The Archival Management of a Geographic Information System

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The Canadian tradition of so-called total archives and the specialization by archival medium which has developed within that tradition has recently been a matter of lively debate in the pages of this journal. In eloquent hyperbole, Terry Cook began the debate by accusing archivists of creating a "tyranny of the medium."[1] At a fundamental level, archivists and researchers alike have realized that all holdings relating to a particular subject or originating from the same source are seldom available through a central access point. The problem of providing intellectual access to archives is becoming more grave as archivists face increasingly complicated records structures and increasingly sophisticated technology. This paper will examine a large computerized information system in order to demonstrate how a more precise focus on the nature of the creation and storage of information might help overcome the potential fragmentation of archives along media lines. We shall first discuss some aspects of the recent debate, and then examine how the creation, storage, use, and disposal of information leads to a profusion of record formats, each of which reflects a particular stage in the life cycle of the information. We intend to illustrate how the complexity of a large information system in fact reinforces the traditional archival need to preserve the integrity and unity of an organic body of information. In spite of the problems of appraising, acquiring, preserving and controlling the records generated by modern information systems, the traditional archival approach is still a sound basis upon which appropriate solutions might be designed and implemented.

The recent examination of the concept of total archives has accurately and constructively reflected reservations many archivists have about how effectively they are coping with the recorded information for which they are responsible. One aspect of the debate, however, has the potential of creating divisions within the archival community. The troublesome element is the emphasis on the negative effects of media specialization. In fact, the effects of media specialization are both good and bad. On the one hand, media specialization has heightened the awareness of archivists and users of archives to a wide range of documentary materials beyond

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1   Terry Cook, "The Tyranny of the Medium: A comment on 'Total Archives'," *Archivaria*, 9 (Winter 1979-80): 141-149; Andrew Birrell, "The Tyranny of Tradition," *Archivaria*, 10 (Summer 1980): 249-252; and Ernest J. Dick, *et al*, "Total Archives Come Apart," *Archivaria*, 11 (Winter 1980-81): 224-227.

the ubiquitous textual file. On the other hand, media specialization has emphasized the medium of the record sometimes to the exclusion of our most important concern, the informational content of the record. Proponents of total archives[2] have identified the benefits to be derived from multi-media archives. Critics are now blaming media specialization for an erosion of basic archival principles. The difficulties archivists are experiencing in maintaining control over multi-media archives of the same agency is being laid at the feet of media specialization. A wholesale rejection of media specialization, however, would be tantamount to throwing the baby out with the bathwater. If archivists are to meet the challenge of managing complex information systems, it will only be through exploiting the positive side of media specialization.

The inconsistency of approach from medium to medium, particularly when records in various formats relate to the same programme activity or creating agency, is the heart of the problem. One has the impression of many sub-systems of information lying about in repositories about as unconnected as the loose pieces of a jig-saw puzzle. No one is even quite certain if all the pieces are there let alone whether adequate intellectual control has been attained. While it is unfair to make media specialization responsible for this fragmentation, certainly the emphasis on format has not strengthened connections which exist among the various components of a multi-media archives. Crucial inter-relationships must be retained if the integrity of information systems is to be ensured. The mechanisms used in archives today to maintain physical and intellectual control over archival holdings seem poorly equipped to handle information in systems.

The information system cited below demonstrates the evolving complexity of these problems by first focussing on an earlier, more simply structured version of the system and the relatively straightforward approach that could be taken to its archival management. The challenges posed by the current more sophisticated version of the same system are then discussed.

For the purposes of this paper, an information system is a collection of records (that is, recorded information) and processes, which are organized to perform a specific set of functions in support of a defined set of objectives. Within the system, processes (for example, copying, analyzing, manipulating) transform the recorded information from one state to another, for example, from working notes to final draft. These processes are related to each other and systematically follow the creation, use, storage, and disposal of the information. These related processes and the records which are created represent the life cycle of information as it flows through the system.

The Canada Geographic Information System (CGIS)[3] is representative of such an integrated collection of records and processes which, as a defined whole, supports

2   W.I. Smith, "The Public Archives of Canada: An Experiment in the Concentration of Historical Resources," *Indian Archives, 20 (January-June 1971): 27-32, and Archives: Mirror of Canada Past* (Toronto, 1972), intro., p. 20; Hugh A. Taylor, "Canadian Archives: Patterns from a Federal Perspective," *Archivaria,* 2 (Summer 1976): 13-14.
3   Information on the system was obtained from *Introduction to the Canada Geographic Information System* (CGIS), Report 1150 (Ottawa: Lands Directorate, Environment Canada, 1981).

the objectives and mandate of a particular programme activity of Environment Canada, a department of the federal government of Canada. The complexity of the structure, the changing nature of the information as it flows through this structure, and the variety of the media involved present a challenge for the archivist who is concerned with the archival management of the entire system. The CGIS is used to support the information requirements of the Lands Directorate of Environment Canada, respond to the enquiries made by researchers, and assist other government agencies at the federal, provincial, regional, and municipal level. Each of these jurisdictions may be concerned with the analysis of land use information required for the planning, evaluation, and monitoring of activities associated with the management of various land-based resources. The information which formed the initial building block for the current system was the Canada Land Inventory (CLI), a collection of information covering the capability of land in Canada to support agriculture, forestry, recreation, and wildlife. It also defined watershed boundaries and provided considerable information on various land use characteristics. The CLI was established as a joint federal-provincial project to guide the development of policy on the control and management of land-based resources.

The system designed to produce and maintain the original inventory was operated manually and was relatively simple in structure. The information collection documents were in the form of working copy maps and series of codes describing the actual and potential land capabilities of various resources, such as forestry and agriculture. These were recorded by field officers who submitted them to a Carto-graphic Centre in Ottawa where they were converted to a final set of land use maps covering most areas of the country. These maps were then analysed manually in order to support the information needs of the Directorate. As a system, the recorded information and processes essentially consisted of observations recorded (process) on input working documents (records) which were then re-compiled (process) onto other map sheets (records) at the Cartographic Centre. A final master map (record) was then produced (process) which led to the reproduction of the map (records) for analysis (process) by researchers who produced their final research reports (records). Policy documents, correspondence, specifications, memoranda and administrative information (records) were also used (process) to guide the system from its initial design to final installation and use. Thus the records or documentary material associated with this system largely consisted of paper-based published and un-published maps, working papers, reports, and administrative material. More significantly, the processes intrinsic to this simply-structured system were limited, precisely defined, and single-purpose in nature (for example, the printing of maps).

In a hypothetical situation, the approach taken to the archival management of the information maintained in this system might have been relatively straightforward. The limited amount and diversity of the material would have been quite easy to handle from an archival point of view. It is instructive to note, however, that based on the current approach to the appraisal, acquisition, and control of archival material, the preservation of the system would not necessarily have been the central aim of the archival strategy employed. For example, policy documents and other administrative material might have been acquired primarily in order to document the evidence of a government programme activity. Maps might have been acquired primarily in order to serve the needs of researchers interested in their informational value. By neglecting to focus on the preservation of the organic unity of an

information system, the tendency to a "media focus"[4] and the fragmentation of archival material is encouraged.

If one recognizes the fragmentation which can so easily occur with respect to a simply structured information system, one might tend to despair when confronted with a more complex computerized information system. The current version of the CGIS is a case in point. By the early 1970s, it was recognized that the growing amounts of information contained in the Canada Land Inventory would make it impossible to manage or analyze the information manually. As a result, the CGIS was developed in order to apply the processing and information handling capabilities of large-scale computers to the difficult task of reducing, tabulating, manipulating, and analyzing the volumes of information collected under the CLI project. During the design phase, the Directorate recognized the possibilities for broadening the scope of the CGIS to satisfy numerous other information needs beyond those of the original CLI. The use of computers, for instance, made it possible not only to analyze the CLI but also to process any kind of descriptive information which could be defined spatially. The CGIS, therefore, was designed to accommodate the processing of combinations of such information as county, census and political boundaries, demographic information, geologic and soil information, and other information which could be analyzed from a spatial perspective. Like other modern information systems, the CGIS is a tool for collecting and storing information on a topic or series of topics and for examining and analyzing this information in order to arrive at one or a set of conclusions. Although the increased complexity of the system was affected by computer technology, the technology itself did not dictate or form this complexity. Rather, the increased diversity and complexity of departmental requirements forced the adoption of computer techniques.

Regardless of the reasons, such complexity and diversity have contributed to the creation of large volumes of diverse types of documentary material. The information contained in the system passes through a number of stages, each of which performs one or a number of transformations affecting both the nature of the information and the medium upon which it resides. The original source documents for the CGIS are working copy maps (records) displaying an image of boundaries and other descriptive information. Based on these documents a scribe (record) and a numbered overlay (record) are produced (process) and the descriptive information is extracted (process). The scribe is scanned (process) by an optical scanning device which digitizes the image information. This information is normally stored (process) on tapes (records) that are actively used (process) in a disk (record) environment. With the assistance of the computer the descriptive information may be overlaid upon the boundary information or manipulated with other boundary and descriptive information to produce a vast number of possible combinations. The extent of the region to be studied in any land information request can be defined in a variety of ways. Some of these may require an overlay of several coverages (for example), superimposing electoral districts on forestry maps). Others (for example, all lands within 200 miles of Regina) require the use of programmes which generate an arbitrary boundary. However, the researcher need not be concerned with the

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4   Cook, "Tyranny of the Medium," p. 144.

mechanics of these operations. He or she simply chooses the most appropriate way to define the study area. These study areas can include a topographical map sheet, an administrative unit, a census unit, a regional development area, an arbitrary circle (such as one hundred miles around Ottawa) or an arbitrary polygon (such as all land included between specific coordinates).

These manipulations (processes) can also lead to a variety of outputs such as draft maps (records) for publication purposes, special purpose maps (records) . responding to specific research requests, map displays, tabulations and special progress reports either on a disk (record) or on a magnetic tape (record) or on a printout (record). Outputs can be produced on either a regular or an ad hoc basis depending upon the time constraints and the information requirements. The system, for instance, is designed to produce monthly and annual reports (records) for departmental purposes and a variety of ad hoc reports (records) for academic researchers and other government officials. Policy documents, memoranda, correspondence, and other administrative materials (records) are also created and used to control and manage the system.

The CGIS presents a considerable number of challenges throughout the archival management process. At the records control stage, there is the need to identify those individual components in the system to which retention periods should be applied. During the appraisal stage, those forms of recorded information which are to be acquired must be identified. The acquisition, processing, and control functions are also affected by the complexity of the system. In what forms should the information be acquired? What parts of the system, once acquired, will adequately reflect the original contents, uses and purposes of the system and yet also best satisfy the potential needs of the research community? It is clear that in order to maintain the integrity of the system, care must be exercised to ensure that the information contained within the system is not fragmented by an over-zealous concern for the media associated with the system. From an archival perspective, the media must remain incidental to the information. The archival management of this information system, therefore, must involve the careful identification of the appropriate points within the system from which information may be obtained. Only after this identification process has occurred should attention be paid to the medium upon which the information resides.

If a representative archival version of a multi-media system such as the CGIS is to be acquired properly, it is obvious that policy documents, maps, magnetic tapes, reports, and aerial photographs would have to be preserved. Currently, at least four divisions of the Public Archives of Canada would be involved in preserving the multi-media record. The management of control functions, however, can only be implemented within an organizational structure which recognizes the organic whole of the information system. Preservation in separate divisions may be necessary in order to deal effectively with the technical peculiarities of different media, but it is unforgiveable to undermine the integrity (or sanctity) of an information system.

If the archivist is perceived as a manager of information rather than of records, media specialization would then be seen as merely a secondary concern within the context of a larger management process. The control of information as opposed to records might free archivists from the "tyranny of the medium." Archival collections, rather than being viewed as a number of tenuously-connected

fragments, might instead be perceived as information systems. Their management as systems would require emphasis on the unity of the information rather than the disparateness of the various physical formats upon which the information resides.

The shift in focus from record medium to information is particularly appropriate in this era of rapid technological change. As demonstrated by the example of the CGIS, there is today no assurance that, having acquired the form, archivists have acquired the substance. Technological developments, particularly in the computer area, have far-reaching implications for archivists. Information contained in computer-supported systems is captured and maintained in formats where stability is not intended and therefore is not achieved. With the push of a button, vast bodies of information may be updated or obliterated without a trace. Where the information and form of the record are so tenuously related, archivists must appraise, acquire, preserve, and control whole systems of information within which various physical media may exist.

The second implication for archivists is that a carefully designed and co-ordinated plan must be developed for the archival management of an information system. An information system cannot be properly acquired unless the archivist is completely familiar with the relationships which exist between the design of the system and the purpose and uses to which it has been put. A thorough understanding of how the system functions in the context of the overall mandate and programme activities of the department is essential. The archivist must also be familiar with systems theory and design and how the information contained within the system is created, used, stored and disposed. The life cycle of each type of information must also be understood. Knowledge of the means by which various physical media can determine the organization of information as it flows through systems must also be acquired. This approach, when applied to the appraisal of recorded information should lead, as a natural extension, to the efficient organization, preservation, control, and servicing of the information contained within the system. Thus the archival management of the information must ensure that evidential value is retained, on the one hand, and secondary research potential, on the other.

Archivists are indeed entering a new period in archival development. At one time the archivist's role might have been passively confined to receiving recorded information in various physical forms and attempting to apply archival principles to it. When information and record were usually integrated and inseparable, it was perhaps acceptable that archivists assume such a stance. In fact, the concept of the management of information systems was clearly enunciated many years ago when Philip C. Brooks suggested that archivists become involved in the selection process as early in the life history of documents as possible. Records management was based upon the concept of the lifetime of records, which was perceived as "an integrated continuous entity."[5] Much of our problem stems from not implementing that concept.

It is well to acknowledge that our emphasis on the media of records and records management of those media has led archivists to a preoccupation with physical

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5   Philip C. Brooks, "Current Aspects of Records Administration: The Archivist's Concern in Records Administration," *American Archivist,* 6 (July 1973): 164 and "The Selection of Records for Preservation," *American Archivist,* 6 (October 1940): 226.

form, but in their preoccupation they have been diverted from their principles. Information, like records, has a collective significance. T.R. Schellenberg wrote that records "have a cohesive character and are part of one another. They have a meaning as a group. . . . They lose their significance if they are dealt with as single items rather than as collective units."[6] Certainly these same words relate to information systems; archivists require no new principles to deal effectively with complex information systems and the changes brought about by advances in technology. Today archivists examine bodies of information in records, discern which portions possess archival value, understand and accommodate various systems of records organization, and ensure the preservation of significant recorded information. Ideally the archivist's approach to records is characterized by a sensitivity to their organic unity; the same approach to information systems may enable the archivist of tomorrow to fulfill his mandate.

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6   T.R. Schellenberg, *The Management of Archives* (New York, 1965), p. 67.

Résumé

Les systèmes d'informations actuels créent une diversité de documents. Cette diversité confond l'archiviste, mais les auteurs croient que les principes traditionnels des archives s'appliquent toujours à de tels documents. Afin de défendre leur argument, ils font allusion à une méthode employée par le Gouvernement du Canada ramassant et apprêtant des renseignements pour faire dresser un inventaire de terrain.