

Article

A Foundation for Archival Engineering

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Abstract: Archives comprise information that individuals and organizations use in their activities. Archival theory is the intellectual framework for organizing, managing, preserving and access to archives both while they serve the needs of those who produce them and later when researchers consult them for other purposes. Archival theory is sometimes called archival science, but it does not constitute a modern science in the sense of a coherent body of knowledge formulated in a way that is appropriate for empirical testing and validation. Both archival theory and practice are seriously challenged by the spread and continuing changes in information technology and its increasing and increasingly diverse use in human activities. This article describes problems with and controversies in archival theory and advocates for a reformulation of concepts to address the digital challenge and to make the field more robust, both by addressing the problems and by enriching its capabilities by adopting concepts from other fields such as taxonomy, semiotics and systemic functional linguistics. The objective of this reformulation is to transform the discipline on the model of modern scientific method in a way that engenders a new discipline of archival engineering that is robust enough to guide the development of automated methods even in the face of continuing and unpredictable change in IT.

Keywords: archive; archival theory; taxonomy; semiotics; systemic functional linguistics



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1. Introduction

People, individually and in both legally established and informal organizations create and use information in carrying out their affairs. Persistent items and ensembles of such information, in written language, image, audio/visual and other forms, constitute archives. While in use or retained because they might be needed in the continuation of those affairs, they are termed current archives. Subsets of archives are selected and preserved because they are deemed to have long-term value, which might be different than and even unrelated to the value they had in the conduct of affairs. These subsets are called historic archives. Possibilities for realizing the value of archives in both phases are hobbled by technical, intellectual and pragmatic factors. The foremost technical obstacle is the challenge that digital information technology poses for archives. The main intellectual impediment is the state of archival theory. A critical pragmatic issue is the confusion of theoretical and practical matters.

This article suggests that all three types of challenges can be addressed by reformulating archival theory. Reformulation here has the sense of expressing in a different way. It does not necessarily entail altering what archival theory asserts, but seeks to express it in a way that enables a more vigorous response to the technical, intellectual and pragmatic challenges faced by the field. Reformulation should be simultaneously conceptual and methodological. The article suggests a fundamental change in the way archival theory is expressed by shifting its priority from providing an intellectual foundation for the performance of archival functions to enabling those who use archives to discover and explore things of interest. This prioritization would also contribute to the performance of archival functions because it would facilitate the development and implementation of automated tools not only to assist archivists in their work, but also to perform tasks that are labor

intensive. Towards this end the intellectual content of archival theory can be enriched by importing and adapting concepts and approaches from related disciplines, notably ontology and taxonomy, semiotics and systemic functional linguistics. With respect to method, archival theory should shift from its predominant expression in natural language to greater formalism so that concepts are more closely and unambiguously mapped to empirical data; inconsistencies and conflicts in current theory can be resolved by invoking higher levels of abstraction; and the expression of archival concepts optimizes opportunities offered by information technology for more extensive, precise and deeper exploration and exploitation of digital archives.

This article does not present a reformulation, but lays the foundation for reformulation by making the case why it is needed and describing how it can be done. Section 2 of this article presents a concise overview of the digital challenge and an explanation of its relevance. It also identifies opportunities that the technology offers for maximizing the realized value of archives by facilitating their exploration and characterization. Section 3 describes both conceptual and pragmatic problems in archival theory, emphasizing aspects of such problems that can be addressed in reformulation. Section 4 articulates two approaches for reformulating archival theory. One addresses archival theory itself. The other identifies elements of other disciplines that could be profitably included in archival theory. Section 5 discusses both possibilities and obstacles for completing the proposed reformulation.

This article introduces several unique or uniquely defined terms for the sake of clarity and coherence. Table A1 in Appendix A defines these and other key terms, and gives the motivation for using each one. Some of these terms are described at this point to facilitate understanding of what follows.

- An *information item* is a persistent and discrete expression of information that is coherent in terms of some semiotic system and comprehensible to an agent that has competency in producing or interpreting information in that system. It is limited to persistent expressions because archives consist only of objectified forms of information in hard copy or digital form.
- An *archival item* is an information item that is produced or acquired by an agent in the conduct of its affairs.
- An *archive producer* is the role an agent performs in producing or acquiring and possibly retaining and organizing information items in the conduct of its affairs.
- An *archival ensemble* is a set of archival items used in related actions.
- An *archival asset* is either an archival item or an archival ensemble.
- An *archive* is an ensemble of archival assets whose membership is determined by their use either by a single archive producer or in the exercise of a function by a set of archive producers acting in succession.

The common thread in most of these terms is the use of the adjective, ‘archival’. Many of these terms have counterparts that are commonly qualified by ‘record’ rather than ‘archive’; for example, ‘record creator’ rather than ‘archive producer’ and ‘record aggregate’ rather than ‘archival ensemble’. The change is motivated by the intent to clearly distinguish two types of relationships. The use of ‘archival’ here is limited to things that are or could be related by an archival bond. The archival bond arises from the use of information items in the conduct of the affairs. It is an empirical relationship that is independent of whether the items are designated or kept as records. The concept of archival bond is described more fully in Section 4.1 below. The qualifier of ‘record’ is limited here to things that are explicitly treated as such, which is commonly done by placing and managing them in a record keeping system. The association of items in archival ensembles may overlap with their organization in a record keeping system, but the correspondence may not be exact and a record keeping systems may include items that were added in anticipation of use but never actually used by the archive producer.

One term with the ‘record’ qualifier used in this article is ‘record keeper’. A record keeper is the role of an agent who maintains and manages records on behalf of one or more archive producers. An archive producer may keep its own archive, but there are also

agents who keep records for archive producers rather than for use in their own affairs, as in the European notarial system [1]. While used only in their ordinary meanings, it should be noted that the terms, ‘produce’ and ‘acquire’, are consistently used here rather than the more common, ‘create’ or ‘make’ and ‘receive’. Those more common terms do not adequately indicate the variety of ways information items can become members of either archives or record keeping systems [2].

2. The Digital Challenge

Fundamentally both current and historical archives require information assets that persist over time and, once they are considered final in form and content by the archive producer, do not vary in any essential respect. The continuing open-ended growth in the amount, variety, and complexity of digital information and in the real world uses of information technology pose severe challenges in exercising the functions needed to fulfill this requirement. Furthermore, the unprecedented nature of developments in IT and its applications conflicts with a presumption behind much of archival theory that its basic concepts are independent of time as well as of the technologies used to produce, preserve and manage archival assets. A large portion of the archival literature of the last half century deals with aspects of the digital challenge and ways to respond to them. A good portion focuses on issues related to archival theory. Significant improvements have been proposed and made. Some of these advances are noted in the discussion of archival theory below. However, it cannot be claimed that improvements to date have been definitive or adequate.

Looking at the digital challenge from the perspective of technology, continuing change that is unpredictable over any significant period of time means that the characteristics of the challenge will change, and that it will not disappear, perhaps not even diminish. From the archival perspective, both theory and practice need to be adjusted for the digital realm and, even more importantly, become adaptable and expandable to respond to ongoing changes. From the perspective of feasibility, responses to the challenge need to be grounded in an appropriate, comprehensive and coherent theory that is adequate and suitable for translation into effective methodology and, ultimately, into functional and data requirements for satisfactory technological solutions. Human labor is inadequate to meet the digital challenge. It requires automated tools for processing digital assets in all archival management functions. To enable the development of effective tools, archival theory needs to be reformulated to constitute an intellectual basis for a new discipline of archival engineering.

Besides posing substantial challenges to archives, information technology offers significant opportunity for increasing the realization of the value of archives, which comes from using them [3]. Access to the holdings of archival institutions has been and is mediated by archival description, which typically starts from the outside with the provenance of records and the functions they served, then moves downwards to the arrangement of records by the agents who created them. It seldom provides data the lowest level of aggregates and almost never about individual records or their contents [4]. For digital archives, technology offers options for more varied and precise discovery and exploration at the aggregate and item levels using techniques such as named entity recognition, and speech act analysis. These and other artificial intelligence techniques can be used not only to generate accurate, comprehensive and detailed archival descriptions, but also and more importantly to enable researchers to find and exploit archival resources [5].

3. The State of Archival Theory

A strong motivation for reformulating archival theory comes from the substantial problems in current theory. This section describes a variety of these problems sufficient to elucidate the need for reformulation. What follows is not exhaustive, but illustrative of the range of problems with current theory. It should not be interpreted as implying that archival theory is without merit, only that there are issues that should be resolved to improve and enrich the discipline.

Archives are the vestiges of any and potentially all human activities. They reflect the immense gamut of ways people produce, acquire, interpret and use information. The extent, variety and richness of the domain are, unfortunately, mirrored in the lack of a clear distinction in the literature between theory as organized knowledge on the one hand and discussions of methodology and even practice on the other [6]. Current archival theory is a heterogeneous set of concepts, principles, summary statements, assertions and arguments related to the production, acquisition, organization and use of information in the conduct of affairs, as well as the management and curation of that information for as long as it is retained. Henttonen identified three basic problems with current theory. (1) The theory does not explain the difference between the information assets that constitute archives and those that do not; furthermore, it includes assertions about archives without explicit justification. (2) Archival methodology lacks a clear theoretical basis, leading to uncertainty about how supposedly guiding principles should be applied. (3) Conversely, theories about the nature and characteristics of archives are asserted as having implications for methodology but how is not adequately elucidated [7]. Another general problem lies in the manner in which archival theory is expressed. By and large, it fails the criterion of being able to generate unambiguously testable, and ideally quantitative, predictions of what should be true empirically if the theory is valid. This limits possibilities for cumulatively and coherently improving archival theory. The remainder of this section explores problems with current archival concepts in more detail in order to lay a foundation for the specific proposals for reformulating theory in Section 4.

3.1. Controversies

Archival theory has witnessed considerable debate for more than a half century. Criticisms of prior theory can be grouped under two headings: external and internal. External critiques criticize the archival domain as a whole. Internal critiques argue that specific concepts inadequately or inaccurately represent the domain to which they apply or that they need to be changed in order to enable improvements in practice.

3.1.1. External Criticism

External criticism starts from the platitude that archival institutions are created and sustained by society and often impose the predominant perspectives and values of society to the extent that they warp the information that can be obtained from archives [8,9]. Rather than leading to efforts to reduce or neutralize such imprints, critics have often advocated for introducing extraneous considerations that are neither explicit in nor readily inferable from either the objects that constitute archives or in the relationships among those objects established by the archive producers. Such critiques not only advocate linking what is literally in the archives with external perspectives and information from external sources, but also insist on revising basic archival concepts to encompass extraneous considerations. There can be value in identifying relationships between archives and other things. Those who seek to understand or use information in archives are well advised to take into account social, cultural and, indeed, economic, biological, psychological, technological and other factors that influenced their creation and use. However, regardless of the merits of identifying extraneous links, integrating them in the way archives are identified, preserved, managed or provided could merely substitute countercultural values for dominant ones.

3.1.2. Internal Criticism

Criticism of specific elements of archival theory typically comes from professional archivists, both academics and practitioners. In recent decades, it has included denigration of several of the basic concepts of archival theory including the identification of archival wholes and the conceptualization of archives over time.

A prominent internal criticism is found in the concept of the series system. It is contrasted with what has been the norm for the top level classification of archives, the archival fonds. An archival fonds is “The ensemble of documents of any type organically

constituted by a producer in the exercise of its activities in accordance with its competencies” [10]. The producer is the independent variable that determines the identity, scope and content of the fonds. The producers of archival fonds have typically organized them in hierarchical classification systems. In these systems, record series are direct children of the fonds. Within a business, for example, personnel files, customer files, and financial records constitute distinct series. The series system was motivated by the recognition that, notably within governments, over time the same series of records may be maintained by different organizations as a result of reorganizations or reassignment of responsibilities. Continuity of archival ensembles across a sequence of archive producers can also occur in the private sector; for example, under corporate acquisitions, mergers and spinoffs. The endurance of a series of records whose organization and contents are likely to be invariant across organizational shifts cannot be addressed within the construct of the archival fonds that presumes that a series is a subdivision of a unique fonds linked to a single agent. In the circumstances encompassed by the series system, the records in a given series would be assigned to different fonds, one for each of the successive organizations. The series system categorizes the record series as a first order class, linked to several agents in succession [11]. The crux of the opposition between the fonds and the series system lies the conflation of theory and practice. Fonds and series are ways of organizing descriptions of archives. Traditionally, when descriptions were in hard copy they determined exclusive paths to discovery and use of historical archives.

At the level of theory, however, the two concepts are not intrinsically incompatible. Rather they classify archives using different criteria. For the fonds the criterion is the archive producer and for the series system the function supported by the records. Both criteria have empirical validity. There are cases where series of records are unique to a sole archive producer and other cases where series have been transferred from one producer to another. The fact of such transfers, as well as changes in the characteristics of the archival assets associated with such transfers, are significant for understanding the archival assets involved. However, it is highly likely that each of the successive archive producers has other series besides those transferred to or received from others. Even when a series is transferred, there is value in knowing about its relationship to the totality of records of each successive producer. Thus, the two criteria define orthogonal perspectives that are complementary rather than conflicting. In the digital realm, the pragmatic difference disappears because the monotonic constraint of printed descriptions is abolished. Databases and semantic web tools enable both the ensemble of all series of a single archive producer and the successional series transferred from one producer to another to be described and used as pathways for research.

Another major debate of recent decades pits a traditional records lifecycle view against an alternate proposal, the records continuum theory [12,13]. The records continuum theory deprecates the lifecycle model from both internal and external standpoints. It specifically addresses archival assets and their management, but its formulation derives from external conceptualizations such as continuum philosophy, structuration theory, and poetry [14,15]. Among other things, continuum theory criticizes the lifecycle approach for differentiating between how current archives are managed and how the same archives are managed in the historic phase, disregarding the fact that during the initial phase the primary objective of managing records is to contribute to the accomplishment of the archive producer’s objectives, whereas in historic archives researchers necessarily have different purposes because the archive producer’s aims have already been accomplished or abandoned. Moreover, uses of historic archives are often independent of, and even orthogonal to, the archive producer’s uses. For example, regardless of the functions they served as current archives, a common use of historic archives is for genealogy [16–21]. In historic archives, the objective should be to provide access to authentically preserved records to eligible users regardless of what purposes they have and regardless of how those purposes relate to the archive producer’s uses or map to the organization imposed by archive producers.

The existence of debates in archival theory is not itself a problem. To the contrary, identifying errors, shortcomings and other flaws in existing theory is necessary for a field to progress. The problem here is that the way archival theory has been characteristically expressed and the attitudes taken by adherents of different views impede progress.

3.2. Problematic Characteristics

Archival theory has a number of troublesome characteristics that show up in treatment of various topics. They include vagueness in articulation, inconsistency in definitions and descriptions, illogicality in arguments, conflation of theory and practice, organization on the basis of typology, and limited formalization.

One problem is vagueness. In many areas, even with basic terms, archival theory does not draw clear lines between different classes of things. Probably the most egregious case of this is the failure to differentiate between ‘document’ and ‘record’. These two entities are often treated as synonymous even though it is recognized that not all documents are records [22–26]. It is also true that a given document can be different records because different agents could acquire the same document and use it for different purposes, as has been shown in external critiques addressing the varying uses of documents in historical archives [8]. In such cases, the essential properties of the documents remain unchanged, but their qualification as records can differ significantly in all of the criteria that make a document a record: whose record it is, the purposes it serves, how it relates to other records, and its function as record: whether dispositive, probative, supporting, enabling, constraining, or narrative.

Inconsistency is another problem. Even when there are not explicit debates about concepts, some are used in a variety of senses, extending even to incompatibility. This is true for one of the most basic terms in archival theory, record. The Dictionary of Archives Terminology published by the Society of American Archivists (SAA) for example, contains two inconsistent definitions of record: “Data or information stored on a medium and used as an extension of human memory or to support accountability” and “Information or data created or received by an organization in the course of its activities; organizational record” [27]. The first does not provide sufficient criteria to distinguish a record from other types of persistent information objects and it ignores the common affirmation that what distinguishes records from other things is their relationship to agents and actions. The second definition adds a contextual condition, but it is too narrow, excluding records of individual persons or families. As these two examples show, definitions of record not only suffer from inconsistency but also have problems of logic and applicability. These issues are also present in the definition of record in the ISO standard for records management: “Information created, received, and maintained as evidence and information by an organization or person, in pursuance of legal obligations or in the transaction of business” [28]. This definition appropriately expands the contextual criterion by including person; however, “the transaction of business” is another inappropriate constraint because it implies that creative artists and social organizations that would not be considered as conducting business do not have records. The definition gives no criteria for distinguishing a record from an ensemble of records. A short letter and an entire archival fonds or successional series could be identified as information. Moreover, the phrase, “maintained as evidence and information” adds confusion because a record has been defined as information but neither the definition nor anything in the entire standard gives any clue to the difference between maintaining a record for what it is and maintaining it as evidence.

Another problem in archival theory, beyond definitions of record, is that some assertions are illogical and even grammatically confused. For example, in external critiques it has been asserted that historic archives are created anew every time they are used. That could only be the case if the information items produced by archive researchers as well as copies they made of assets in historic archives were integrated with the archives which they researched, which would both destroy the integrity of the existing archive and produce a

new archive rather than change the meanings of an existing one. The situation would be even more absurd if the research extended over several fonds or successional series.

It has also been argued that slaves should be included among the authors of records about slavery because without them there would be no such records. By this logic, cows should be identified as authors of records of dairy farming. Furthermore, some external critiques fail to differentiate between the information that archives can communicate of themselves and what can be learned by combining them with other information sources.

The records continuum theory also has logical problems. The theory categorizes 'Create', 'Capture', 'Organize', and 'Pluralise' as dimensions rather than actions. Actions are types of events and like events, as Allen and Furgusson explain, are essentially linguistic or cognitive. They do not exist independently of the things involved in them [29]. In the Basic Formal Ontology, the "dimensions" of continuum theory would be classified as occurrent entities; that is, things that have temporal parts, unfold in time and exist only in their unfolding, in contrast to continuants, entities that persist and maintain particular identities through time [30]. Something that has only a transitional existence cannot be a dimension of something that persists over time.

Coexisting with vagueness in articulation, archival theory has also been marked by rigidity in application of particular ideas. As Cunningham noted, "While a deep knowledge of the theory, practice and history of our discipline is essential, the tendency to operationalize this knowledge as rigid rules and implacable certainties too often becomes a straightjacket that constrains innovation and questioning, blinds us to the opportunities and realities of today, and risks making us either utterly irrelevant or the unwitting agents of powerful and more self-aware interests in society" [31] (pp. 1–2). An example of this is that proponents and opponents of the series system both have an exclusive "either/or" stance and both often oversimplify and otherwise misrepresent the other view. On the one hand, advocates of the continuum ignore the fact that both lifecycle and continuum models assert that archives should be managed in a comprehensive and coherent manner for as long as they exist. On the other, advocates of the life cycle generally ignore the fact that many of the ideas they embrace seriously obscure the coherence of the life cycle concept. For example, Schellenberg categorized records as different than archives, reserving the former term to the current archives phase and the latter term to the same documents in historic archives, effectively making differences in how the documents are managed in each phase into categorical differences in what archival assets are [32,33].

Similar antagonism has been common in debates about other elements of archival theory. External critiques that advocate expanding the factors relevant to understanding archives often reject established core concepts, rather than add new ones tailored to the factors proposed. Such rigidity should not be equated with consistency in the sense of consistent application of concepts that are clear in their connotation and denotation.

Even when archival concepts are articulated with a broad scope and multifaceted perspective, their intent is often thwarted by the insularity of the archival profession and the channels it uses to communicate [34]. Well-founded intentions can backfire, as in the case of the continuum theory. Part of the agenda of continuum theory is to advocate a single comprehensive approach to managing records throughout their existence. A corollary to this is that records management and archives management should be the domain of a single profession, without the division of labor between records managers and archivists. Advocates of the continuum approach have had noteworthy success, leveraging their influence in national archives to shape standards for archives and records management [35]. However, the broad effect desired has not been achieved. Instead of melding with the archival profession, records management has morphed into information governance, encompassing information security, compliance, data management, risk management, privacy, knowledge management, analytics, enterprise architecture and other disciplines in addition to records management [36,37].

Another problem found in much of the literature is a conflation of theory and practice. A major impetus for the records continuum theory can be found in a conflation

of theory and practice by prominent archival theorists of the last century. Early in the century, Jenkinson limited the qualification of records as “archival” to cases where one can demonstrate or reasonably presume integrity of record ensembles established by their creators throughout their retention and preservation. His position is known as the chain of custody. The chain exists only if the records are controlled by an unbroken sequence of trustworthy custodians [33]. This concept focuses on physical objects and their storage. It is not appropriate for the digital environment. As Menne-Haritz observed, “Digital storage teaches the lessons, that even if the physical objects are kept in good condition, the recordings might not be understandable any more. So the custody of material is just one among other means to keep the information potential untouched” [38] (p. 62). To address the difference, the Preservation Task Force of the first InterPARES project introduced the concept of the chain of preservation, a process that extends over the entire duration of archival assets and documents the controls enforced and actions taken in order to establish a basis for assessing their authenticity [39]. The chain of preservation is a methodological construct which does not propose or alter theoretical concepts.

Conflation is evident both in the articulation of concepts that meld abstract and pragmatic elements and in treatment of implementations, such as policies and procedures, as if they were of a kind with theory. Thus, the records lifecycle is often presented as a model of records management, rather than of the records themselves. It can be and has been used to generate process models and linked to the performance of various functions. However, these articulations at least implicitly adopt the artificial distinction between records and archives, and are generally limited to the phase of current archives [40–42].

There are also cases where theory is expressed in a way that cannot readily be applied in practice. Some externalist critics admit that their views have not been implemented in archival practice and—intimating why—that extraneous considerations can so overburden archival concepts that they become impracticable [35,43,44]. A pragmatic problem with continuum theory is that its primary graphic expression, used in many publications, is idiosyncratic, not conforming to any modeling method. It provides a visual basis for reflecting on a variety of considerations relevant to archives, but is not a tool suited to translating abstract concepts into practice [14,15,45–47].

A fundamental trait of archival theory that contributes to vagueness and confusion and fosters controversies is that it classifies concepts and objects using a typological approach wherein classes are defined and related to one another on a conceptual basis. This is obvious in the articulation of both the archival fonds and the series systems. An alternative, taxonomic structure, built from the bottom up on the basis of empirical considerations, should be more fruitful, offering the possibility of accommodating apparently opposed ideas by tying them to empirical variations and allowing greater variety in the way different things, like agent, series, etc. are related [44,48,49].

Another problem is that archival theory has been expressed predominantly in natural language. Expression in natural language—often more rhetorical than descriptive—does not readily yield inferences that can be empirically validated. Theoretical concepts have been used to make empirical inferences but by and large have not gone beyond citing examples that conform to a concept being advocated. Empirical considerations have been fitted into the theories, but often without specificity [45].

The vague expression of concepts does not support a necessary characteristic of scientific testing: the possibility of falsification. Moreover, given the exclusivity characteristic of much of the theoretical literature, falsification is used as a basis for arguing that alternate views are wrong because they do not hold in all cases. A more constructive approach in cases where a concept does not apply universally would be to redefine the concept’s range and, where appropriate, develop a higher level concept that encompasses the full intended range of the given concept and includes one or more other constructs that cover nonconforming cases.

Where theory has been translated into more formal expression, it has most often taken the form of data models for automated systems [50–52]. These versions tend to translate

ideas from natural language literally, assuming their intensional and extensional validity and thus perpetuating their problems. There have been some attempts at more abstract expression of aspects of archival theory, but they have not gained traction [53–55].

Formal expression has been most common in support of archival description. A significant development in this area, Encoded Archival Description uses an XML document type definition (DTD) for encoding descriptive data. The DTD provides substantial flexibility in tagging descriptive data in order to accommodate the variety of existing descriptive practices; however, this adaptability obstructs automated processing, linking and use of data [47,56].

Formalizations in other functional areas have similar issues. For example, many archival institutions have adopted the PREservation Metadata: Implementation Strategies (PREMIS) standard for metadata about digital preservation. PREMIS is intended to be “a comprehensive, practical resource for implementing preservation metadata in digital preservation systems” [57]. However, it is essentially task orientated. Thus, the definition of ‘Intellectual Entity’ in the PREMIS ontology as “A set of content that is considered a single intellectual unit for purposes of management and description” [58] makes the identification of an instance of this class dependent on its use in management or description, rather than on its ontological or empirical status. The PREMIS data dictionary further encumbers the identification of an Intellectual Entity by making it contingent on relevance to a designated community [59].

In sum, current problems in archival theory include efforts to incorporate extraneous factors within existing concepts rather than adding them in ways that would specifically indicate their distinctive character; disparaging concepts when there are exceptions to them, rather than refining the definition of their scopes or positing broader alternatives that would encompass both unexceptional and exceptional instances; introducing new ideas in opposition to existing ones rather than enriching the field without discarding what is valid in current theory; vaguely articulating concepts making it difficult to decide when they do or do not apply; defining concepts inconsistently or illogically rather than offering clear-cut formulations that would make their application uniformly decidable; conflating theory and practice rather than rigorously distinguishing intellectual and pragmatic elements; and structuring theory on a largely conceptual basis that does not adequately map to or reflect empirical realities. The problems motivate reformulation of archival theory. The alternatives suggested in the “rather than” phrases here indicate how these problems can be addressed in reformulation.

4. Laying a Foundation for Archival Engineering

Section 4 explores possibilities for reformulating archival theory from two perspectives. The first is that of the archival domain, encompassing archival assets, theory, practice, profession, institutions, and also the value and use of archival assets. The second perspective explores concepts and methods from other disciplines that can contribute to enriching archival theory. In both perspectives, the discussion assumes that the sound elements of archival theory, both long established and recently proposed, should be retained; modified when necessary to reduce ambiguity or eliminate unnecessary controversy; and adapted to better reflect the diversity of archives and their inherent dynamism. Reformulation should reduce or eliminate the kinds of problems described above, not to eliminate but to foster critical insights with the objective of making archival theory more rigorous, responsive to empirical factors, testable, and better suited for translation into methodology and for implementation in practice. In addition to reducing problems in theory, reformulation should positively improve theory and facilitate further enhancements.

4.1. The Archival Domain

What follows is a thought experiment that explores the possibility of a simultaneously fundamental and overarching shift in the way archival theory is articulated. Across the board, existing archival theory is concerned with the functions performed by archivists

and archival institutions. The discussion that follows would shift the focus of archival theory from providing an intellectual framework for the performance of archival functions to optimizing the return on investment in archives by making the successful use of archival assets its primary objective. The motivation for this thought experiment comes from the opportunities that IT offers for major improvements in discovery and exploitation of archives, as described in Section 2, and from the recognition that, with the exponential growth in the quantity of information that has been and is being enabled by IT, in the foreseeable future—if not already—the combination of born-digital and digitized archival assets will constitute the majority of historical archives [60].

The value of archives is realized in use and successful use of both current and historical archives means users obtain information from archival assets that is valuable to them. Maximizing the realization of value can come from focusing on the differential value of archives; that is, the advantages that archives offer in comparison to other sources for learning about the past. A crucial difference between archives and other sources is that they are instruments and byproducts of actions and thus, in addition to their contents, convey information about what archive producers considered valuable in their actions and how they used it in carrying out their affairs.

Learning about the past includes the benefits that archives producers can obtain from their current archives as well as what anyone might learn from historic archives. In current archives, the highest priority should be given to use by the archive producer to achieve the producer's objectives. In historic archives, priority should be assisting researchers to learn about the past. In the case of historical digital archives, systems should encompass capabilities for researchers to discover relevant assets, to determine their appropriateness and estimate their authenticity for the researchers' purposes, to explore the archival assets themselves, and to link the assets and data about them with data from other sources.

Criteria

The proposition that the value of archives is realized when users obtain desirable information from them entails three criteria for archival theory and systems that implement it: (1) users should be able to explore archives from a foundation of trust; (2) theory and its implementation should optimize the informative potential of archives; (3) possibilities for access and exploitation should not favor any particular use or types of use of archives over others. Each of these criteria is described below, followed by a discussion that illustrates, but does not exhaust, how concepts could be reformulated to better support the objective. Techniques and other aspects of archival practice are out of scope of this article.

(1) Basically, trust in archives rests on their authenticity. The value that archives offer depends on their remaining authentic. Archival authenticity is not synonymous with veracity or trustworthiness. An archival asset may be reliable with respect to the facts or acts it describes, but it could also contain errors or intentional misinformation. Authenticity in archives is authenticity as archives. To say that an archival asset is authentic is to assert that the object is one that the archive producer produced or acquired in its activity and remains unchanged in all its essential characteristics. The authenticity of an archival asset is established by demonstrating that it remains what the archive producer produced or acquired in its activity, even if it contains factual errors or is a forgery.

A common definition of archival authenticity is "the quality of a record that is what it purports to be and that is free from tampering or corruption" [10]. These two qualities of identity and integrity are appropriate, but there are cases where this formulation is inadequate or would lead to erroneous conclusions. With respect to identity, a document in an archive may be exactly what it purports to be on the face of it, but everything that can be determined about a document from the document itself may not be sufficient to determine what it is as an archival asset. This could be the case for documents acquired in any activity that had a different purpose than the one for which they were created, such as documents collected in audits, criminal investigations, performance reviews and the like.

With respect to integrity, corruption would seem to be a clear diagnostic, but what does it entail? The original of one of the most important documents in history, the Declaration of Independence of the United States, preserved in the National Archives is physically corrupt: the ink has faded, the parchment has darkened, and bits of ink have moved into what should be white space; however, the physical degradation of the original is consistent with the history of the document from its production in 1776 to its transfer to the National Archives in 1952 [61]. In this case, absence of physical corruption would indicate the document was not authentic. As argued above, the concept of authenticity should be articulated in a manner that is unambiguous and can be readily translate into practical guidance. Essentially, changes that would corrupt an archival asset are ones that would significantly alter the information it conveys. Physical or chemical corruption would not otherwise qualify as archival corruption.

A formulation of integrity consistent with this insight was elaborated in the Preservation as a Service for Trust (PaaST) project in the fourth InterPARES collaboration. PaaST reversed the formulation of integrity from corruption to the positive identification of the essential properties of records that must remain invariant. It provided for variability in essential properties of different types of records and different cases, provided that the set of properties in every case should enable the record to convey the same message as it did in its archival context [62,63].

Archival theory that prioritizes use should both distinguish between and correlate the attribute of authenticity with the assertion of authenticity. Authenticity is binary: something either is or is not authentic, but an assertion of authenticity is a belief statement [64]. In general, an assertion of authenticity depends on what the person making the assertion considers the thing to be and what characteristics the person considers important. For example, for a literary critic the primary attributes of a written text related to authenticity would be the correct identification of the author and that the form and content of the text had not changed from what the author wrote, even though the visual appearance of the published version was different. In contrast, for a forensic document expert access to an instance in the author's handwriting might be critical, as well as attributes that could reveal intentional document alteration or particularities indicative of the reliability of a device or method used to produce the copy available to the analyst [65]. Authenticity has long been treated as a qualified attribute in one part of archival theory, diplomatics [66–68]. However, like other aspects of archival theory, its concern was with the performance of an archival function, in this case determining the authenticity of copies with respect to originals, entirely apart from consideration of users' criteria.

The theory of archival authenticity should be reformulated to apply to the archive constituted by its producer and also to accommodate the varying criteria of different users of archives as to what they are looking for. That is not to assert that archives should be managed to accommodate users' criteria, but that data about archives that would enable users to determine if they satisfy their criteria should be available to them at least insofar as their criteria relate to information about the records that an archival institution could reasonably be expected to have.

(2) The value of archives is realized when people who consult them obtain information that is responsive to their interests. The informative potential of archives is their capability of providing such information. The potential depends on both the archive and the user's interest. The user must be capable of interpreting the information an archive provides, and the information must make a difference for the user; for example by answering a question or otherwise reducing or eliminating an unknown [69]. In pragmatic information theory, the receipt of information results in a behavior and/or a change of state of the receiving system. Behavioral responses to information take many, diverse forms, such as a person picking up a phone to answer a call, gesturing or speaking, or an information system displaying data in response to a query. State changes include addition, alteration, deletion or confirmation of information the recipient already possessed [70].

The immediate informative potential of an archive comes from the content and form of the assets in it and also from the archival context, which includes the relationships between or among assets, and their relationships to the agent who produced them and to the activities in which the agent used them. Thus, the archival context comprises properties and relationships that either are part or aspects of the archive or contributed directly and specifically to its production [71].

The first facet of the informative potential of an archive derives from the properties of the individual documents in it. The basic assumption that a document has a fixed form and stable content is challenged by digital documents [72]. The digital data that determine the form and content of a document can be output with different content—by selection, combination or processing—and/or form. A text document can be rendered as audio. Rows in a spreadsheet can be arranged in different sorts. Data in a database can be selected and joined in a variety of ways. Illustrating an expansive reformulation of archival theory, rather than discarding the notion of fixed form and content, the second InterPARES project introduced the concept of bounded variability, which has two basic parameters: (1) fixed data stored in a form that is at least conceptually invariant, either within a system or across systems in the case of communicated data, together with functionally identical capabilities for processing and outputting the data and (2) restriction of output options to those that were available in the system used by the archive producer. Under these constraints exercising the same options produces identical outputs [73]. The boundary in this reformulation excludes outputs that can be generated using capabilities that were not available to the archive producer. Such capabilities can add to the informative potential of a document; however, because they are outside of the archival context they do not reliably convey what the document meant to the archive producer. Moreover, even an output that falls within the boundary unquestionably qualifies as an archival asset only if the archive producer is known to have produced that output. There could be a probabilistic basis for assessing other possible outputs as authentic, even if instances of them do not survive, if there is sufficient evidence, such as a capability provided by a system specifically designed to meet requirements of the producer, or that the producer at least desired to be able to generate that type of output.

A second contributor to the intrinsic informative potential of an archive originates in relationships among archival assets. An archival asset can have a structural position and a functional role in an archive. Its position is determined when the archive producer assigns it to a category in an information system. Archival theory and practice have focused, in both physical and digital realms, on systems designed explicitly to satisfy records management requirements; however, the informative potential of an archival asset is enhanced by knowledge of its place in an information system even if that system does not have records management capabilities because system design indicates how the archive producer used or expected to use assets. Arguably, even if the “system” was nothing more than an accumulation of assets over time, their retention indicates that the archive producer evaluated them as having continuing value [38]. As Horsman observed, “Every type of order, including physical ones, assigns meanings to the archive. It allows users to interpret how records should and can be understood, or how they were interpreted before, sometimes how they may or may not have been made available” [74] (p. 18). Modifying archival theory by expanding the appreciation of the positions of archival assets, whatever the nature of the structure in which they were placed, would enrich the informative potential of the archival context. The expansion might also encompass the not uncommon cases where a structure or ordering of assets by the archive producer has been obscured or obliterated. Rather than adhering to the monolithic principle of respect for original order in cases where it is not applicable, the expanded concept would support systematic accounting for the nature and causes of deviations. This expansion would be valuable in interpreting both current and historical archives because restructuring by an archive producer can of itself indicate that there were pressures the producer needed to address.

More fundamental than positioning of assets within an archive are the functional relationships as articulated under the concept of the archival bond. The archival bond is the relationship between or among archival assets that arises from their use by an agent in an activity. This relationship is empirically prior to and conceptually independent of whether an asset is kept by the agent and whether and how it is managed. For example, a response to an incoming message is undeniably related to that message. From such binary relationships, the archival bond grows as additional documents are used in an activity. It ceases to grow when the activity terminates [75]. Consideration of the archival bond reveals that agent and activity are definitive of the archival context and are critical for the interpretation of archival assets. A key aspect of interpretation is that relationships based on use may not be evident in or inferable from the content of documents considered by themselves. For example, documents related to contracts, expenditures and inventories would not of themselves reveal that they were collected in an investigation of alleged fraud.

The concept of the archival bond, however, has been used in a way that conflates theory and practice by equating the archival bond as equivalent to the placement of archival assets in a records keeping structure. Arrangement can reflect the archival bond when the organization of archival assets corresponds to the processes that produced them, but records management and business processes are different. As Foscarini notes, when documents that are related by their use are set aside as records, “the business needs and professional background of the creators and internal users of the records meet the records managers’ expertise and knowledge of the ‘record needs’”. That is a critical moment, as the two parties have different purposes and most likely do not share the same culture” [76] (p. 3). Typical hierarchical filing systems rarely mirror business processes in their entirety. For example, in corporate bodies the documents produced and acquired in recurring processes conform to policies, but policy documents are not included in case files [77]. Similarly, laws, regulations, contracts, and other documents with legal status may legally contain other documents even though the referring documents include only citations of the others [78]. Moreover, records classification is generic and cannot reveal features—even crucial features—that distinguish instances of a process from one another. Such differences can be critical for users of both current and historic archives. The situation is further complicated in the digital realm where the information architecture of business systems does not map to records management categories or where the conduct of affairs often involves email and social media which are not necessarily integrated into a records management system.

The archival ensemble delimited by an archival bond constitutes a coherent whole by virtue of use in an activity by an agent. However, the concept as such does not include terms that distinguish individual objects or relationships or types of relationships within the ensemble. Its value in the description and analysis of archives would be enhanced by additions of such terms, defined specifically with reference to the archival bond rather than more general characteristics of archives. Such enhancement would also increase the informative potential of an archive.

More broadly, the boundary of an archival bond is artificial with respect to informative potential regarding activities that involve participants in addition to an archive producer. Even if the focus of interest is a single producer, information about an activity is incomplete if it says nothing about other actors and their actions. Thus, the archival bond needs to be complemented by another concept that would encompass all actors and actions in an activity. This concept might be called an activity network. Figure 1, Activity Network, is an Euler diagram of a hypothetical activity network comprising the archives of five participants in a set of related activities.

The intersections of the five archives represent what documents were exchanged or shared by their producers, giving evidence of their interactions. The producers of Archives 2 and 3 each interacted with the producer of Archive 1, sometimes jointly and sometimes separately. They also interacted with each other in actions not involving the producer of Archive 1. The producer of Archive 4 also interacted with the producer of Archive 1. The

intersection of Archive 5 with Archive 4 indicates that the producer of Archive 5 interacted in related actions, although not with the producers of Archives 1–3.

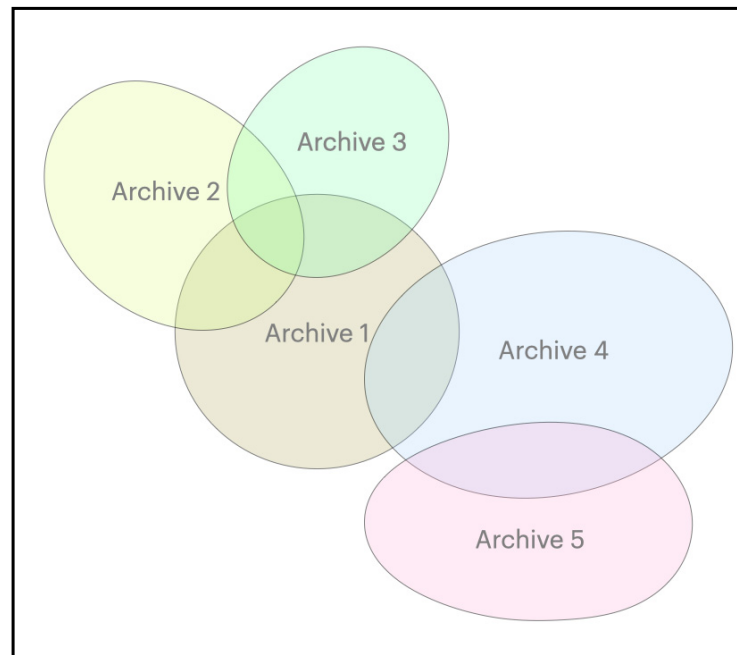


Figure 1. Hypothetical Activity Network. The figure shows 5 ovals each representing an archive that relates to actions that were used in an activity in which the producers of each archive participated. The intersections indicate archival assets common to more than one archive.

In some cases, relationships revealed by the intersections of the shared assets could be found in the contents of a single archive, for example, by attributes such as sender and receiver. However, that would not necessarily be the case in documents pro-actively acquired by an archive producer rather than those sent as messages to the producer. Moreover, a researcher could learn more about actions and actors by examining documents and ensembles outside of the intersections of related archives than from only one archive. There have been numerous efforts to make such connections among archives explicit using linked data in archival descriptions [79]. Current archival theory lacks a conceptual basis appropriate for guiding and expressing such relationships, but the initiative of the International Council on Archives (ICA) to develop a comprehensive standard for description of archives is addressing that issue [26].

In addition to the intrinsic informative potential of the archival context, there is additional, potentially open-ended informative potential in relating archives to things outside of them. Developing an appropriate basis within archival theory for exploring external connections faces some difficulties. As the account of criticisms of current theory above has shown, trying to incorporate what are essentially extraneous concerns into established archival concepts has not been very fruitful. Nonetheless, many criticisms of current theory identify factors outside of the archival context that do shape the formation of archives and should be addressed, as appropriate, by associating them with, if not assimilating them into, archival theory.

A major difficulty is the plethora of meanings of ‘context.’ Bazire and Brézillon found 150 different definitions of context on the web [80]. A possible approach would be to define within archival theory a model of layers of contexts based on proximity of things in external contexts to an archive or to things in it. Such a model is illustrated in Figure 2, Layers of Context.

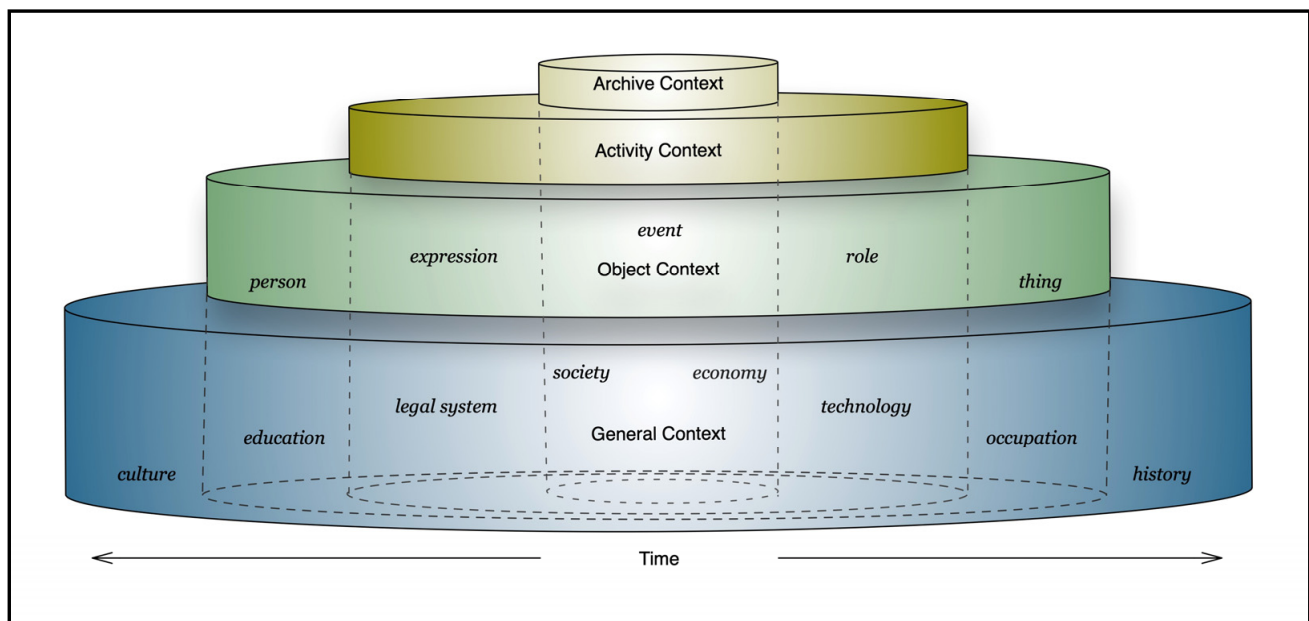


Figure 2. Layers of Context. Starting with the context of a single archive at the top, the figure displays three other contexts, Activity, Object and General, in which archives are formed, persist, and are used. Each layer downward is less specifically connected to the archive and larger in scope than the layer above it. The words in each layer indicate the kinds of things in that context.

At the top center of the model is an archive context; that of a single archive. Broader contexts are arranged below it. The second layer, the Activity Context includes the archives of all other archive producers who interacted with the producer of a given Archive Context and may include activities of other interacting agents about whom available information—for whatever reason—does not come from their archives. The Euler diagram in Figure 1 above illustrates a set of archives that would be located in the Activity Context if the Archive Context in Figure 2 were any of the archives in Figure 1.

The third layer, the Object Context, comprises particular things mentioned in the Activity and Archive Contexts. Things in this layer might include persons who were actors or merely mentioned in higher layers, descriptions of roles played by actors, and biographical data or other information about persons. The Object Context would also include expressions, which could include a variety of things that characterize information in archives, including documentary forms, system architectures, data models, and semantic fields of terms used in archives. Expressions could also include standards or norms about such things. In many sectors, such as IT, medical care, and aerospace, such norms are set by associations or regulatory agencies that may not directly interact with the archive producers in the top two layers [81–83]. Under events, this layer would include activities that impacted or were impacted by activities in the Activity Context. Information about things in this layer would be related to one or more particular things in higher layers and could come from any source outside of the top two layers.

The bottom layer, General Context, includes such things as society, economy, the education system, legal system, occupations, technology, culture, history et al. Things in this layer would be those which are known to have influenced or been influenced by things in higher layers or which are worth exploring for such influences.

The relative positions and dimensions of layers in Figure 2 are significant. Successive layers increase in thickness going downwards, reflecting the amount and variety of things that might be included in each. The horizontal dimension relates to time. Each layer encompasses the entire duration of the one above it and extends both backwards and forwards in time. The backward extension encompasses cases where something in a given layer can subsequently influence things in layers above it. Conversely, the time line extends

forward because something in a higher layer can impact something that comes after it. Information about things in each layer would be positioned according the relative date of its source, with sources that were contemporaneous with things in layers above it being located directly below them, as suggested by the dashed lines in Figure 2, and sources that were earlier or later further away, which would be outside of those lines.

In any given case, the model would be populated with empirical data about the things in each layer. Archival systems should be designed not only to facilitate linking data across layers but also to ensure that such links are valid or at least to enable users to assess their validity. In this way the model would provide a systematic basis for incorporating in archival practice additional factors that shaped the past, such as those identified in both external and internal criticisms of current theory.

Empirically what is included in the layers of this model can vary significantly among instances. The elements that would appear in a layer and their attributes or roles that are relevant depend on the interests and intentions that archives researchers bring to bear.

An additional dimension of context that should be addressed by archival theory and included in archival systems, although not represented in Figure 2, is the difference between structural and episodic elements. A structural context element is a persistent configuration, possibly a state of affairs, a process that regularly occurs within a context, or a typical outcome of such a process. An episodic context element is a change in a regular feature produced when something anomalous happens. An episode can be external or internal. An internal episode is something that happens within a context layer and impacts how an event, activity or process plays out, who or what is involved in it, the characteristics of their involvement, or more broadly changes the possibilities or probabilities of different outcomes. For example, within the archive context of a corporate body, internal episodes could include changes in leadership and major modifications of information systems. An external episode is one that would not be expected within a given context or that is precipitated by factors independent of that context. A natural disaster would be an external episode in any context, except those related to emergency preparedness or response. Episodic context may only impact a particular situation, but it might change or disrupt structural context. Taking the distinction between structural and episodic elements into account in archival theory and enabling users to make this distinction when exploring archives would enrich what they could learn about the past and contribute to ensuring the validity of data linking across layers of context.

(3) When an archive has informative potential for any qualified user, the management and operation of an archival institution should enable that potential to be realized. Currently there are two generic barriers to satisfying this criterion. The first is that archival theory prioritizes archival institutions over researchers. The second, pointed out in Section 3.2 above, is that the management and performance of archival functions may impose the predominant perspectives and values of society to the extent that they warp the information that can be obtained from archives. Reformulating archival theory to prioritize users should significantly lower the first barrier. It could also address the second, but that issue goes well beyond theory.

Any reformulation of archival theory, whether it shifts priority from support for the functions of archival institutions to use of archival assets or not, should cleanly separate theory from practice, but articulate theory in a way that is able to generate consistent, unambiguous guidance for practice and is receptive to feedback from practice. Reformulation should produce

“a dynamic intellectual edifice, one that has pathways for systematically collecting and organizing empirical information about new types of electronic records, and new ways that technology is applied in the conduct of business or could be applied in the discovery and delivery of archival records. This intellectual environment needs conceptual spaces suitable for analyzing information, for its impact within the domain of the management of records, and for what it reveals concerning changes in business processes and in the relationships between these

processes and records. We need to integrate the results of such analysis into the solid foundations of archival science and the effective application of archival methods in automated systems. Such integration could be described as ‘archival engineering’ [84] (p. 7).

Use of archives depends on the performance of apposite functions. Archival practice, from overarching management functions to daily transactions, could benefit from an approach that is pragmatic, adaptable, extensible, and amenable to empirical validation. Reformulating theory would enable the transformation of archival practice into a discipline of archival engineering. Engineering is “the application of scientific knowledge to practical problems, or the creation of useful things” [85]. Archival engineering would apply archival theory to the performance of archival functions. The conceptual foundation for archival engineering would be archival science, a body of knowledge developed and validated using scientific method. The reformulation of archival theory into a scientific discipline would enable rectifying problems related to how archival theory is expressed, provide a context for resolution of conflicts, and constitute a systematic basis for addressing the digital challenge.

4.2. *Interdisciplinary Potential*

The reformulation of archival theory could benefit substantially by integrating into archival theory intellectual resources drawn from the disciplines such as taxonomy, semi-otics, systemic functional linguistics and other fields of linguistics. These fields can contribute to the expressivity, extensibility and clarity of archival theory by enriching the language of discourse; strengthening empirical orientation; introducing varied and flexible methods, expanding the range of subjects and problems that can be addressed; and analyzing entities and relationships with more flexibility or at a higher level of abstraction than has been typical. Perhaps most importantly, these disciplines can contribute to the grounding of archival theory in empirical data, substantially enhancing the possibilities for a variety of users to realize the informative potential of archives.

4.2.1. *Taxonomy and Ontology*

The categorization of the archival domain in the literature and in formal models is basically typological. Concepts are expressed in abstract terms and categories are derived from them. In contrast, taxonomy builds categories from the bottom up on the basis of empirical data [49]. By distinguishing groups of things based on their properties, and demarcating boundaries of relationships and degrees of generalizability of constructs, taxonomy can contribute to the formulation of archival concepts that encompass and reconcile ideas that are currently or potentially in conflict [86].

An archival taxonomy might seem superfluous in light of the initiative of the ICA to produce a comprehensive standard for describing archives in the form of the Records-in-Contexts Ontology (RiC-O) and related conceptual model [26,87,88]. RiC-O could be seen as a taxonomy in the mode of computer science, but not in the more general sense of a formal model of the world or the part of the world relevant to this knowledge domain. Computational ontologies are formulated to enable implementation in computer systems [89]. The RiC-O ontology is meant to serve as the basis for automating archival description.

An empirically based taxonomy would provide RiC-O with a more substantive basis for assigning instances to classes and would bring to light things, attributes or relationships not recognized in an ontology derived from concepts. Conversely, relationships between classes in RiC-O could serve to rationalize, extend or otherwise improve the data models in the taxonomy.

Taxonomy can also contribute to realizing the informative potential of archives because it can be articulated in a way that simultaneously represents an empirical domain and addresses user needs [48,90,91]. An empirical taxonomy could help resolve some of the controversies in archival theory.

Furthermore, RiC-O is a task ontology [92]. Although intended to support other archival functions, the current draft lacks entities and relationships essential in them. RiC-O employs a top-down methodology, but its base is in the middle of things, incorporating or adapting earlier descriptive standards. Although it contains top level entities, they have been defined on an ad hoc basis. To maximize its potential, RiC-O will need to be improved by drawing on existing, well-formed top ontologies, and it needs either to be expanded into a comprehensive domain ontology or to be reconciled with such an ontology if one is developed.

4.2.2. Semiotics

Semiotics is the study of signs, what they mean, and how they are used. It has been developed and applied in numerous disciplines including philosophy, biology, education, marketing, design, mathematics, medicine, psychology, and others [93–100]. Archivists are not usually concerned with the meaning of particular items or ensembles in archives, but the scope of archival theory encompasses producing, obtaining, communicating, interpreting, and using information in the conduct of affairs. Semiotics provides a fertile framework for analysis of these processes. As with archival theory, the domain of semiotics encompasses potentially all human activities. Moreover, prioritizing users' needs and interests in the discovery and exploitation of digital archives requires extending archival theory to both probe within archival assets and to link them to related information.

Like archival theory, semiotics addresses the forms in which meaning is expressed and the effects that it has on both the production and interpretation of content. Its applicability to archives includes both the information systems used by the producers of archives and those used in archival management and research.

The relative richness of semiotics can be seen by comparing the concept of agent in RiC-O with that of actant in semiotics. Agents in RiC-O are “entities that act or perform activities in the world and in the course of performing the activities generate records that are the products or by-products of the activity performance” [26]. An actant is a category of actor specified by the context in which action takes place. Actants play roles, but a role is not entirely deterministic. An actant assumes a role by virtue of competence and realizes the role in performance. An actant may alter a role by the way it actualizes the semiotic potential present in a context [101]. Actant categories are differentiated according to their roles in both communication and the accomplishment of objectives, both of which are significant in the production and use of archives. An actant may determine what is communicated, how and to whom; be an object of concern; or be a recipient of the information. An actant may contribute to accomplishing objectives; be a subject of the action; or oppose the action [102–104].

The core object in semiotics, a sign, as defined by Peirce, one of the founders of the field, is “something which stands to somebody for something in some respect or capacity” [105] (vol. 2, p. 228). The literature names the elements of this definition in a variety of ways. Here, the first element in the definition, the “something which stands for,” is called the sign vehicle. A sign vehicle can be simple, such as a word, a gesture, a stick figure depicting a human, or complex, such as an annual report, or an anatomical chart presenting details of the human body or systems within it.

The “something” to which the sign vehicle refers is its domain. Domain is preferable to the more commonly used ‘object’ because what a sign refers to can be not only some physical or conceptual thing but also some aspect or aspects of a thing [106]. It can be a single object, such as a dog named ‘Spot,’ or a composite of arbitrary complexity, such as the domain of science. Given that a sign might only refer to aspect(s) of a domain, semiotics differentiates the immediate object from the dynamic object of a sign in a given context [107]. The immediate object is the domain of a particular expression of a sign, while the dynamic object corresponds to a domain that can be inferred cumulatively from the set of traces expressed in a given context. Both immediate and dynamic objects could be construed differently in different contexts. Hypothetically, many domains extend beyond

any particular context, framing possible expressions because different aspect(s) of a domain could be addressed in different contexts [108].

The distinction between immediate and dynamic objects can be fruitful in addressing external critiques of archival theory without muddying the messages that archives can communicate by themselves. Just as an action can be part of a process that includes other kinds of actions, the actions and states of affairs documented in archives can be viewed in different ways, such as when an archival asset is interpreted in light of progressively higher levels of aggregation in a record keeping system. The dynamic object of an asset at one level expands when considered more broadly. The concept of the dynamic object can be useful in describing how archival assets function as instruments of activity.

How a sign vehicle “stands for” something else is its morphism. ‘Morphism’ is not a term used in semiotics, but the variety of terms that are used to indicate this relationship: referent, meaning, thought, sense, definition, conception, interpretant, intendat, representation, use, et al., reveals there is no consensus among semioticians about it. ‘Morphism’ is imported from category theory where it is some mapping between two objects. It is a richer term than those cited and better conveys the possibility that the relationship between a sign vehicle and a domain can be complex. Morphisms can take a variety of forms including physical, psychological, or conceptual relations and even processes that unfold in time. In category theory morphisms are constrained to unique mappings [109]. That has the advantage of being unambiguous, but this constraint might seem inappropriate in dealing with natural languages given the nebulous meaning of many words. However, it accords with the definition of sign: when a sign vehicle has more than one mapping to a domain, each determines a different immediate object, or the variants may constitute different signs [110,111]. A morphism may represent a domain or it may project an expectation of effects, such as a disposition of a sign user to react to a sign vehicle in a particular way; for example, a soldier responding to a command or a computer processing a type of input. In either mode, a sign can have either a generic or a contextual meaning. The word, ‘soldier,’ has a generic meaning, but “Soldier, . . . ” at the start of a spoken command refers to a specific person [112]. In archives, meanings are accessible only in objectified expressions, archival assets. Despite this limitation of the extensionality of signs in archives, distinguishing between representation and expectation and between generic and contextual meanings is necessary for authentic understanding of archives.

The “somebody” in Peirce’s definition is a sign user, in archives either a human or an information system. Different sign users can associate the same sign vehicle with different domains or associate the two using different morphisms. For example, black clothing has traditionally been associated with mourning in the West, while mourning is indicated by white clothing in East Asia and red in South Africa. A sign vehicle can have different morphisms in different contexts. While white in Christian culture was traditionally associated with purity or holiness, in sixteenth century France white clothing indicated mourning when worn by a queen, an unmarried woman or a child who had lost a parent [113].

Besides individual signs, semiotics recognizes complex signs composed of many other signs, layers of signification of individual signs, and series of signs where the sign vehicle in one sign becomes the domain of another and so on [108,114]. Semiotics often refers to complex signs as “texts.” As with ‘document’ in archival theory, ‘text’ in semiotics is not limited to language but can take any form that can be used to encode or communicate meaning [115].

Producing and interpreting signs are the two basic semiotic processes. They differ in what they operate on. Production forms signs. Interpretation reacts to existing signs. Logically, information must be produced before it is interpreted, but both processes occur in any communication. Production can also occur together with interpretation when an interpreter produces new signs, alters the relationships among the elements of signs, or uses signs in a different respect or capacity than that of the producer of the signs being interpreted.

The treatment of signs in semiotics is often limited to what is called the semiotic triangle, comprising the sign vehicle, domain and morphism but omitting the sign user [114,116–119]. Differences between or among sign users can entail problems. For example, there are often miscommunications between technologists and clients in the design and development of information systems. This led the International Federation for Information Processing in 1998 to sponsor the development of a conceptual framework which would be useful in communications between clients and technologists. The resultant FRamework of Information System COncepts (FRISCO) augmented the semiotic triangle into a tetrahedron by placing an ‘actor’ at the center, thus including all four components of Peirce’s definition [120]. The semiotic tetragram (Figure 3) illustrates the FRISCO model using the terms of this article. The central element in the tetragram is the Sign User. The Sign User is or embodies a semiotic system capable of producing or interpreting signs. A sign user can switch between production and interpretation of signs even in very short durations; for example, a writer considering whether a sentence just written should be changed switches from producer to interpreter. The Domain is what a sign refers to and the Sign Vehicle is the expression the Sign User associates with the Domain. The Morphism maps the Sign Vehicle to the Domain.

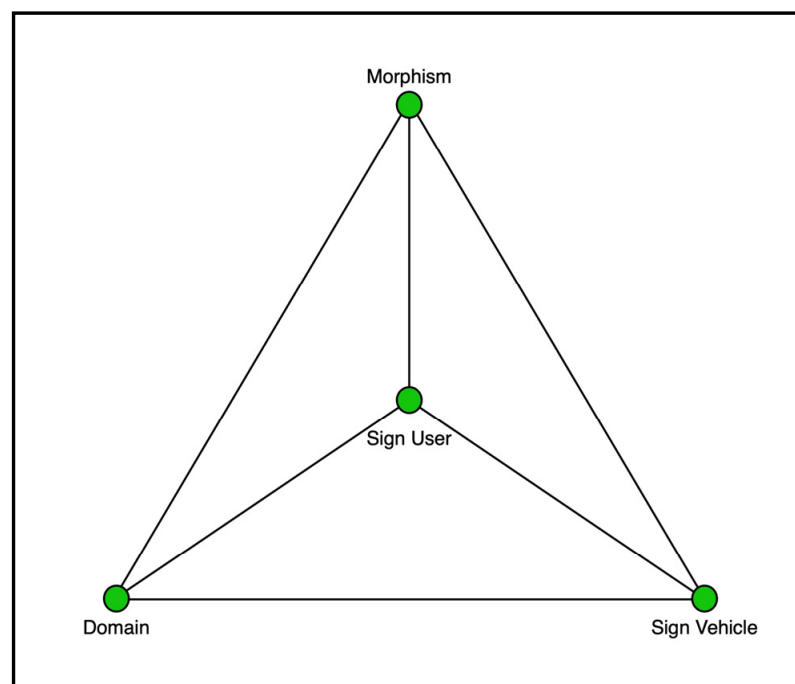


Figure 3. Semiotic Tetragram: The four components of a sign in semiotics are the Sign User who produces or interprets the sign, the Domain to which the sign refers, the Sign Vehicle which represents the domain, and the Morphism which maps the Domain to the Sign Vehicle for the Sign User.

The Semiotic Tetragram could be used in the archival domain to analyze and specify how different actants, including archive producers, archival institutions, and archive researchers, interpret archives differently. Figure 4, The Semiotics of Archival Production and Research, illustrates the different semiosis of an archival asset for an archive producer and subsequently for an archive researcher.

For the producer, the domain is its activity. The producer expresses something significant about the domain in an archival asset, which is thus a sign vehicle for the producer. However, for an archive researcher the archival asset is the domain in which the researcher is interested in understanding. Examination of the archival asset, either by itself or in some context, results in the production of a new sign; that is, some information about the asset, its content or its relation to other things. Thus, Figure 4 depicts what external critics assert about the use of historic archives: it produces new meaning; however, the result is a new sign, not a change in any aspect of the archival asset as an element of an existing archive.

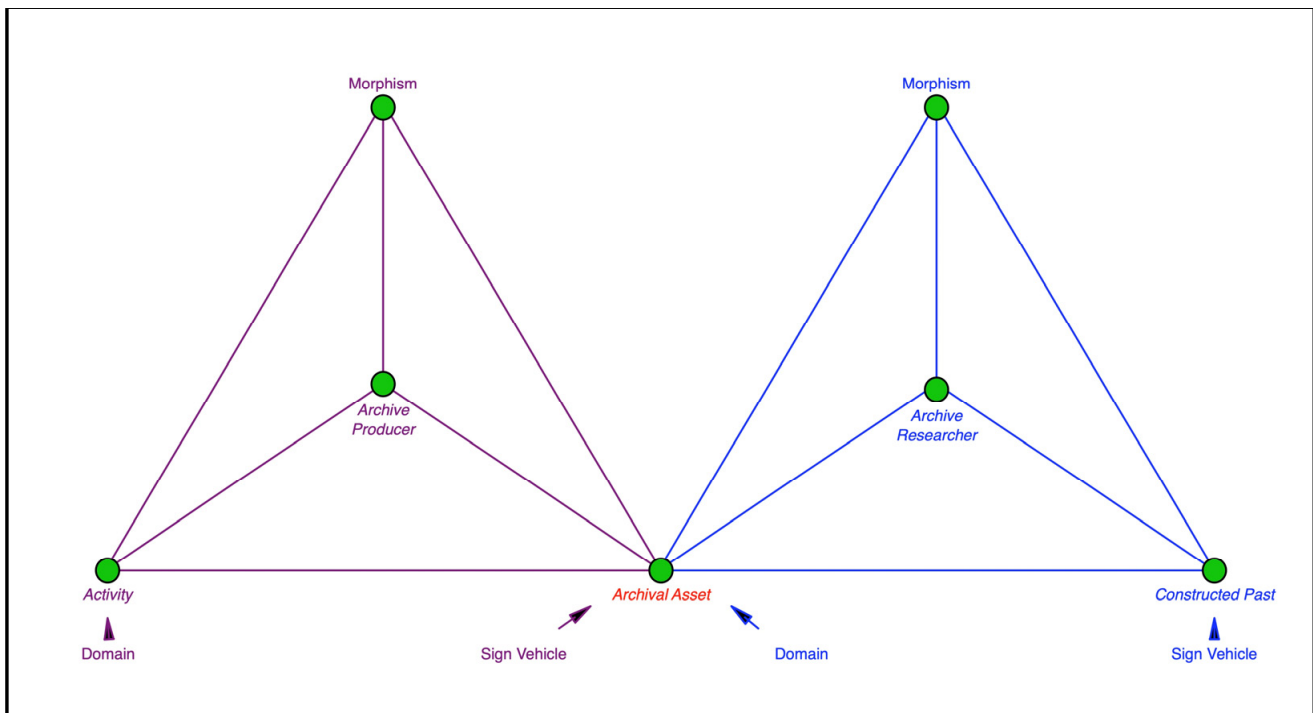


Figure 4. Archive Production and Research, illustrates that an archival asset is a different type of element in a sign for an archive producer and an archive researcher. For the producer, it is a sign vehicle. For the researcher it is a domain.

More generally, there are basic differences between the morphisms of current and historical archives. In a current archive, archival assets are produced for a particular pragmatic purpose and subsequently interpreted for purposes that are consonant with or derivative from the purpose of production. In a historic archive, the existing assets no longer function as instruments or byproducts of the producer's activity, but as starting points of interrogation. Often, the sign users of historic archives have purposes different than, and possibly orthogonal to, the purpose of the current archives phase. Users of historic archives may require or benefit from understanding their meanings in the earlier context, but they may want nothing more than to obtain factual information that satisfies criteria unrelated to earlier purposes. In the use of historic archives, instances of existing archival assets may be acquired by the archive researcher and connected to other items relevant to that user, but as such they are assets in a different archive. They do not change the informative potential of the existing archive per se.

4.2.3. Systemic Functional Linguistics (SFL)

In cognitive semiotics, the morphism between sign vehicle and domain is a process whereby a producer or recipient of a sign connects the sign to its surrounding reality and interacts with it accordingly [110,121]. From its initial concentration on written and spoken language, SFL has, like semiotics, extended its scope to encompass visual imagery, mathematical symbolism, sculpture, architecture, gesture and other modes of interaction as resources that contribute to making and interpreting meaning [122,123].

Social and cultural contexts are significant aspects of an individual's reality. As Kress points out, "The social is in the sign; it is not a question of a correlation between an autonomously existing sign, and an external social reality, of a context around the sign, or around the text as complex sign. The sign is fully social, the work of social/semiotic agents expressing their sense of the social world at a particular moment, and of their affective response in it" [124] (p. 76).

Analysis of the use of signs in context is the forte of SFL. Context in SFL is not a fixed state. It can change as actions occur. The context in which people communicate shapes but does not predetermine the meanings that are generated. Interactions construct relationships among forms, material processes, social actions and things [125]. As Duranti and Goodwin state, context should be considered first

“From the perspective of an actor actively operating on the world within which he or she finds him- or herself embedded; second, tying the analysis of context to study of the indigenous activities that participants use to constitute the culturally and historically organized social worlds that they inhabit; and third, recognizing that participants are situated within multiple contexts which are capable of rapid and dynamic change as the events they are engaged in unfold” [126] (p. 5).

SFL and semiotics look to how the use of language serves different purposes. Thus, signs may be used not only to represent domains and indicate expectations about a domain, but also to convey and foster intentions. SFL’s concentration on the use of signs in interactions for pragmatic purposes makes it especially germane in the archival domain [127]. Tautologically, any archival asset that is or was an instrument in an activity has a pragmatic aspect and recognizing the purpose it served for the archive producer is essential to understanding it as an archival object. Even assets that were not instruments but byproducts of activity can inform about the activity and the archive producer’s intentions.

SFL construes language as a social semiotic system shaped by what users wish to accomplish by using it [128]. How language is used depends on the contexts in which communication occurs. SFL distinguishes two levels of context: first broadly under the umbrella of the anthropological concept of the context of culture and second in specific instances in which communication occurs. The context of culture comprises historically evolved assumptions, meanings, ways of interacting and expectations that condition how a people in a social group communicate, defining the available options for effective communication [129]. The context of culture may not be explicit in all situations. Bărbuleț clarifies that the context of culture can include “extrasituational context,” explaining “Extrasituational context refers to the background knowledge that is not (or, at maximum, barely) perceptible if considered alongside the immediate setting” [130] (p. 379).

SFL designates the immediate setting as a context of situation, an instance of communication within a context of culture. Contexts of situation are characterized according to three main features: the *field*: what is being done using language; the *tenor*: who is involved and how they interact considering roles, status, competence and familiarity; and the *mode*: the function of language in the interaction, the form it takes and the norms that apply to it [131–133]. Naively, human participants in communication have roles of either speaker or writer on the one hand or listener or addressee on the other, but SFL posits that participants often shift between these basic roles, whereas their relative social distance (close, neutral or distant), social status (equal or unequal), and knowledge (as a means of exerting power) more consistently influence communication in a context of situation. Given that meaning is a function of choosing among semiotic options available in the context of culture, a context of situation can be dynamic in both live and asynchronous interactions [134].

A context of situation is a network of actual relationships in an instance or series of interaction. Contexts of situation can be reconstructed from evidence of interactions preserved via the archival bond and expatiated using archival data about actants involved in the production of an archive or action network and the functions of archival assets in the activities they document. Unless there are disruptive episodes, the field in an archival bond or action network is likely to be constant across steps in an activity and even across related activities. However, the tenor and mode could change substantially.

The layered context model in Figure 2 provides an abstract way of relating various elements of context at different levels of immediacy. Elements of the context of culture would be found in the General and Object layers of the figure, while the particular elements of as context of situation could extend from the Archival Context into the Object Context. The archival bond or its extension in an activity network can elucidate the context of

situation in which archival assets were produced. The extent of the archival bond or action network in terms of the types of documents it connects, the archival ensembles it encompasses, and the variety of actions and actants involved may reveal a web of related, overlapping contexts of situation. Both the intersections of the archives in Figure 1 and their complements provide indications of the components of such a web. The possibility of discovering and defining past contexts of situation through exploration of the archival bond adds to the motivation for further articulation of the concept to distinguish things and relationships within the archival bond. A fuller appreciation of a context of situation would relate it to things at lower levels of the model in Figure 2.

The archive producer is always a participant or represented by participants in a context of situation revealed by an archival bond. Completely specifying the SFL tenor identifies all participants and their roles, including actants and actions in the disjoint set that includes only what is in the largest circle in Figure 1 and not anything in the archives within it. When archives are organized as records according to actants, such as correspondence files, customer management records or patients' health records, data about the archival bond also informs about the tenor. In contrast, ensembles arranged on the basis of actions in which archival assets were used parallel instances of processes. Such case files probably identify participants besides the archive producer or its representatives, but not necessarily all participants. For example, a research grant application may be routinely subject to peer review without the reviewers' identities being disclosed in review documents. However, case files are likely to give a more extensive indication of the SFL field and mode than ensembles based on persons. Given that access to the context of situation of archives depends on what is available in archival assets, the form is always written. Its role can vary according to its archival function. The norms that apply to it may be explicit in other archival assets, for corporate bodies particularly in directives that regulated or guided the conduct of affairs.

Norms may also be evident in or inferable from the intrinsic and extrinsic elements of form of the archival assets used in instances of activities. These elements are the focus of *diplomatics*, a discipline which analyzes the creation, form and status of transmission of documents as well as their relationships with their creators and the facts they represent [135]. *Semiotics* provides a framework in which the diplomatic analysis of individual documents and forms of documents can be integrated with examination of semiotic specializations generated by participants in the activities in which the archives were produced as well as variations in those specializations over time and among different participants [136].

The context of situation can also be applied fruitfully to address the creativity that external critics have noted in the use of historical archives by researchers, extending beyond the difference between archive production and research shown in Figure 4. Research uses define contexts of situation that are different than those in which an archive was produced. The mode is inevitably different: researchers in archives do not repeat the activities of the archive producer. The tenor is necessarily different: the archive producer is not an actor in research in its archive in the historical phase and may not be involved or may have a different role in *ex post facto* research in its current archive. The SFL field may be very similar to, even practically identical with, that of the active phase if a researcher is interested in the history of the topics mentioned in the archive. If the researcher's attention is not focused on the content of the archive, but on the producer, the activity or other actors involved in the activity, the field will be different. If the researcher's interest is not in the producer or activity, but in data that can be gleaned from the archive related to topics only incidentally or tangentially related to the producer's interests or actions, the field can be quite different than that of the producer. In its proper context of situation, research may create a new archives, but with the researcher as producer. That does not change the archive examined in the research as a unique complex semiotic object.

4.2.4. Other Linguistic Disciplines

Several archival writers have pointed out the applicability of another linguistic discipline, speech act theory to the analysis of archives, some even classifying records as speech acts [7,137]. Speech act analysis has a narrower conceptual range than either semiotics or SFL, but it could be applied as a special technique within either. Empirically, it has been demonstrated that speech act analysis can determine the role a record played in an activity, adding to the traditional techniques of diplomatic analysis a tool that can be very useful in characterizing large, heterogeneous collections of digital records [64]. However, an archival item cannot be categorically identified as a speech act because many archival items contain multiple speech acts of different types; moreover, an archival item may quote or include by reference another asset that also contains different types of speech acts. Nevertheless, the identification of speech act theory as relevant to archival theory is basically valid [138].

Similarly, genre theory and rhetorical structure theory could be paired with SFL and other concepts from semiotics because they share much in common, though developed from a different perspective. Similar to speech act analysis, they have a narrower focus than SFL. Genre is an element in SFL mode, expanding outward from mode to deal with topics such as pragmatics, communication and time. Rhetorical structure theory provides analytic tools to address issues about communication, semantics, and the nature of the coherence of texts [7,96,139–142].

Another recent development that offers substantial potential for enriching archival theory is Constructed Past Theory (CPT), which, though not discussed here, offers a very generalized conceptualization of what is involved in producing and interpreting information about things in the past [143,144].

5. Discussion

This article has identified difficulties that confront the realm of archives coming from continuing growth and change in IT and its uses, establishing the need for archival theory not only respond to current difficulties but also to become more adaptable, expandable and verifiable to deal with future changes. Changes of this sort would shift archival theory from its current, largely informal state to an engineering discipline that provides a solid foundation for development of applications to overcome digital challenges. Doing so entails reformulating existing archival theory in order to make it more rigorous and both logically and empirically sound. The reformulation should be strengthened and enriched by importing elements of other fields such as taxonomy, semiotics and systemic functional linguistics. The argument describes specific aspects of archival theory that could be improved by these perspectives.

The article provides the rationale and lays the groundwork for a reformulation of archival theory, but does not propose one. That is an area of ongoing research and development.

Implementing a discipline of archival engineering would not be a trivial matter. The merits of doing so will have to counterbalance numerous issues in the current state of archival methods and practice, as well as the endemic problems of insufficient resources and practitioners who lack adequate and appropriate formation to adopt and implement a new approach. While archivists and records managers need not be responsible for development of applications, it is likely that they would encounter the types of communications problems between clients and technologists described in the FRISCO report. They need skills to recognize and resolve such difficulties.

Developments in recent decades provide grounds for optimism. They include a number of collaborative and multidisciplinary efforts, as well as several initiatives in formalization of archival theory, most prominently the ICA's RiC-O project.

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Appendix A

Table A1. Definitions of Key Terms.

Term	Definition	Rationale
Archival	Pertaining to an archive, a subset of an archive, multiple archives, the activities of archival institutions, information about archives, or the discipline and profession devoted to managing, preserving and providing access to archives.	The core of this definition is to restrict the adjective essentially to information items and ensembles that are related by an archival bond, thus differentiating them from relationships established by means of a record keeping system. There can be intersections of the two sets.
Archival Asset	An archival item or archival ensemble.	Both archival items and ensembles have value to the archive producer.
Archival Ensemble	A set of archival items related by their use in related actions. An archival asset is either an archival item or an archival ensemble. Archival ensembles may be nested.	Used rather than ‘archival aggregate’ because aggregate can designate a collection, group or mass of things indiscriminately, whereas an ensemble connotes a set whose members are interrelated. An archival ensemble may or may not be identical to a set of records in a filing system depending on how the filing system relates to the conduct of business by the archive producer.
Archival Institution	A place or institution that that manages one or more archives. This includes both institutions that are responsible for historical archives and records management or other units or systems that served the interests of archives producers in the case of current archives.	
Archival Item	An information item that is produced or acquired by an agent in the conduct of its affairs.	Used instead of the more common term, ‘record,’ to distinguish information items that have an archival bond with other information items used by an archive producer. The archival quality is established by use and is independent of whether an item is designated or kept a record by the archive producer.
Archive	An ensemble of archival assets whose membership is determined by their use either by a single archive producer or in the exercise of a function by a set of archive producers acting in succession.	Generally English uses “archives” only in the plural, and it uses to refer to the information materials that constitute archives or the institutions and buildings where they are preserved and accessed. Here, ‘archive’ denotes only the top level archival ensemble of a single archive producer or successional series and the sub ensembles and items in it.
Archive Producer	The role an agent performs in producing or acquiring and possibly retaining and organizing information items in the conduct of its affairs.	It is used in lieu of the common term, ‘record creator.’ It is universally acknowledged that agents both produce and acquire information items in the conduct of their affairs. In the latter action, the supposed “creation” of a record does not actually create anything. It only qualifies an existing item as a record.
Constructed Past	The information that results from an effort to learn about a target past.	Imported from Constructed Past Theory [141].
Domain	In semiotics, what a sign refers to. A domain can be a physical, biological, psychological or intellectual objet or some aspect or set of aspects of an object.	The term is necessary because it is an element of the definition of sign in semiotics. Adopted from the FRISCO model [120].
Information Item	A persistent and discrete expression of information that is coherent in terms of some semiotic system and comprehensible to an agent that has competency in producing or interpreting information in that system	The domain of archival theory is limited to information that is carried in a persistent object outside of the human mind.

Table A1. Cont.

Term	Definition	Rationale
Morphism	The relationship of a sign vehicle to its domain	The term is necessary because it is an element of the definition of sign in semiotics. It is adopted from category theory in lieu of other terms in the semiotics literature that refer to the relationship between sign vehicle. Adapted from category theory to indicate that the relationship is not necessarily static but may in every instance be the result of a process executed by a sign user.
Record	An archival item that is retained by or on behalf of an archive producer and treated as a record either in a system that serves the purpose of maintaining and managing archival assets or by some other means.	The term designates a subtype of archival item that is kept and somehow designated as worth keeping. The status of archival item depends only on use by an archive producer regardless of whether they are retained or designated as records.
Record Keeper	A role of an agent who maintains and manages records on behalf of one or more archive producers.	An archive producer may keep its own archive, but there are also agents who keep records for archive producers but do not use them in their own affairs, as in the European notarial system [1].
Sign Vehicle	The expression a sign user associates with a domain	The term is necessary because it is an element of the definition of sign in semiotics.
Sign User	A semiotic system capable of producing or interpreting signs.	The term is necessary because it is an element of the definition of sign in semiotics.
Successional Series	A series of records that is transferred successively from one archive producer to another.	Used to differentiate ‘series’ addressed in the series system concept from record series that are established and maintained by or on behalf of a single archive producer.

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