



LIBRARIES/
TECHNOLOGY
AND THE FUTURE//

13-15 FEBRUARY
MELBOURNE CONVENTION
& EXHIBITION CENTRE

Skills for IT specialists in digital preservation: a fourth lens for DigCurV?

Sarah Mason
Digital Preservation Specialist – Outreach and Training
Bodleian Libraries

sarah.mason@bodleian.ox.ac.uk

 <http://orcid.org/0000-0002-3156-1586>

Abstract:

This paper investigates the current landscape of best practice curriculum frameworks for IT specialists working in digital preservation. The DigCurV curriculum framework was developed for digital preservation, but does not currently include a lens for IT specialists; the Skills Framework for the Information Age (SFIA) 6 framework for IT specialists does not encompass digital preservation tasks. Recommendations for improving the current skill frameworks include advocating the addition of digital preservation skills to SFIA version 7 and adding a technical specialist focus to the three DigCurV lenses.



First published 1 February 2018



This work is licensed under a [Creative Commons Attribution-NonCommercial License](https://creativecommons.org/licenses/by-nc/4.0/)

Introduction

Digital collections are continuing to change the relationship between librarians and IT staff. In order to acquire, preserve, maintain, access, and use digital materials, librarians, archivists, and IT specialists rely on each other. IT specialists are increasingly responsible for the development and maintenance of digital repositories and access web applications; each of these relies heavily on digital preservation to ensure the long-term accessibility of digital materials. Therefore, IT specialists not only need to work with librarians or archivists who have expert digital preservation knowledge, they need themselves to have an understanding of the core concepts, tools, lifecycles, and activities.

Best practice frameworks, such as the DigCurV (2013) curriculum framework, outline the skills necessary to sustain a digital preservation programme at an institution. While aimed at librarians, archivists and research data managers, the framework does not take into account the range of skills required by developers working with digital collections and preservation. Conversely, the Skills Framework for the Information Age (SFIA) version 6 (SFIA Foundation, 2015) is the best practice set of skills for professionals in information and communication technology. However, SFIA does not take into account digital preservation as a competency required for professionals in the digital world. This gap means that auditing the skills of IT specialists working in digital preservation, or building training to augment those skills, is without appropriate benchmarks. This paper discusses the Digital Preservation at Oxford and Cambridge (DPOC) project, in which research was undertaken to seek to develop benchmarking practices for auditing the skills of IT specialists involved in digital preservation activities.

Digital Preservation at Oxford and Cambridge

The DPOC project is a two-year collaborative research project funded by the Polonsky Foundation. The project is investigating the digital preservation programmes at Bodleian Libraries (Oxford) and the Cambridge University Library (Cambridge). Oxford and Cambridge have engaged three Polonsky Fellows at each institution to look at various programme aspects:

- 'the policy and planning development and implementation (Policy & Planning Fellows);
- the development of expertise and training based on findings from institutional skills audits and community outreach (Outreach & Training Fellows);
- the specification and implementation of the technical tools and workflows which underpin digital preservation activities (Technical Fellows)' (Mason et al, 2016, para. 2).

The Fellows work in collaborative pairs, drawing on each other's varied knowledge and expertise.

This project is unique, because the roles were designed to view digital preservation challenges holistically, rather than assuming the challenges and solutions were merely technical. The project created roles that would look at digital preservation from three areas: the resources, the organisation and the technology needed to

create a sustainable digital preservation programme. This reflects the three-legged stool of digital preservation, which suggests digital preservation can only be successful if all three areas (resources, organisation and technology) are supported (McGovern, 2007).

There are two main phases to the project: an auditing phase and an implementation phase. During the auditing phase, the Outreach and Training Fellows were responsible for assessing current skill competencies in order to implement training solutions. This led to a review of the DigCurV curriculum framework (Molloy et al., 2013) for the development of interview question templates and online surveys to audit current skill competencies. It was during the auditing phase that gaps in the DigCurV framework with respect to digital preservation IT specialists were discovered and investigated further.

As software developers and other IT specialists are part of the digital library teams at Oxford and Cambridge, their skills would also be assessed as part of the wider DPOC project skills audit. Without a best-practice framework to benchmark against, it would be difficult to undertake the audit. Further research was done to determine the best-practice skill set for IT specialists. This included reviewing the DigCurV and SFIA 6 frameworks and mapping job descriptions to DigCurV in order to produce a skill set for IT specialists to benchmark against during an audit.

Literature Review

Digital preservation, digital curation, and sustainability

Digital preservation has long been the term used in libraries and archives to mean the managed activities ‘required to maintain access to digital materials beyond the limits of media failure or technological and organisational change.’ (Digital Preservation Coalition, 2015, glossary). Not everyone involved in the life of digital materials, from the creator to a librarian, will have an involvement in its management all the time; there are many different interests and involvement with digital material over its life. This is why digital preservation adopts a lifecycle approach to identify challenges, dependencies and mechanisms to ensure that the digital material remains accessible long-term through active, ongoing management (Digital Preservation Coalition, 2015).

Similarly, digital curation is a term that relates to ‘maintaining, preserving and adding value to digital research data throughout its lifecycle. The active management of research data reduces threats to their long-term research value and mitigates the risk of digital obsolescence.’ (Digital Curation Centre, 2004). Digital curation has often been associated mainly with research data and data management at higher education libraries or data archives, but essentially includes the same lifecycles, management activities, and principles as digital preservation (Yakel, 2007). Therefore, for the purposes of this paper, digital preservation will be used instead of digital curation, except where the specific language of the framework favours digital curation. However, it was determined during the Outreach & Training Fellows’ research that the overlapping terms were broadly interchangeable and use of them

was determined largely by field of practice or preference (Yakel, 2007, p. 339; Lazorchak, 2011, para. 1).

Digital preservation is not a concept referenced often in computer science; it does not appear in the SFIA 6 (SFIA Foundation, 2015) framework. The term 'sustainability' is more often seen in computer science, often following the definition of sustainability from the UN World Commission on Environment and Development (1987, p. 41) as 'development that meets the needs of the present without compromising the ability of future generations to meet their own needs.' This definition encompasses more than measuring greenhouse gas emissions or energy consumption of technology (Mobbs, 2012); it includes related factors like the features of programs or operating systems and the processing of information or storage.

Mobbs (2012, p. 10) argued that sustainability extends to our information keeping practices: 'the reliability of our record keeping/data storage systems is important.' This touches on the overlap between digital preservation in libraries and archives and sustainability in computer science. Mobbs' view of sustainability in computer science 'considers not only the impact on the planet today, but also how we develop, use and preserve information resources for ourselves and others in the future' (2012, p 10). However, while sustainability in computer science is similar to digital preservation, Mobbs' view still aligns with the common IT belief that digital preservation is only about storage and back up (Bailey, 2013). Mobbs argues that the 'purpose of backing up is to preserve important data.' (2012, p. 86). While this is an important part of digital preservation, it is not the only important one and the Training & Outreach Fellows concluded that sustainability in computer science should better reflect this.

This research has suggested that librarians and archivists should also think about digital preservation as included within sustainability. Sustainability is a term understood in a number of disciplines (not just computer science) and linking these concepts might be a vital element in ensuring that digital preservation activities and theories are better understood by IT specialists.

Reviewing and selecting skills frameworks

Prior to selecting the DigCurV curriculum framework as the foundation for reviewing digital preservation skills, a number of frameworks were reviewed. The Archive and Records Association (ARA [no date]) competency framework and the Chartered Institute of Library and Information Professionals ([CILIP], 2014) professional knowledge and skills base were reviewed, but not selected because research suggested that neither framework adequately reflected digital preservation skills and knowledge. Unlike the ARA or CILIP skills frameworks, DigCurV (2013) focuses on skills and knowledge for digital preservation activities, which include traditional library and archives skills including, selection, appraisal and information seeking. For this reason, the Outreach and Training Fellows selected the DigCurV curriculum framework instead of ARA and CILIP skills frameworks.

The Skills Framework for the Information Age (SFIA) was selected for reviewing IT skills because it is the most commonly used framework for benchmarking ICT skills worldwide (SFIA Foundation, 2015). It is used by professional computing

organisations, including the Australian Computing Society (2016); the BCS – The Chartered Institute for IT uses the SFIA framework as a basis for its SFIPlus skills and competency framework, which adds in training and professional development resources (BCS, 2017, para. 2). The IEEE computer society has also used the SFIA framework to define professional skill levels for its educational products (IEEE, 2012). This research suggests that SFIA is a leading IT skills framework and forms a foundation of other IT skills frameworks, so it was selected for review.

DigCurV curriculum framework

The DigCurV curriculum framework was originally created to provide different ways of assessing and creating digital preservation training curricula (Karvelyte et al., 2013). While DigCurV was created with research data in mind, the skills and attributes align closely with those required in digital preservation more broadly. DigCurV remained flexible enough in areas like ‘subject-specific knowledge and definitions’ (KIA 1.1) and in the subcategory Data Skills (KIA 5) to be applicable outside of digital curation/data management (DigCurV, 2013). The DigCurV curriculum framework consists of 110 possible skill descriptors that fall into four quadrants and fourteen subcategories. These skill descriptors are then mapped to three lenses: Practitioner, Manager, Executive (DigCurV, 2013). Each lens maps the skill descriptors that are relevant to each role’s responsibilities. The skills are assigned either ‘is aware of’, ‘understands’ or ‘is able to’ depending on the level of the skill descriptor required for the role (Molloy et al., 2014). A list of skill descriptor definitions is included with the lenses for additional clarity (DigCurV, 2013).

The skills do not merely focus on technical knowledge and skills, but also personal attributes and behaviours that should be shaped in training or assessed during recruitment (Molloy et al., 2014). They are arranged into four quadrants with fourteen subcategories, to allow users of the framework to ‘examine the full scope of digital curation activities, or drill down into the skills associated with specific areas of interest’ (Molly et al., 2014, p. 235). The four main quadrants are:

- Knowledge and Intellectual Abilities (KIA),
- Personal Qualities (PQ),
- Professional Conduct (PC), and
- Management and Quality Assurance (MQA).

It is not expected that any one person in digital preservation will possess all the skills listed in DigCurV; rather, it was created as an ‘aspirational’ model, intended to provide a range of competencies and knowledge that a person in digital preservation should aspire to (Molloy et al., 2013).

There were discussions in the DigCurV project team about extending the framework beyond the original three lenses with the addition of a fourth to incorporate data creators (Moles & Ross, 2013); this was after suggestions were made to create a lens for personal record keeping. It was argued that a lens for data creators would be ‘more in keeping with DigCurV’s orientation’ (Moles & Ross, 2013, p. 18) towards research data than a personal record-keeping lens; both lenses involve the creators of digital materials. Another suggestion, given at a roundtable discussion, was that there should be a fourth lens dedicated to IT specialists (Cirinnà et al., 2013).

However, this suggestion was not pursued further. A fourth lens has yet to be developed. It should be noted that DigCurV has not been reviewed or revised since project completion in 2013.

SFIA framework

The SFIA framework was created by the non-profit SFIA Foundation in 2003 (SFIA Foundation, 2015). It is a skills and competency framework for people who 'manage or work in information systems-related roles of any type' (SFIA Foundation, 2015, p. 8); this includes technical staff working with digital collections and digital preservation. SFIA has seven different levels of responsibility and each level is defined by describing four attributes: autonomy, influence, complexity and business skills (SFIA Foundation, 2015). The skills at each level are split into six categories:

- strategy and architecture;
- change and transformation;
- development and implementation;
- delivery and operation;
- skills and quality; and
- relationship and engagement.

Within these are seventeen subcategories that contain a total of 97 skills, which is slightly less than the 110 available in the DigCurV framework. Like DigCurV, each skill has a unique code for quick reference. Not all skills are defined at each level of responsibility, but when a skill is included, it has a level-specific definition as well as an overall definition of the skill (SFIA Foundation, 2015).

Currently at version 6, the framework is regularly updated through a public consultation process; the last revision saw significant changes to security measures, relationship management and the increasing demand for digital services (SFIA Foundation, 2015). There is currently a call for input on version 7. Unlike the DigCurV curriculum framework, the SFIA framework is sustainably managed and revised on an ongoing basis. It also contains a deeper level of granularity through the number of competency levels and skill categories and subcategories.

Skills for an IT specialist in digital preservation

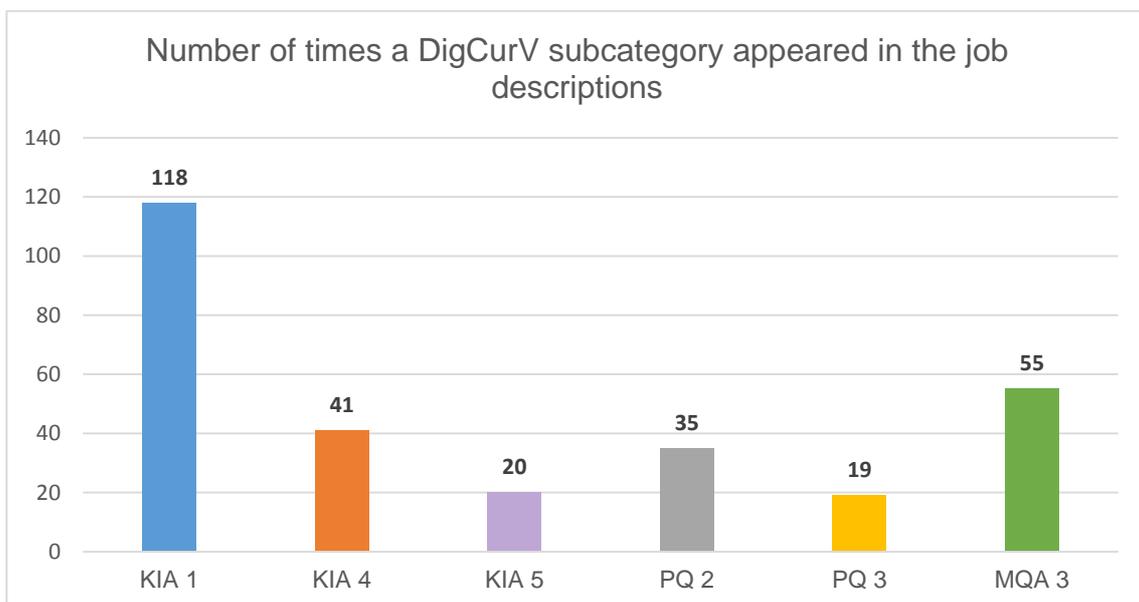
An audit of available digital library or digital preservation IT specialist job descriptions, later outlined in the Research Methods section, was conducted to identify common skills in IT roles. Fourteen job descriptions for mostly software development and senior software development roles were audited. Most roles mapped to the Practitioner lens, but five also included Manager lens skill descriptors. One managerial role (Associate University Librarian for Technical and Digital Services) mapped into the Manager and Executive lenses only. Just under 50% fit neatly into the Practitioner lens, suggesting many IT specialist roles are practical; these roles are based on the execution of technical tasks required for digital preservation (Molloy et al., 2013).

Table 1. List of job descriptions assessed.

Sample number	Year	Institution	Job title
1	2017	Cambridge University Library	Senior Software Developer
2	n.d.	DuraSpace	Senior Software Developer
3	2017	Preservica	Senior Java Developer
4	2017	University of Virginia Library	Senior Developer, Scholar's Lab
5	2016	British Library	Technical Analyst
6	2017	Wesleyan University Library	Associate University Librarian for Technical and Digital Services
7	2015	Texas Digital Library	TDL Software Engineer
8	2017	Wake Forest	Developer for Digital Scholarship
9	2017	Virginia Tech	Software Engineer (Lecturer)
10	2017	University of Hull	City of Culture Digital Archive Software Developer
11	2016	National Library of Wales	ARCW Software Developer
12	2016	Stanford University Libraries	Digital Library Software Engineer - Linked data engineer
13	2017	University of Colorado	Digital Library Software Architect
14	2017	Boston Public Library	Digital Repository Developer

When the selection criteria (both required and desired) were mapped against the DigCurV skills descriptors, 55 out of the 110 skills descriptors was present. The most commonly found skill descriptor subcategories were: Subject Knowledge (KIA 1), Information Skills (KIA 4), Data Skills (KIA 5), Communication and Advocacy (PQ 2), Responsiveness to Change (PQ 3) and Resource Management (MQA 3).

Figure 1. Job description audit findings



Subject Knowledge (KIA 1) scored high, in part due to the number of degree awards and previous experience required, but also because it is the only subcategory to discuss technical skills. Those technical skill descriptors available were:

- select appropriate technological solutions (KIA 1.8);
- apply appropriate technological solutions (KIA 1.9); and
- information technology definitions and skills (KIA 1.15) (DigCurV, 2013).

These skill descriptors are very broad and most selection criteria that required maintaining infrastructure, programming skills, and open source project development or software experience were included in one of these categories.

Resource Management (MQA 3) focuses largely on project management, but also staff and financial management. Of the skill descriptors available in MQA 3, project management skills were most heavily represented in the job descriptions. Information Skills (KIA 4) were also high because of KIA 4.2: 'how to support information access and sharing' (DigCurV, 2013). This was due to the large number of developer job descriptions involved with designing web applications to access digital repositories (sixteen different selection criteria across eight roles). Fifty-seven percent (57%) of job descriptions also listed familiarity or experience with various metadata standards (KIA 4.5, KIA 4.6) in the selection criteria.

There was a strong emphasis on Communications and Advocacy (PQ 2), particularly communicating with staff, both technical and non-technical. Thirty-six percent (36%) of job descriptions also included some form of training delivery to either staff or stakeholders as part of the selection criteria. This gave 100% of job descriptions some kind of communication requirement, whether it was formalised training, managing stakeholder relationships, presenting at meetings or being prepared to communicate technical ideas to non-technical staff members. This focus on communication skills contributes to dispelling the notion that IT specialists must also be introverted (Mengal, 2014).

Research Methods

Mapping the frameworks

Both the SFIA framework and the DigCurV curriculum framework were initially assessed individually for their design, relevance and inclusion of digital preservation skills. The frameworks were then mapped to each other, starting with the DigCurV lenses to the SFIA seven levels of responsibility. Once the lenses and levels of responsibility were mapped, DigCurV skill descriptors and SFIA skills were mapped against each other. Similarities and gaps were recorded and investigated further.

Table 2. The seven SFIA levels of responsibility mapped to the three DigCurV lenses

SFIA 6 framework	DigCurV curriculum framework
Level 1: Follow	Practitioner
Level 2: Assist	Practitioner
Level 3: Apply	Practitioner
Level 4: Enable	Practitioner/Manager
Level 5: Ensure, advise	Manager
Level 6: Initiate, influence	Manager
Level 7: Set strategy, inspire, mobilise	Executive

Overall, the mapping between the levels of responsibility and lenses showed that there was more overlap with the Practitioner lens in SFIA; there will be more variations on Practitioner lens roles than on Manager or Executive.

Mapping the job descriptions

The job description sample was obtained from a number of searches, including generic Internet searches. Many of the job descriptions were pulled from listserv advertisements, mainly from the Code4Lib group. Lastly, job descriptions were submitted by colleagues who were willing to share them. Job descriptions were included in the sample if they were:

1. involved working with a digital repository,
2. working on the development of web applications for accessing digital materials,
3. in commercial enterprise developing digital preservation software, or
4. the job descriptions involved some combination of these criteria.

The sample was then read for references to digital preservation in the background of the institution, the role responsibilities, the required selection criteria and the desirable selection criteria. Where references were found, a notation was made and recorded. The required and desired selection criteria were then mapped against the DigCurV skill descriptors. First, the selection criteria were mapped against Practitioner lens skill descriptors; the process was repeated with the Manager lens and in some cases the Executive lens. Each criterion could be mapped to multiple skills, and references to each skill could be counted multiple times within one job description. If selection criteria did not match, each criterion was recorded separately for a gap analysis of the DigCurV curriculum framework.

Discussion

Gaps in the frameworks: DigCurV

When DigCurV took into account the three lenses on which this framework is based, it did not include IT specialists in the category of staff involved in digital preservation. The framework creators considered mainly Chief Executive Officers (CEOs), library/data managers, research data librarians, digital archivists, and librarian or archivist assistants (Karvelyte et al., 2013). However, these are not the only roles

that have levels of involvement with digital preservation activities. In reality, a complex network of staff with various skills sets works on digital preservation, and an awareness of certain tools, concepts, and terms will be required from each of them if the team is to be able to communicate and collaborate well. These teams include IT specialists. They should therefore, have a place within the DigCurV curriculum framework; they currently do not.

While DigCurV does provide good levels of granularity for the different quadrants and skill descriptors, it does not always make progression paths clear. Some important skills, such as Resource Management (MQA 3) have very clear progression. For example, the Practitioner lens only requires awareness of project management, while the Manager lens needs to be able to manage projects, people and teams, as well as to make sound decisions regarding digital preservation. Finally, an Executive lens role needs to understand project management, but is additionally required to manage funding and strategic planning. However, progression paths around knowledge of, or ability to use, digital preservation tools are not clear. The Manager lens role requires an awareness of 'KIA1.11: Digital curation tools (at high level)' but the Practitioner lens requires no knowledge of or ability to use digital curation tools.

After conducting institutional skills audits for the DPOC project, the Outreach & Training Fellows concluded that some skills are not represented accurately in DigCurV. The Manager lens is responsible for making the case for staff training and development (PQ 2.7), and planning and implementing sound staff training and development (MQA 3.11), which involves delivering the training as well as planning it (DigCurV, 2013). In the institutional skills audits, both Outreach & Training Fellows found that many Practitioner lens roles were also involved with delivering training; if not responsible for the planning, many Practitioners will contribute to it. This should be reflected in DigCurV, either to ensure that Practitioners are selected to partake in train-the-trainer courses or so that it can be reflected in job descriptions and professional development planning.

During research, the DigCurV skill descriptor definitions manual, which describes only some descriptors in detail, was found by the Fellows to be vague and incomplete. The research suggested that in order to avoid being granular and too prescriptive, the DigCurV project team did not provide enough detail to fully describe some skills, such as 'KIA 1.8: select appropriate technological solutions'; in the manual there is no other definition or examples to accompany skill KIA 1.8 (DigCurV, 2013). This skill would look very different for a Practitioner lens role and an IT specialist, let alone Manager or Executive lens roles. Overall, DigCurV is vague on some of the technical skills required for digital preservation and some of the broader technical categories should be fleshed out; for example, there is little information regarding linked open data, the semantic web, data modelling, and data visualisation or analysis techniques.

DigCurV also has gaps in the Personal Qualities (PQ) section. At least 64% (n = 9) of job descriptions mentioned at least one of the following skills in the selection criteria:

- problem solving;
- adaptability; and
- quick ability to learn and a responsibility for managing one's own professional development.

These are personal qualities that would benefit many librarians and archivists working in digital preservation, due to the changing nature of technology and obsolescence (Bailey, 2013). These skills should be considered in recruitment and developed through professional development or training; they should be included in the DigCurV curriculum framework to reflect this and ensure these valuable skills are not overlooked.

Gaps in the frameworks: SFIA

The largest gap in the SFIA framework is the lack of explicit references to digital preservation. This is despite being a skill and competency framework intended to apply across disciplines or organisations that have any staff working with information systems (SFIA Foundation, 2015). This suggests a very low level of awareness of the importance of digital preservation in the wider community, and that digital preservation is not considered a core competency by professional standards. The SFIA framework has a wider audience than DigCurV and is regularly revised and updated (SFIA Foundation, 2015), yet neither fully addresses the needs for IT specialists in digital preservation. While DigCurV lacks a technical focus, SFIA lacks the focus on digital preservation.

However, the SFIA framework does include Data Management (DATM) as one of the skills under the strategy and architecture category (SFIA Foundation, 2015). The SFIA Foundation defines Data Management as 'management of practices and processes to ensure the security, integrity, safety and availability of all forms of data and data structures' for created and in-use information from an organization (2015, p. 35). This skill definition mirrors closely that of digital preservation, but for data that is in-use or created by an organisation; it includes tasks such as the transfer of data to new formats, planning for safe storage, addressing issues, and supporting information retrieval or accessibility (SFIA Foundation, 2015). While SFIA uses the term 'data management' to mean only information created by that organisation, digital preservation often includes data that has been collected. The collected data is used and managed in a way different than was originally intended; this needs to be reflected in standards and processes that make it slightly different to data management. Even if the terms 'digital preservation' and 'preserve' are absent from the SFIA 6 framework, some skills are closely related. Rather than a shared language spanning across disciplines, this suggests that the field of digital preservation contains more jargon, making digital preservation concepts obscure when translated into the language of the SFIA framework.

Overall, SFIA and DigCurV did not map well against each other. While DigCurV skill descriptors such as Risk Management (MQA 2), Resource Management (MQA 3), Communication and Advocacy (PQ 2), Evaluation Studies (KIA 3), and Data Skills

(KIA 5) were well represented in SFIA, very few other areas overlapped. The stronger business and technical skills focus of SFIA made mapping difficult; recommendations for how skills from each framework could be integrated into the other requires further research.

Table 3. Mapping example between DigCurV and SFIA 6 frameworks

	SFIA 6	DigCurV
Skill and code	Digital forensics (DGFS)	Is able to execute analysis of and forensic procedures on digital objects (KIA 5.4)
Definition	The collection, processing, preserving, analysing, and presenting of computer-related evidence in support of security vulnerability mitigation and/or criminal, fraud, counterintelligence, or law enforcement investigations.	<ul style="list-style-type: none"> • PRONOM & DROID • Library of Congress directory of digital formats • Technical metadata extraction practice and tools such as JHOVE, JHOVE2 • National Library of New Zealand metadata extractor • Apache Tika
Level(s) or Lens	<p>Level 4: contribute to investigations, process and analyse evidence</p> <p>Level 5: conducts investigations, communicates findings to stakeholders</p> <p>Level 6: sets policies and standards</p>	Practitioner lens only (is able to)

From the example, it is clear that the term digital forensics in the SFIA framework spans more roles and responsibilities than DigCurV. However, DigCurV emphasises the use of digital forensics for digital preservation, whereas SFIA only includes its use for criminal or counterintelligence investigations (SFIA Foundation, 2015). It does not include preserving the integrity and authenticity of digital materials as part of the digital forensics skills; DigCurV does this exclusively.

Gaps in IT job descriptions

The largest gap found in the job descriptions sample was the lack of mentions of digital preservation. While ten job descriptions reference digital preservation somewhere, only four of them listed any digital preservation skills or concepts (such as the Open Archival Information Systems (OAIS) reference model). Of the four job descriptions that include digital preservation in selection criteria, two listed them as required skills and the other two as desired skills. This reflects the thinking found among IT managers during the Outreach & Training Fellows skills audits that digital preservation is optional for IT specialists, even though these specialists are directly involved in designing and maintaining the services that support preservation and access. They will also be implementing the preservation and curation tools that will be used in workflows. While IT specialists such as software developers might not need to be experts in digital preservation, an awareness and core understanding will

help open a dialogue with the experts; it will also ensure they consider the implications for the preservation of digital materials while they are designing new applications or maintaining older ones.

Table 4. Use of the term digital preservation in job description sample.

Sample number	Does it mention digital preservation?	In institutional background?	In selection criteria?	Required criteria?	Desired criteria?
1	X		X		X
2	X	X			
3	X	X			
4					
5	X	X	X	X	
6					
7					
8					
9	X	X			
10	X	X			
11	X	X			
12	X		X		X
13	X	X	X	X	
14	X	X			
Total	10	8	4	2	2

It is encouraging that ten out of fourteen job descriptions mention digital preservation as an activity the institution is undertaking or a part of role responsibilities. However, 71% of role descriptions do not include digital preservation as a necessary skill and it is therefore not considered during recruitment. This could be because someone else is already responsible for it. Perhaps there is an institutional view that preservation can be added later and is not the responsibility of the IT development team to handle. This view is detrimental to preservation: by not including preservation in the selection criteria, it may not be considered during recruitment and the gaps may persist. If at least mentioned as desired criteria, it can be placed on a new recruit's professional development plan. Training could then be provided. While librarians and archivists need a common language to speak with IT, IT specialists also need a common language to understand the preservation needs of librarians or archivists. Writing digital preservation skills and knowledge into job descriptions would either lead to recruiting for those skills at the outset, or ensure training is provided as or when required.

While the sample job descriptions were strong in a number of DigCurV areas, there were a number of areas not found in the sample. These were:

- KIA 2: Selection/Appraisal;
- PC 1: Regulatory Requirements;
- PC 2: Regulatory Compliance; and
- MQA 2: Audit and Certification (DigCurV, 2013).

This suggests that while there is a strong overlap in the areas of information and data skills, subject knowledge, communication and the management of resources, there are other areas that have less significance to IT specialists. Audit and certification skills (MQA 2), might have more significance in higher-level roles, where compliance with standards such as ISO 27001 (Information Security Management Standard) might be required. However, the legal and regulatory frameworks (PC 1 & PC 2) that librarians and archivists must operate within are of lower priority to IT specialists. They require only enough information to ensure their applications apply the right level of security and access identified for digital materials. The minutiae are the responsibility of librarians and archivists. Similarly, the same principles apply for the selection and appraisal of digital materials (KIA 2); this is certainly an important role for many librarians and archivists, but IT specialists only require the ability to implement technical solutions in applications as, and if, necessary.

A new lens for DigCurV? Or something else?

Overall, there was a very strong overlap in most of the quadrants and subcategories between the DigCurV Practitioner lens and IT specialist roles. While the original suggestion was to create a fourth lens for IT specialists, it seems unwise to completely separate these roles from the rest of the DigCurV lenses. The Outreach & Training Fellows propose that the existing Practitioner, Manager and Executive lenses be reviewed and updated for digital preservation skills and attributes that are not currently present. This would include linked open data and data modelling skills, and attributes such as problem solving. Alongside each lens would be a new lens: Practitioner – Technical, Manager – Technical, Executive – Technical. These would contain additional skill descriptors and advancement levels that IT specialist staff would require.

Once the DigCurV lenses are updated, a more in-depth gap analysis of the SFIA 6 framework and a larger sample of job descriptions will help to identify additional skills, or amendments in the level of advancement of current skill descriptors that would support the creation of 'technical' lenses. For example, the skill descriptor KIA 4.2 (how to support information access and sharing) is at an 'understands' level for the Practitioner lens. For many IT specialists, this should be at an 'is able to' level because many roles involve designing and maintaining the web applications used for access.

Table 5. Proposed amendments to the DigCurV Practitioner lens to create a Practitioner – Technical lens

DigCurV skill descriptor	Current Practitioner lens level	<i>Proposed Practitioner – Technical lens level</i>
KIA 4.2: how to support information access and sharing	Understands	Is able to
KIA 2.3: articulate benefits and long-term value of collections	Is able to	Is aware of
MQA3.11: plan and implement sound staff training and development	(Manager lens only)	Is able to
KIA 5.3: database types and structures	Understands	Is able to (create & manage)
PQ 2.9: communication protocols for designated community	Understands	Is able to (initiate & apply)

The SFIA Foundation (2015) is currently taking input for a new version of the framework, SFIA 7. As this framework is regularly managed and updated, opening a dialogue about the inclusion of certain digital preservation skills would create the possibility of reaching a much larger audience. Various organisations and individuals in nearly every country use SFIA for range of human resource systems and people-management processes, from training to job descriptions (SFIA, 2015). Digital preservation is not a concern for libraries and archives alone; it spans every industry that uses digital materials.

The Outreach & Training Fellows research suggests that a better way to reach SFIA and parts of the IT community would be to talk about digital preservation in terms of sustainability, or data management when discussing the management of live data. By framing it using a well-understood term, instead of using digital preservation and library-specific terms, there might be a higher level of uptake. Already SFIA has skills such as ‘sustainability engineering’ (SUEN) that includes ‘efficient coding design and adoptions of re-use/sharing principles’ (SFIA, 2015, p. 48). The skill ‘capacity management’ (CPMG) includes ‘the management of the capability, functionality and sustainability of service components’ (SFIA, 2015, p.60). Nowhere are the terms ‘preservation’ or ‘preserve’ mentioned, but sustainability appears more than 50 times. Aligning digital preservation with the principles and actions associated with sustainability could increase awareness and become a valuable advocacy tool. In turn, this will see the inclusion of digital preservation skills in more IT specialist roles, in organisations, and in training and education.

Conclusion

By excluding IT specialists like software developers from the conversation about digital preservation, institutions are losing an opportunity to ensure that their services are developed with preservation as a priority. Institutions run the risk of relegating digital preservation to an afterthought, for someone else to worry about after the development and design work on the applications has been done. There is also the view that if IT specialists are building access applications to digital materials, then preservation is not a concern for them. However, providing access requires a good preservation service. Without understanding how to provide sustainable access with respect to the preservation needs of digital materials, these materials may be placed at risk. Therefore, IT specialists require certain digital preservation skills.

Revisiting and redesigning the DigCurV curriculum framework is a good place to start. Revisiting the current lenses and adding a 'technical' focus to each lens will highlight the skills required for these roles. This would also provide a progression pathway for librarians and archivists who want to move into more technical roles, such as technical analyst positions. In addition, as the SFIA Foundation (2015) is calling for contributions for a new version of the framework, SFIA 7, input should be given by the digital preservation community. As this framework is regularly managed and updated, opening a dialogue about the inclusion of certain digital preservation skills would create the possibility of reaching a much larger audience.

For roles working with digital repositories or access applications, IT specialist job descriptions would benefit from the inclusion of digital preservation skills and knowledge in the selection criteria. This would help drive training in institutions and fill gaps in the current job descriptions. Even if some digital preservation knowledge and skills were desirable, but not considered during recruitment, they could be noted in the professional development plans of new recruits. This would encourage the provisions of necessary training during induction or over the course of the first year. Putting digital preservation-related selection criteria into IT specialist job descriptions provides accountability for management to develop those skills in staff. Not all skills in any of the suggested DigCurV 'technical' lenses will apply to every job description, but like the original DigCurV lenses, the 'technical' level is meant to be an 'aspirational' model rather than a prescriptive one (Molloy et al., 2013).

Ultimately, higher education curricula will have to change in order to prepare the workforce for preserving the output of our digital world (National Research Council, 2015; UK Digital Skills Taskforce, 2014). Computer science courses need a module on digital preservation. Digital preservation teaching could also form part of modules on sustainability and data management, due to the related principles (Abernethy & Treu, 2014) or else, where sustainability is part of an introductory course, digital preservation could be included at that point. Conversely, librarians and archivists could take an introductory computer science module as part of the formal coursework, which would better prepare them to work with and preserve digital collections (National Research Council, 2015).

References

Abernethy, K, Treu, K 2014, 'Integrating sustainability across the computer science curriculum', *Journal of computing sciences in colleges*, vol. 30, no. 2, pp. 220 – 228.

Archives and Records Association no date, *ARA Competency Framework: 3 areas; 10 functions; 37 competencies (version 6)*.

Australian Computing Society, 2016, 'MySFIA self assessment', viewed 13 October 2017, <https://www.acs.org.au/professionalrecognition/mysfia-b2c.html>

Bailey, H 2013, 'Parallel session 2: Staffing and skills', unconference discussion at the *NE NDSA Regional Workshop*, Boston, viewed 8 March 2017, https://projects.iq.harvard.edu/files/ne_ndsa/files/staffing_hb.docx

BCS – The Chartered Institute for IT, 2017, 'IT skills framework (SFIAplus)', viewed 13 October 2017, <http://www.bcs.org/category/17784>

Chartered Institute of Library and Information Professionals, 2014, *My professional knowledge and skills base*, viewed 20 July 2016, <http://www.cilip.org.uk/pksb>

Cirinnà, C, Fernie, K & Lunghi, M 2013, Creating a common vision for digital curation education: Building alliances, roundtable discussion at the *Framing the Digital Curation Curriculum Conference*, Florence, Italy viewed 6 March 2017, <http://www.digcur-education.org/eng/Resources/DigCurV-2013-proceedings/paper28>

Digital Curation Centre 2004, 'What is digital curation?', viewed 8 August 2017, <http://www.dcc.ac.uk/digital-curation/what-digital-curation>

DigCurV 2013, *A curriculum framework for digital curation*, viewed 4 March 2017, <http://www.digcurv.gla.ac.uk/>

Digital Preservation Coalition, 2015, *Digital Preservation Handbook* (2nd ed), viewed 8 August 2017, <http://www.dpconline.org/handbook>

IEEE Computer Society, 2012, 'IEEE-CS Adopts Skills Framework for the Information Age', IEEE, viewed 13 October 2017, <https://www.computer.org/web/pressroom/framework>

Karvelyte, V, Klingaite, N, Kupriene, J, Molloy, L, Snow, K & Gow, A 2013, *Deliverable D2.1 for DigCurV 510023. Report on baseline survey and evaluation framework. Section 2: Evaluation framework*, DigCurV, viewed 6 March 2017, <http://www.digcur-education.org/eng/Resources/D2.1.2-Evaluation-Framework>

Lazorchak, B 2011, 'Digital Preservation, Digital Curation, Digital Stewardship: What's in (Some) Names?', *The Signal*, web log post, 23 August, viewed 12 October 2017, <https://blogs.loc.gov/thesignal/2011/08/digital-preservation-digital-curation-digital-stewardship-what%E2%80%99s-in-some-names/>

Mason, S, Halvarsson, E, Mooney, J, Pretlove, L, Langley, S & Gerrard D 2016. *Digital Preservation at Oxford and Cambridge*, viewed 8 August 2017, www.dpoc.ac.uk

McGovern, N 2007, 'A Digital Decade: Where Have We Been and Where Are We Going in Digital Preservation?', *RLG DigiNews*, 15 April, viewed 8 August 2017, https://deepblue.lib.umich.edu/bitstream/handle/2027.42/60441/McGovern-Digital_Decade.html?sequence=4

Mengal, P 2014, 'Are all software developers introverts?', *Mindful hacker*, web log 11 September, viewed 8 August 2017, <http://www.mindfulhacker.com/are-all-software-developers-introverts/>

Mobbs, P 2012, 'A practical guide to sustainable IT', *Association for Progressive Communications*, viewed 8 August 2017, https://www.apc.org/sites/default/files/PracticalGuideSustainableIT_full_report.pdf

Moles, N & Ross, S 2013, *Deliverable D6.2 for DigCurV 510023. Report on DigCurV curriculum framework*, DigCurV, viewed 6 March 2017, <http://www.digcur-education.org/eng/Resources/D6.2-Report-on-the-context-of-the-DigCurV-curriculum-framework>

Molloy L, Gow A & Konstantelos L 2014, 'The DigCurV curriculum framework for digital curation in the cultural heritage sector', *International Journal of Digital Curation*, vol. 9, no. 1, pp. 231 – 241, viewed 8 August 2017, <dx.doi.org/10.2218/ijdc.v9i1.314>

Molloy, L, Konstantelos, L, Gow, A, Wilson, D, Ross, S & Moles, N 2013, *Deliverable D4.1 for DigCurV 510023. Initial curriculum for digital curators*, DigCurV, viewed June 2017, <http://www.digcur-education.org/eng/Resources/D4.1-Initial-curriculum-for-digital-curators>

National Research Council, Committee on future career opportunities and educational requirements for digital curation and the board on research data and information 2015, *Preparing the workforce for digital curation*, The National Academies Press, Washington D.C.

SFIA Foundation 2015. SFIA 6: The complete reference guide, viewed 8 August 2017, <https://www.sfia-online.org/en/sfia-6/documentation/framework-reference>

UK Digital Skills Taskforce 2014, *Digital skill for tomorrow's world*, beta edition July 2014, viewed 12 October 2017, <http://www.ukdigitalskills.com/wp-content/uploads/2014/07/Binder-9-reduced.pdf>

World Commission on Environment and Development 1987, *Our common future*, viewed 8 August 2017, <http://www.un-documents.net/our-common-future.pdf>

Yakel, E 2007, 'Digital curation', *OCLC Systems & Services: International digital library perspectives*, vol. 23, no. 4, pp. 335-340, viewed 12 October 2017, <https://doi.org/10.1108/10650750710831466>