

A nine dimensional framework for digital cultural heritage organizational sustainability

A content analysis of the LIS literature (2000–2015)

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Abstract

Purpose – The purpose of this paper is to report on how library and information science (LIS) as a field operationalizes the concept of organizational sustainability for managing digital resources, projects and infrastructures such as digital libraries and repositories over time. It introduces a nine dimensional framework for organizational sustainability in the digital cultural heritage community.

Design/methodology/approach – Content analysis of publications from three LIS databases (2000–2015).

Findings – Comparing the articles to the nine dimension framework shows that most LIS articles discuss technology, financial or management dimensions. Fewer articles describe disaster planning, assessment or policy dimensions.

Research limitations/implications – Three LIS databases might not include all relevant journals, conferences, white papers and other materials. The data set also did not include books; library management textbooks might include useful material on organizational sustainability. Claims about the prevalence of themes are subject to methodological limits of content analysis.

Practical implications – Organizations that steward digital collections need to be clear about what they mean when they are referring to organizational sustainability so that they can make appropriate decisions for future-proofing their collections. The analysis would also suggest for a greater need to consider the full range of dimensions of organizational sustainability.

Originality/value – By introducing a new nine dimensional framework of organizational sustainability the authors hope to promote more and better conversations within the LIS community about organizational sustainability. The authors hope these conversations will lead to productive action and improvements in the arrangements of the people and work necessary to keep digital projects and services going over time, given ongoing challenges.

Keywords Sustainability, Content analysis, Data and digital repositories, Digital longevity

Paper type Research paper

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1. Introduction

The creation of information infrastructures such as data archives, repositories and digital libraries require significant outlays of public or philanthropic funding, and they serve as rich sources of content that support research across the disciplines. Recently, the larger digital resource community has called for concerted attention to the long-term sustainability of these digital cultural heritage organizations (DCHO) (Ember and Hanisch, 2013; Kitchin *et al.*, 2015), raising concerns about both the sustainability of digital materials, but also the sustainability of the DCHO that manages the materials (i.e. the organization's sustainability). This paper focuses primarily on the latter – the sustainability of the DCHO that develop, manage and support digital cultural heritage. To further the goal of increasing DCHO sustainability, this paper introduces nine dimensions of DCHO organizational sustainability. By generating a broader understanding of the different elements of organizational sustainability, we can improve communications about sustainability efforts and better spread new ideas and best practices.

What does organizational sustainability mean in the library and information science (LIS) community? The slipperiness of the term poses challenges for DCHO that concern themselves with curating and managing content and objects over time, perhaps a very long time (Chowdhury, 2014). We conceptualize organizational sustainability for DCHO as consisting of nine dimensions that we discuss below; but for starting purposes, we define organizational sustainability in the DCHO context as consisting of the arrangements of people and work practices that keep digital projects and services going over time, given ongoing challenges. Other definitions used in the literature allude to breadth and complexity of the concept of organizational sustainability, referring to it as a “broad term which refers to many factors” (Dasgupta, 2005). While this paper focuses on organizational sustainability, it is important to recognize that digital preservation of bits and files represents an important and large outlay for DCHO charged with curating content over time. But, this paper focuses on the DCHO sustainability challenges beyond these technical dimensions of digital preservation.

We analyze a sample of the LIS literature from 2000 to 2015 in light of a nine dimensional view of DCHO sustainability and show what dimensions LIS authors currently emphasize, or what dimensions they tend to ignore, when talking about DCHO sustainability. By introducing a new nine dimensional framework of organizational sustainability for DCHO we hope to promote more and better conversations within the LIS community about organizational sustainability. We hope these conversations will lead to productive action and improvements in the arrangements of people and work necessary to keep digital projects and services going over time, given ongoing challenges.

Our nine dimensional framework stems from a review of LIS literature about organizational sustainability from 2001 to 2003, and a review of major theoretical frameworks of organizational sustainability from across a variety of academic fields (Eschenfelder and Shankar, 2016). We drew on ideas from other frameworks such as the groupings of skill areas for sustainability recommended by the Knowledge Exchange Project (2014) sustainability index which lists target skills needed at different stages of organizational sustainability. From the organizational theory literature, we examined Ostrom and Hess's (2011) institutional analysis and development framework (IAD) which describes how actors organize themselves to sustainably manage commons resources, and Burnard and Bhamra's (2011) resiliency framework which depicts organizational “resilience” in terms of feedback loops of environmental scanning and organizational learning. This review resulted in definitions and coding rules for nine dimensions of organizational sustainability: technology, management, relationships, revenue, costs, valued product/service, disaster planning, legal/policy, metrics/assessment. Each of the dimensions had multiple sub-codes representing different aspects of the dimension.

2. Research design

Aims and objectives

This paper introduces nine dimensions of the sustainability of the organizations that support digital collections. It presents quantitative data about the prevalence of each dimension in the LIS literature, and it presents qualitative analysis of what each dimension encompasses. The paper addresses the following research questions:

- RQ1. How do discussions of organizational sustainability appear in the literature?
- RQ2. What dimensions of organizational sustainability are more prevalent in the literature?
- RQ3. Which dimensions of organizational sustainability are less prevalent in the literature?
- RQ4. What subthemes emerge within each dimension?

Methodology

In order to answer these questions, the authors conducted a structured content analysis (focusing on the concept of organizational sustainability as defined above) of 15 years of the LIS literature (2000–2015) from three LIS databases using a codebook based on the nine dimension framework.

To develop the corpus of texts for analysis, the authors collected the results of queries of English-language-only articles published from 2000 to 2015 and indexed in the databases Library & Information Science Full Text, Library, Information Science & Technology Abstracts, and Library and Information Science Abstracts in Autumn 2016. The authors used the following query string: “Sustainability in abstract AND digital in abstract AND (library or archive or repository)” to identify relevant abstracts from journal articles (both peer reviewed and not peer reviewed), white papers, conference reports and master’s theses.

Not all returned articles were relevant, so one co-author reviewed all articles in the initial results set for applicability. The authors excluded articles about environmental sustainability, non-digital-program sustainability (e.g. sustainability of information literacy programs), print collection sustainability, sustainability of the entire scholarly communication industry (as opposed to a particular project), or considerations of the environmental impact of information and communication technologies. Importantly, retained articles did not have to use the word “sustainability.” Retained articles also used synonyms such as “longevity,” “future availability,” “future use” or “long-term health” of a collection. Some articles in the initial results set made only passing reference to sustainability and were not suitable for further analysis. In order to qualify for retention, the article’s treatment of sustainability had to consist of more than five lines of text, or the treatment had to be mentioned multiple shorter times within the paper, or the treatment of sustainability had to be visually separated in the text (e.g. in a header), or the treatment had to be included in a table or figure.

After culling articles that did not meet the inclusion criteria, 64 articles were left in the analysis set. The authors obtained the full text of each article in the analysis set.

In order to analyze articles against the nine dimensions, the authors had previously created a codebook and a set of coding rules for each of the nine dimensions based on a pilot study of similar articles from 2001 to 2003. To ensure coding quality, all co-authors participated in four rounds of coder training in which the authors co-coded the same articles, compared the results, discussed discrepancies, and augmented the coding rules for the nine dimensions.

The authors then split into pairs to use the codebook to code the 64 articles in the analysis set. Each pairs of analysts read and coded the complete text of 25–30 articles each.

Each pair compared results for their articles, and resolved discrepancies, before reporting final results. All results reported below are computed from the analysis set of the 64 coded articles from across the fifteen year analysis period of 2000–2015.

3. Results

Overview of literature and prevalence of the dimensions in the literature

At a high level, analysis suggests that authors in the LIS literature talk about sustainability in a passing manner, rather than at length or in great depth. Most articles only briefly discussed sustainability within the context of an article addressing other issues. In general, most articles described only one project, and discussions of any aspect of sustainability were limited to that project. Only four of the analyzed articles presented more abstract, theoretical or comparative views of organizational sustainability (Arnoldus *et al.*, 2011; LeFurgy, 2009; Palaiologk *et al.*, 2012; Zorich, 2003).

Most of the LIS authors used the concept of organizational sustainability as part of an expression of aspiration to continued success based on personal testimony. They explained how “if our project does/has these things, it is/will be sustainable.” Authors also used the concept of organizational sustainability as a tool of compulsion: “If we don’t get x, we won’t be sustainable,” or as a recommendation or warning to peers: “You really ought to do x to be sustainable.”

We analyzed the nationality of each article by identifying the location of the first author’s listed institution. Most of the articles were written by authors at institutions in the northern hemisphere. In all, 45 percent articles were from the USA and 17 percent were from the UK. The majority of the remaining articles were European in origin. About 11 percent of articles stemmed from nations not in the northern hemisphere (e.g. China, Nigeria and Malaysia). Using Ulrich’s database to distinguish publication types, analysis found the vast majority of the articles in the analysis set were published in peer reviewed LIS journals. The second most common type of publication was professional journals. Other publication types included conference papers, newsletters, reports, and a thesis. Quantitatively, Figure 1 shows the number of articles addressing organizational sustainability grew unevenly from 2005-2015. They rose dramatically from 2000 (one article) to 2006 (five articles). After 2006, the number of articles per year has ebbed and flowed, most recently falling to only two articles in 2015.

Table I shows the results of the prevalence of the dimensions in the analyzed literature. The most commonly discussed dimensions in the LIS literature include technology, management, relationships with partners and key stakeholders, and sources of revenue.

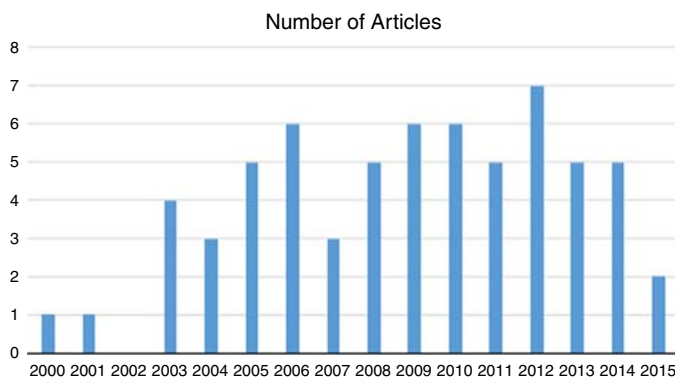


Figure 1.
Number of LIS articles
addressing
organizational
sustainability
over time

The authors found that 65 percent of the LIS articles talked about technology in relation to organizational sustainability. The second most common dimension was management; 55 percent of articles discussed management aspects of sustainability. The third most prevalent was relationships, with 47 percent of articles discussing sustainability in terms of relationships between a digital archive, library or repository and other individuals or organizations. The fourth most frequent dimension was revenue; 44 percent of LIS articles discussed sustainability with regard to revenue. Costs and valued produce/service were also common (29 and 24 percent each). The dimensions of disaster planning, legal/policy and metrics/assessment were all described by fewer than 20 percent of coded articles. It is important to point out that if one combines the cost and revenue dimensions, then general financial issues were dominant (73 percent of articles).

The authors had expected that management and financial issues (i.e. revenue and costs) would be prominent dimensions, but the technology dimension dominated. Also, given the prominence of formal evaluation in contemporary institutions, it was surprising that so few articles discussed metrics/assessment in relation to organizational sustainability (11 percent).

The paper continues by describing the qualitative analysis of subthemes within each of the nine dimensions of organizational sustainability. We use direct quotes from articles in our sample to demonstrate subthemes.

The technology dimension of organizational sustainability. Technology was the most commonly dimension discussed in the articles (65 percent). Subthemes include standards, data formats, characteristics of software (commercial/open source/proprietary), redundant configuration of servers (clouds, back up arrangements), various types of metadata (identifiers, authenticity) and documentation of technology documentation practices. Inductive analysis of the data focused on illuminating how authors explained the relationship between technology and organizational sustainability (positively or negatively). Not surprisingly, articles discussing the technology dimension had the most overlap with concerns about digital preservation, and this section therefore includes digital preservation concerns in discussion of subthemes.

The two most prominent subthemes included technology in aid of organizational sustainability and technology as a hindrance. Other threads that emerged from analysis included the importance of technology frameworks for sustainability (e.g. Trusted Digital Repositories certification, Open Archival Information System (OAIS) (Lee, 2010; International Organization for Standardization, 2012), and standards compliance and open source technologies as promoting sustainability. Less prominent subthemes included the statement that one must conceptualize technology and sustainability as a process, recycling of technologies and technology as labor- and cost-saving devices.

One set of claims stated that use of technologies with certain characteristics could make DCHO more sustainable than they might otherwise be; or in other words, that a specific

Table I.
Organizational
sustainability theme
prevalence in
LIS literature

Code/theme	% Articles using this theme	No. of articles using this theme
Technology	65	40
Management	55	34
Relationships	47	29
Revenue	44	27
Cost	29	18
Valued product service	24	15
Disaster planning	15	9
Legal/policy	13	8
Metrics/assessment	11	7

technology or technologies would aid organizationally sustainability. The examples were short simple statements based on the author's personal experience, often phrased as a recommendation that might be linked to another dimension of organizational sustainability. For example, Arnoldus *et al.* (2011) recommended the value of standardized or common technologies for lowering costs, "The use of open standards in the back office and generic technology for the long-term are more sensible decisions [...]" (p. 45). Other authors argued that standardized technologies could also decreasing maintenance costs while also increasing ease of use. For example, Dasgupta (2005) recommended "use standards" "monitor" changes, and "migrate" when necessary (p. 7). Many authors referred more to things that would support digital preservation. For example, Fyffe and Warner (2005) recommended metadata and file standards as a means of promoting "technical sustainability": "Technical sustainability is directly related to the standards and best practices followed when creating the digital files [...]" (p. 98). Other authors recommended metadata practices to ensure interoperability and migration of files over the long term, but also for aiding tracking of projects and operations by DCHO. Other sustainability promoting characteristics of technology or technology practices named in articles included: customizability, openness, sharing, seamless interfaces and services, common database systems, central clearinghouses for technical information, and use of sustainable formats.

Some authors warned of how technology issues may inhibit DCHO sustainability. For example, Zorich (2003) described how use of overly local metadata practices may impede sustainability: "one of their greatest sustainability problems is rooted in the heterogeneous recording practices that plague the museum community" (p. 25). Manaf *et al.* (2013) described problems with the adoption of inappropriate standards: "There are significant risks to these investments due to the adoption of inappropriate technologies and standards. This can result in creating resources which are quickly obsolete and unusable or which require the investment to be repeated within a short time frame" (p. 6). Other problems authors addressed included content loss due to technical failures, inability to access storage devices, and loss of software necessary to interpret stored information.

The relationships between standards, sustainability and technology were strong in the LIS literature. This included articles discussing being a trusted repository, articles discussing OAIS (or related models), and articles discussing open source software. As an example of articles that focused on digital preservation aspects of technology, Madalli *et al.* (2012) explained how open standards promoted the digital preservation: "It is necessary to convert items from proprietary formats into open formats and open standards, so they can then be uploaded into a digital archive for future storage, retrieval, and preservation" (p. 164).

But many authors spoke to how technology promoted organizational sustainability more broadly. For example, Manghi *et al.* (2010) argued that "customizability, openness, sharing, reuse and orchestration of the given services enable sustainable patterns" in an organization. Renwick (2011) suggested that use of open source technologies was an indicator of an organization's willingness to "grow, develop, and adapt" to changes, which are qualities of sustainable projects (p. 11). Armstrong (2012) and Arnoldus *et al.* (2011) wrote about banishing "boutique projects" and using open standards and generic technologies to increase sustainability. Awre (2012) argued that open source could promote sustainability by generating wider interest in projects that "foster [...] sustainability of the community around this open source development." (p. 1).

Fewer papers talked specifically about the importance of storage in terms of sustainability, technology reuse or recycling as a sustainability method or the use of technology to save labor costs.

In summary, the most prominent subthemes within the technology dimension of DCHO sustainability included the arguments that technology can both aid and hinder sustainability, the importance of digital preservation, the importance of technology standards (e.g. OAIS, trusted digital repositories) for guiding sustainability, and the value of open standards and technologies.

The management dimension of organizational sustainability. Management was the second most common dimension addressed by articles in the data set. In all, 55 percent of articles included an argument linking management practices and organizational sustainability. Analysis yielded many subthemes including the role of strategic planning and market research, having professionalized processes/procedures/ policies and having a business model. Lesser subthemes included the value of scale and changing organizational forms.

One of the most prominent subthemes within management was strategic planning. Authors attested to the importance of systematic planning well beyond the initial phases of a project, and how planning should encompass many aspects of the project. Karim (2004) explained that a project “will need to have a well-planned business strategy in order for it to be sustainable.” (p. 8). For the most part, articles did not give instructions or examples of how to do strategic planning for digital projects and services, but rather simply referred to its importance. (Some exceptions include Arnoldus *et al.*, 2011; Smith, 2001).

Another prevalent subtheme within management was the importance of market research and marketing for sustainability. Authors argued that repositories should identify a target audience for projects and conduct market research in order to develop a highly valued and used service. For example, Armbruster and Romary (2010) critiqued other projects for failing to identify content that is “relevant” and “interesting” to target audiences (p. 6). LIS authors usually did not give instructions or examples of how to do market research, but simply emphasized its importance. Related to market research, authors described the importance of marketing of existing services. Ngulube (2012) notes, “Marketing is therefore critical in ensuring that the archives are well-known by prospective users” (p. 3). Although articles explained that marketing was essential, they did not provide instruction about how to go about marketing.

Stakeholder engagement was a related subtheme; authors argued that engagement increased sustainability. For example, Oldman *et al.* (2014) critique past projects for lack of engagement: “Many cultural data aggregation projects have failed to address these foundational elements contributing instead to a landscape that is still fragmented, technology driven and lacking the necessary engagement from humanities scholars and institutions” (n.p.).

Another subtheme was “business model.” While many articles used the term, fewer attempted to define it beyond a general sense of “how things are done” or “how organizations remain sustainable” (Zorich, 2003). Articles stressed the need to have business models aligned with target audiences, organizational missions, and current or future sources of income. At the same time, as Zorich points out “no one is certain which models work” given their context dependency (p. 26). So the pointers to the importance of business models typically lacked guidance about what business models work when.

A few articles provided more extensive definitions of the term business model, but presented very different views of its components, suggesting a lack of consensus in the field about what a “business model” consists of. For example, Arnoldus *et al.* (2011) described nine elements of value propositions, customer segments, channels, customer relationship, key activities, resources and partnerships. Royan (2003) defined a business model in terms of licenses, subscriptions and rights management systems.

The final major subtheme in the management and sustainability theme was professionalization, or moving from ad hoc decision-making to having formal policies, procedures and processes. LeFurgy (2009) notes the need for “controlled processes” for long-term care of collections (p. 6). Articles argued that policies, procedures, and processes

are important to managing growth, making good decisions, developing and managing relationships and contracts, resource sharing and managing digitization.

Fewer articles discussed management in terms of labor. Those that did tended to emphasize that strong managerial skill sets are important for organizational sustainability. For example, Dasgupta (2005) argues for further development of managerial skills in “public relations, networking and marketing” for project sustainability and that “[...] strong, charismatic, confident project leadership, these techniques have to be acquired.” (p. 10).

Another less often discussed subtheme considered the need for managers to plan for possible changes to their organization in order to increase sustainability in areas such as partnerships, mergers, or succession planning. For example, Cruse and Sandore (2009) summarized projects that reshaped programs and developed “new organizational structures” for long-term sustainability (p. 4). Downs and Chen (2010) described succession planning arrangements made for data in case their repository closes.

In summary, the most prominent subthemes within management were the arguments that strategic planning, market research and business models are important to sustainability. Most articles however, gave little guidance about how to accomplish these tasks.

The relationships dimension of organizational sustainability. The relationships dimension was the third most common theme in the data set. The most common subthemes included pooling resources/reducing costs and flexibility/efficiency. Less common subthemes within relationships included the pros and cons of such: creating strategic partnerships (aka “marry rich”) as a sustainability strategy as well as the downsides of collaborations that impede sustainability.

Many authors described how sharing resources or building other relationships that reduce cost (e.g. by streamlining processes, sharing expertise and training, working on common standards), increases sustainability. A related subtheme was flexibility and efficiency, and authors argued that by collaborating, pooling resources and streamlining processes, projects can more quickly adapt to any expected or unexpected changes, thereby making them more sustainable. Collaborations could also ensure long-term preservation of data resources by ensuring back up homes if repositories close. As noted by Downs and Chen (2010), “Development of collaborations within and between institutions and associated contingency plans provides viable options for the long-term survivability of data” (p. 6).

Several articles discussed the importance of strategically building partnerships with resource-rich partners (primarily funders or other “important” actors) by aligning goals and processes with those partners. We called this the “marry rich” subtheme. Authors argued that by partnering with those that have more money or prestige, digital projects could benefit from a more stable environment, or the social capital from the partner’s reputation. For example, Kretschmar and Potter (2010) argues that partnership with a university library increases the sustainability of the project, “In order to be the most sustainable, we have to align [...] with the mission of the library” (p 444).

However, three articles were more cautious about collaboration. Conner *et al.* (2009), for example, discussed how multi-institutional partnerships can be problematic for collection sustainability, and emphasized how partnership conversations must include long-term sustainability planning. Oliver *et al.* (2010) discuss finding a balance between competition and collaboration among partners, and the role of identifying variable information needs to determine whether collaboration or competition is more appropriate. Young (2009) describes the difficulty of communications between partners and how it may negatively impact sustainability.

In summary, the most common subthemes in relationships were arguments that organizational sustainability is aided by resource pooling. This can reduce costs and increase flexibility, allowing digital archives, libraries and repositories to react more quickly to changing opportunities and constraints. While the LIS literature overwhelmingly

presents relationships as positive, a few authors note complications, discussing how partnerships can complicate long-term sustainability planning or actions.

The revenue dimension of organizational sustainability. Revenue was the first of two financial dimensions of sustainability that, when taken together, dominated the corpus of articles. Within revenue, many articles described current or aspirational sources of revenue. A prominent subtheme was the need to have diversified and reliable sources of revenue. Less prominent subthemes included distinctions between startup funding and sustaining funding, challenges of getting grant funding, or the importance of reputation to funding.

The most prominent subtheme related to revenue was the need to have reliable revenue sources. A number of authors described current or aspirational sources of revenue or recommended investigation of a variety of revenue sources. Sources mentioned include, but are not limited to: endowments, donors, sponsorship advertising, and host institution/institution operating budgets, grants, contracts for service, user fees, consortium fees, instructional fees, author fees, user donations/contributions, and lotteries. Many authors expressed opinions about the goodness or badness of these sources of revenue.

Authors argued that lack of reliability of any given source of funding detracted from sustainability. Several authors cast doubt on the reliability of government funding sources or other sources often perceived to be reliable. As Francis (2008) notes, projects historically depending on government funding “are always subjected to the vagaries of budgetary allocation and redistribution. And it is useful to bear in mind that in times of economic crisis, funding for digital libraries could end abruptly” (p. 5).

Another subtheme was the distinction between startup funding and sustaining funding. Authors warned that while sustaining funding is very important to sustainability, it is harder to achieve than startup funding. As Hamilton (2004) advises, “it is best to start from the premise that external funding obtained to establish a project will rarely be an appropriate source to provide ongoing, unlimited funding for its continuation.” (p. 393). Digital projects may not have access to renewable grants available in some areas of the sciences to keep projects going. As Kretzschmar and Potter (2010) explain: “The fact is that most digital humanities projects, even famous ones, are managed by just one developer, or by a small working group, with inconsistent and unreliable funding. We do not have access to grant funding in the same way that our colleagues in the natural and physical sciences have it, with renewable grants that can keep laboratories running for long periods.” (p. 440).

Few LIS authors talked about the importance of reputation or “brand” in getting and maintaining funding but a few alluded to the concept. Zorich (2003) explained how a strong brand can make it easier to win funding, noting that organizations may receive other kinds of support from those that “hold it in high regard” (p. 20). Fewer authors discussed the need to plan and monitor funding both as a managerial activity; however similar themes in costs (see below) were more prominent. Related to brand, a limited number of articles suggested that partnerships might give access to new sources of funding (see relationships above), and one recommended linking digital projects to existing resources in the field so that they come to be seen as permanent fixtures that ought to be funded (see the “marry rich” argument in relationships).

In summary, the most common subthemes included descriptions of current or aspirational sources of revenue, the need to have reliable sources of revenue, and the need to plan well for sustaining sources of revenue.

The costs dimension of organizational sustainability. Costs were the second most-discussed financial dimension. Within costs (i.e. expenditures), the most prominent subthemes include lists of costs, awareness of costs (i.e. cost modeling) and costs associated with ongoing maintenance and access services. Less frequent subthemes included the argument that projects should, at their outset, plan for costs of ongoing operations, and that

boutique projects are less sustainable than scalable projects or projects that share resources or employ standardized solutions.

Many authors listed types of costs they experienced. Numerous authors advised the importance of knowing all of the costs associated with running digital projects and services. A subset of authors recommended that more cost data is important for sustainability. For example, Evens and Hauttekeete (2011) explained that “institutions are unable to report on the expenses” (p. 2). Palaiologk *et al.* (2012) argued that “[m]ore detailed figures are required to enable better decisions and thus sustain the future of the archiving entity and its data” (p. 196). LeFurgy (2009) contended that good information about costs increased sustainability by increasing transparency and accountability to stakeholders, improving an organization’s ability to “conduct necessary functions within defined cost parameters,” augmenting institutional capacity to pass audits, and facilitating setting of prices and fees (p. 420). But LeFurgy (2009) also presented a counter argument that clear cost information might decrease sustainability by making it easier for funders to make cuts, explaining that “[p]roviding information about the money going into preservation might be an invitation for cuts” (p. 422).

Few articles used the formal term “cost model” or presented recognizable cost models (for one exception see Palaiologk *et al.* (2012) who presents an activity-based cost model), most referred to tracking or mapping costs. A small subset of articles reported on costs for digitization for their projects. Another subtheme was the argument that digital projects ought not to spend all their money on digitizing or acquiring content but should instead save money to support and improve ongoing use and promotion. For example, Fuller (2006) calls for “more strategically spending must be done to ensure that resources that are purchased get used” (p. 16). Several articles noted how use of custom solutions increased costs over standardized solutions. One author argued that small projects are less sustainable because they cannot reduce costs through economies of scale. In sum, the most prominent subtheme in costs was the argument that having good information on costs made digital projects more sustainable.

The valued product/service dimension of organizational sustainability. Discussion of the value of an archive’s products and services to the user community (or lack thereof) was common in the literature. Articles advised that those beginning a project must identify a market of users for the project, have an understanding of what users need and want, and offer tools and services that meet these needs in order to develop high usage rates needed for sustainability. For example, Hamilton (2004) explained how the founders of an archive should have their market in mind, and not create an archive that only serves their or their colleagues’ needs. Other authors discussed the need for continuous feedback from users, as their needs are not static.

Taking a long-term perspective, a few articles argued that sustainable projects must be able to use of data in new ways that may not have been conceptualized when the archive was established. A few authors discussed how having good metadata enables data to be usable in the future. Dasgupta (2005) stressed how sustainability requires collection policies about what not to keep: “The policies have also to lay down criteria for preservation because not all on-line material needs to be preserved on a long-term basis” (p. 7). Timing was identified in several articles as essential when considering the value of a project to potential user communities. As Zorich (2003) explained, the “good ideas bad timing” problem where some projects were unsustainable because they were “ahead of one’s time” (p.32).

The disaster planning dimension of organizational sustainability. Disaster planning, as a dimension of organizational sustainability, was not commonly discussed in the articles (15 percent or nine articles). There was some discussion of threats to the ongoing maintenance of the digital objects including the project, or organization ceasing to exist, mitigating against human error or malfeasance, natural disasters (such as flooding, earthquakes) or technological failures.

As described in the Trustworthy Repositories Checklist (Center for Research Libraries and OCLC, 2007), disaster planning as part of a larger risk management strategy is necessary to creating a trusted digital repository but require “[c]onstant monitoring, planning, and maintenance, as well as conscious actions and strategy implementation” (p. 3).

The legal/policy dimension of organizational sustainability. Legal and policy dimensions of sustainability were not often addressed in the articles (13 percent or 8 articles). A few discussed the balance between facilitating maximum access and use of works and encouraging capital investment in digital cultural projects and economic innovation by those projects. For example, Fyffe and Warner (2005) argue, “a balance must be struck between society’s legitimate interest in maximizing access to and use of the work and society’s equally legitimate interest in encouraging capital investment in digitization, dissemination, and long-term curation” (p. 4). In addition, several articles discussed copyright as an obstacle to digital preservation.

The metrics/assessment dimension of organizational sustainability. A few authors described the role of project evaluation and measurement as a dimension of organizational sustainability (11 percent or 7 articles). For example, Zorich (2003) describes the need for formative evaluation to develop a business plan and evaluate the need for and importance of a particular project to foster sustainability. Fuller (2006) explained the importance of demonstrating impact: “funding comes after a demonstrable educational impact” (p. 15). In general, metrics and assessment were discussed in terms of two subthemes: as “inward facing” activities of organizational planning and risk management and as “outward facing” activities for demonstrating need and impact to stakeholders.

In terms of “inward facing” assessment, many articles mentioned either the Trustworthy Digital Repository Audit and Certification Checklist or the OAIS model, both of which provide assessment frameworks for digital projects that arguably could be used to increase sustainability (Lee, 2010). The Trustworthy Digital Repository Audit and Certification Checklist encourages the use of various evaluation tools by organizations in order to track the need for change and manage risk (2007). Similarly, the OAIS model provides both a framework for development and a set of benchmarks against which a data project can gauge compliance with international best practice and standards.

Assessment and metrics can also assist the data project in its “outward facing” mission of demonstrating success, relevancy, trustworthiness. For example, a few authors argued how tracking citations, or other indicators of use, (and promoting data citation) can prove value and contribute to continued use (and arguably then sustainability). However, in general, there was little discussion of citations/use tracking as a specific component of an institutional sustainability strategy.

4. Discussion

This paper compared LIS authors’ discussion of the organizational sustainability of digital libraries, archives and repositories with a nine dimensional framework of DCHO sustainability. Analysis shows that when LIS authors talk about DCHO sustainability, they mostly discuss the technological dimensions – specifically technological encouragers and inhibitors of organizational sustainability and digital preservation. However, if one combines the costs and revenue dimensions, then financial dimension of organizational sustainability dominates the conversation. LIS authors talked a great deal about having reliable sources of revenue, and understanding all costs inherent in a digital project or service. Management dimensions of organizational sustainability were also prominent.

It is not surprising that the financial, technology and management dimensions were dominant. These are common challenge areas for DCHO. One interesting point related to the revenue dimension: No LIS author argued that their project should not be expected to be sustainable.

While some articles did emphasize the desirability of government funding over fees and other sources of revenue, analysis did not find authors arguing that digital projects ought to be able to subsist solely on public funding due to their nature as public goods. Rather, LIS authors seem resigned to the need to diversify revenue.

We hope that the nine dimensions of organizational sustainability we employed in this paper will promote broader conversations about organizational sustainability. But the nine dimensions are just one example of possible frameworks to use to achieve this goal – other frameworks with more or different dimensions could draw out different aspects of organizational sustainability. The trusted digital repository and OAIS models can also serve that purpose, although they tend to be narrower in scope. As mentioned earlier, an alternative framework we drew on in creating our nine dimensions is the Knowledge Exchange (2014) sustainability index which lists target skills needed at different stages of organizational sustainability. From the organizational theory literature, Ostrom and Hess's (2011) IAD describes how actors organize themselves to sustainably manage commons resources. We used both of these in creating our nine dimension framework. Both emphasize the importance of policy, assessment and responsiveness to stakeholders through governance processes (we coded for this as part of relationships) – but these dimensions which did not appear prominently in our data.

It is interesting to consider why LIS authors didn't talk more about the dimensions that appeared less often in our results: disaster planning, legal/policy and metrics/assessment. Our review of the literature suggests that these are important dimensions (Eschenfelder and Shankar, 2016). One reason may be methodological: for example our search approach did not capture articles about disaster planning for DHCO that did not also include the search term of sustainability in the paper abstract. Discussion exists that is not in our analysis set. But, it could also be that our cultural bias toward stories of program success limits broader discussion. All the articles we examined presented sustainability as a positive thing, and no one argued that projects ought to be allowed to run their course and close down. When closures were discussed, they were presented as something to be avoided (if planned for). There is a need to consider the limits of organizational sustainability. In one of five discussions of closures, Zorich (2003) describes some LIS professionals' belief that projects need support to close "in a dignified manner; otherwise, these projects might linger for years, draining resources to no avail" (p. 25). Greater attention to the closure of projects, the process of gracefully winding things down and the responsible transfer of collections could be very helpful to LIS professionals. Cultural biases that celebrate program creation and successes may unfortunately dampen this conversation.

In another example, the authors had expected more discussion of metrics and assessment in relation to organizational sustainability due to its potential importance in retaining trust of financial supporters and governance bodies. One possible explanation for the modest showing of this dimension is that we did not consider use of technology framework models (e.g. OAIS, trusted digital repository) as assessment. Including references to these frameworks would increase the counts for the metrics/assessment dimension somewhat. Second, in relation to dimensions related to use, fewer tools existed to make systematic assessment of use or impact easy to complete, or the tools were beyond the purview of most institutions. For example, turn-key analytics software to measure digital resource use (web analytics) were more do-it-yourself in early 2000s via log file analysis. Social media platforms only arrived in the mid-2000s and social media impact analysis arrived later. Third, many of the dimensions not related to use would be difficult to assess because the LIS community does not have commonly accepted comparative metrics. For example, with respect to revenue, assessment remains hazy beyond "bring in more" or "diversify" and DCHO may be hesitant to compare revenue or cost data with others.

The results presented in this work are limited by the scope of the article population, drawn from three different LIS databases in order to capture a global sample of the literature. These would not include all relevant journals, conferences, white papers and other materials. The data set also did not include books, and it is possible that LIS management textbooks might include useful material on organizational sustainability. Claims about the prevalence of dimensions are subject to methodological limits of content analysis.

5. Conclusion

This paper reports on how LIS as a field operationalizes the concept of organizational sustainability for managing digital resources, projects and infrastructures such as digital libraries and repositories over time. Using structured content analysis, the authors evaluated the literature from three LIS databases from 2000 to 2015. Nine significant themes emerged but most of the articles evaluated focus on technology/preservation/standards, management, relationships or revenue generation.

We conducted this analysis because language matters and words engender actions. By introducing a nine dimensional framework of organizational sustainability for DCHO into ongoing conversations in the field, we hope to promote more and better conversations about organizational sustainability. We hope these conversations will lead to productive action and improvements in the arrangements of people and work necessary to keep digital projects and services going over time, given ongoing challenges. By outlining nine dimensions of organizational sustainability, the paper helps organizations that steward digital collections think more broadly about what organizational sustainability encompasses, and it helps them be clear about what they mean when they are referring to organizational sustainability. We also hope the framework will facilitate more cross-institutional, comparative analysis to assist institutions to take a more evidence-driven approach to their long-term sustainability.

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