ORIGINAL PAPER



Tacit attitudinal principles for evaluating digital preservation success

Stephen Abrams¹

Accepted: 22 February 2021 / Published online: 19 March 2021

© The Author(s), under exclusive licence to Springer Nature B.V. 2021

Abstract

Digital preservation fulfills a critical role in the digital continuity of individual, institutional, and cultural memory. It is important for archival stewards and stakeholders to know whether or not those activities have been successful in order to deploy finite programmatic resources most relevantly, effectively, and productively. While preservation trustworthiness has been subject to extensive examination, the complementary evaluative quality of success has received less critical consideration. This study looks at how the preservation community ascribes meaning to the concept of success through attitudinal norms tacitly embedded in domain discourse. These are recovered through qualitative content analysis of selected preservation policy statements, which act as public affirmations of the archival service "contract" regarding stewardship intention and reciprocal stakeholder expectation. Success is a measure of the alignment between anticipated outcomes and actual preserved state resulting from intentional intervention. Communicological critique of the norms illuminates why the measure of success remains problematic and suggests avenues by which metrical practice can be augmented to enhance its evaluative power. This includes repositioning evaluative prerogatives to incorporate concern for the persistence not only of authentic digital information objects but also legitimate communicative experiences.

Keywords Digital preservation · Success · Policy · Content analysis · Communicology

Introduction

No meaningful future understanding of prior time in the digital age will be possible without recourse to the preserved digital resources that underpinned and continue to document that past. As the time horizon of that aspiration extends into the indefinite

School of Information Systems, Queensland University of Technology, Brisbane, Australia



Stephen Abrams stephen.abrams@hdr.qut.edu.au

future, it is accompanied by ever-growing disparities in technology, cultural context, and lived experience. In response, increasingly sophisticated forms of intervention may be necessary to ensure ongoing purposive engagement with preserved content, which is central to the continuity of individual, institutional, and cultural memory. Given the challenges attendant to that pursuit, it is incumbent upon the archival community to question how it can know whether or not its efforts have been successful. Unfortunately, digital preservation success continues to be "a metric that's defied measuring" (Lee and Tibbo 2007). To make progress towards measurable metrics, this study questions how the digital preservation community ascribes meaning to the concept of success in terms of evaluative norms underlying domain discourse. Critique of those norms illuminates why definition and operational deployment of measurable metrics remains problematic, and suggests ways to augment practices to remedy their evaluative limitations.

The trustworthiness of preservation programs and systems has received much attention as an evaluative benchmark (Donaldson 2015; Giaretta 2011; Traczyk 2017). Success, however, remains an ill-defined domain concept (Dearborn and Meister 2017), and the preservation community has limited recourse to operational success metrics (Donaldson 2016). Nevertheless, expressions of general evaluative principles regarding success permeate domain discourse. Digital preservation is a highly specialized activity generally delegated to dedicated organizational units or external agents; see, for example (Altman et al. 2009; Bermès and Fauduet 2011; Kirchhoff 2008; Partners for Preservation: Advancing Digital Preservation Through Cross-Community Collaboration 2019; Ravenwood et al. 2015). This situation can be abstracted as a service-provider/stakeholder relationship in which preservation specialists act on behalf of curators and collection managers. The degree of satisfaction derived from such relationships depends upon alignment of provider intentions and stakeholder expectations (Mason and Simmons 2012). In the preservation context, a successful result is one in which expectational goals of curatorial or consuming stakeholders were fulfilled by actual outcomes of intentional activities of preservation providers. Thus, a reliable means of identifying intentions and expectations is critical for greater understanding of success criteria.

The National Library of Australia's proposal for explicit preservation intention statements (Webb et al. 2013) has not received widespread adoption. Search of Library & Information Science Abstracts; Library, Information Science & Technology Abstracts; and Google reveals no substantive publications or web references beyond citations to the original paper or internal NLA activity. However, an alternative means for gaining a broad sense of relevant obligatory and aspirational attitudes is provided by digital preservation policy statements. Policies purposefully articulate the terms and conditions controlling service-provider/stakeholder interactions (Innocenti et al. 2010). They bind providers and stakeholders in an implicit psychological or social "contract" of reciprocal rights and responsibilities (Jeong et al. 2018). Relevant intentions are explicitly expressed as programmatic obligations, schematically representable as: "Provider P will perform activity A or ensure condition C on behalf of stakeholder S." Public affirmation of intentional terms of service provides a basis for corresponding, if implicit, stakeholder expectations: "Stakeholder S depends upon provider P to have performed activity A or ensured condition C." The



alignment of aspirational and anticipated results constitutes an implicit evaluative norm: "Did provider P perform activity A or ensure condition C for stakeholder S?" These norms are recoverable by a content analysis technique suitable for identifying manifest and tacit expressions of policy obligations. Once recovered, they are subject to communicological analysis to determine their suitability for characterizing digital preservation success.

Communicology is the study of human discourse as a system of expressive signs whose meaning and understanding emerges through individually, institutionally, and culturally situated interpretation (Eicher-Catt and Catt 2008; Lanigan 2013). Historically, digital preservation has been approached primarily as a managerial activity, centrally concerned with custodial stewardship and technical intervention regarding digital information objects (Becker et al. 2011; Gladney 2006; Nicholson and Dobreva 2009; Wilson 2017; Xie and Matusiak 2016). Nevertheless, the underlying imperative of that activity is future use of those objects (Conway 2010). That use, however, is contingent with respect to time, place, person, and purpose (Bishop and Hank 2018; Morrissey 2014). Communicological analysis is explicitly cognizant of the inherent contingency of any human information exchange (Cook 2001; Hansson 2005). Thus, it is an appropriate basis for inquiry into digital preservation as a mediating act of intersubjective communication across time and concomitant technical and cultural distance (Abrams 2018). Evaluative criteria and metrics characterizing the success of that act should encompass factors related to legitimate experiential as well as authentic artifactual persistence.

Firmer quantification of digital preservation success is important from theoretical and practical perspectives. A conceptually sound metrical framework provides practitioners better means for articulating significant nuanced gradations of intentions and obligations, ensuring more realistic expectations. Operational benchmarks for success are an important mechanism by which preservation programs can remain demonstrably accountable and relevant to stakeholders. Furthermore, communicological analysis of existing evaluative norms and principles exposes limitations of theoretical and conceptual structures now dominant in digital preservation thinking and practice, and suggests incremental expansion of those structures supportive of new investigatory approaches. Digital stewardship concerns are common to both archival and library communities of theory and practice. While this research draws from and is applicable to both, it primarily reflects institutional and professional experience in library rather than archival records management contexts.

Current evaluative prerogative

The ever-growing reliance on, if not indispensability of, digital content in critical aspects of contemporary life has been accompanied by persistent calls for proactive efforts to combat the specter of a "digital dark age" (Bollacker 2010; Brand 1999; Jeffrey 2012) in which digital corpora are susceptible to irretrievable damage or loss through obsolescence, attack, inattention, or ineffective stewardship. Some scholars downplay the likelihood or severity of this threat (Anderson 2015; Johnston 2020). However, this position depends upon widespread availability and adoption of mature



tools, practices, and sustained institutional commitments for addressing preservation risks. Much effort has gone into articulating capabilities and capacities necessary to meet the challenges of long-term preservation of critical digital heritage; see, for example (CLIR 2002; Corrado and Moulaison Sandy 2017; Owens 2018; Traczyk 2017; Waller and Sharpe 2006; Waters and Garrett 1996). The goals of the preservation enterprise include assurances of risk mitigation (Frank 2019), trustworthiness of managerial stewardship (Giaretta 2011), and the resulting authenticity, accessibility, integrity, reliability, understandability, and usability of managed digital content (Burda and Teuteberg 2013).

The accepted framework for digital preservation analysis and operation is the ISO 14721 *Open Archival Information System* (OAIS) reference model (Xie and Matusiak 2016). OAIS defines digital preservation as "The act of maintaining information, Independently Understandable by a Designated Community, and with evidence supporting its Authenticity, over the Long Term" (ISO 2012b). The quality of independent understandability depends upon preserved information being directly interpretable and usable by a designated community without expert assistance or supplementary information, relying instead upon an assumed body of shared background knowledge. A successful preservation outcome is one in which independent understandability is achieved, but the standard itself does not provide guidance on how to identify or measure that success. It does, however, call for subsequent development of appropriate evaluative instruments for determining whether OAIS responsibilities have been fulfilled.

The primary OAIS follow-on activity has focused on trustworthiness of preservation programs and systems (Donaldson 2016; Traczyk 2017). Trustworthiness may be demonstrated through instruments such as nestor/DIN 31644 Criteria for Trusted Digital Repositories (Maemura et al. 2017), CoreTrustSeal (L'Hours et al. 2019), or ISO 16363 Audit and Certification of Trustworthy Digital Repositories (TDR) (ISO 2012a). However, these instruments define trustworthiness in terms of descriptive programmatic or technological attributes, rather than operational outcomes of those programs or technologies (Dryden 2011). Thus, trustworthiness is a quality best associated with preservation management, rather than exploitive consumption of resources preserved through that management (Yoon 2014). In other words, trustworthiness primarily measures what preservation managers do (Xie and Matusiak 2016), not the stakeholder-facing experiential affordances *enabled* by that doing. Thus, the prevalent norm of trustworthiness is consistent with—and demarcated by—the preservation field's conceptual emphasis on the evaluative perspective of managerial agency and activity (Becker et al. 2011; Wilson 2017). Furthermore, trustworthiness is a determination of presumptive ability, rather than substantiated actuality (Donaldson 2016), that is, it provides confidence regarding what should result but not necessarily evidence of what has resulted.

The human response to an information resource arises through complex interplay of shifting meanings inhering *in* the fabric of that resource, adhering *to it* through contextual association, and cohering *about it* interpretatively by the consuming human agent (Buckland 2013). In the digital realm, this intersubjective process depends upon intermediating computational performance to (re)present preserved digital content in analog form amenable for human consumption (Becker





2018). Thus, the operative goal of digital preservation is the persistence not just of authentic information-laden artifacts, but also legitimate human *experience* of those artifacts (Duranti and Thibodeau 2006; Sacchi 2015). In other words, preservation's teleological imperative is inherently *communicative*, embracing concern for the experiential quality of performative preservation outcomes, not just the managerially intermediating artifactual and technological vehicles enabling those results. In this study, preservation *management* is defined in OAIS-consistent terms as encompassing custodial acquisition, hosting, planning, monitoring, intervention, and exposure for discovery. Subsequent external exploitation of managed resources is considered *communicative*.

Whereas trustworthiness is an appropriate measure of preservation management, the characterizing evaluative quality of a communicative act is its success. Preservation success entails future use of past informative expression instigating meaningful cognitive, affective, or conative human response, that is, something germane to the directed or serendipitous purpose of that use is newly known, felt, or acted upon (Ketelaar 2012; Kuhlthau 2017; Savolainen 2019). Future use of preserved resources, often in ways unintended or unanticipated at the point of production or acquisition, is dependent upon a socio-technical complex of practitioners, policies, procedures, and systems (Abrams 2018). The exploitive experience of and epistemic response to preserved resources are contingent upon ever-evolving information needs and aspirations contextually situated in time and place. This communicological repositioning of the digital preservation enterprise raises challenges regarding its effective evaluation. While metrics for trustworthy resource management provide a necessary evaluative foundation, they are not sufficient to characterize fully the degree to which preservation's teleological goal has—or has not—been fulfilled. Existing artifactual measures need to be supplemented with those quantifying the communicative experiential and epistemic outcomes attendant to use of preserved resources. Insight into underlying intentions and expectations, whose alignment is central to determination of success, is provided by the recovery of attitudinal norms and principles articulated in digital preservation policy statements.

The ISO 16363 TDR standard emphasizes the documentary importance of policy statements (Sanett 2013) in order that "activities of the repository will be understood by stakeholders and management [emphasis added]" (ISO 2012a). In other words, TDR acknowledges that policies establish a contractual sense of reciprocal intentions and expectations underlying manager/stakeholder interactions. While TDR goes on to claim that this documentation "ensures that repository policies and procedures are carried out in approved, consistent ways [emphasis added]" (ISO 2012a), in doing so it overstates the causal certainty that documentation of intention necessarily leads to completion of intention. Policies are enabling, not conclusive, factors in successful preservation outcomes. While archival policies articulate programmatic responsibility, subsequent demonstration of successful fulfillment of those responsibilities requires verification. Evidence of success is dependent upon operational criteria and metrics as yet undefined by TDR or similar evaluative instruments. Nevertheless, progress towards operative definition starts with establishing the scope of intentions and expectations held by providers and stakeholders as expressed through controlling policy terms.



Attitudinal recovery

Ninety-five prospective policies issued by international memory institutions were deduplicated from lists identified by the Library of Congress (Sheldon 2013) and SCAPE project (SCAPE 2016), supplemented with a general Google search (www. google.com) on 21 February 2019, for:

"digital preservation" (policy OR policies)

The Library of Congress contributed 29 policy documents, one uniquely; SCAPE, 44 documents, five uniquely; and Google, 83 documents, 47 uniquely. (Twenty-three were found in two of the sources and 19 in all three.) Six representative statements were purposefully selected from this larger set through paradigmatic case sampling (Robinson 2014) with regard to geographic, sectorial, and mission-oriented diversity (see Table 1). Digital preservation concerns are important to the aims of many memory institutions, including libraries, archives, and museums as traditional stewards of cultural and documentary heritage, as well as data centers and institutional repositories. The sample set draws from all five categories to establish commonality of policy viewpoint and practice as broadly conceived across the preservation landscape. Selection was explicitly biased towards large, well-known, and mature organizations under the assumption that they are more likely to reflect the most sophisticated understanding of relevant issues, resulting in the clearest and most comprehensive policy articulation. Additionally, they are more likely to serve as exemplars of model policy regimes for smaller institutions.

Evaluative attitudes embedded in these statements were recovered through qualitative content analysis (QCA) (Schreier 2013; White and Marsh 2006). While the subjective undertones of QCA leave it prone to concerns over interpretive validity (Maier 2018), a systematic research approach with rigorous application of well-structured analytic steps bolsters confidence regarding analytic findings (Krippendorff 2019). A new QCA technique of *predicate synthesis* (PS) was developed for this study. PS was informed by prior methods of syntagmatic analysis (SA) and evaluative assertion analysis (EVA). SA, which examines meaning arising from contextual word choice, has been used for establishing implicit community domain models for the concepts of information (Green 1991) and libraries (Nitecki 1993). EVA provides tools for determining latent attitudinal positions regarding textually referenced concepts (Krippendorff 2019; Osgood et al. 1956). PS shares these techniques' reliance on transformative textual manipulation, but incorporates newly defined grammatical criteria for the identification of relevant textual snippets.

Predicate synthesis encompasses five sequential steps: four initial analytic activities of statement identification; propositional expansion; predicate reduction; and predicate canonicalization; and a final synthetic activity of kernel construction. Those kernels can be viewed as emergent, as opposed to a priori, thematic codes derived through a well-structured process of data reduction (Stemler

¹ The policy document dataset and codebook are available at https://doi.org/10.17605/OSF.IO/ZHTQJ.



Table 1 Analyzed policy statements

•			
Organization	Location	Sector	Mission
Baltimore Museum of Art (BMA) (BMA 2016)	United States	Cultural heritage	Museum
Cambridge University Libraries (CUL) (CUL 2018)	United Kingdom	Academic	Library
Inter-University Consortium for Political and Social Research (ICPSR 2018b)	United States	Academic	Data center
Leibniz Information Centre for Economics [Leibniz Information Centre for Economics] Germany (ZBW 2018)	Germany	Research	Institutional repository
Nationaal Archief [National Archive of the Netherlands] (NAN) (NAN 2015)	Netherlands	Government	Archive
National Library of New Zealand (NLNZ) (NLNZ 2012)	New Zealand	Government	Library



2001). The grammatical classification underlying PS follows the *Cambridge Grammar of English* (Carter and McCarthy 2006).

Step 1: Statement identification Contextual statements expressing intentional policy obligations are identified by the presence of three grammatical markers:

An inflected copular verb ("to be", "to have", etc.) expressing a state or action of existential necessity on behalf of its subject:

Example 1

"Monitoring and reporting <u>is</u> an essential aspect of digital preservation activities [emphasis added]" (CUL 2018)

A modal auxiliary verb ("must", "will", etc.) expressing agential commitment by its subject regarding its subject:

Example 2

"The BMA will provide authenticity, discovery, and access to digital assets for current and future generations [emphasis added]" (BMA 2016)

A lexical verb expressing affirmative obligation on behalf of its subject towards its object:

Example 3

"ICPSR preserves social science digital assets and provides its members with ongoing access to its digital collections [emphasis added]" (ICPSR 2018b)

Statements are relevant for analysis if they assert an obligation regarding the preserved state of digital *resources*. Statements pertaining to administrative, financial, or operational aspects of preservation systems or programs are out of scope for this study. Selected statements are characterized with respect to their structural context, that is, the named or numbered section in which they are embedded.

Step 2: Propositional expansion Many contextual statements are coordinated in structure through combining conjunctions ("and", "or", etc.) or imputed composition of related but independent concepts. These statements are factored into sets of unitary propositional clauses each with nominal subject-verb-object form:

Example 4



- "The NA ensures that users are able to understand *and* use the information that it has made available [emphasis added]" (NAN 2015)."
- → "The NA ensures that users are able to understand the information."
- → "The NA ensures that users are able to use the information."
- → "The NA ensures that information has [been] made available."

The first two propositions above result from grammatical expansion of the "and"-linked coordinated phrase; the third, from semantic expansion recognizing that the concept of availability fundamentally underlies consideration of understanding or use, that is, one can neither understand nor use a resource that is not available at hand.

Step 3: Predicate reduction Each propositional clause is reduced to a single analytic verb-object predicate expressing the core intentional obligation:

Example 5

"Archives New Zealand ... and the National Library of New Zealand ... have agreed to give access to digital objects [emphasis added]" (NLNZ 2012)

→"give access"

Often, predicate terms can be extracted directly from the proposition, as shown above. In other cases, appropriate terms must be synthetically assumed based upon an interpretive sense of the stated obligation:

Example 6

"The primary objective of digital preservation activities is the ability to meaningfully <u>access</u> digital content over time [emphasis added]" (BMA 2016)

→"[ensure] access"

Step 4: Predicate canonicalization To facilitate subsequent clustering of analytic predicates and synthetic kernels, the terms of the initial predicate are passed through a thesaurus for replacement by standardized vocabulary:

Example 7

"give access"

→ "ensure accessibility"

The thesaurus was populated during processing of source documents. Preferred canonical terms were chosen for clarity of meaning and consistency of inflected



Table 2 entries	Sample thesaurus	Entry	Relation	Preferred term	
		Access	USE	Accessibility	
		Access conditions	USE	Security	
		Accuracy	USE	Authenticity	
		ACQUISITION decision	BT	Provenance	
		Adhere to	USE	Ensure	
		Administrative metadata	BT	Metadata	
		Archive [intangible quality]	USE	Ensure	
		Archive [tangible entity]	USE	Preserve	
		Assets	USE	Resources	
		Assure	USE	Ensure	
		Availability	USE	Accessibility	
		:	:	:	

Ta er

Table 3 Synthetic kernel templates

Kernel role	Template
Managerial obligation	"P / verbs object / for S"
Consumptive expectation	"C expects / P / to verb object"
Relational evaluation	"Did P / verb object / for S?"

form (see Table 2).² New terms were added until full saturation was reached, that is, no new non-canonical terms were found.

In some cases, preferential distinctions are made based upon a term's context. For example, the verb "archive" is normalized to "ensure" when referring to intangible qualities, such as accessibility or integrity, but "preserve" in reference to tangible entities, such as objects or metadata. The relational tags "USE", indicating synonymy or lexical variation, and "BT" (broader term), indicating superordination, are defined by ISO 2788 and ANSI/NISO Z39.19 (Aitchison et al. 2000).

Step 5: Kernel construction Canonical predicates are used to construct synthetic kernel phrases expressing underlying managerial obligation, consumer expectation, and relational evaluation. These are formed by filling in template placeholder slots (indicated by underlined italics in Table 3) with inflected predicate verbs and objects:

The three kernels follow from the definition of success as intentional/expectational alignment. The first expresses an indicative claim of provider intention; the second, a subjunctive statement of stakeholder expectation; and the third, the interrogative criterion for evaluating alignment of the first two. The fixed symbols "P" and "S" represent abstract classes of preservation service-providers and stakeholders, respectively.

² The thesaurus and codebook are available at https://doi.org/10.17605/OSF.IO/X4SDN.



Example 8

- "ensure usability"
- → "P / ensures usability / for S"
- → "S expects / P / to ensure usability"
- → "Did P / ensure usability / for S?"

The final kernel defines a general attitudinal principle for evaluating success in terms of intentional/expectational alignment. While generated through a qualitative process, these principles are subject to subsequent quantitatively oriented word-based analysis (Guest et al. 2014). In particular, frequency is assumed as a reliable indicator of relative conceptual importance (Krippendorff 2019). Because the kernels' underlying predicates are expressed in terms of standardized vocabulary, a simple lexical sort automatically forms clusters of cognate preservation imperatives and evaluative criteria.³

Recovered evaluative norms

The six policy documents express 267 relevant statements of obligatory intention, embedded within the structural context of 102 named and/or numbered sections. These often complex or coordinated statements expand, reduce, and canonicalize into 527 singular predicates. 464 predicates are unique with respect to the statement from which they are derived, while 414 are unique with respect to their structural context (see Table 4):

In most cases, a given statement resolves into a single predicate. In others, multiple instances of the same predicate result from propositional expansion and canonicalization. Similarly, multiple statements within a given structural context can lead to repeated instances of the same predicate. This degree of localized duplication is reasonable to expect given presumed topical coherence of a statement or section. In these cases, repetition may result largely from rhetorical convention that doesn't add compelling evidence regarding relative importance. Duplication across sections, however, can be assumed more topically uncorrelated and therefore reasonably indicative of conceptual significance. Thus, the count of predicates that are unique-to-context is used for purposes of subsequent analysis. The relative proportion of predicates across the three tallying categories—total-in-document, unique-to-statement, and unique-to-context—are consistent across all documents, so choice of count does not have a negative impact on analytic integrity.

The ten most frequently occurring predicates, whose instances represent 85% of the total, are shown in Table 5. Only the topmost six are found in all six source documents with a relative frequency above 5%. Since the others are not universally

³ The predicate synthesis dataset and codebook is available at https://doi.org/10.17605/OSF.IO/75Q29.



Table 4 Policy analysis summary

	man family family	6					
Institution	Contexts	Statements	Propositions		Canonical predicates		
			Total in document	Unique to document	Total in document	Unique to statement	Unique to context
BMA	5 (5%)	27 (10%)	76 (14%)	70 (15%)	76 (14%)	66 (14%)	62 (15%)
CUL	20 (20%)	52 (19%)	135 (26%)	129 (27%)	135 (26%)	103 (22%)	89 (21%)
ICPSR	12 (12%)	30 (11%)	51 (10%)	48 (10%)	51 (10%)	48 (10%)	42 (10%)
NAN	23 (22%)	77 (29%)	134 (25%)	121 (26%)	134 (25%)	122 (26%)	109 (26%)
NLNZ	27 (26%)	54 (20%)	81 (15%)	71 (15%)	81 (15%)	78 (17%)	66 (16%)
ZBW	15 (15%)	27 (10%)	50 (9%)	27 (6%)	50 (9%)	47 (10%)	46 (11%)
N=	102	267	527	466	527	464	414



Predicate	BMA	CUL	ICPSR	NAN	NLNZ	ZBW	Overall
Ensure accessibility	14 (23%)	15 (17%)	11 (26%)	21 (19%)	11 (17%)	7 (15%)	79 (19%)
Preserve resources	11 (18%)	15 (17%)	13 (31%)	15 (14%)	14 (21%)	7 (15%)	75 (18%)
Preserve metadata	4 (6%)	13 (15%)	2 (5%)	18 (16%)	4 (6%)	4 (9%)	45 (11%)
Ensure integrity	5 (8%)	9 (10%)	2 (5%)	12 (11%)	14 (21%)	2 (4%)	44 (11%)
Ensure authenticity	6 (10%)	2 (2%)	3 (7%)	10 (9%)	9 (14%)	1 (2%)	31 (8%)
Ensure usability	2 (3%)	4 (5%)	2 (5%)	9 (8%)	2 (3%)	6 (13%)	25 (6%)
Ensure IPR	5 (5%)	7 (8%)	4 (4%)	_	_	2 (4%)	18 (4%)
Ensure security	2 (2%)	4 (5%)	3 (7%)	2 (2%)	1 (5%)	1 (2%)	13 (3%)
Ensure provenance	3 (3%)	3 (3%)	_	1 (1%)	1 (3%)	1 (4%)	2 (>1%)
Preserve bitstreams	1 (1%)	_	-	3 (3%)	3 (5%)	3 (7%)	10 (7%)
Other	9 (14%)	17 (19%)	2 (5%)	18 (16%)	6 (9%)	12 (26%)	64 (15%)
N=	62	89	42	109	66	46	414

 Table 5
 Frequency ranking of evaluative predicates by count and percentage

referenced in significant number, they cannot be considered representative of broad community attitudes and are excluded from further analysis. Of the six, two refer to assurances regarding tangible entities: digital resources and metadata. However, their operative verb, "preserve", leads to a tautological expression of a preservation obligation to preserve, which does not provide practical guidance. Consequently, these two also are not subject to further consideration. The remaining four predicates refer to assurances of more specific qualities: *accessibility, integrity, authenticity*, and *usability*. In essence, these quality-based predicates offer granular definitional detail as to what preservation of resources and metadata entails. Consequently, they are taken as representing the primary evaluative attitudes of the digital preservation community towards assessment of preservation success.

Communicological critique

The first three evaluative norms—integrity, accessibility, authenticity—are consistent with prior expressions regarding non-functional requirements for digital preservation (Burda and Teuteberg 2013), but are now established empirically. They define not only high-level assessment *criteria* but also imply operational *metrics*. Criteria are generic evaluative qualities, while metrics are specific standards for obtainable measurements of those qualities (Black et al. 2008; Seffah et al. 2006). An effective system of measurement depends upon conceptual understanding of the domain of interest sufficiently granular and detailed to establish relevant evaluative categories, referenceable values, and procedures of interrogation (BIPM 2012). Integrity, accessibility, and authenticity are well-accepted concepts in archival theory and practice, referring respectively to the quality of a resource being whole and uncorrupted; known to exist and capable of being located, requested, and retrieved; and what it purports to be (Duranti 2005; SAA 2020). Being well-defined, they can function as categorical criteria for evaluating the quality of digital preservation activity; see for



example (Korenkova and Hägerfors 2011). Furthermore, the detail of their definition lends itself to establishment of characterizing measures, such as fixity for determining bit-level integrity (Bountouri et al. 2018), description and discovery methods for accessibility (Bak and Armstrong 2008; Whitelaw 2012), and digital diplomatics for authenticity (Rogers 2015). However, while these qualities are core concerns of consuming stakeholders, they are primarily *ontological* rather than *epistemological* characteristics, indicating the existential nature of preserved *artifacts*, but not the communicative consumer *experience* of those artifacts. These factors may enable but do not necessarily ensure preservation's imperative goal of future exploitive use of preserved material.

Integrity and authenticity bolster confidence in the appropriateness of the artifactual vehicles underlying that exploitation (Ross 2006), while accessibility empowers user, as opposed to managerial, agency regarding contextual use (Menne-Haritz 2001). However, they do not characterize the experiential conditions of that use. Integrity can be viewed as a subcomponent of authenticity (Duranti 2005), which is defined by the InterPARES glossary as "Trustworthiness of a record as a record [emphasis added]" (InterPARES 2008), that is, as a quality of the artifact itself. While InterPARES defines accessibility as the availability and usability of information, neither of those sub-concepts are themselves defined. The cognate concept of access is found in the glossary, but defined in instrumental terms as the "right, opportunity, or means" to engage with preserved information. That is, access is an enabling managerial condition, but independent of the actual resulting use. Thus, accessibility is also primarily characteristic of the artifactual vehicle rather than consuming experience. A communicological view of the preservation enterprise calls for consideration of both expressive vehicle and phenomenological experience (Eicher-Catt and Catt 2008; Lanigan 2010). That experience corresponds to the evaluative norm of *usability*. Unfortunately, the concept of usability is not as welldefined as the other three principles (Hirtle 2008; Ross 2012).

Usability

Usability is not formally defined in the SAA dictionary, InterPARES glossary, or the archival standard ISO 15489 (InterPARES 2008; ISO 2016; SAA 2020). The SAA and ISO definitions of "access" do encompass permission to retrieve *for* use, but only as an enabling condition and without consideration of the degree of resulting usability on the part of the retrieving user. When usability is referenced in the literature and best practice guidance as a core precept of preservation activity, it is generally unaccompanied by any detailed explanation of exactly what constitutes "use" or how that use can be quantified for efficacy; see for example (Caplan 2008; DPC 2015; Heslop et al. 2002; Traczyk 2017; Waters and Garrett 1996; Yakel 2007). The DPC glossary does indirectly define usability in terms of artifactual retention of qualities essential to creative or acquisitional intent (DPC 2015). However, this does not recognize the important distinguishing factor of underlying purposive aspiration by the *user* (Giaretta 2011; Ross 2006; Walters and Skinner 2011) and subsequent communicative response of meaningful cognitive, affective, or conative





consequence *to* that user. Part of the difficulty in arriving at a suitable definition for usability is that stakeholder need and experience are inherently intersubjective and potentially unique to the individual (Bishop and Hank 2018). One cannot meaningfully speak generically about singular canonical *use*, but only specifically about manifold individual *uses* (Abrams 2018), which cannot be comprehensively anticipated, especially over archival timespans.

Any proposed metrical framework for evaluating the efficacy of preservation-enabled usage needs to be cognizant of, and responsive to, the nuanced situational context of user and use. This can be facilitated by deconstructing the conceptual dimensions of usability to enable derivation of operational success metrics applicable to the diverse varieties of user and use. Future research activity will explore a communicological breakdown of usage concerns. Stamper's digital semiotic framework (Mingers and Willcocks 2017; Stamper 1996) provides a useful starting point for analysis, distinguishing independent concerns for the persistence of abstract semantic meaning, expressive syntactic form, empiric symbolic encoding, physical manifestation, interpretive context, and pragmatic understanding. These factors should be augmented with additional inquiry into behavioral performance (Becker 2018; Heslop et al. 2002) as the necessary intermediating channel between the preserved digital vehicle and analog human perception. A robust system of evaluation must provide effective means for quantifying usability-alongside integrity, accessibility, and authenticity—relative to all relevant semiotic aspects of preserved digital resources.

Methodological limitations

The six examined policies are a relatively small sample set—approximately 6% of the 95 collected statements—purposefully selected as paradigmatic cases for representational coverage. Thus, while the study's current results can be considered suggestive and transferable, further evidence and analysis are needed for more expansive claims regarding their being fully indicative and generalizable (Jenson 2008). This can be provided by future extension of the scope of investigation to greater number and diversity of policies.

Policy statements can be distinguished as either *guidance* or *control* policies (Becker et al. 2014; Sierman et al. 2013). The former express relatively abstract strategic obligations, while the later provide more tactical or operational detail of required, recommended, permissible, or prohibited actions or conditions (Madsen and Hurst 2019). At this stage of investigation, examined policy statements were not classified as falling into, or tending towards, either category. Depending upon where policies, or their individual terms, are positioned along the guidance/control spectrum, embedded norms may be expressed naturally as either general aspirational principles, not directly amenable as operative metrics, or more specific obligations suitable for evaluative deployment. A control policy can provide detail through explicit internal definition or reference to accepted external conceptual terminology. The latter is the case for norms of integrity, accessibility, and authenticity, which carry well-understood archival meaning. Usability, on the other hand, is expressed



as a guidance policy in the statements examined so far. Follow-on research activity will characterize potential policies and terms regarding their functional type to ensure heterogeneity of sources and generalizability of results.

Some institutions may conceive of preservation policy narrowly, but accompany it with other policies concerned with related issues. ICPSR, for example, provides an independent policy statement focused on access (ICPSR 2018a). Thus, it is possible that preservation policies may not refer to concerns such as usability by explicit intention, although this is not true in the ICPSR case, as both documents make consistent references to usability. For this study, only individual documents explicitly labeled as "digital preservation" policies were considered. Future research will identify and examine all of an institution's relevant policies as a unitary policy regime to ensure recovery of all appropriate preservation obligations.

Conclusion

Extant evaluative prerogatives in the digital preservation field continue to focus on the trustworthiness of managerial processes and organizations without sufficient consideration of the user-experienced outcomes of those organizational processes. Managerial trustworthiness is an important evaluative factor, especially given that it is a leading indicator predictive of subsequent success. However, a fuller and more confident understanding of preservation efficacy requires confirmatory measure. Furthermore, criteria and metrics for trustworthiness focus on artifactual persistence rather than persistence of communicative experience, placing primary attention on managed information objects rather than subsequent human engagement with those objects. Extending the conceptual framing of the preservation enterprise as a communicological, and not just managerial, endeavor provides firmer foundation for evaluating efficacy by augmenting consideration of intermediating managerial means with final communicative ends. The managerial/communicative and artifactual/experiential distinctions revealed in this study clarify an important conceptual consideration for future digital preservation research. Practitioners and stakeholders also will welcome future availability of operative success metrics to bolster responsible fulfillment of imperative mission, productive allocation of finite programmatic resources, and relevancy and accountability to stakeholders.

A communicative perspective emphasizes the relationship between human actors who respectively manage and consume preserved information. In such a service-provider/stakeholder relationship, success is defined as the alignment of provider intention and stakeholder expectation relative to the actual preserved state of managed digital resources. Thus, operational metrics for success depend upon understanding of intentions and expectations. These critical attitudes are recoverable through qualitative content analysis of their tacit articulation in digital preservation policies, which document the controlling service "contract" obtaining between providers and stakeholders. While recovered norms are consistent with general sentiments in the literature and practice, they are now established empirically rather than anecdotally.

This analysis identifies four evaluative norms: three enabling artifactual qualities of *integrity*, *accessibility*, and *authenticity*, and the teleologically superordinate





quality of experiential *usability*. However, usability, of which success is a prime characterizing quality, remains underdefined in theory and practice. Subsequent research is needed to establish a theoretically sound concept of usability from which operational criteria and metrics for success can be derived. These will augment existing measures of managerial persistence of authentic digital information artifacts with those of communicative persistence of legitimate information experience. It is important to note that the eventual availability of metrics does not imply that success can be finally and definitively designated. On the contrary, the open-ended nature of the preservation imperative and the intersubjective context in which it exists means that success is inherently a relative rather than absolute measure and that its determination is an ever-ongoing process.

Author contributions SA is the sole investigator of the reported research and the sole author.

Data availability All data are publicly available via the Open Science Framework (OSF) at https://doi.org/10.17605/OSF.IO/ZHTQJ, https://doi.org/10.17605/OSF.IO/X4SDN, and https://doi.org/10.17605/OSF.IO/75Q29.

Declarations

Conflicts of interest The author declares that he has no conflict of interest.

References

- Abrams S (2018) Theorizing success: measures for evaluating digital preservation efficacy. In: JCDL '18, 18th ACM/IEEE joint conference on digital libraries, Fort Worth.
- Aitchison J, Gilchrist A, Bawden D (2000) Thesaurus construction and use: a practical manual, 4th edn. Aslib IMI. London
- Altman M, Adams MO, Crabtree J, Donakowski D, Maynard M, Pienta A, Young CH (2009) Digital preservation through archival collaboration: the data preservation alliance for the social sciences. Am Arch 72:170–184. https://doi.org/10.17723/aarc.72.1.eu7252lhnrp7h188
- Anderson D (2015) The digital dark age. Commun of the ACM 58:20–23. https://doi.org/10.1145/28358
- Bak G, Armstrong P (2008) Points of convergence: seamless long-term access to digital publications and archival records at Library and Archives Canada. Arch Sci 8:279–293. https://doi.org/10.1007/ s10502-009-9091-4
- Becker C (2018) Metaphors we work by: reframing digital objects, significant properties, and the design of digital preservation systems. Archivaria 85:6–36
- Becker C, Antunes G, Barateiro J, Vieira R, Borbinha J (2011) Control objectives for DP: digital preservation as an integrated part of IT governance. PASIST 48:1–10. https://doi.org/10.1002/meet.2011. 14504801124
- Becker C, Faria L, Duretec K (2014) Scalable decision suport for digital preservation. OCLC Syst & Serv 30:249–284. https://doi.org/10.1108/OCLC-06-2014-0025
- Bermès E, Fauduet L (2011) The human face of digital preservation: organizational and staff challenges, and initiatives at the Bibliothèque nationale de France. Int J Dig Cur 6:226–237. https://doi.org/10.2218/ijdc.v6i1.184
- BIPM (2012) International vocabulary of metrology—basic and general concepts and associated terms (VIM), 3rd edn. Bureau International des Poids et Mesures, Sèvres
- Bishop BW, Hank C (2018) Measuring FAIR principles to inform fitness for use. Int J Dig Cur 13:35–46. https://doi.org/10.2218/ijdc.v13i1.630



Black PE, Scarfone KA, Souppaya MP (2008) Cyber security metrics and measures. In: Voeller JG (ed) Wiley Handbook of Science and Technology for Homeland Security. Wiley, Hoboken, pp 1–8. https://doi.org/10.1002/9780470087923.hhs440

BMA (2016) Digital preservation policy. Baltimore Museum of Art, Baltimore

Bollacker KD (2010) Avoiding a digital dark age. Am Sci 98:106–110. https://doi.org/10.1511/2010.83.

Bountouri L, Gratz P, Sanmartin F (2018) Digital preservation: how to be trustworthy. In: Ioannides M (ed) Digital cultural heritage. Lecture notes in computer science, vol 10605. Springer, Cham, pp 364–374. https://doi.org/10.1007/978-3-319-75826-8_29

Brand S (1999) Escaping the digital dark age. Libr J 124:46-48

Buckland M (2013) Document theory: an introduction. In: Willer M, Gilliland AJ, Tomić M (eds) Records, archives and memory studies. University of Zadar, Zardar, Crotia

Burda D, Teuteberg F (2013) Sustaining accessibility of information through digital preservation: a literature review. J Inf Sci 39:442–458. https://doi.org/10.1177/0165551513480107

Caplan P (2008) What is digital preservation? Libr Technl Rep 2:7-9. https://doi.org/10.5860/ltr.44n2

Carter R, McCarthy M (2006) Cambridge grammar of English. Cambridge University Press, Cambridge CLIR (2002) The state of digital preservation: an international perspective. CLIR reports pub107. Council on Library and Information Resources, Washington, DC

Conway P (2010) Preservation in the age of Google: digitization, digital preservation, and dilemmas. Libr Q 80:61-79. https://doi.org/10.1086/648463

Cook T (2001) Archival science and postmodernism: new formulations for old concepts. Arch Sci 1:22. https://doi.org/10.1007/BF02435636

Corrado EM, Moulaison Sandy H (2017) Digital preservation for libraries, archives, and museums. Rowman & Litlefield, Lanham

CUL (2018) Cambridge University Libraries Digital Preservation Policy. Cambridge University Libraries, Cambridge. https://doi.org/10.17863/CAM.32927

Dearborn C, Meister S (2017) Failure as process: interrogating disaster, loss, and recovery in digital preservation. Alexandria 27:83–93. https://doi.org/10.1177/0955749017722076

Donaldson DR (2015) Development of a scale for measuring perceptions of trustworthiness for digitized archival documents. Ph.D. thesis, University of Michigan

Donaldson DR (2016) The digitized archival document trustworthiness scale. Int J Dig Cur 11:252–270. https://doi.org/10.2218/ijdc.v11i1.387

DPC (2015) Digital preservation handbook, 2nd edn. Digital Preservation Coalition, Glasgow

Dryden J (2011) Measuring trust: standards for trusted digital repositories. J Arch Organ 9:127–130. https://doi.org/10.1080/15332748.2011.590744

 $Duranti\ L\ (2005)\ The\ long-term\ preservation\ of\ accurate\ and\ authentic\ digital\ data:\ the\ InterPARES\ project.\ Data\ Sci\ J\ 4:106-118.\ https://doi.org/10.2481/dsj.4.106$

Duranti L, Thibodeau K (2006) The concept of record in interactive, experiential and dynamic environments: the view of InterPARES. Arch Sci 6:13–68. https://doi.org/10.1007/s10502-006-9021-7

Eicher-Catt D, Catt IE (2008) What can it mean to say that communication is "effective" (and for whom) in postmodernity? Atl J Commun 16:119–121. https://doi.org/10.1080/15456870802086903

Partners for preservation: advancing digital preservation through cross-community collaboration (2019). Facet, London

Frank RD (2019) The social construction of risk in digital preservation. JASIST 71:474–484. https://doi. org/10.1002/asi.24247

Giaretta D (2011) Advanced digital preservation. Springer, Berlin. https://doi.org/10.1007/978-3-642-16809-3

Gladney HM (2006) Principles for digital preservation. Commun ACM 49:111–116. https://doi.org/10. 1145/1113034.1113038

Green R (1991) The profession's models of information: a cognitive linguistic analysis. J Docu 47:130–140. https://doi.org/10.1108/eb026874

Guest G, MacQueen KM, Namey EE (2014) Applied analytic techniques. Sage, Thousand Oaks. https://doi.org/10.4135/9781483384436

Hansson J (2005) Hermeneutics as a bridge between the modern and postmodern in library and information science. J Doc 61:12. https://doi.org/10.1108/00220410510578032

Heslop H, Davis S, Wilson A (2002) An approach to the preservation of digital records. National Archives of Australia, Canberra



- Hirtle PB (2008) The history and current state of digital preservation. In: Westbrooks E, Jenkins K (eds) Metadata and digital collections: a festschrift in honor of tom turner. Cornell University Library, Ithaca, pp 121–140
- ICPSR (2018a) ICPSR access policy framework, version 3. Inter-University Consortium for Political and Social Research, Ann Arbor
- ICPSR (2018b) ICPSR digital preservation policy framework, version 4. Inter-University Consortium for Political and Social Research, Ann Arbor
- Innocenti P, Vullo G, Ross S (2010) Towards a digital library policy and quality interoperability framework: the DL.org project. New Rev Inf Netw 15:29–53. https://doi.org/10.1080/13614571003751071
- InterPARES (2008) InterPARES 2 project glossary. international research on permanent authentic records in electronic systems (InterPARES) 2: experiential, interactive and dynamic records. Associazione Nazionale Archivistica Italiana, Padova
- ISO (2012a) Space data and information transfer systems—Audit and certification of trustworthy digital repositories. 16363. ISO, Geneva
- ISO (2012b) Space data and information transfer systems—open archival information system (OAIS) reference model. 14721. ISO, Geneva
- ISO (2016) Information and documentation—Records management—Part 1: concepts and principles. 15489-1. ISO, Geneva
- Jeffrey S (2012) A new digital dark age? Collaborative web tools, social media and long-term preservation. World Archaeol 44:553–570. https://doi.org/10.1080/00438243.2012.737579
- Jenson D (2008) Transferability. In: Given LM (ed) The SAGE encyclopedia of qualitative research methods. Sage, Thousand Oaks, pp 888–887. https://doi.org/10.4135/9781412963909
- Jeong J, Kurnia S, Samson D, Cullen S (2018) Psychological contract in IT outsourcing: a systematic literature review. In: Bui T (ed) 51st Hawaii international conference on system sciences. Waikoloa Village. https://doi.org/10.24251/HICSS.2018.019
- Johnston L (2020) Challenges in preservation and archiving digital materials. Inf Serv Use. https://doi. org/10.3233/ISU-200090
- Ketelaar E (2012) Cultivating archives: meanings and identities. Arch Sci 12:15. https://doi.org/10.1007/s10502-011-9142-5
- Kirchhoff AJ (2008) Digital preservation: challenges and implementation. Learn Publ 21:285–294. https://doi.org/10.1087/095315108X356716
- Korenkova M, Hägerfors A (2011) Quality criteria for digital information in long-term digital preservation. In: Archiving 2011 conference, Salt Lake City, May 16–19. IS&T, Springfield, VA
- Krippendorff K (2019) Content analysis: an introduction to its methods, 4th edn. Sage, Thousand Oaks
- Kuhlthau CC (2017) Information search process (ISP) model. In: McDonald JD, Levine-Clark M (eds) Encyclopedia of library and information sciences, 4th edn. CRC Press, Boca Raton, pp 2232–2238. https://doi.org/10.1081/E-ELIS4
- Lanigan RL (2010) Verbal and nonverbal codes of communicology: the foundation of interpersonal agency and efficacy. In: Eicher-Catt D, Catt IE (eds) Communicology: the new science of embodied discourse. Fairleigh Dickinson University Press, Madison & Teaneck, pp 102–128
- Lanigan RL (2013) Information theories. In: Cobley P, Schulz P (eds) Theories and models of communication, vol 1. De Gruyter Mouton, Berlin, pp 58–83
- Lee CA, Tibbo H (2007) Digital curation and trusted repositories: steps towards success. J Digital Inf 8:2 L'Hours H, Kleemola M, de Leeuw L (2019) CoreTrustSeal: from academic collaboration to sustainable services. IASSIST Q 43:1–17. https://doi.org/10.29173/iq936
- Madsen C, Hurst M (2019) Digital preservation policy and strategy: where do I start? In: Myntti J, Zoom J (eds) Digital preservation in libraries: preparing for a sustainable future. ALA, Chicago, pp 37–48
- Maemura E, Moles N, Becker C (2017) Organizational assessment frameworks for digital preservation: a literature review and mapping. JASIST 68:1619–1637. https://doi.org/10.1002/asi.23807
- Maier M (2018) Content analysis: advantages and disadvantages. In: Allen M (ed) The Sage encyclopedia of communication research methods. Sage, Thousand Oaks, pp 240–242. https://doi.org/10.4135/9781483381411
- Mason C, Simmons J (2012) Are they being served? Linking consumer expectation, evaluation and commitment. J Serv Mark 26:227–237. https://doi.org/10.1108/08876041211237532
- Menne-Haritz A (2001) Access—the reformulation of an archival paradigm. Arch Sci 1:57–82. https://doi.org/10.1007/BF02435639



- Mingers J, Willcocks L (2017) An integrative semiotic methodology for IS research. Inf Organ 27:7–36. https://doi.org/10.1016/j.infoandorg.2016.12.001
- Morrissey SM (2014) "How can we know the dancer from the dance?" Intention and the preservation of digital objects. New Rev Inf Netw 19:1–15. https://doi.org/10.1080/13614576.2014.883935
- NAN (2015) Preservation Policy. Nationaal Archief, Den Haag
- Nicholson D, Dobreva M (2009) Beyond OAIS: towards a reliable and consistent digital preservation implementation framework. In: 16th international conference on digital signal processing, Santorini-Hellas, 5–7 July. IEEE. https://doi.org/10.1109/ICDSP.2009.5201126
- Nitecki D (1993) Conceptual models of libraries held by faculty, administrators, and librarians: an exploration of communications in the Chronicle of Higher Education. J Doc 49:255–277. https://doi.org/10.1108/eb026915
- NLNZ (2012) Digital preservation policy manual. Archives New Zealand; National Library of New Zealand, Wellington
- Osgood CE, Saporta S, Nannally JC (1956) Evaluative assertion analysis. Litera 3:47-102
- Owens T (2018) The theory and craft of digital preservation. Johns Hopkins University Press, Baltimore
- Ravenwood C, Muir A, Matthews G (2015) Stakeholders in the selection of digital material for preservation: relationships, responsibilities, and influence. Collect Manag 40:83–110. https://doi.org/10.1080/01462679.2015.1011816
- Robinson OC (2014) Sampling in interview-based qualitative research: a theoretical and practical guide. Qual Res Psychol 11:25–41. https://doi.org/10.1080/14780887.2013.801543
- Rogers C (2015) Diplomatics of born digital documents—considering documentary form in a digital environment. Rec Manag J 25:6–20. https://doi.org/10.1108/RMJ-03-2014-0021
- Ross S (2006) Approaching digital preservation holistically. In: Tough A, Moss M (eds) Record keeping in a hybrid environment: managing the creation, use, preservation, and disposal of unpublished information objects in context. Chandos, Oxford, pp 115–153. https://doi.org/10.1016/B978-1-84334-142-0.50006-2
- Ross S (2012) Digital preservation, archival science and methodological foundations for digital libraries. New Rev Inf Netw 17:43–68. https://doi.org/10.1080/13614576.2012.679446
- SAA (2020) Dictionary of archives terminology. Society of American Archivists, Chicago
- Sacchi S (2015) What do we mean by 'Preserving Digital Information'? Towards sound conceptual foundations for digital stewardship. Ph.D. thesis, University of Illinois at Urbana-Champaign
- Sanett S (2013) Archival digital preservation programs: staffing, costs, and policy. Preserv Dig Technol Cult 42:137–149. https://doi.org/10.1515/pdtc-2013-0019
- Savolainen R (2019) Elaborating the sensory and cognitive-affective aspects of information experience. J Libr Inf Sci. https://doi.org/10.1177/0961000619871595
- SCAPE (2016) Published preservation policies.
- Schreier M (2013) Qualitative content analysis. In: Flick U (ed) Sage handbook of qualitative data analysis. Sage, London, pp 170–193. https://doi.org/10.4135/9781446282243
- Seffah A, Donyaee M, Kline RB, Padda HK (2006) Usability measurement and metrics: a consolidated model. Softw Qual J 14:159–178. https://doi.org/10.1007/s11219-006-7600-8
- Sheldon M (2013) Analysis of current digital preservation policies: archives, libraries, and museums. Library of Congress, Washington
- Sierman B, Jones C, Bechhofer S, Elstrøm G (2013) Digital policy levels in SCAPE. In: Borbinha J, Nelson M, Knight S (eds) 10th international conference on preservation of digital objects, Lisbon. Biblioteca Nacional de Portugal, Lisbon
- Stamper R (1996) Signs, information, norms and systems. In: Holmqvist B, Andersen PB, Klein H, Posner R (eds) Signs of work: semiosis and information processing in organisations. Foundations of Communication and Cognition, De Gruyter, Berlin, pp 349–398
- Stemler S (2001) An overview of content analysis. Pract Assess Res Eval 7:17
- Traczyk T (2017) Requirements for digital preservation. In: Traczyk T, Ogryczak W, Pałka P, Śliwiński T (eds) Digital preservation: putting it to work. Studies in computational intelligence, vol 700. Springer, Cham, pp 3–14
- Waller M, Sharpe R (2006) Mind the gap: assessing digital preservation needs in the UK. Digital Preservation Coalition, Glasgow
- Walters T, Skinner K (2011) Digital Curation for Preservation. Association of Research Libraries, Washington, DC



- Waters D, Garrett J (1996) Preserving digital information: report of the task force on archiving of digital information. Council on Library and Information Resources; Research Libraries Group, Washington, DC
- Webb C, Pearson D, Koerbin P (2013) "Oh, you wanted us to preserve that?!" Statements of preservation intent for the National Library of Australia's digital collections. D-Lib Mag 19. https://doi.org/10. 1045/january2013-webb
- White MD, Marsh EE (2006) Content analysis: a flexible methodology. Libr Trends 55:22–45. https://doi.org/10.4135/9781446282243
- Whitelaw M (2012) Towards generous interfaces for archival collections. In: International council on archives congress, Brisbane, August 20–24. ICA, Paris
- Wilson TC (2017) Rethinking digital preservation: definitions, models, and requirements. Digit Libr Perspect 33:128–136. https://doi.org/10.1108/DLP-08-2016-0029
- Xie I, Matusiak K (2016) Digital preservation. Discover digital libraries: theory and practice. Elsevier, Amsterdam, pp 255–279
- Yakel E (2007) Digital curation OCLC. Syst Serv 23:6. https://doi.org/10.1108/10650750710831466
- Yoon A (2014) End users' trust in data repositories: definition and influences on trust development. Arch Sci 14:17–34. https://doi.org/10.1007/s10502-013-9207-8
- ZBW (2018) Preservation policy: guidelines for digital preservation at the ZBW. Leibniz Information Centre for Economics, Hamburg

Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Stephen Abrams is head of the digital preservation program at the Harvard Library and a confirmed doctoral candidate in information science at Queensland University of Technology, pursuing research into communicological frameworks for evaluating digital preservation outcomes.

