Finding the balance: Modelling successful workflows for digital library collections

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Abstract Workflows can be powerful tools for building and sustaining effective communication and efficient processes, especially in large organisations where expertise and responsibility is distributed across numerous departments and divisions. Drawing on the experiences of five practitioners working in academic libraries, this paper presents a set of recommendations for creating and modelling workflows to build and sustain digital library collections. This paper also synthesises some key considerations for successful workflow management, and argues that the creation and use of workflows can help practitioners manage and balance some of the common challenges that organisations and teams face in their efforts to build and sustain well-curated, interoperable, persistent, discoverable and accessible digital collections.

KEYWORDS: workflows, digital libraries, digital collections, project management

INTRODUCTION

Creating and managing digital collections in libraries, museums, archives and other cultural heritage organisations is an exercise in finding balance between standardisation and customisation, centralisation and federation, discrete projects and ongoing work, and highly detailed versus more lightweight processes, tracking and documentation. This paper draws on the experiences of digital library managers in five large academic research libraries to explore some of the common challenges and considerations in their efforts to find the balances that enable them to manage digital collection workflows effectively.

This group of practitioners first came together to present in a panel at the Digital Library Federation Forum in 2016.[1] Each member of this group identifies as a digital library manager within their respective academic research libraries, but their job titles, position descriptions and portfolios of responsibility vary widely. For each, the creation and use of workflows is critical to finding and sustaining these balances.

This paper begins with an overview on modelling workflows, followed by a more in-depth exploration of some of the common challenges practitioners encounter in defining roles, responsibilities and relationships, and in managing organisational and technological change. While the panel discussion that inspired this paper had each practitioner describing and discussing workflows in their own organisation, this paper is an effort to synthesise some commonalities, supported by specific examples from first-hand experience.

MODELLING WORKFLOWS

Simply put, a workflow is a sequence of steps towards the completion of a defined task.[2] Workflows are used to manage repetitive, ongoing processes.[3] In digital libraries, museums and archives, the goal might be to create a new digital collection, which could

include specific activities such as developing a project proposal, selecting appropriate equipment, defining technical specifications, digitising a collection, wrangling the metadata, ingesting the collection to a repository or promoting the collection for broader use. Well established in business and information technology management, workflow modelling, or the creation of logical visual representations of workflows,[4] is an important tool for successful project management and, more broadly, programme and service management.

Building well-curated, interoperable, persistent, highly discoverable and widely accessible digital collections is complex work with numerous decision points, actions and handoffs.[5] Digital collection projects proceed most efficiently from inception to delivery when they follow a clearly defined workflow. At the same time, workflows must be sufficiently flexible to accommodate variation between projects and inevitable changes in staffing, organisational structure and technology. Although the creation of each collection is often approached as a discrete project with a beginning and an end, effectively managing a programme of activity to create and maintain these collections is more about process than projects.

Workflow modelling can help participants and stakeholders understand the sequence and steps in a given workflow before starting a new process or to improve an existing one. Workflow modelling can also help identify patterns, gaps and bottlenecks to enhance the efficiency of underlying processes and improve team dynamics. As a group activity, workflow modelling and analysis can serve as a way to check performance, surface issues and challenges, and adapt to change.[6]

The following are considerations for creating effective, useful workflows:

- *Articulate the goal of the workflow:* Workflow modelling should start with a clear, concise goal statement. What is the purpose of the model? Who is the audience? And what process(es) will the model represent? Although many different things can be learned from a workflow model and from the process of creating it, each model should ideally have only one clear goal. Trying to make a single model serve multiple goals is a recipe for confusion.
- *Define where the workflow starts and ends:* Does the workflow begin when a new digitisation project is proposed, or when the digitisation work begins? Does the workflow end when the digital collection is successfully ingested into a repository, or when it has been shared and promoted?
- *Decide on the 'object' that moves through the workflow:* In the digital collections, sphere is the object moving through the workflow the digital project broadly? Or is it a specific item in the collection, such as a book, a folder, a photograph or a film? The former might help newcomers or stakeholders outside of the workflow conceptualise the work at a high level, and the latter might be more operationally useful for tracking actual work as it moves through each step in the workflow.
- *Determine the appropriate level of detail:* For workflow models to be useful, a balance must be struck between representing the work in exhaustive detail and keeping the model (and the modelling process itself) flexible and lightweight. A greater level of detail might be needed in order to ensure that each step in a complex workflow is adequately represented and, thus, delegated. On the other hand, creating a highly detailed workflow model can be very time-consuming, and too much detail can lead to clutter and confusion.[7]
- *Choose a modelling methodology:* There are many different ways to model a workflow, and no one-size-fits-all approach to workflow modelling.[8] The best approach will depend on the local context. Having a type of model in mind at the outset will however facilitate the modelling process. In any modelling methodology, it is important to capture all the steps in

sequence and try not to create endless loops or points in the process where conditions can never be met and so the process never ends. Remember that all models should have clear start and stop points as mentioned earlier.[9]
- *Provide a key:* Specifying the conventions used in the workflow in a symbol key or legend assists with clarity and reusability in different versions or levels of detail (see, eg, Figure 1).

Figures 2 and 3 from the Ohio State University Libraries illustrate some of these recommendations. Both workflow models were created to facilitate communication with different groups about how digitised collections are created at Ohio State. The 'object' that moves through the workflows is a project to digitally reformat a collection. Figure 2 shows a high-level model laying out the general steps in the workflow. It was developed as a tool for communicating with internal stakeholders who are not directly involved in reformatting collections, as well as with peers and colleagues outside of the organisation. Figure 3 adds the details of the subprocesses involved in each step. This latter model was created to help team members who are involved in the workflow understand all of the steps involved. In particular, Figure 3 has been useful for talking about the process with curators, archivists and other collection managers who are interested in proposing a new reformatting project. The Head of Preservation and Reformatting brought a draft of Figure 3 to reformatting team members for discussion and revision. In both cases, the workflow was modelled as a cycle in order to emphasise that the 'assessment' step should feed back into the workflow. In both examples, the 'launch' step and 'assessment' step are lighter to indicate the fact these steps needed further development at the time the models were created. These models were created in 2016, and in both cases, the modelling methodology was informal.

- *Start with the actual and move towards the aspirational:* Process improvement starts with understanding how things work *now*. Even if an organisation has no established workflow, it is possible to start modelling the current process with just a single project. Moving from the actual workflow to the ideal workflow also reveals bottlenecks, gaps and steps that need to be better defined or delegated more clearly.
- *Engage anyone with formal and informal knowledge of the workflow in the modelling process*: Bring all participants together for a whiteboard workflow modelling session at the outset of the process or get a smaller

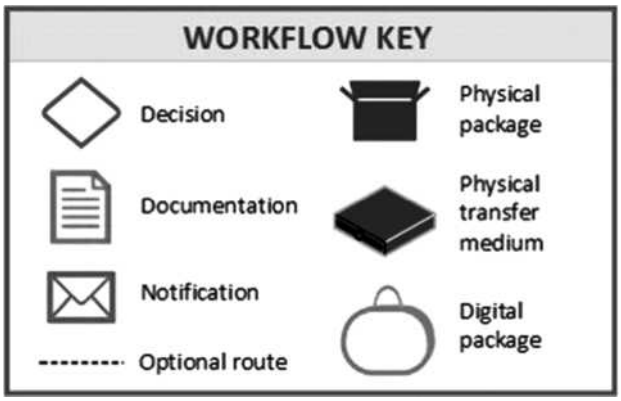

Figure 1: Key from the Digital Preservation Management Tools workflow model (2013–15)

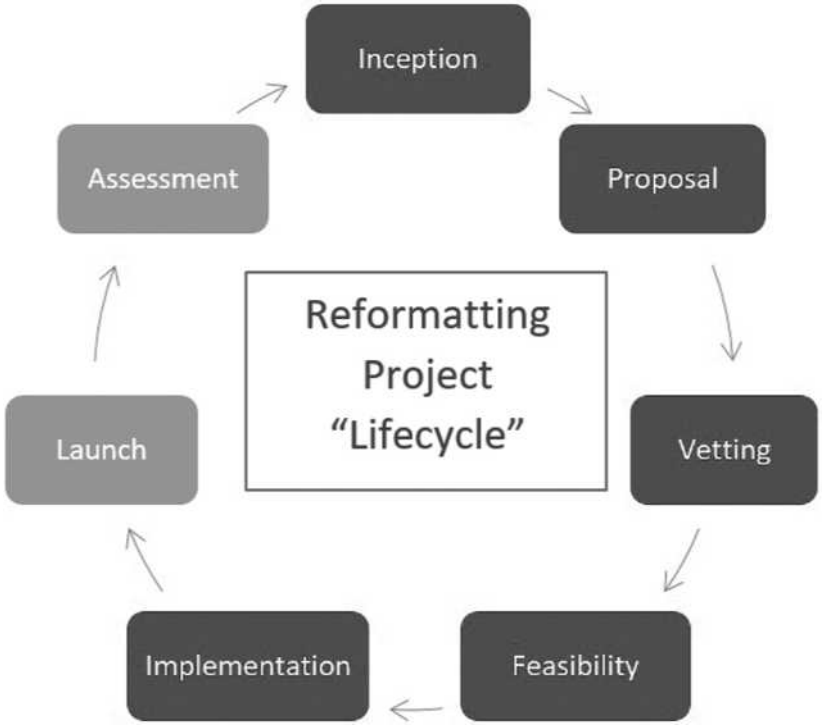

Figure 2: High-level 'life cycle' model from the Ohio State University Libraries (2016)

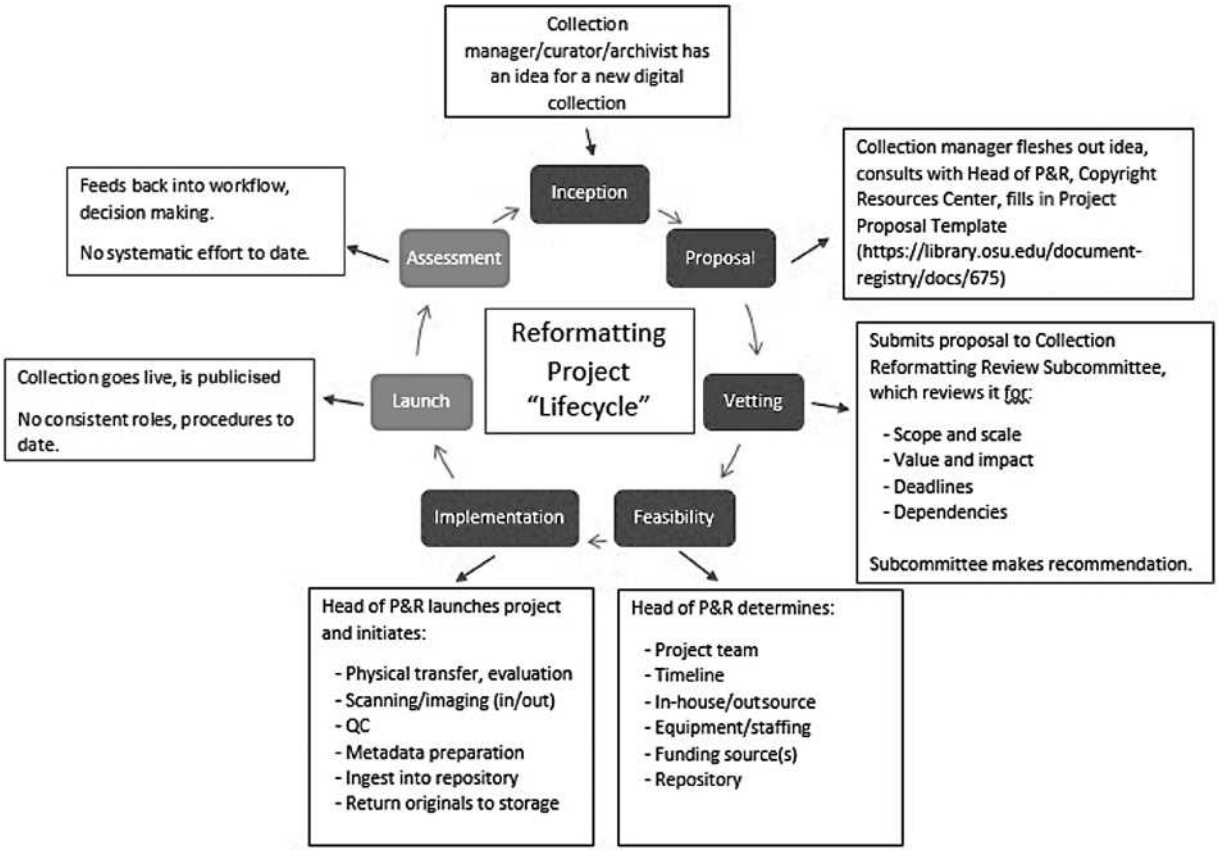

Figure 3: More detailed view of the 'life cycle' model from the Ohio State University Libraries (2016)

group (or even an individual) to develop a draft before soliciting feedback from others. It is important to include feedback from different stakeholders with both broad and more detailed knowledge in the review of the draft workflow, and to model the actual or achievable steps, not just the ideal process.

- *Scale the type of documentation to the purpose of the workflow:* The process of workflow mapping often begins with pen and paper or a whiteboard. Once the sketch has been discussed with the appropriate stakeholders, presentation software, such as Visio, Prezi or PowerPoint, is useful for presentation or display purposes. In some cases, software such as JIRA might have built-in workflow management features and tools. It is important to scale the investment in terms of time and energy to learn and maintain a given method, proportional to the task and the process.

The simple sketch in Figure 4 was created in order to brainstorm on the steps of the ingest process and demonstrates the difference in the workflow for 'ongoing' smaller projects versus more large-scale digital projects. At the UC San Diego Library, there was an increase in small projects in 2016, comprising

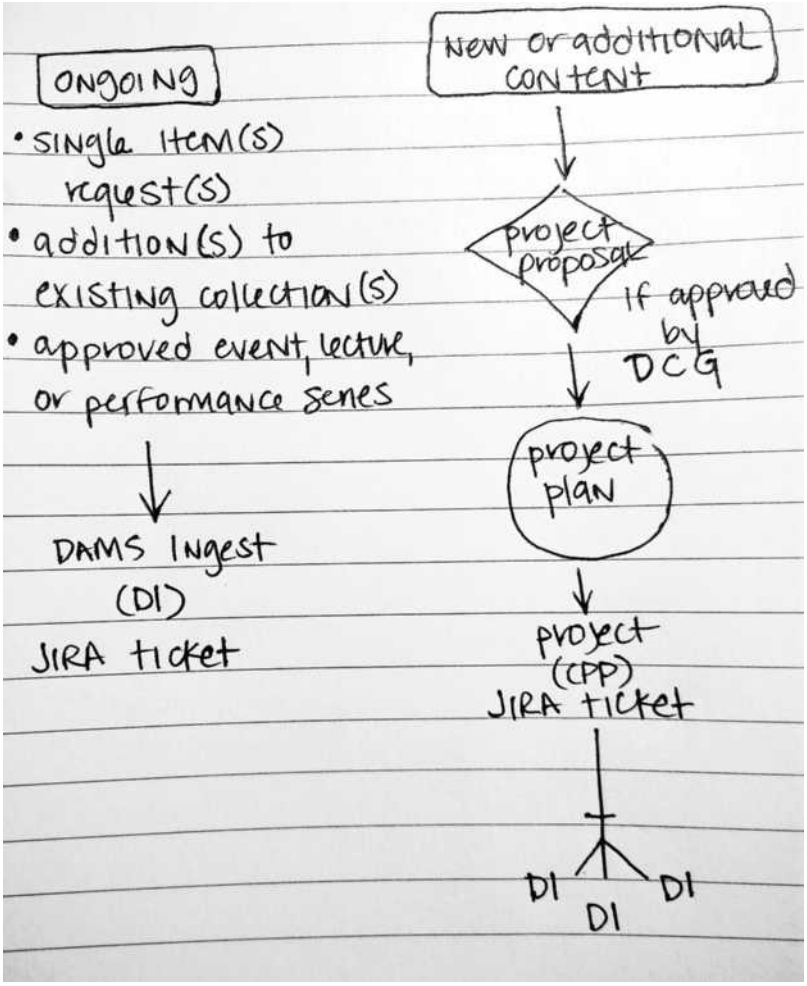

Figure 4: Sketch of the ingest process for simple 'ongoing' work versus larger, more complex projects from the UC San Diego Library (2016)

single item requests, additions to existing collections and continuing library or campus events such as lectures or performance series. The sketch differentiates between the process for ingesting content into the digital repository for ongoing smaller projects versus larger, complex digital projects that require greater resources and a more in-depth planning process. In this case, it simply remained a sketch because the goal was to think through the process and come up with a short-term solution. At the time, the UC San Diego Library was migrating to a new digital repository system, and this process was only used in the interim.

In contrast, the Prezi diagram[10] in Figure 5 is a more intricate example from the UC San Diego Library. While reevaluating the scope of the Metadata Policy Group (previously the Cataloging Committee) in 2012, the group created extensive data flow models to determine the 'database of record' or system(s) in which metadata was stored and managed. The exercise identified four distinct metadata systems: Millennium for monographs and serials, the digital asset management system for digital objects, Shared Shelf for still images, and Archivists Toolkit for finding aids and some types of digital objects. Useful as both a thinking exercise and team building activity, it resulted in the creation of subgroups within the Metadata Policy Group to oversee policies and procedures for each metadata management tool. In this case, the results were presented in Prezi in order to represent the relationships between the different data-flow models, including inputs

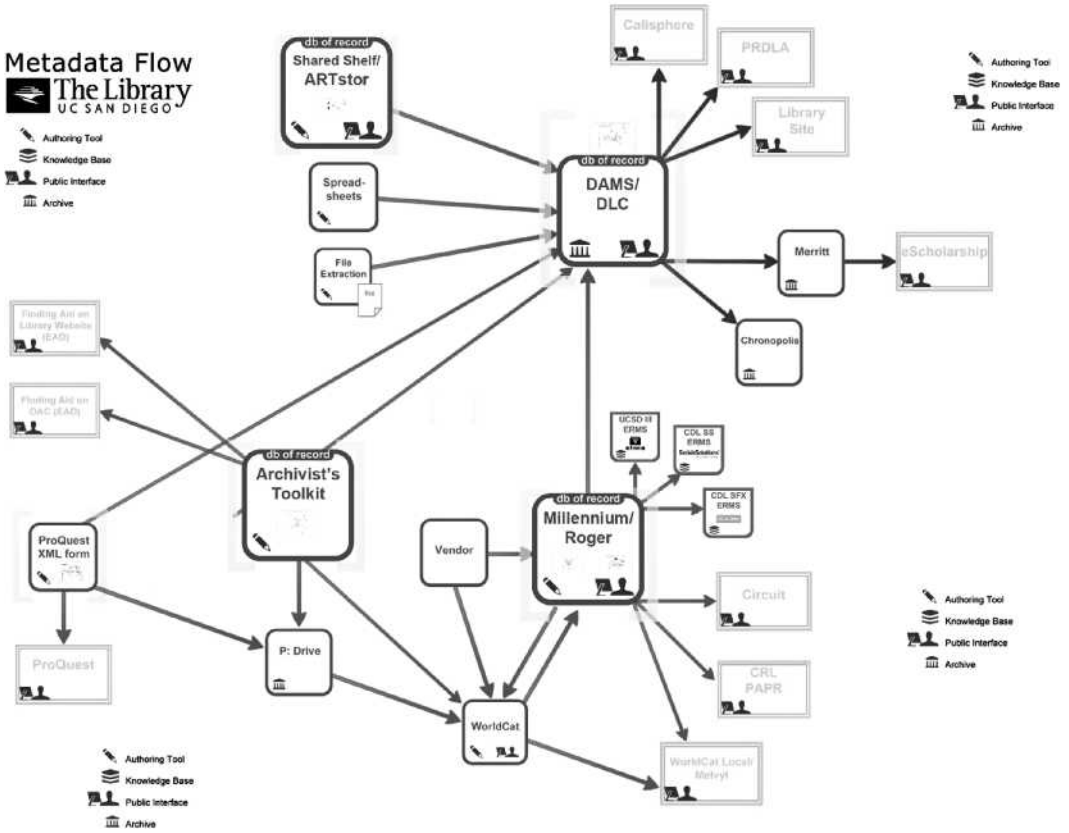

Figure 5: An analysis of the flow of metadata through different management systems from the UC San Diego Library (2012)

and outputs, and to create an image of the overall landscape.

- *Validation is a critical part of creating workflows:* Taking a closer look after a workflow is completed improves the quality and maximises the benefits to modelling workflows. At this point, it is good to play out 'what-if' scenarios to determine where changes may need to be made. Walk through the workflow, asking questions, clarifying terms, adding, subtracting or moving steps. It is also good to determine where data can be collected to track progress and measure improvement (time of certain task, volume of work accomplished, etc).[11]
- *Adaptive workflows are built over time with experience:* The initial workflow model designed may fail or need to change course. It is an iterative process. Workflow systems may be too restrictive and therefore can stop being used, or workarounds may form. Adapting to unforeseen circumstances, such as changes in requirements or processes that are too restrictive, improves workflow execution.[12]

Ultimately, workflow modelling and analysis are tools for enhancing communication, productivity and responsiveness. The examples provided in this section demonstrate balance between thoroughness and ease of creating and maintaining workflows. As work in the digital collections, sphere is prone to rapid and regular changes in staffing, resource allocations, organisational structures and technology, the real-world processes that workflow models represent must be adaptable.

DEFINING ROLES, RESPONSIBILITIES AND RELATIONSHIPS IN WORKFLOWS

Because of the wide range of skills and expertise required to create and manage digital collections, there is a wide variety of approaches across the cultural heritage sector for determining the most efficient and effective way to organise this work. In most cases, work on digital projects criss-crosses the organisation, with staff in multiple units responsible for different steps in the process. This kind of distributed workflow leverages partial resources (< 1 full-time staff) from specialised departments. Formally defining roles, responsibilities and relationships is crucial in any workflow, but especially in a distributed model where different organisational units bring their own work style, pace and culture to a cross-departmental project. A formalised workflow will create a structure that enables decentralised specialists to engage in effective collaborative work towards a common goal.

The following are recommendations for managing roles, responsibilities and relationships across distributed workflows:

- *Focus on the roles not people:* Developing processes that focus on people instead of roles introduces risk to a workflow; if the responsible person leaves the organisation, or if their time is redirected, a workflow can be disrupted or fail. A responsibility assignment matrix in the form of a RACI chart is an excellent tool for identifying the work at hand, the groups that will contribute to the project, and whether each participant group is responsible, accountable, consulted or informed as the project proceeds.[13] To keep the focus on roles rather than people, define roles and responsibilities using a RACI chart, visual model and/or other documentation tool first. Only after the necessary roles have been established should individuals be assigned to the workflow. To that end, models should reference roles or profiles and not individuals' names.

The cross-functional flowchart in Figure 6 was created in 2010 by the UC San Diego Library to show the relationship between areas of the library in the object life cycle

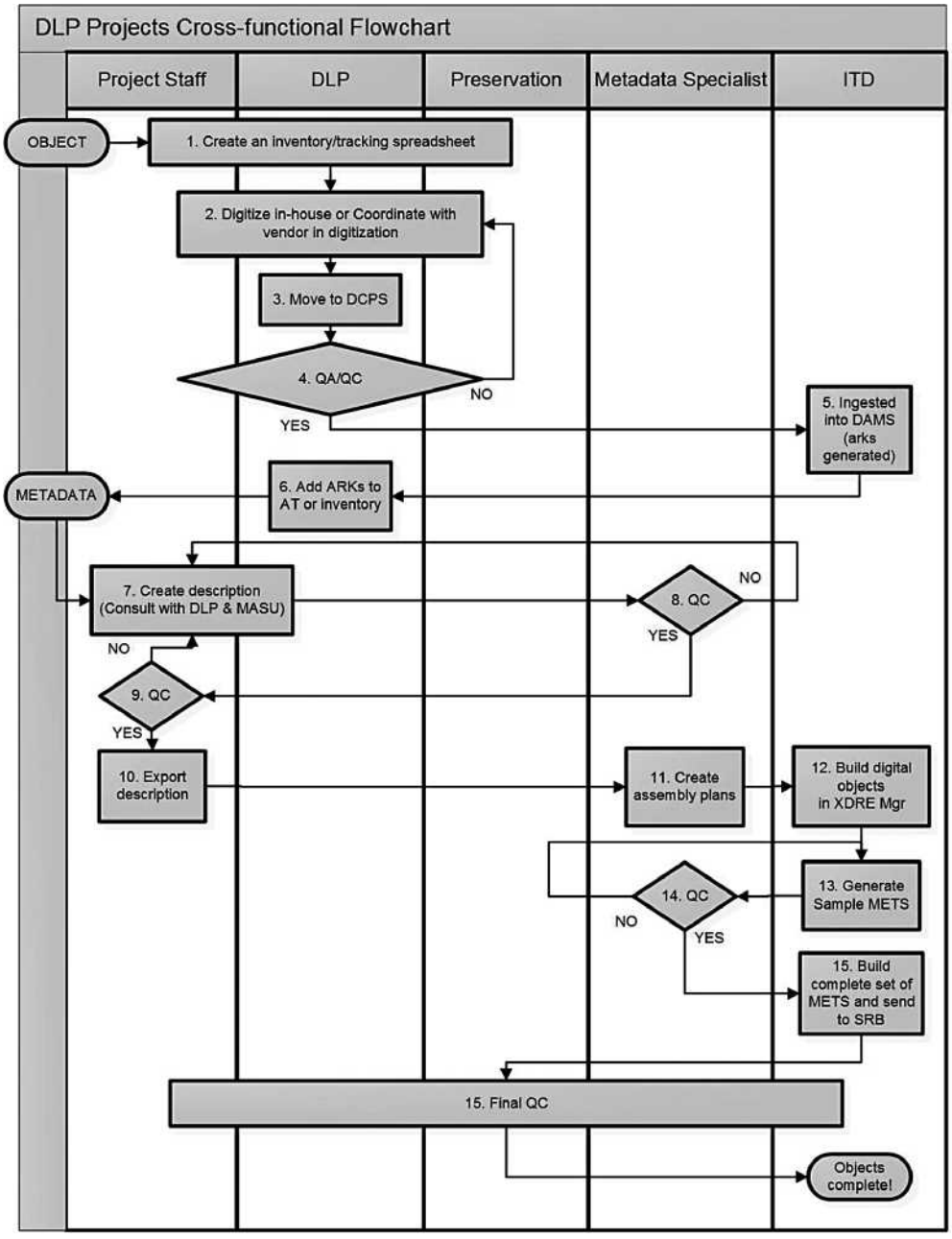

Figure 6: Cross-functional flowchart of the digital object life cycle from UC San Diego Library

from digitisation to ingest into the digital repository. It was used to determine roles and responsibilities at each step, discuss the coordination and hand-off points, and work through issues, such as who should be doing quality control and at what point? After analysing the workflow, one major finding was that project staff should consult with metadata specialists earlier in the process.

- *Find the balance between a rigidly structured workflow and one that will easily engage necessary stakeholders:* Building the right system involves creating a governance

structure that clearly identifies the stakeholders, the champions, the builders and those accountable for the entire project. The workflow, however, should not be so complex and inflexible as to discourage participation from key stakeholders. Instead, effective workflows should have a documented model that is clear to understand and can be modified easily, as those in the structure see fit.

For example, approval processes allow resource managers and library administration the opportunity to set priorities for institutional resources. Balancing this need with the effort required to engage project submitters and comprehensively vet projects can be challenging. Workflow managers should engage participants with an eye for pain points and work to revise processes accordingly. At Duke University Libraries, the Digital Collections Program Manager has worked with the digital collections approval team to set thresholds to streamline small projects, instead of going through the formal approval process.[14] This came after years of the approval team consistently approving small projects — a process that brought confusion, complexity and delays to project schedules. Finding the balance by creating a separate process for projects with low overhead brings more library participants into digital collections development and offers new opportunities for campus engagement, all while still maintaining an oversight system for bigger and more strategic projects.

The subprocess model shown in Figure 7, created in 2015, depicts a specialised feasibility review conducted by staff in three distinct functional areas (digitisation/reformatting, metadata and copyright) which informs a larger project selection and prioritisation process. A subset of the selection process, the 'deep dive' review is triggered only after certain selection criteria are met, due to the time investment required from staff conducting the three types of assessment. This deeper feasibility review of what originates as a brief project proposal greatly informs the accuracy of scope, cost and risk presented to the larger approving committee. While documenting this workflow, the specialists involved identified gaps and redundancies, which led to overall process improvements around documentation and handoffs.

- *Modelling distributed workflows improves hand-off points:* As mentioned earlier, digital collection building often incorporates distributed workflows because projects require many different skill sets. An effective model will show a team and its implementers when they will be expected to hand work from one department to another through the course of the project. A standard way to express workflows that draw on multiple departments is to use swimlanes, as shown in Figures 4 and 5. Each example uses swimlanes to clearly demarcate project contributions by different areas of the library. Swimlanes are not the only way to show handoffs between departments; Figure 8 illustrates a hand symbol to note these handoffs. Workflows, however, are rendered, it is important that departmental handoffs can be clearly seen and understood in any distributed workflow model.

Figure 8 uses the tools developed for the Digital Preservation Management workshop series to depict a subprocess in the distributed digitisation workflow at the Massachusetts Institute of Technology (MIT) Libraries during 2013–15.[15] The hand-off points are clearly identified with the hand symbol. Each handshake step is explicitly noted to capture the moment that content changes hands and the responsibility for it moves from one group to another. This allows for roles to be defined and staff to be clear about the activities during the handshake. The roles are shown above and below the workflow steps; above the bubbles is the

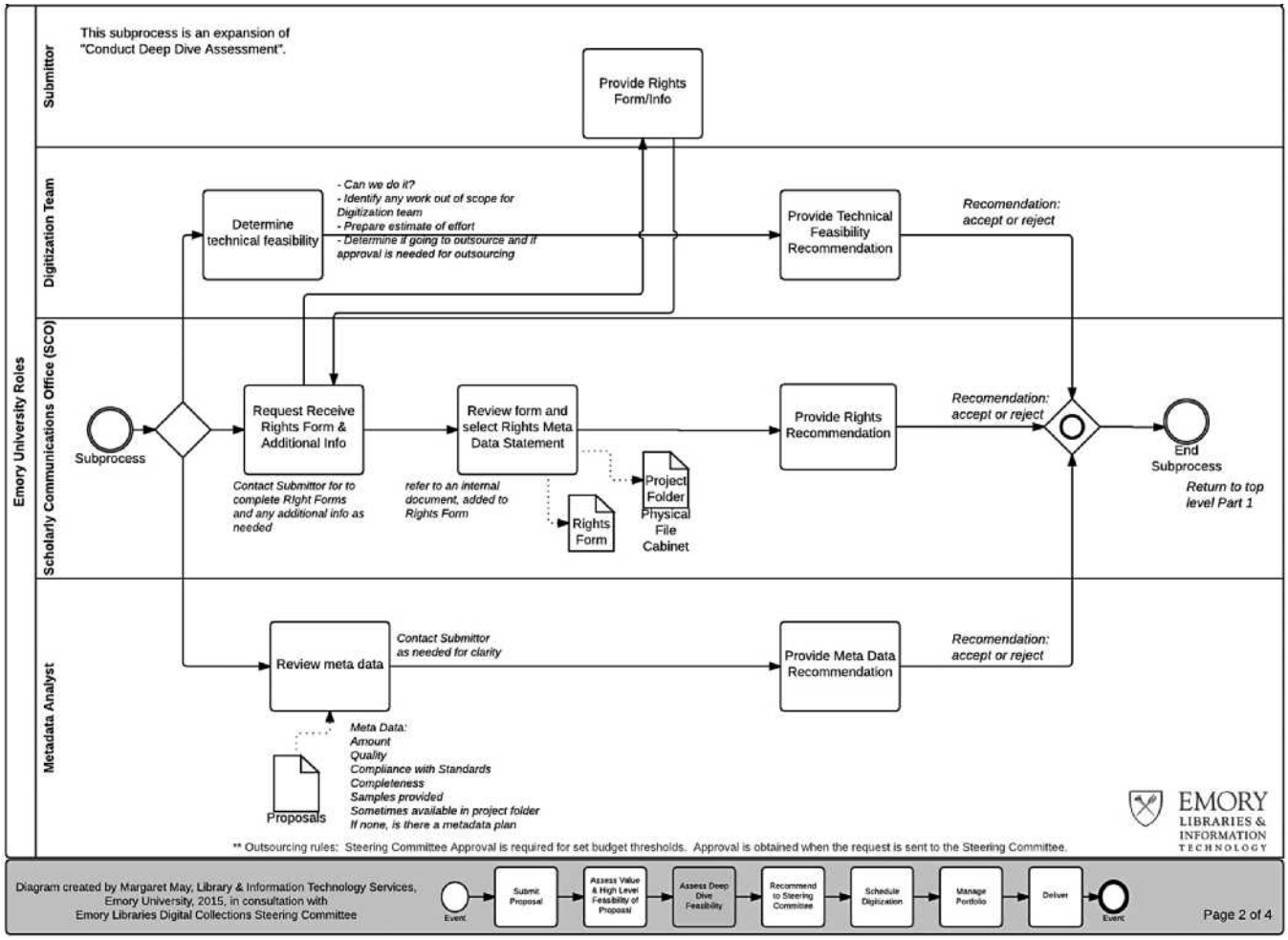

Figure 7: 'Deep dive' selection workflow — Feasibility subprocess from Emory University

RACI role of accountable and below the bubble are the RACI roles of responsible or service provider. In this example, the content curator (CC) is responsible for decisions along the process and the service provider roles are done by Preservation Services, Rights Group, Reformatting and Partner (vendor). Along the bottom of the diagram is an indicator that capturing chain of custody and evidence of activities is a critical outcome of the handshake. Using the handshake step in the digitisation workflow at MIT has provided explicit chain of custody documentation, item tracking, and has ensured that content (physical or digital) is only transferred from one location to another by specifically designated persons at a scheduled date and time. This has increased staff confidence with using distributed digitisation workflows as staff know that explicit handoff and documentation are expected and can be traced.

- *Use workflow models and documentation to clarify complex reporting relationships:* Distributed workflows regularly require a project manager to delegate and oversee the work of colleagues who do not report directly to them. Clearly assigning and documenting the roles of each specialist in a project makes it easier for project managers and contributors to navigate any issues that arise from this indirect

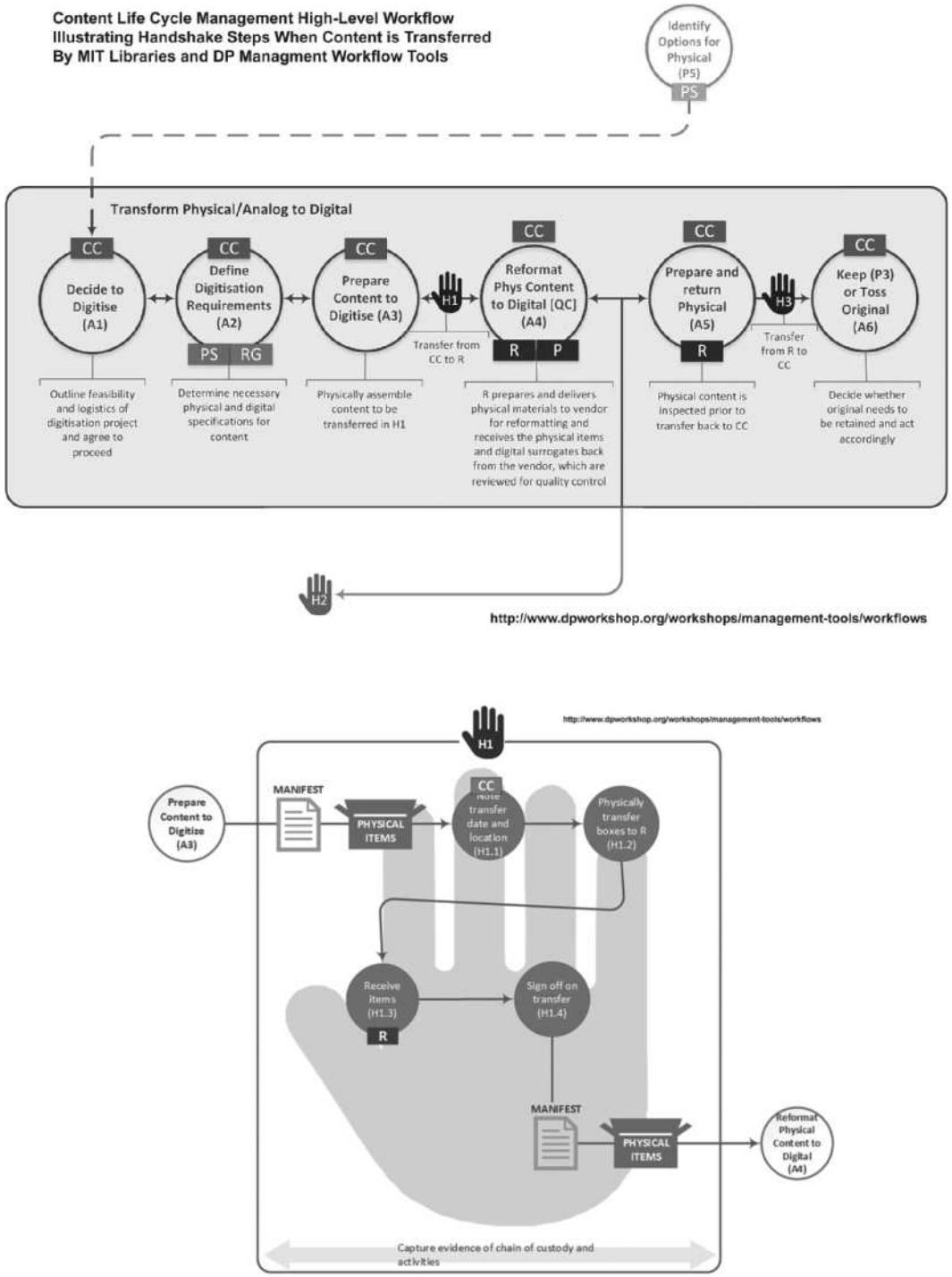

Figure 8: A section from the content life-cycle management workflow showing hands to indicate the handshake step when the custody of content transfers from one role to the next (MIT Libraries, 2013–15)

managerial relationship. Visualisations and models like those shown throughout this paper help project managers and a distributed team understand and execute their part of the process effectively. In addition to models, RACI charts like those described earlier, project charters and memoranda of understanding explicitly assign responsibilities and goals to specific roles and individuals.[16] Workflow visualisations and documents set clear expectations for resource managers and demonstrate when and what resources are allocated to projects outside of a specialist's primary department. They therefore sidestep any confusion that may arise when managing the work contributions of a colleague from a separate department.

- *Relationship building is fundamental in workflow management:* Project managers should invest time in building solid relationships with all representative groups and key individuals. Understanding stakeholder needs, assumptions, priorities and culture will help a project manager prioritise deliverables and run their team effectively. Building trusting relationships takes time, and requires project managers to meet deadlines as well as communicate expectations and updates regularly. Agile development tools like personas and user stories can help formalise stakeholder needs even when these stakeholders are not in the implementation team.[17] Additionally, holding regular meetings with a governance group or including a post project reflection step in a workflow will ensure regular communication with stakeholders. Taking the time to develop strong and trusting relationships will pay off in the long run, especially when a project manager needs to make changes to a workflow or when projects incur setbacks.

Managing cross-departmental workflows requires a project manager to clearly identify roles, responsibilities and processes in order to create a successful and sustainable outcome. Workflows do not only include the staff implementing projects, but also the stakeholders that propose, approve, prioritise and resource that work. It is up to project managers, their teams and their stakeholders to find the balance between a rigorously structured system and a more lightweight process for completing their goals. The 'right' approach to workflow modelling will vary depending on each institutional setting. Ultimately, a documented workflow helps set and reinforce pertinent workflow roles, responsibilities and relationships across the library.

MANAGING ORGANISATIONAL AND TECHNOLOGICAL CHANGE

The development and management of digital library workflows is directly affected by broader changes across organisations. These organisational changes can drive the development of a better workflow. In some cases, however, development may be impeded by organisational and technological changes, which may cause speed bumps or additional bureaucracy in the process of preserving and making digital collections accessible.

Organisational staffing models vary widely across institutions. About half of the authors of the present paper are under what may be described as the 'collections' division of the library and the other half are a part of the 'information technology' division. These reporting distinctions can affect the way processes are built and communicated to other divisions in the library, as well as stakeholders outside the library. In some cases, effective processes may be autonomously established by the manager of a department, service team or *ad hoc* group with roles and responsibilities that cross multiple divisions. Building decentralised digital library workflows, however, can be a complex and even disruptive undertaking that is often a

catalyst for changing operations. It involves building more formal and agreed-upon processes that involve hand-off points across the library.

Technological change is also often an impetus for major workflow and process redesign. For instance, the University of Michigan Library is building from scratch a brand new system to host and preserve its digital collections. It may be obvious, but because the models, the software, the access interfaces and the repositories will all be different when the project is complete, the process for creating a new digital collection will also go through significant changes.

Table 1 demonstrates the constant administrative and technological change faced by the authors' institutions. Changes listed in the table had a significant impact on the development and/or modification of workflows.

Types of organisational and technological changes, and the impact on creating workflows, are listed as follows:

- *Individuals who have redefined roles or left organisations:* One of the most common changes impacting organisations is when people switch or leave positions. As indicated in the previous section,

Table 1: Organisational and technological changes affecting digital libraries in the last five years

Institution	Organisational changes	Technological changes
Duke University	New AUL for Information Technology Services (ITS) (2014) Restructured ITS (2016) New digital collections proposal process (2013 and again in 2017)	Moving from a homegrown digital collections system to Hydra/Fedora repository (2015–ongoing as of 2017) Migrating back end storage from one campus vendor to another and incorporating DuraCloud (2016–ongoing as of 2017)
Emory University	Merger of campus Libraries with Information Technology Services (LITS) (2013) New University Librarian appointed (2014) Digital Library Program unit established (2015) Library Technology & Digital Strategies Division formed (2015) Library Software Engineering restructuring (2017)	Deployment of commercial digital asset management system (working archive) (2016) Migrating home-grown Fedora 3 repository applications to Hydra/Fedora 4 platform (2017)
Ohio State	New Head of Digital Initiatives (2013) New Head of Preservation & Reformatting (2014) New Vice Provost/Director (2016) New Associate Director for IT (2016) Strategic planning process in process (2017)	Development of a Hydra/Fedora repository; migration from FTP storage server (2014–ongoing as of 2017)
UC San Diego	Library-wide reorganisation (2012–13)	Move from locally developed RDF digital repository (DAMS) and access system to Hydra front end (2013) Migrating to Hydra/Fedora 4 platform (2016–17)
University of Michigan	New Dean of the Libraries (2013) New Associate University Librarian for IT (2014) Reorganised LIT (one new department, two new department heads, finished in 2016) New digital collections proposal process (2012 and again in 2016)	Moving from 20-year-old home-grown system to Hydra (modelling started in 2016) Moving to Fedora 4 (started in 2015)

workflows should identify the role or skill set, not the person. When changes occur, having a defined role in the workflow can aid in the transition, in either training the new person, justifying replacement of the person, or rethinking the workflow.

Figure 9 shows a visual depiction of a workflow developed in 2016 specifically detailing the roles of the agents between the divisions for creating rights investigation memos for each digital collection created and hosted. For example, the 'Copyright Officer' performs the initial approval to host the collection, and is indicated by role instead of by the name of the individual. This workflow will not require constant updating when individuals change positions over time.

- *Organisational restructuring*: These changes are often more radical, involving new or merged departments, personnel changes either to the roles and responsibilities or the reporting lines in the library and, last but not least, new ways of thinking about the structures that make up the division (such as, 'how are we a service organisation?'). Change management, paradigm shifts and cultural change can all indicate when a workflow may need to change.
- *New administrative management*: A change in leadership can radically shift the goals and focus of a library. During administrative changes, it may be important to provide context for the work and to promote the value of the digital library. In particular, it is important to impress upon administration both the dedicated effort related to building an essential workflow, and the roles that govern and sustain it. Models are a simple way to demonstrate to new administration how a particular workflow is integrated within and impacts the entire organisation.
- *New systems*: These can run the gamut from new software or ticketing systems to new repositories or division-wide protocols. For instance, the University of Michigan instituted a new method for proposing projects for the Library Information Technology division. This affected the entire library and

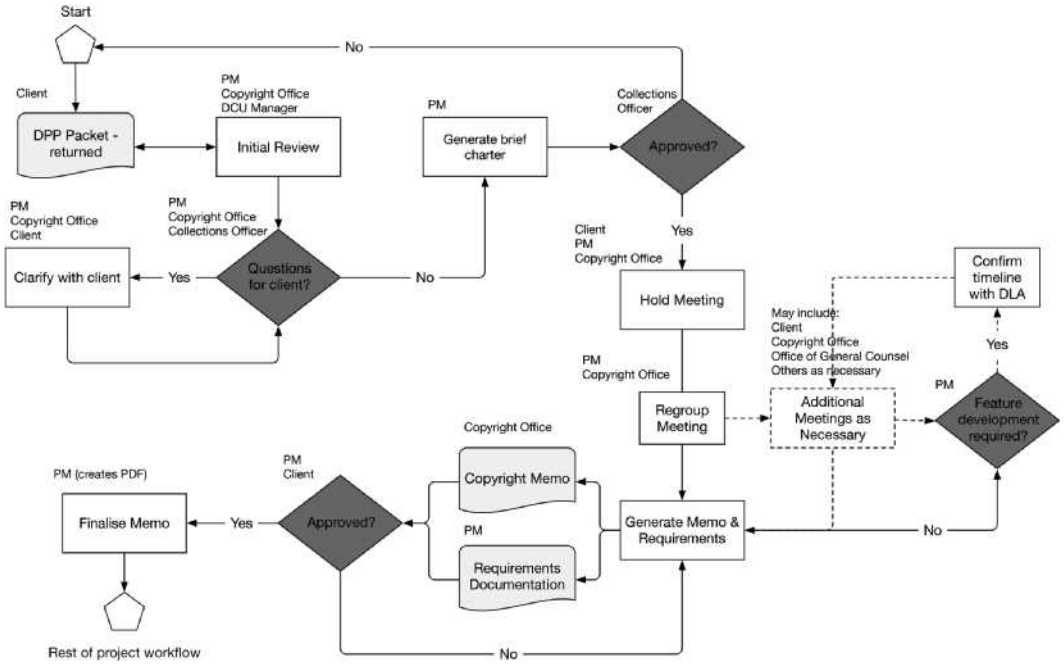

Figure 9: University of Michigan's workflow between Digital Content & Collections and the Copyright Office

necessitated ramping up a brand new tool, making significant changes to roles and responsibilities and creating at least two new library-wide functional teams. It is important to recognise the impact of new systems on any specific workflow. Having established workflow models can help forecast how new systems will affect operations and services.
- *System or other technology migrations*: While such changes do impact operations, the work tends to be more manageable in terms of process change because it is localised and handled internally. While migrations might not affect regular workflow, they may have an impact on new workflows being developed going forward.

While challenging, these sorts of organisational and technological changes can serve as good inflection points, or 'the point in a workflow execution where an unforeseeable eventuality arises'.[18] Inflection points can be used to examine what might need to change completely, be modified or require further analysis. They can provide the impetus to push for new perspectives or rethinking of processes to bring about improvements. Ultimately, as mentioned earlier, these sorts of changes make workflows more adaptable.

Organisational structures and technology platforms both have a large impact on digital library operations and frequently change over time. This, compounded by periodic staff turnover, reinforces the best practice to identify role-based responsibilities in workflow models, as opposed to naming individuals. Whether they are minor or disruptive, as organisational, technological or project changes occur, workflow models benefit from periodic review and retrospective evaluation.

CONCLUSION

This paper provides practical workflow recommendations and considerations from five digital library managers in academic libraries. The examples and best practices shared demonstrate how workflow modelling can be a highly effective tool for building and managing digital collections, especially in distributed settings. Creating effective workflow models and documentation is an iterative process improved over time. The value of investing in workflow modelling is in shifting the thinking from individual projects to systematic processes, and working programmatically to become more adaptive. Visual models of processes and accurate documentation makes roles and responsibilities clear, identifies points for process improvement, acts as communication tools for stakeholders and resource managers, and helps teams maintain balance in the ever-changing organisational and technical landscape in digital libraries.

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The models, tools and techniques provided here are available in the references section; more information is available online and at the DLF Project Managers Toolkit (https://wiki.diglib.org/DLF_Project_Managers_Toolkit#Workflows).

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