Article:
Read, A. and Cox, A. orcid.org/0000-0002-2587-245X (2020) Underrated or overstated? The need for technological competencies in scholarly communication librarianship. The Journal of Academic Librarianship, 46 (4). 102155. ISSN 0099-1333

https://doi.org/10.1016/j.acalib.2020.102155

Underrated or overstated? The need for technological competencies in scholarly communication librarianship

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Abstract

A number of attempts have been made to determine the key competencies for librarians supporting scholarly communications (SC), but it remains unclear what technical competencies are required. To explore this issue, the study undertook thematic analysis of in-depth semi-structured interviews with UK based librarians working in SC. Typical technologies in use were identified and six typical ways of talking about technologies uncovered. Partly because of the out-sourcing of key technologies, SC librarians need soft skills and certain positive orientations to technology rather than practical technical skills. They acquire these skills through learning on the job and through communities of learning. A concept of socio-technological competence is proposed to encapsulate this skillset.

Keywords

Introduction

Scholarly Communication (SC) has been defined as the "system through which research and other scholarly writings are created, evaluated for quality, disseminated to the scholarly community, and preserved for future use" (ACRL, 2003). It has also been described as a "culturally pervasive, complex and widely distributed ecosystem that produces, analyses, packages, and disseminates new scientific and scholarly knowledge" (Anderson, 2018: p. 1). This definition is useful as it underscores the wide range of stakeholders involved. Scholars, authors, peer-reviewers, and publishers are key players within the SC world, with academic libraries historically playing a more peripheral role around collection, access and discovery. However, as SC has evolved into a complex digital ecosystem, library services have extended their role to match it. Today, libraries are involved in a wide range of SC activities: including open access (OA), publishing, copyright law, metrics and impact measures, repository management, and research data management (NASIG, 2017). To handle these specialist areas, libraries are increasingly forming SC-focused teams (Schmidt, Calarco, Kuchma, & Shearer, 2016). Whether staff are redeployed or freshly hired, they need a range of new skills, expertise, and attitudes – that is, 'competencies' – to fulfil their specialised roles (Klain-Gabbay & Shoham, 2016).

The literature has explored the skills and knowledge needed by librarians working in SC at a number of levels. Some research has looked broadly at the future of academic libraries, considering which services need to be expanded and what skills staff will need to deliver them, often particularly in reference to research support (Auckland, 2012; Glusker & Exner, 2018). Other studies investigate the roles of specialists in areas such as bibliometrics or research data management (RDM) (e.g. Cox, Gadd, Petersohn, & Sbaffi, 2017). A more limited number of studies focus on SC librarianship in particular, and of these there are a small number that the competencies needed by staff specifically in the UK (Blanchett & SC3, 2019; Calarco, Shearer, Schmidt, & Tate, 2016).

The profiles produced in such literature frequently include discussion of the technical, technological, or digital demands of SC (NASIG, 2017) - a term used throughout this paper to broadly refer to tools, systems, software, online platforms, or other digital ways of working. Library work is increasingly premised on digital technologies such as institutional repositories (IRs), Current Research Information Systems (CRIS) and scholarly social networking sites. Furthermore, the number of tools and platforms being deployed by researchers as users is

proliferating (Bosman and Kramer, 2015; Nicholas et al., 2015). Technological competencies seem to be even more crucial in this context. There has, however, been little investigation into the relative need for and importance of technological competencies in SC staff compared to other skills, knowledge or attitudes. In this context, the purpose of the current paper is to report an interview based investigation of SC librarians' own perceptions of the importance of technical skills in their work.

Literature Review

Although definitions vary, most LIS literature agrees that 'competencies' are, more or less, a combination of skills, knowledge and attitudes (Peyvand Robati & Singh, 2013). According to the European e-Competence Framework (2014, p. 11), a competence is "a demonstrated ability to apply knowledge, skills and attitudes to achieving observable results". The inclusion of attitudes as an aspect of competencies is sometimes contested because attitudes are far less visible and measurable than skills or knowledge (Peyvand Robati & Singh, 2013). 'Competency profiling' are methods for identifying the skills, knowledge and attitudes needed in a particular role (Shellabear, 2009). Creating profiles is useful for both employers and employees, "provid[ing] a framework against which employees' skills can be evaluated […and] a tool for increased fairness in job competitions and performance reviews" (Fraser-Arnott, 2017, p. 67). In a developing area such as SC, where terminology is inconsistent and understanding of roles is limited, competency profiling can be used to beneficially demystify what attributes staff need (Sewell, 2018). Although the practice of profiling is typically associated with HR departments, studies by librarians into librarian competencies are abundant.

A baseline of technological competencies, often described as 'core IT skills' or 'computer literacy', is called for amongst all academic librarians. Basic soft skills or interpersonal qualities are also universally required. This is reflected in the competency profiles that exist for generic academic librarian or information professional roles.

A useful document for understanding the competency needs of the entire librarianship profession is OCLC WebJunction's *Competency Index for the Library Field* (2014), which synthesises multiple American competency sets. Core technology competencies are in fact the first items to be listed, closely followed by core interpersonal skills, since these together are "fundamental for everyone who works in a library in any position" (2014, p. 3). Core technology competencies listed by WebJunction (2014) include using email and scheduling applications; familiarity with basic hardware, devices, and operating systems; common applications such as word processors; understanding of the internet and information literacy; appreciation of how technology can be used for collaboration and learning; and so on.

The SLA also include "Information and Knowledge Systems and Technology" in their general profile for information professionals (SLA, 2016). Their list comprises more specific technologies than WebJunction, such as library management systems, social media, and information retrieval tools. The skills mentioned are also more advanced, including requirements analysis, interface design, and scripting (SLA, 2016). Additional competencies in "Information and Data Retrieval and Analysis" are described, with emphasis on extracting, analysing and visualising data (SLA, 2016). Interpersonal qualities are added almost as an afterthought under "enabling competencies", comprising communication, relationship building, initiative, leadership, and more (SLA, 2016).

In the UK, CILIP's (2012) Professional Knowledge and Skills Base takes a middle ground between WebJunction and the SLA, uniquely grouping core IT and communication competencies together. Technologies listed include databases, repositories, digital libraries, social media, and open source software; communication comprises oral, written, presentation, networking and PR skills (CILIP, 2012). This is interesting, as most studies tend to divorce IT from soft skills entirely.

Various authors and professional groups have produced competency lists for SC or SC-adjacent roles. These have gradually changed over time, often to include more technological elements.

In 2012, RLUK commissioned the influential report *Reskilling for Research,* which listed 32 skills and knowledge areas that they anticipated were necessary or desirable within future research support work (Auckland, 2012). These mainly revolved around knowledge or awareness of research processes, funder mandates, copyright, and SC trends such as the OA movement. On the technological front, the report included skills in data management,

manipulation, and mining; metadata; mobile technologies; Web 2.0 technologies; and digital preservation (Auckland, 2012). A large proportion of these technological competencies were identified as being potential 'significant skills gap' areas (Auckland, 2012). Two years later, the ACRL noted that SC competencies were increasingly in demand in both general and specialised academic librarian posts (Bonn, 2014). The technological competencies listed in this paper concurred with RLUK's but expanded them to include digital humanities and repository management (Bonn, 2014).

In 2016, the 'Joint Task Force on Librarians' Competencies in Support of E-Research and SC' produced another useful competency profile for SC and OA librarians (Calarco et al., 2016). This breaks down competencies along the lines of specific service areas: scholarly publishing, open access repositories, copyright & OA advice, and assessment of scholarly resources (Calarco et al., 2016). Technological skills are mentioned throughout these sections – for example, knowledge of digital standards like DOIs under 'scholarly publishing'. The most technologically-oriented section is 'repository services', wherein librarians are suggested to have knowledge of repository software, metadata, and data tools, as well as the ability to manage and update the platform (Calarco et al., 2016).

Perhaps the most comprehensive competency profile for SC is NASIG's (2017) *Core Competencies for Scholarly Communication Librarians*. This document describes four underpinning themes – background knowledge, technical skills, outreach and instruction, and team building – along with five 'areas of emphasis', which are similar to the Task Force report (NASIG, 2017). These five are:

- Institutional Repository (IR) management
- Publishing services
- Copyright services
- Data management services
- Assessment and impact metrics

Unlike the Task Force, ACRL, and RLUK reports, which do not specifically mention attitudes, NASIG includes a section on 'personal strengths', including qualities such as enthusiasm and adaptability (2017). NASIG (2017) develops the competencies needed for IR management more deeply than other studies, including mention of aspects such as usage statistics and interoperability. Their 'data management' section likewise requires technical skill and knowledge in areas such as data storage, repository infrastructure, third-party datasets, and optional knowledge of text and data mining (NASIG, 2017). However, under their 'technical' theme, NASIG (2017) remarks that having an "active awareness of new technologies […] is generally of greater importance for the SCL than deep technical expertise in any single venue" (p. 2).

One of the difficulties apparent in studies of SC is the lack of standardisation of roles and job titles. Finlay, Tsou and Sugimoto (2015) performed detailed analysis of job ads and found marked variation in the extent to which ads containing the phrase SC actually involved core SC activities. Their results suggested "that many different positions in the library are likely to include SC components" which perhaps demonstrates "a lack of clear definitions and boundaries for SC librarians" (p. 1236). More anecdotally, librarian attendees at a 2018 Jisc OA event agreed that "job titles aren't very helpful in describing roles" (Blanchett & SC3, 2019). Because job titles are not necessarily representative, it can be difficult to determine what competencies are linked to what roles. Pontika's (2019) study analysed job descriptions for SC roles grouping them into three subfields – OA, repositories, and RDM – and found that these demanded a narrower set of distinct skills, in addition to a long list of 'general competencies' which applied to all roles. However, SC roles again appeared resistant to attempts to delineate their boundaries. Noting that most 'clean' job descriptions (jobs focused on one subfield) originated from Russell Group institutions, she theorises that their larger research services teams can afford to have subfield-specialised employees (Pontika, 2019).

Methodology

As a key objective of this study was to explore the attitudes and perspectives of SCLs on technological competencies, the research adopted an interpretivist approach prioritising "people's subjective interpretations and understandings of social phenomena and their own actions" (Matthews & Ross, 2010, p. 28). Data was

collected through semi-structured interviews. The semi-structured format proved useful for this underexplored research area. The interviews followed a set of common topics enabling comparison, but also extemporaneously adapting questions (Matthews & Ross, 2010) permitting:

- Flexible exploration of unanticipated avenues of discussion
- Adaption to the specific context and participant (for example, by adopting the vocabulary of the specific institution, or re-ordering questions as topics naturally arose)
- Provision of greater opportunities for individual interpretations to surface (King & Horrocks, 2010)

Other studies of competencies tend to favour job advertisement analysis, which, though widely practised, has its limitations. Adverts do not necessarily designate the true requirements of a post: they may be generic, forward-looking, or sketch out a role whose responsibilities are yet to be clearly defined (Cox & Corrall, 2013; Harper, 2012). Furthermore, job ads (especially in SC) lack controlled vocabularies and may be of varied written quality, decreasing their comparability (Cox & Corrall, 2013; Harper, 2012). By using semi-structured interviews, the researcher was able to collect richly detailed data from those directly involved in the practice, bypassing some of these issues.

Due to the limited population of library staff working in SC support, purposive sampling was used to identify a small group of participants who could fruitfully contribute to the study from their professional experience. Although drawing from a small study population, maximum variation sampling was used to ensure a range of job titles and institutions were represented (Patton, 1990). The study included participants from universities described as “new”, “teaching-led”, or “post-1992” in addition to representatives from the more commonly studied “research-intensive”, “pre-1992” universities. By examining a heterogeneous sample of institutions, significance could be afforded to both the commonalities appearing across diverse examples (which we can infer are core aspects of SC support regardless of context) and unique distinctions (Patton, 1990).

Table 1 below describes the final sample of interviewees. Further details cannot be provided without compromising the anonymity of participants because job titles are quite unique and combined with type of institution and gender could effectively reveal the identity of participants. The sample is predominantly female; however, the researchers did not consider this of undue concern as it reflects the female-dominated nature of the UK’s librarian workforce (CILIP & ARA, 2015).

Participant	Gender	Institution	Key area(s) of work
A	Female	Research-intensive	Research data management
B	Female	Research-intensive	Institutional repository
C	Female	Research-intensive	Open access
D	Female	Research-intensive	Institutional and data repositories
E	Female	Research-intensive	Open access; skills training
F	Male	Research-intensive	Open access
G	Female	Teaching-led	Open access; article processing charges
H	Female	Teaching-led	Institutional repository; open access
I	Female	Teaching-led	Open access; research data management
J	Male	Teaching-led	Skills training; DMPs; gold OA
K	Male	Teaching-led	REF; repositories

Table 1: Break-down of final participant sample

Participants were selected on the basis of selecting individuals who were currently working in a UK academic library team concerned with ‘SC’ or ‘research support’ and have a job title indicating such. However, the

researchers sought diversity within these parameters. This meant that participants could, in the words of King and Horrocks, “represent a variety of positions in relation to the research topic, of a kind that might throw light on meaningful differences in experience” (2010, p. 29). They were recruited through existing contacts of the authors and searches of library web sites. Eleven was determined to be a suitable number of interviews for several reasons. Firstly, the interviews produced rich, dense data, with each transcript needing considerable analysis. Secondly, during data collection saturation was reached: Later participants introduced few new ideas, but instead reinforced points raised in previous interviews.

Nine out of eleven interviews were carried out using Skype. The key advantage of computer-mediated communication methods is that geographically scattered participants can easily participate (Matthews & Ross, 2010). This held true in this study as participants joined from northern, southern and eastern English cities. The researcher’s experience was the same as that of Deakin and Wakefield (2014): interviewees were open and responsive, and prior email communication created comfortable familiarity. Furthermore, although one interview suffered connection problems and needed to be resumed at a later time, this did not appear to create a loss of intimacy, and both parties recommenced conversation easily (Iacono, Symonds, & Brown, 2016).

An interview guide was prepared combining questions and prompts for the interviewer, organised in seven sections (see appendix 1 below). Participants were first asked about their own role and their position in the organisational structure, then direct questions about their own technical skills. This was followed by questions about the organisation of key SC activities such as RDM support and bibliometrics. Other questions were about training, hiring and future skills required. The guide was used flexibly, allowing the interview to flow naturally. Interviews lasted between 30 and 60 minutes, with an average length of around 40 minutes.

Transcriptions of the interviews were imported into the qualitative data analysis software NVivo, which aided the researcher in organising, coding and querying the files (Bazeley, 2011). NVivo facilitated ‘playfulness’ with ideas: codes could be altered, ideas restructured, and quotes recontextualised without undue labour (Bazeley, 2011). Thematic analysis was used to analyse this data following the step-by-step process proposed by Braun & Clarke (2006). This begins with familiarisation and initial code generation. The process was methodical and iterative: from a short list of initial codes based on prior familiarisation with the text, the researcher expanded the codes from one transcript to the next, before returning to the first transcript for review. Finally, overarching themes were identified by gathering related codes together and applying a higher level of interpretation (Braun & Clarke, 2006). For example, from coded content where participants discussed formal training, learning skills on the job, and learning from team peers or professional groups, emerged the theme “communities of learning”, which at an abstract level captures how SCLs rely on one another to fill competency gaps. The final main themes identified were: diversity of roles and teams, homogeneity of systems and technology, tech skills and attitudes, communities of learning, and the value of generic skills.

Results

The following sections reflect the themes in the data. The first section reveals the diversity of individual job roles and team structures found in SC teams – though there was a difference in the size of teams between research-intensive and teaching-led institutions. In contrast, the second section, shows that the technologies that are supported are very similar in all the institutions. The third section identifies five typical attitudes to technology that recurred in the interview data: the interpreter, the customiser, the avoider, the commissioner, the enthusiast/ the expert. The fourth section explains how participants gained and maintained their skills: through communities of learning. The fifth and final section, explains that participants stressed the value of generic skills over technological skills.

Diversity of Roles & Teams

The data revealed that individual job roles and team structures are very diverse across libraries, with participants tackling different aspects of SC and relying on differing types and levels of competencies. However, a foundation of common activities and concerns underpin these varied approaches to SC support.

All participants had uniquely oriented roles and responsibilities which were at least partly reflected by their divergent job titles. Only two participants shared the same title ("Research Support Librarian"), although some terms appeared more frequently than others – see Table 2 below.

Term	Occurrence
Research	8
Librarian	6
Manager	4
Open Access	2
Scholarly Communication(s)	3
(Institutional) Repository	2
Publications	2
Research Data Management	1
Digital Scholarship	1

Table 2: Word frequencies in participant job titles

The term 'scholarly communication(s)' appeared less frequently than the more generic vocabulary of 'research'.

The core responsibilities of participants were also varied (see Table 1), but despite their differing niches, participants performed many of the same activities or worked with similar systems. IRs were a ubiquitous topic, often described as the starting point from which research teams grew. Although not every role was focused on IR management, the IR was invariably woven into their jobs to greater or lesser extents. OA, specifically in relation to advocacy work, was likewise universally discussed.

All participants belonged to 'SC', 'research support' or 'research services' teams. Despite differing names, all teams performed more-or-less the same functions. As with job titles, the term SC was favoured by pre-1992 universities.

A striking although expected difference between research-intensive and teaching-led institutions was team size. The teams in teaching led institutions were all made up of around four people, often including job-shares or part-timers. The largest team of sixteen belonged to the most affluent research-intensive institution involved in the study. The larger the team, the more likely it was to contain subdivisions dedicated to certain work niches. Even small teams appeared to dedicate specific personnel to managing the IR.

Homogeneity of Systems & Technologies

Despite the diversity of teams and roles described above, the institutions interviewed favoured many of the same technologies, tools and business practices, with EPrints and Symplectic Elements appearing to hold near monopolies over the IR and CRIS markets.

The technologies employed in SC are much the same as those used elsewhere in the academic library, with only a few unique technical areas. Accordingly, participants agreed that the level of overall technological competency needed by SCLs is usually only that of 'core' IT literacy.

Thus, unsurprisingly, SCLs are using Microsoft Office software for a variety of work, with Excel noted as particularly important. Multiple participants discussed needing spreadsheet and 'data skills':

> I think extracting data, being able to analyse it and […] produce visualisations of it, so looking at it for different audiences, particularly senior management. —P.E

> […] things like doing VLOOKUPs, you know? We've got so much data and it's in so many systems, that we're having to manipulate it from various systems to make it be what we need it to be. […] That kind of, I suppose 'data skills', rather than 'tech skills', is important. —P.A

Other 'core' technologies that participants suggested are key to SC included content management systems, social media platforms, image editing software and organisational tools for scheduling or emailing. More specialised skills were mentioned around the topic of coding and APIs, with a few participants describing current knowledge or a desire to learn more:

> [I had] heard of things like R [programming language] and knew they were a bit scary because I didn't really understand them. [So I did] lots of training, things like 'Introduction to GitHub' courses or 'Introduction to Python' and finding out about […] how people deal with code. I think code is something that we see a lot, and if you've not coded before can seem quite odd. —P.B

> I know my colleague would like to develop skills with APIs and that sort of thing […] – and programming skills as well – but how to fit that into a really busy job already... —P.E

Institutional Repositories were particularly important technologies. Five out of seven participating institutions used EPrints as their repository software of choice, with DSpace and Pure used by two pre-1992 universities. The majority of repositories were externally hosted – a fact which has a considerable impact on the kind of technological competencies SC staff need.

> We actually outsource the technical side of the repository to an external provider, to the university of London computer service, so they do all the upgrades for us. Our IT department purely do all the basic maintenance […] Everything else, all development work, is done by the University of London. —P.G

Other participants concurred that the most technical elements of repository management were outsourced to their partners, although as Participant D pointed out "External hosting is great, but you still need to understand even if you can't actually do it; you need to understand what you want [the repository] to do".

The other type of technologies particular to the field of SC support are CRISs. In this study, the most popular choice of CRIS was Symplectic Elements, used by four of the seven institutions. Pure and Worktribe were also mentioned, and the final institution explained that the work of a CRIS was performed manually by staff. CRISs were usually managed by separate administrative research offices with whom SCLs coordinate. As with external hosting, this fact makes SC support work increasingly appear to be one of relationship management rather than personal technological expertise.

Attitudes to Technology

Throughout the interviews, participants used similar language to describe their relationships with technology and relevant intermediaries such as the IT department or commercial repository staff. Grounded in the data, the analysis identified six attitudes to technology, which are explained and evidenced in the sections below. Although distinct, they are not mutually exclusive. Participants often described themselves as playing multiple roles or shifting between them over time – for example, changing from an Avoider to a confident Interpreter and Customiser. This captures the complexity and ambivalence of orientations towards technology.

<u>The Interpreter</u>

Participants overwhelmingly depicted themselves as 'interpreters' whose role is to understand the terminology used by technical specialists and translate those ideas into plain English for researchers and co-workers. Many interviewees drew an analogy between the difficulties of communicating with colleagues, particularly in IT, with the notion of speaking a foreign technological language:

> […when] the university's IT department talks to me about user data and integrating systems, I don't know what they're talking about and sometimes can't put it into the language that I need to ask [questions] back. —P.E

> Nobody is asking me to [develop technological competencies], but I think it does sometimes put me at a disadvantage to the rest of the team who probably are almost talking a different language on some things. —P.A

The job of SCLs according to this characterisation is therefore to learn enough of this language that they may mediate conversations between library staff, systems staff and researchers. In the words of Participant E, "I'm almost the link between understanding how the developers work and what our users here need, and how I can translate it into a way that both of them can interpret."

The Customiser

Participants commonly portrayed themselves as 'customisers' – individuals who tailor systems and software to match the needs of the team/institution. As with interpreting, customising does not require all that much technical knowhow. Instead of delving into the inner workings of systems, SCLs access interfaces through which they can affect surface changes. Participant E explained, "I don't have the technical knowledge to get into the backend of the repository, so I can only do what's set up through the user interface, which is quite a lot". In the context of repositories, substantial work is usually accomplished by the external host:

> There're certain things I can do to a point and then I have to get [EPrints] to [do it]. If they need to apply a new plugin to the repository, they need to do it because they host us […], but little things I can do myself. —P.D

The Avoider

Interviewees sometimes characterised themselves as 'avoiders' who find technology to be challenging, confusing, or 'outside of their comfort zone'. This was typically described as a temporary state-of-being, usually at the beginning of one's SC support career, from which participants progressed to increased confidence. Note that Participant C's explanation also fits with the interpreter metaphor of language acquisition:

> I went to a meeting [about systems] within about two weeks of starting, and I walked out of it and thought "oh my god. I didn't understand the words; I certainly didn't understand the acronyms. What the hell is this?" And it's gradual. It's a gradual shift of "oh okay, I know what this means, I know what that means." —P.C

Participant G's hesitant explanation of herself as both not-techie *and* techie exemplifies an uncertainty most participants seemed to feel about their level of technological competence:

> I think that [repository work is] probably what people from my background, moving into research support [roles… find] hardest because… I'm not a techie person… well, I am a techie person in the sense I know how to use what knowledge I have, but not under the bonnet type stuff, not my comfort zone… I don't get involved in the data entry, I know how to do it because I show other people how to do it, but I wouldn't know the ins and outs of it, but then probably none of the team do, we rely on a lot of IT support for that side of it. —P.G

Despite confidence that they can function as interpreters, SC staff seem to fear that without this 'under the bonnet' understanding, they cannot count themselves as truly technologically competent.

The Commissioner

When an SCL behaves as a 'commissioner', they are providing a vision or goal for the team's use of technologies but are delegating the practical work itself. Participant A admitted "I think very often we all are just telling somebody else 'this is what we need to do, can you make it happen?'". As with interpreters, commissioners need to have baseline knowledge and an appreciation of what is feasible:

> So we'll go "I don't like the way the data citations display, can we change it?" and [my repository expert co-worker] can go off and do those kinds of things for us. And it's useful to have an understanding of what's technically possible. —P.B

It is important to note that, as in Participant B's example above, Commissioners rely upon having Enthusiasts or Experts present in order to implement or alter technologies.

The Enthusiast & The Expert

'Enthusiasts' are those with a personal interest in using and discovering technologies, and who seem to have a 'knack' for systems. A more formally educated enthusiast, 'experts' are knowledgeable, experienced, and confident tech-users (possibly with a background in computer science) who generally have a deeper understanding of technologies. One SC manager described looking to hire an enthusiast in order to enjoy the associated benefits:

> […] I wanted somebody who could think about tools in the same way that [previous enthusiast co-worker did]. You know, for somebody to be looking outside, for somebody to be [listening to experts and attending events]. And I don't think you have to be massively technical to do that, but there's something in your brain that has got to be interested in it. —P.A

Significantly, none of the participants described themselves as Enthusiasts or Experts, but many referred gratefully to co-workers as such. For example, in a discussion of repository migration, Participant F claims "[we were] lucky that we had two people that knew what was going on and could talk to the IT guys… I think it would have been tricky without that." The presence of Experts or Enthusiasts in teams appeared to cause a lack of incentive for participants to upskill themselves. Participant F continued "I don't think we all need to have that level of expertise, but it is good having somebody who […] has a slightly deeper understanding of things".

Communities of Learning

In order to plug technological skill or knowledge gaps, SCLs turn to different sources for advice, reassurance and training. Participants overwhelmingly agreed that most development of their competencies has occurred 'on-the-job'. Participant F explained "a lot of what we do is learnt by osmosis, you know – being familiar with the previous system and transferring those skills over to the newer system". Participant A agreed: "I've probably done most of my learning on the job, or from other people in this area in our library", before going on to note that SC departments have generally "kind of made it up as we went along. There really is a sense in which that is true across the UK".

To some extent, SC staff have little choice but to learn on the job. Participant G reflected that "[five] years ago, there wasn't the training out there, [and] I'm not sure how much training there is now". Participant F likewise thought "I'm not sure there is a lot [of] actual training as such", and Participant A admitted "I haven't really done much formal training to be honest."

Other participants had better fortune, however, even this training sounds somewhat opportunistic or ad-hoc, and reliant on resident enthusiasts:

> My boss who's just left was quite encouraging to go on lots of training courses. I think we're quite lucky […] to have some real open enthusiasts amongst our researchers, who put on things like GitHub training [...] so there's always little courses to go on or things to try out. —P.B

Interviewees reported success in using professional communities to support their work, especially around implementing or upgrading technologies. Participant G, for example, explained how the South-West IR Manager's Group "[got] together to share experiences" about repositories, before broadening into "almost a research support group". Participant D agreed that

> Groups are quite useful, email groups like UKCoRR and Sympletic user groups […] those are useful because someone will ask a question that you're [interested in] or you can ask a question yourself, [or for] getting sector contacts, to learn what other people are dealing with and where other people are at, it can make you feel quite reassured.

One of the benefits of using a large commercial solution such as EPrints is access to a user community to whom one can relate on a system-level. As Participant D noted, what's most useful is "finding someone who's got the

same or a similar set-up to you" in order to share ideas. Participant C explained a further benefit of how these communities can cooperate on resource developments:

> The benefit of EPrints is that there is a large community, so you don't have to do everything yourself. In the mailing lists, people will say 'hey, we're developing this right now' […or] you can simply put a call out, and if someone else is interested who has time, they'll work on [a project you suggest] for the benefit of everybody.

On the whole, interviewees agreed that they rely on a combination of on-the-job learning, help from team peers, advice from external groups and other sources. Participant E provides a useful summary:

> Yeah, [I've learnt a lot on the job]. I'm very dependent on asking questions, but also experiencing working with ePrints, watching what's going on in the UKCoRR list, and answering questions, attending meetings… so its learning from peers as well. But it's forming good relationships with people in the university as well, so you can ask those questions.

The Value of Generic Skills

Throughout the interviews, participating librarians were keen to stress the importance of generic, transferable, 'soft' skills, tending to rate them as more valuable than technological competencies. The skills they listed largely matched those described in the literature and SC job advertisements.

When asked to outline the essential competencies of an SCL, all participants expanded on the need for varied 'people skills'. Participant E explained that "given that we all interact with users […] we can't really have anyone in the team who is [technologically] backend only, they've all got to be able to deal with people". Participant A likewise said that "a lot of [SC work] is about communication, about relationships, about building people's confidence in us as a service", linking advocacy and networking competencies to more general communication skills.

Interviewees agreed that, when seeking a new employee, communication skills are more important than technical knowhow. Participant G explained how her team hired someone for a research data related post not for her data and coding skills but because "she could actually communicate; she was great at presenting things and talking to people". Participant B went so far as to speculate that "I think sometimes if you're too systems focused it can detract from your ability to build relationships".

Participant G also related communication skills with "negotiating [and] persuading skills", which others mentioned. Participant A pointed out the utility of negotiation skills when dealing with commercial partners such as CRIS or IR creators: "you're trying to influence developers who are basically asking you what do you want as a customer, but also what's your justification for wanting that, because it's a global product".

In addition to people skills, other less communication-oriented skills were mentioned by participants, such as Participant G's "financial, data-manipulation type skills for forming reports" and Participant C's description of "being properly numerate, [because] tracking and recording financial transactions is […] complex". This ties into the need for spreadsheet and data competencies mentioned earlier. Multiple participants used the phrase "attention to detail" to explain the kind of thoroughness required by SCLs. Participant C explained the need for excellent time management skills too, as the work is non-stop: "things do really come at you, there are smaller things; stuff you should be doing; stuff you want to do […] you get a phone call and suddenly an hour of your day is gone".

Discussion

Interviews revealed that the basic technologies employed by SCLs parallel those used by general academic librarians. The main technologies participants reported using in their work aligned with those listed under core IT sections of generic profiles, such as WebJunction's (2014) competency compilation: word processors, spreadsheets, webpages, communication and organisational tools, etc. Participants also largely concurred with SC-specific profiles that identified competency needs in areas such as repositories, metadata, webpages, OA

standards, etc. Existing profiles do, therefore, provide outlines of SC competency needs which reflect reality. However, there are a number of key areas which profiles either under or over emphasise.

IRs were far and away the most well-discussed technology in the interviews. Whilst older papers may not have foreseen their importance, recent studies give appropriately heavier weighting to the status of IRs (Auckland, 2012; Bonn, 2014). NASIG (2017), for example, afford IR management a fifth of their main competency index, and correctly pinpoint areas such as metadata and reporting which participants also highlighted. That said, profiles do not seem to realise the substantial effect external hosting and outsourcing has on IR competency needs. NASIG (2017) does accurately state that SCLs should understand "both hosted and open source repository solutions" (p. 5) and that depth of knowledge depends on institution-specific implementations. However, existing literature does not make the connection, revealed here in interviews, between externally hosted repositories and

a) the need for significant interpersonal skills to manage relationships with providers, and
b) a declining need for practical technical skills, since operational support is outsourced.

Competencies around systems and metadata integration are another area that may be understated by SC profiles. Interviewees often brought up metadata, crosswalks, and integrations between (for example) CRIS and IR systems as areas requiring expert knowledge. The literature, however, tends to gloss over this type of understanding, more often referring to metadata standards alone (Calarco et al., 2016).

Participants consistently explained that although technological knowhow can be valuable, SCLs do not typically need advanced skills themselves provided they can connect with colleagues and experts who have them. A notable factor already mentioned is the outsourcing of technical IR supervision to commercial partners, which means SCLs are not themselves involved in back-end IR work. When staff require assistance with, for example, applying plug-ins or smaller modifications, they usually communicate with their provider. Alternatively, librarians can rely on communities of practice for help, such as EPrints user groups or regional associations.

"As a profession, librarians excel at the creation of collaborative organizations" (Arlitsch & Grant, 2018, p. 274). This certainly appears to be the case amongst the SCLs sampled, who agreed that membership in groups can be very beneficial. These communities not only pool knowledge but allow librarians to bypass technological skills gaps entirely. For example, a librarian with no knowledge of scripting can download and install a plug-in shared on a DSpace wiki site. The cooperative nature of SC librarianship might, then, mean that the inclusion of advanced skills like coding in competency lists such as the SLA's (2016) is excessive.

SCLs perhaps have little choice but to rely on interpersonal connections, since training appears to be unavailable. Various literature concurs with the participants that SC training is deficient: Sewell (2016) suggests that "there is a systematic lack of education on SC issues". Practical technological training is a particular concern. Bresnahan and Johnson's (2013) assessment of librarian training needs revealed that staff were specifically anxious about data-related topics, and concluded that these should be a training priority. Participants here placed similar value on data skills, so this recommendation may still be worthwhile today.

Regardless of whether an institution has librarians doing "a little bit of everything" (Faniel & Connaway, 2018, p. 107) or can afford to let staff specialise, participants in this study expressed a shared conviction that generic, transferable competencies or qualities – especially interpersonal ones – are crucial to SC support work, and likely more so than any technological competencies. This is not, however, the impression given by SC profiles such as NASIG (2017) or Calarco et al. (2016). Studies outside the LIS field have noticed a discrepancy between the perceived value of hard versus soft skills. In their survey of IT professionals, Patacsil and Tablatin (2017) found that soft skills such as teamwork and communication were ranked as very important for new hires, but that interns overstated the importance of hard skills. Within LIS literature, Saunders (2015) states that "although much of the literature focuses on specific content knowledge and 'hard' skills such as technology competencies, there is evidence that 'soft' skills such as communication and interpersonal skills are at least as important" (p. 430). In this study, participants stressed competencies such as communicating, negotiating, networking, empathy and relationship management – perhaps understandably considering the volume of stakeholders they are interacting with.

The most common role participants claimed to play was that of Interpreter. Based in metaphors of language, fluency and translation, this attitude is undeniably bound up with communicative competencies. Other literature has also tended towards such descriptions. Bonn (2014) describes a broad expectation that librarians be "fluent in the language of SC" (p. 132); Glusker and Exner (2018) describe how the cross-disciplinary nature of SC "calls into play librarians' skills as translators" (p. 105). Saunder's (2015) focus group discussion on technology skills perhaps best matches how this study's participants conceived of their tech competency need:

> Academic and corporate librarians emphasized the need for librarians to be able to speak fluently with IT personnel, to assess and make recommendations about new systems and software, and to have at least some back-end knowledge of the building and structure of websites, databases, and so on. However, all of the participants agreed that the ability and confidence to learn new technologies were key competencies. (Saunders, 2015, p. 438)

SCLs are therefore *combining* soft skills with broad rather than deep technological competencies.

The metaphor of technology as language pervades both in this study and wider literature. It seems to be easily grasped by SCLs (perhaps since they are well-acquainted with concepts of information *literacy* and scholarly *communication*) and imparts a positive sense of ability to progress through the six attitudes. Where Avoiders lack the language needed to embrace technology. Commissioners know enough to phrase requests, and Customisers can make sense of (or 'read') interfaces well enough to affect small changes themselves. Interpreters – the majority of SCLs – are able to translate technological concepts for others. The even more fluent Enthusiasts and Experts are those seeking out and establishing technologies, writing new programs and documenting the process for others.

In this study, the key differences noticed between research-intensive and teaching-led institutions were the scale and resources of SC teams. Whilst unsurprising, it is worth exploring the implication that team size has on roles and levels of specialisation. Participants belonging to larger SC units were more likely to be specialised – that is, to have a role with fewer and more specific responsibilities, such as a focus on the IR or RDM. These findings concur with Pontika's hypothesis on 'clean' job descriptions , as well as other literature claiming that smaller/less affluent institutions rely on fewer, more generalist SC staff (Finlay et al., 2015; Thomas, 2013). But does specialisation into a more technical SC-subfield necessitate *advanced* technological competencies? The evidence of this study suggests not:

- Key technologies such as IRs are externally hosted and managed by commercial providers – hence SCLs are not deeply involved in back-end working
- Communities of practice support one another and share developments, thus competencies are shared amongst wide groups
- All participants, regardless of title, focused on core technologies and related skills; all prioritised transferable skills for hiring; and none described themselves as tech Experts.

Furthermore, one might question whether SC staff are truly specialised at all. Throughout this study, the concept of SCLs proves difficult to pin down: team names, job titles, specific responsibilities, and service-subfields appear to differ considerably. Yet paradoxically, interviews revealed a homogeneity of technologies, practices, communities, and distinct agreement on the type of competencies core to the field. Despite surface variations, it may be that SCLs are all, in fact, functioning (to greater and lesser degrees) as generalists.

Literature inspecting the broader realm of academic librarianship certainly points to increasingly blurred boundaries between roles. Paraphrasing multiple authors, Inskip (2016) describes how technological changes are turning librarians into "polymaths" or "blended professionals", merging "identities and practices" and crossing "contested jurisdictions" into rival service areas (p. 65). In SC, too, it seems that staff must combine the skills of liaison, data, digital, e-resource, research and other librarians, as well as dipping into specialist subfields like bibliometrics or RDM (S. Brown, Alvey, Danilova, Morgan, & Thomas, 2018; Cox, Gadd, et al., 2017; Koltay, 2019). If SCLs are functioning as research support generalists, this "suggest[s that] a wide, almost overwhelming number of skills, qualities, and knowledge areas [are] necessary" to the profession (Saunders, 2019, p. 7). This

can cause competency profiles and job ads to be "excessively demanding in terms of experiences and skills" (Schmidt et al., 2016, p. 6) and misrepresent the technological competency needs of SC staff.

Conclusion

This paper has documented various factors which impact the competency needs of today's SCLs. Several factors suggest a decreased requirement for staff to have advanced technological skills; others suggest an increased need for soft, transferable, interpersonal skills. Indeed, as the need for technological competencies decreases, the need for communicative soft skills increases. For example, advanced knowledge of IRs is needed less because back-end IR work is outsourced to providers; and outsourcing to providers increases the need for SCLs to be adept at communication and relationship management. Similarly, the existence of communities of practice leverages how effectively librarians connect and share knowledge; and in doing so creates less need for the individual to rely on personal technical skills.

In addition to balancing technological and interpersonal competencies, SCLs need to have a positive and receptive attitude towards technology. Saunders (2015) found in her study that employers "were less concerned with a specific set of skills than with a general comfort with technology—a willingness and an ability to try out and learn new technologies as they emerge" (p. 444). Percell, Sarin, Jaeger, and Bertot (2018) agreed that "successful information professionals must demonstrate both useful skills and a confident, flexible, and adaptive approach toward learning technology on the job, that is, aptitude and attitude" (2018, p. 155) – especially since technology is so fast-moving.

Soft skills and a positive attitude towards technology do not by themselves make a SCL technologically competent enough to be successful. A baseline level of computer literacy and technological understanding is also necessary. A useful concept to borrow is Twidale and Nichols' (2006) 'computational sense'. Although not aimed at SCLs, Twidale and Nichols' (2006) description of computational sense effectively captures the level of technological competency that both participants in this study and wider literature have pointed towards:

- The authors discuss a "comfort and fluency with computational systems" (Twidale & Nichols, 2006, p. 3) echoed by Participant B's explanation that "being comfortable using multiple different systems and knowing how they all work at one time is really important".
- The need for "metacognitive skills in learning about new computational resources" (Twidale & Nichols, 2006, p. 3) matches the willingness to learn noted by Saunders (2015) and others in the literature.
- "Fluency in tailoring applications" and a sense of apps as "co-designed artefacts" (Twidale & Nichols, 2006, p. 4) brings to mind empowered Interpreters and Customisers who will engage with technological intermediaries or interfaces to alter systems.

Although over a decade old, this 'computational sense' has enduring significance because it describes a baseline aptitude for technology in terms of mental approach rather than skills with specific technologies which would become rapidly outdated.

This paper proposes that instead of specific technological skills or knowledge, SCLs should be seen as requiring overarching 'socio-technological competence' which could be summarised in three competency areas:

1. Interpersonal skills in order to manage relationships with varied stakeholders, thrive in communicative/generalist roles, and function as Interpreters;
2. A positive 'interpretive' attitude to technology in order to understand technologies/intermediaries; a willingness to learn and progress their computational sense;
3. An appropriate level of computational sense, less in specific skills/knowledge and more in fluency with systems and an appreciation of technological possibilities.

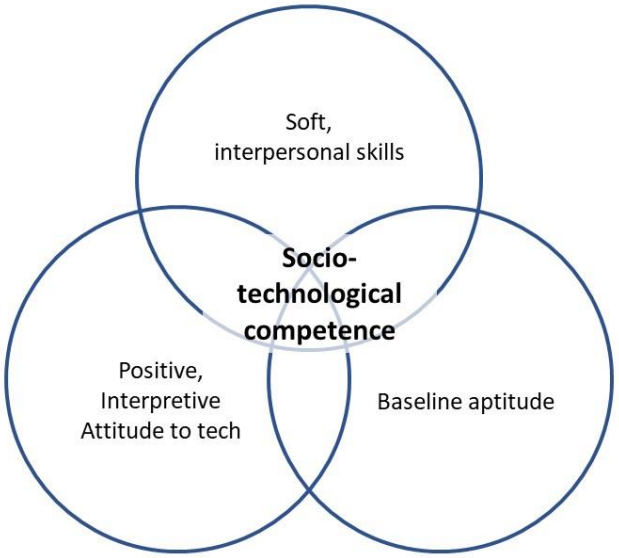

Figure 1 Socio-technological competence

Since the underlying factors shaping this orientation apply across librarianship we can speculate that this summary applies to some degree across the profession as a whole, though to verify that would require much more research.

A number of practical recommendations arise from the study. Recruitment practices can show even greater recognition of the value of soft skills and focus on certain orientations to technology rather than practical technical skills. The implication for Information Schools is that they should continue developing well-rounded practitioners with a broad awareness of technologies. However, they and training providers should consider offering units which explore IRs and data skills in more depth. Activities to encourage interpersonal skills (communication, teamwork, relationship management) should be interwoven through courses, and emphasis given to the collaborative, networked nature of today's technological world.

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Appendix 1 Interview questions

About you
Is your job title x?
Can you tell me a little about your role? Responsibilities?
How long have you held this post? Do you come from a librarian background?
Do you interact with researchers directly, or are you more behind the scenes? Acting as bridge?

Team structures & relationships
Could you tell me about the team/office? Name, size, focus?
Is there another research office? What's your relationship?
Do you work closely with the IT dept?
Any tech work outsourced, e.g. to ePrints, London?

(Tech) competencies
Overall, demand for you to be more than merely computer literate? Just basic/core IT skills?
Key systems you are working with? E.g. CRIS, helpdesk?
What competencies are most important in your role? E.g. communication
Specialised or need to be a jack-of-all-trades? Different across team roles?
Any occasions where you've felt the lack of particular tech skills/knowledge?

Institutional repository	**RDM**
How/who involved?	How/who involved?
Tech side (ingesting, editing)?	Need to understand data types across fields?
Outreach (training, user queries)?	Separate data repository?
Customising or altering system?	Long term preservation?
Metrics/impact	**Other themes**
How/who involved?	Text/data mining?
Tools, systems?	Coding/programming?
IDs, DOIs	(Self) publishing?

Training & development
Learning on the job?
Peer learning? Communities? Other unis?
Formal training? How useful? Time to attend?
Do you think specialised tech skills are valuable for career progression?

Hiring & ideal skills

Are tech skills looked for in new hires? Anything specific?

Are soft skills more important? What is most important?

Hard to find hires with right skill sets? Change over time?

Preference for researchers or librarians or comp scientists, etc.?

In the future

Any areas of increasing importance? Growth areas? E.g. preservation, RDM, data analysis, mining

Any particular skills related to those areas? Will skills need to change?

Will SC staff become increasingly specialised?

Will teams grow?