Paper Minds: The Revolution in Information Management

and Archives in the Post-Custodial and Post-Modernist Era," *Archives and Manuscripts* 22, no. 2 (November 1994), p. 303.

31 Linda Henry, "Schellenberg in Cyberspace," *American Archivist* 61, no. 4 (Fall 1998), pp. 309–27.

32 Not that objectivism is without its merits as a practical strategy for avoiding political conflicts over the meaning, and hence the control, of the archives. For several decades now, the historical profession has been grappling with much the same dilemma, and with less-than-encouraging results. See Peter Novick, *That Noble Dream: The "Objectivity Question" and the American Historical Profession* (Cambridge, 1988).

33 Terry Cook, "Easy to Byte, Harder to Chew: The Second Generation of Electronic Records Archives," *Archivaria* 33 (Winter 1991–92), p. 206.

34 Tom Nesmith, "Still Fuzzy, But More Accurate: Some Thoughts on the 'Ghosts' of Archival Theory," *Archivaria* 47 (Spring 1999), pp. 145–46.

35 The need for, and the difficulty of constructing, models of such interactions is a frequent theme in organization studies, as well as in the work of David Bearman, among others, in the archives field. See, for instance, David Bearman, "Archiving and Authenticity," Research Agenda for Cultural Heritage on Information Networks: The Getty Art History Information Program, <http://www.ahip.getty.edu/agenda/archiving.html>, p. 2 (last visited 22 May 2000). From the management science perspective, see Thomas W. Malone, Kevin Crowston, Jintae Lee, Brian Pentland, Chrysanthos Dellarocas, George Wyner, John Quimby, Charles S. Osborn, Abraham Bernstein, George Herman, Mark Klein, and Elissa O'Donnell, "Tools for Inventing Organizations: Toward a Handbook of Organizational Processes," *Management Science* 45, no. 3 (March 1999), pp. 425–43.

36 Catherine Bailey, "From the Top Down: The Practice of Macro-Appraisal," *Archivaria* 43 (Spring 1997), pp. 89–128.

37 Margaret Hedstrom, "Building Record-Keeping Systems: Archivists Are Not Alone on the Wild Frontier," *Archivaria* 44 (Fall 1997), p. 65.

38 See Richard Brown, "Macro-Appraisal Theory and the Context of the Public Records Creator," *Archivaria* 40 (Fall 1995), pp. 121–72.

39 Margaret Hedstrom, "Understanding Electronic Incunabula: A Framework for Research on Electronic Records," *American Archivist* 54, no. 3 (Summer 1991), p. 350.

40 See Frank Boles and Julia Marks Young, "Exploring the Black Box: The Appraisal of University Administrative Records," *American Archivist* 48, no. 2 (Spring 1985), pp. 121–40. Also, Hans Booms makes the absurdity of this strategy abundantly clear, yet, as he acknowledges, the black box has the advantage of political neutrality, albeit at the expense of political impotence for the archives. See Hans Booms, "Society and the Formation of a Documentary Heritage: Issues in the Appraisal of Archival Sources," *Archivaria* 24 (Summer 1987), pp. 69–107.

41 For a cautious, indeed rather tepid, endorsement of this approach, see Francis Blouin, "A Framework for a Consideration of Diplomatics in the Electronic Environment," *American Archivist* 59, no. 4 (Fall 1996), pp. 468–69.

42 Luciana Duranti, "The Concept of Archival Appraisal and Archival Theory," *American Archivist* 57, no. 2 (Spring 1994), p. 343. On the role of diplomatics in archival practice and theory, see Luciana Duranti, *Diplomatics: New Uses for an Old Science* (Lanham, Md., 1998).

43 See Hilary Jenkinson, *A Manual of Archive Administration*, new and revised ed. (London, 1937).

44 Tora Bikson, "Organizational Trends and Electronic Media: Work in Progress,"*American Archivist* 57, no. 4 (Winter 1994), p. 66.

45 David Bearman, "Record-Keeping Systems," *Archivaria* 36 (Autumn 1993), pp. 19–33.

46 See Terry Cook, "The Impact of David Bearman on Modern Archival Thinking: An Essay of Personal Reflection and Critique," *Archives and Museum Informatics* 11, no. 1 (1997),

pp. 28–30. Also, along these same lines, Paul Marsden has cautioned archivists against drawing a firm line between "records systems" and "information systems" which produce documents not deemed to fit the requirements of an archival record. Paul Marsden, "When is the Future? Comparative Notes on the Electronic Record-Keeping Projects of the University of Pittsburgh and the University of British Columbia," *Archivaria* 43 (Spring 1997), pp. 162–63.

47 Margaret Hedstrom, "Electronic Archives: Integrity and Access in the Network Environment," *American Archivist* 58, no. 3 (Summer 1995), p. 323.

48 See Frank Upward, "Structuring the Records Continuum – Part One: Postcustodial Principles and Properties," *Archives and Manuscripts* 24, no. 2 (November 1996); and "Structuring the Records Continuum – Part Two: Structuration Theory and Recordkeeping," *Archives and Manuscripts* 25, no. 1 (May 1997).

49 Glenda Acland, "Managing the Record Rather than the Relic," *Archives and Manuscripts* 20, no. 1 (1992), pp. 58–59. See also Sue McKemmish, "Are Records Ever Actual?" in Sue McKemmish and Michael Piggott, eds., *The Records Continuum: Ian Maclean and Australian Archives First Fifty Years* (Clayton, 1994). This work is also available at: <http://www.sims.monash.edu.au/rcrg/publications/smcktrc.html> (last visited 24 May 2000).

50 Margaret Hedstrom, "Descriptive Practices for Electronic Records: Deciding What is Essential and Imagining What is Possible," *Archivaria* 36 (Autumn 1993), pp. 53–63.

51 Indeed, from a theoretical point of view, I would argue that all management decisions require, as a first step, the appraisal of information sources. See, for instance, Alfred D. Chandler, Jr., *Pierre S. Du Pont and the Making of the Modern Corporation* (New York, 1971). In this book, Chandler describes Pierre Du Pont's struggle to improve the efficiency and competitiveness of DuPont, and later General Motors, by raising the quality of information generated at the higher staff levels.

52 This argument is inspired directly by Shannon and Weaver's classic analysis of "signal-to-noise ratios" in information systems. See Claude Shannon and Warren Weaver, *The Mathematical Theory of Communication* (Urbana, 1949).

53 For a full discussion of hierarchies as tools for decision making, see Herbert Simon, *The Sciences of the Artificial* (Cambridge, 1969).

54 On the relevance of routines in the formation of organizational memory, see Barbara Levitt and James March, "Organizational Learning," *American Review of Sociology* 14 (1988), pp. 319–40.

55 See Bruno Latour, *Science in Action: How to Follow Scientists and Engineers Through Society* (Cambridge, 1987).

56 Following Marshall McLuhan, we could think of records as "media" insofar as they act as "extensions" of human intellect and sense perception. See Marshall McLuhan, *Understanding Media: The Extensions of Man* (New York, 1964).

57 This argument is a central feature of Maurice Halbwachs's classic study of social memory. See Maurice Halbwachs, *On Collective Memory,* Lewis Coser, trans. (Chicago, 1992).

58 Hugh Taylor, "'My Very Act and Deed': Some Reflections on the Role of Textual Records in the Conduct of Affairs," *American Archivist* 51, no. 4 (Fall 1988), pp. 467–68.

59 The interrelationship between tacit and explicit knowledge is a much-discussed feature of activity theory. See Yrjo Engestrom, *Perspectives on Activity Theory* (Cambridge, 1999).

60 See, for instance, Edwin Hutchins, *Cognition in the Wild* (Cambridge, 1995).

61 See Lucy Suchman, "Making Work Visible," *Communications of the ACM* (New York: Association for Computing Machinery) 38, no. 9 (September 1995), pp. 56–64.

62 Terry Winograd and Fernando Flores, *Understanding Computers and Cognition: A New Foundation for Design* (Reading, Mass., 1987).

63 Lucy Suchman, *Plans and Situated Actions* (Cambridge, 1987).

64 Marc Berg, "The Politics of Technology: On Bringing Social Theory in [sic] Technological Design," *Science, Technology and Human Values* 23, no. 4 (Autumn 1998), pp. 456–90.

65 The most complete statement of this approach is Chapter 9, "Categorical Work and Boundary Infrastructures," in Geoffrey Bowker and Susan Leigh Star, *Sorting Things Out: Classification and Its Consequences* (Cambridge, 1999), pp. 285–317. See also Susan Leigh Star, "Layers of Silence, Arenas of Voice: The Ecology of Visible and Invisible Work," lecture, University of Michigan, <http://www.si.umich.edu/ICOS/Presentations/020599/> (last visited 22 May 2000).

66 See Thomas P. Hughes, *Networks of Power* (Baltimore, 1983).

67 Geoffrey Bowker and Susan Leigh Star, *Sorting Things Out* (Cambridge, 1999).

68 This has proven to be an effective move in the field of social studies of science and technology. See, for instance, Wiebe E. Bijker, *Bicycles, Bakelites, and Bulbs: Toward a Theory of Sociotechnical Change* (Cambridge, 1995).

69 Joan Haas, Helen Samuels, and Barbara Simmons, *Appraising the Records of Modern Science and Technology: A Guide* (Cambridge, 1985), p. 23.

70 On the relationship between plans and actions in a practical setting, see Lucy Suchman, *Plans and Situated Actions: The Problem of Human-Machine Communication* (Cambridge, 1987).

71 See Charles C. Ragin and Howard Saul Becker, eds., *What is a Case?: Exploring the Foundations of Social Inquiry* (Cambridge, 1992). See also Anselm L. Strauss, *Qualitative Analysis for Social Scientists* (Cambridge, 1987).

72 John Seely Brown and Paul Duguid, "The Social Life of Documents," *First Monday* 1, no. 1 (May 1996) at <http://www.firstmonday.org/issues/issue1/documents/> (last visited 8 May 2000).

73 See Jean Lave and Etienne Wenger, *Situated Learning: Legitimate Peripheral Participation* (Cambridge, 1991).

74 On the role of boundary objects in socio-technical systems, see Bowker and Leigh Star, *Sorting Things Out*. Star and Bowker's research offered many key insights for this project as I sought to extend their ideas to the world of archives.

75 Personal interview (5 December 1999).

76 On communications in such projects, see Thomas Finholt and Lee Sproull, "Electronic Groups at Work," *Organization Science* 1, no. 1 (1990), pp. 41–64. See also Janet Fulk and Geraldine DeSanctis, "Electronic Communication and Changing Organizational Forms," *Organization Science* 6, no. 4 (1995), pp. 337–49. For a discussion of records management in distributed work groups, see Rich Lysakowski and Leslie Doyle, "Electronic Lab Notebooks: Paving the Way of the Future in R&D," *Records Management Quarterly* (April 1998), pp. 23–30.

77 After the UARC project was officially completed in 1998, the group was awarded a new grant by NSF for a new project, the Space Physics and Aeronomy Research Collaboratory, or SPARC. Our research includes this project, but for the sake of simplicity this section is limited to our findings from the UARC project. See <http://www.si.umich.edu/sparc>.

78 This work will only summarize results from the case study, which will be reported in much greater detail elsewhere.

79 Gary M. Olson, Daniel E. Atkins, Robert Clauer, Thomas A. Finholt, Farnum Jahanian, Timothy L. Killeen, Atul Prakash, and Terry Weymouth, "The Upper Atmospheric Research Collaboratory (UARC)," *Interactions* 5, no. 3 (1998), pp. 48–55, <http://www.acm.org/pubs/articles/journals/interactions/1998-5-3/p48-olson/p48-olson.pdf> (last visited 22 May 2000).

80 See Helen Willa Samuels, *Varsity Letters: Documenting Modern Colleges and Universities* (Metuchen, N.J., 1992).

81 By focussing on narratives in this case, I am more interested in the perception of time in relation to particular events, as explored by Fernand Braudel, than in the tropes or rhetorical structures used by subjects in relating their perception of a sequence of events, as Hayden White emphasizes. See, for example, Fernand Braudel, *Civilization and Capitalism, 15th-18th*

Century, Sian Reynolds, rev. trans. (New York, 1981); and Hayden White, *Metahistory: The Historical Imagination in Nineteenth Century Europe* (Baltimore, 1973).

82 Ironically, we found it unlikely that any of the collaborations we studied could implement a record-keeping system like the electronic notebook being developed by the Collaborative Electronic Notebook Systems Association. See <www.censa.org> (last visited 6 June 2000).