

Project Report

Distributed Team Working - Approaches for DiSSCo

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Reviewable v 1

Received: 08 Nov 2023 | Published: 20 Nov 2023

Citation: Hardy H, French L, Humphries J, von Mering S, Giere P, Berger F, Koivunen A, Grieb J, Vipp M, Smith VS (2023) Distributed Team Working - Approaches for DiSSCo. Research Ideas and Outcomes 9: e115454.

<https://doi.org/10.3897/rio.9.e115454>

Abstract

As a highly decentralised research infrastructure, the Distributed System of Scientific Collections (DiSSCo) will need to develop cross-institutional teams, adopting work practices where individual staff are intensively working collectively on common tasks in a distributed environment. These flexible and distributed working practices will be essential to the delivery of the research infrastructure across a wide range of delivery partners and a geographically dispersed set of scarce resources and skills, particularly in more technical roles. Since work to consider secondment and distributed working in DiSSCo was first envisaged, there has been a step change in distributed working owing to the Covid-19 pandemic and lockdowns or other restrictions to where work could take place. This report examines distributed team working practices and how they have changed, through interviews with a range of key roles across DiSSCo Prepare institutions. It briefly examines key project management and technical team delivery techniques. It documents how some of these approaches have been piloted within DiSSCo Prepare for the development, testing and delivery of DiSSCo Policy and Digital Maturity tools. Finally, bringing this together with previous work on secondment policies and practices for DiSSCo, we make recommendations about how secondment and distributed team working can be approached to enhance DiSSCo capabilities and the likelihood of successful implementation of the research infrastructure.

Keywords

secondment, distributed working, teamwork, capacity, capability, competency, competencies, skills, human resources, natural science collections, natural history collections, digitisation

Project context

This project report was written as a formal Deliverable (D3.3) of the DiSSCo Prepare Project (Koureas et al. 2023) and was previously made available to project partners and submitted to the European Commission as a report. While the differences between these versions are minor, the authors consider this the definitive version of the report.

The following text is the formal task description (Task 3.3) from the DiSSCo Prepare project's Description of the Action (workplan):

'Implementing the vision for DiSSCo requires improving the staff capacity and spread of expertise across partner institutions. This challenge is most acute in technical, engineering and project management areas where specialist staff are fundamental to delivering core parts of the DiSSCo Programme.'

'The most rapid approach to building capacity is the temporary transfer of staff or the formation of dedicated cross-institutional distributed teams. This is key to sharing of best practices and develop trust across the consortium.'

Introduction - distributed working in DiSSCo

The Distributed System of Scientific Collections (DiSSCo) will be a highly distributed research infrastructure, geographically and institutionally. It will need to ensure effective delivery of technical infrastructure in a way that draws upon scarce resources and skills based in different teams and locations; as well as ensuring joined up and consistent approaches across an even wider range of partners for the delivery of content and services, including digitised collections data. Distributed team working, enabling individuals and groups to work effectively together for delivery, is therefore critical to DiSSCo implementation.

Work carried out as part of DiSSCo Prepare and previous related projects has already provided extensive experience about distributed working across the many partners involved in work packages and tasks; including tools for virtual collaboration and central project management, such as use of the Teamwork project management software. Originally, it was envisaged that this report would focus on best practice from our own and other research communities and wider industry (e.g. broader technology development approaches).

Since then, however, the outbreak of the Covid-19 pandemic and widespread lockdowns from 2020 and other measures that impacted where work took place, have transformed the landscape of distributed working. Many more teams and individuals now make daily use of tools for virtual collaboration and have changed their policies and approaches to where and how work takes place. In this context, 'best practice' has become more fluid - approaches are still developing and falling into place, with a wide variety between different sectors, organisations and teams. In order to recognise this shift, we decided to adopt a semi-structured interview approach, exploring the topic of distributed working and the changes over the last two years in more detail with a range of key stakeholders and roles, including technical and coordination roles. This report presents the insights from those interviews. We then look at how some of these approaches have been applied in the context of developing two tools for DiSSCo and the lessons from that pilot.

Previous work (Hardy et al. 2022) has examined secondment procedures for DiSSCo, concluding that DiSSCo secondments would need to benefit not only the individuals and institutions directly involved, but also the wider needs of the DiSSCo infrastructure and consortium, delivering either skills growth or transfer considered to be needed for DiSSCo implementation and/or concrete delivery of DiSSCo components, such as technical infrastructure development. For the most part, distributed team working is likely to be a simpler and more cost-effective approach with constrained and distributed resources than full secondments of staff from one institution to another; however, these approaches can be complementary, falling along a spectrum of options available to DiSSCo to ensure that the right skills are deployed to the right tasks at the right time. Distributed teams may need some in-person establishment time, for example, or secondments could be virtual and for the duration of a particular task, illustrating the close relationship between these two areas. The final section of this report sets out our conclusions and recommendations, bringing together our work on distributed working with this previous analysis of secondment procedures and with the wider work carried out through this DiSSCo Prepare Work Package about competencies and skills.

Distributed working tools and practices

Following the changes to working practices resulting from the Covid-19 pandemic, we wanted to seek the views of our community on best practices and on what was working well and less well for them in terms of the tools and approaches available for distributed working. We considered a survey approach, but felt that a smaller set of semi-structured interviews would enable a deeper exploration of the reasons for preferring different approaches, as well as allowing us to explore what changes have taken place and why in particular teams.

Interviews were carried out over September to November 2022. Interviews were carried out by task partners, largely within their own institutions to facilitate understanding of local organisational structures and practices and to allow interviews to be held in the first language of the interviewees. A total of fifteen interviews were conducted - the interview brief, questions and a list of interviewees can be found at [Annex 1](#). Interviewees were

chosen to represent a range of key roles in relation to DiSSCo infrastructure development and use, including developers; digitisers and digitisation coordination roles; curators and collections staff; researchers; SYNTHESYS Virtual Access coordinators; and roles representing the Consortium of European Taxonomic Facilities (CETAF and the DiSSCo Coordination & Support Office (CSO - the central organising hub of DiSSCo)). Some quotes from the interview notes are interspersed with the summaries below, to give a flavour of the responses.

Where and how work is done

All interviewees had previously worked primarily on site at their institution, but worked for an extended period wholly or mostly at home during the pandemic lockdowns in 2020 and often beyond.

Both institutional and personal approaches towards coming back to work and the balance between virtual and in-person working vary considerably. For institutions, some have retained a very fluid policy, for example, allowing employees to agree with their manager whether and when they may need to be on site. Others have established a minimum percentage of time or number of days to be in the office (ranging from 20-60% for all staff, up to 100% in roles which require a physical presence); although typically these policies still allow for greater home working than before the pandemic and, even for those on site full time, some flexibility in working hours is appreciated. Some roles require in-person working all or most of the time, for example, digitisation which requires proximity to collections. Even for these, though, there is somewhat more flexibility than pre-pandemic, for example, transcription activities can sometimes now be conducted remotely. Some teams had had members working partly remotely before the pandemic, often in, for example, technical roles, but this is considerably more prevalent now. Fieldwork paused for many for a long time, but has now mostly re-started similarly to before Covid.

For individuals, there was also a lot of difference in approach, depending on roles and personal preferences. There is currently a full range of working locations and patterns from almost entirely remote to full time in person. Some strongly preferred to return to the office, often because they found it preferable to see colleagues in person and have company and more regular interaction or felt meetings are better in person. Others preferred the flexibility of remote or mixed approaches and the absence of distractions and disturbances at home. Those who attend the office perhaps a day or two a week noted that they use their office and home working days for different purposes, for example, working on documents or code at home and using in-person time to support their team, maintain personal contacts or attend key meetings. Newer staff in particular appreciate the opportunity to be in the office to meet more colleagues.

'Working online has the great advantage of being more flexible (less long term planning for in-person meetings etc.) and it results in much less travel. The down-side is that people miss the non-work related aspects of an in-person meeting, for example, a common dinner'.

Some key areas of work were affected particularly strongly by lockdowns and remote working, including work in laboratories (e.g. for research analyses and advanced imaging); teaching; and work on collections (including digitisation). This was difficult, but also had benefits in terms of innovation and ingenuity in coming up with new approaches. In particular, one interviewee who manages laboratories felt that the pandemic had encouraged agile problem-solving that the team had found rewarding. This had included good collaboration and a sense of shared mission with other teams, such as a more flexible approach adapting IT security to enable remote technology access; and had resulted in good options for many users including guided remote access with a small on-site staff, although software solutions for remote access were not always successful (e.g. time lags and latency affecting imaging solutions). These changes also involved a change of model, from training users to support themselves, to a more service-based approach - this was not entirely positive and has now largely been reversed, as it is good to build user capabilities through training and self-supported work.

'...strangely the best thing I think about it was that temporary period where we were just thrown into the task of solving a huge amount of problems as quickly as possible, with freedom to literally try stuff...that side of things worked really, really well and now we're back into the kind of routine grind - it's less enjoyable'.

Some interviewees commented on how changes to working patterns have affected productivity and here again there have been mixed experiences. Not commuting and doing work suitable to home working, perhaps with fewer meetings, were felt to have been good for productivity. Additionally, some 'backlog' tasks such as completing publications were achieved during lockdowns. However, work that requires physical presence, for example, work on collections, had, of course, to be paused.

Many, but not all, interviewees had experience of working in DiSSCo or linked projects as distributed teams across Europe before the pandemic. Distributed working using English as the common language is not considered problematic for most teams, certainly for those directly involved in DiSSCo distributed working currently, but often for their wider teams as well. Many teams within institutions are multi-national and multi-lingual in any case, particularly in the Netherlands and in Brussels and may use English in other working contexts besides DiSSCo, for example, University of Tartu (Estonia) maintain their development documentation in English. Nonetheless, it is helpful for DiSSCo to retain a focus on language, for example, to think about language(s) for infrastructure access and training. Some wider teams are less fluent in English and this may impact wider DiSSCo communications and engagement with potential users. Additionally, some respondents mentioned that, for example, they find writing in English harder than speaking or vice versa.

'Sometimes it would be nice to be able to express yourself in your own language. But I'm used to using English because it's the working language in our team anyway'.

Tools for distributed working

All but one respondent had been issued hardware for remote working by their institution (and the one who had not could have requested this if they wanted it) - usually laptops, peripherals such as headphones and sometimes mobile phones. Some preferred to use their own hardware when working at home, which was often of a higher standard.

'...our employer would have provided all hardware except the desk, but I chose to use some of my own or buy some myself so I don't need to take them back to the office'.

Tools for distributed working make a huge difference - the prevalence of these and their high take-up and increasing familiarity to many people in lockdown have had a permanent impact on how work is done. While many institutions have particular software supplied for primary work use, it is common to use multiple tools for different projects, contexts or collaborations. Specific comments were made about particular software as follows:

- The most common **video conferencing solutions** are Zoom and Teams. Some also use Google, Skype, Webex and BigBlueButton (a platform designed for online education). One respondent commented that, in BigBlueButton, it is easy to set up a common virtual room where all members of the group can always enter and start a conversation. Less familiar apps, or those not supported by institutional IT teams, were generally more likely to cause problems and most people sometimes experienced problems joining meetings. Overall Zoom is preferred by most.
- The most common **chat/messaging apps** used are Slack and Teams. Slack was mentioned as having good integrations and is also used by some now for conferencing. One respondent mentioned an increase in emails with remote working, while for others chat tools such as Team and Slack have displaced email traffic. Matrix Chat was also mentioned by one interviewee.
- Google was preferred by most for **collaborating on documents, spreadsheets etc.** and for the functions of Google sheets (better linking between sheets, good querying language). Microsoft collaboration tools are found to have time lags and other issues.
- GitHub and GitLab are preferred for **collaborative work on development projects**, technical documentation and code.
- Most interviewees are familiar with **DiSSCo's use of the Teamwork software for project management**, but few use this regularly or find it intuitive (including those also using it in other EC projects).
- Miro was the most-mentioned **virtual whiteboard** - interviewees who have used these tools have mixed views about their usability, with some finding them very versatile while others struggle to navigate them.

- Institutions offer **virtual private networks** (VPNs) for accessing certain work software - these are useful, but accessing some systems remotely (e.g. the collections management system at NHM London) can sometimes be difficult.
- Other tools mentioned included those for **storing and/or sharing files** (DropBox, WeTransfer); **task, ticket or project management** (Trello, Jira, Teams planner, ClickUp, Pivotal Tracker) - where no solution seems to be wholly satisfactory for users or strike the right balance between offering sufficient functionality without getting too complex; TimeCamp for **time recording/management**; and the Confluence wiki for **internal knowledge sharing**.

'I prefer everything which is Open Source'.

'Video Conferencing with screen sharing makes it much easier now in meetings to make sure that everyone talks about the same thing'.

In most cases, the majority of meetings are still being held online or hybrid, with an option to attend virtually. This is considered useful for larger meetings in particular. Where pre-Covid most meetings were held face to face, now most are fully or partly virtual. Hybrid meetings are recognised as useful, but frequently cause problems either related to hardware/software or to how meetings are run, for example, side conversations in the room. Interviewees would like to see better and more innovative hardware and software for hybrid meetings.

'...although most meetings are organised face-to-face, there is always an option to participate over the web if someone prefers so'.

'...earlier about 90% of meetings were held in person, now about 90% are held remotely online'.

'Hybrid meetings are most difficult, since our facilities and equipment do not properly support them'.

What's working well and less well

Problems identified by interviewees included:

- physical health - for example,. repetitive strain injury from typing, vision problems from overuse of screens and/or reduced exercise and mobility through working 'through a screen' at home and not, for example, cycling to work regularly;
- mental health, for example, the impacts of not being around other people, not feeling motivated;
- lack of social time and emotional connection with colleagues, whether at the employing institution or through conferences/events with wider peers;

- long working hours with virtual working or lack of distinction between work and personal time and space (although some also felt home working improved their work-life balance or control over working hours);
- where particular groups, for example, researchers are working more remotely, this has weakened communication with colleagues in other areas;
- it can be difficult to plan and know who will be available when, for example, knowing who will be on-site on a particular day or what physical space is available with an increase in hot-desking.

Benefits of changes to working included:

- saving time and money on commuting (and sometimes getting more work done by using this as work time);
- reduced travel, which is good for individuals and for reducing planetary impact, for example, through fewer flights;
- less disturbance or distraction when working from home (though a few felt more focused when in the office and not thinking, for example, about domestic chores);
- ability to fix software and server problems remotely was mentioned as a positive by one interviewee;
- online meetings can facilitate meetings that accommodate different time zones (e.g. without having to be in the office very late or early).

Most respondents particularly appreciate the flexibility in ways of working that the last few years have brought. While there are mixed views about, for example, the experience of hybrid working, the element of choice is welcomed by all, as is having more control over personal schedules, for example, to do work at different times and manage domestic commitments more flexibly around work.

'Having a choice between off- and on-site working is very good for me'.

'The best thing is that now we have the ability to work from home and that it is recognised that you can be just as productive at home as in the office. The best thing overall is the current policy of combining home-office and being physically at the office'.

'I would really like to emphasise the importance of physical meetings (from time to time) in order to socialise with (distributed working) team members and build trust and confidence. Also I would like to emphasise that if a meeting is held virtually, it must always have an agenda and the organiser must be very clear about the expected outcomes of the meeting, in order to avoid a reduced efficiency...'

'Since we now do most of our team meetings remotely via Zoom, talking about and presenting software related issues has become easier because anybody can quickly share

their screen at any time. In physical meetings, you often encounter hardware issues and it is more cumbersome (you need a projector, need to change the connected laptop etc.)’.

‘It is not as easy to get to know your colleagues online and the meetings feel much more formal and focused strictly to work’.

Many were not aware of approaches in other organisations or wider working practices that they wanted to try. One interviewee mentioned product management approaches as something they would like to see explored and used more widely. It was also mentioned that sometimes processes for internal approval of funding, projects etc. do not keep pace with technical approaches and development.

Recruitment and induction

Some interviewees are not involved in recruitment or induction processes and a few had seen no changes. Those most involved, however, had experienced changes during and after the pandemic. During the pandemic, remote interviewing and induction was necessary. Remote interviewing was possible, but several felt it was harder to get a full impression of candidates this way. Some roles, for example, digitisation and some lab work, require physical handling tests or training on equipment which need to be performed on site. Some institutions had reworked their induction materials, for example, producing a pack of information that could be shared remotely. More focus was needed for remote induction and sometimes this had not worked well, for example, new colleagues were not introduced as widely.

Offering flexible, remote and hybrid working is something most institutions are now doing or considering - within the limits of their individual policies about in person working for instance - to help make roles attractive. This is very necessary as many are struggling to recruit, particularly to more technical roles which can command higher salaries in other sectors, although many sectors also now offer remote working. This is less of an incentive in countries or locations where local commuting cost and distance are lower.

‘Applicants now ask for 100% remote jobs, which did not use to happen before. However, we can only hire according to the policy (60%/40%). Applicants especially asked for remote working out of other countries; however, this is not possible due to tax laws and funding policies’.

Working with partners can help to address recruitment challenges, for example, working with local higher education institutions to secure interns as a pipeline of talent.

Events and collaboration

As with many aspects of changes to working practices, interviewees have had mixed experiences of online events. A key positive here seems to be inclusivity - many report seeing greater and more diverse attendance at virtual events and attending events themselves virtually that they could not have taken the time or had funding to visit in

person. Barriers to attendance in terms of time and costs are reduced or removed, with no travel costs and often no or small registration fees. Those presenting or organising have felt the benefit of larger and wider audiences, for example, feel that their message is more widely disseminated. On the other hand, many feel that virtual events lose out on key aspects of networking, even where virtual tools are offered for this. Additionally, it was also mentioned that it is easier to become distracted from events and lose focus - though it can also be a positive being able to be selective about which sessions to attend. Some had attended remote training or workshops and felt these had gone as well as physical events would have done.

Overall, collaboration - including international collaboration - has become easier as more people are familiar with a range of tools for remote working. Virtual collaboration is time- and cost-effective. Face to face meetings and interactions still clearly have a place in this and are important to many collaborators, particularly when building relationships. Where individuals are still primarily employed in a wider role, though, finding time and focus for DiSSCo distributed working will always remain challenging.

'International collaboration in general is easier now because everyone has got used to video conferencing systems. Online events/conferences are more difficult now, because the networking part, which is very important, is missing'.

'The problem isn't being distributed, it's being primarily focused on another institution and/or set of tasks as priorities'.

Key overall themes and insights from the interviews

Overall, key themes and insights from the distributed working interviews are as follows:

- From this limited pool of interviews, there are no clear patterns in relation to roles, other than the fact that some roles are only possible to perform in person while others could theoretically be entirely remote. There seems to have been slightly more likelihood that technical roles already involved some remote working and tools before the pandemic, but this experience is now universal.
- While this was not a direct question in this process, it was apparent from the responses that many of the teams and individuals working in DiSSCo are involved more widely in distributed and collaborative working, for example, their roles involve working with a wide range of teams within their institutions; with national and international stakeholders; and with different specialisms, such as technical, research and other roles. This is likely to be a strength for DiSSCo, as these individuals will approach distributed working confidently and effectively.
- Virtual working practices and tools have made collaboration easier and more inclusive, with lower barriers to entry. It will be easier for DiSSCo to leverage these approaches post-pandemic. On the other hand, many people feel strongly about face-to-face interactions, including a mixture of work and social contact. This is

particularly important for newer staff or for forming teams, connections and collaborations. Thought should be given to the key points in a distributed project when face-to-face contact may be most beneficial, including perhaps for kick-off events/meetings and for seeing in person how other organisations do things (e.g. seeing digitisation workflows first hand if that is relevant to the project).

- Flexibility and choice are universally appreciated, both in working practices, such as location of work and in choice of tools for different purposes. Wherever possible, DiSSCo should avoid being prescriptive in these areas and allow distributed working teams to identify what practices and tools best suit their group and purpose. However, groups should then document these agreed working practices and agree, for example, how to be clear about their availability, to facilitate communication and planning.
- Finding time for distributed working alongside wider roles and challenges can be difficult. Secondment or similar arrangements to dedicate time to a particular task for an agreed period may help to resolve this.

IDigBio have run a webinar series and shared resources about resources and virtual collaboration for Natural History collections post-pandemic (IDigBio 2020). This included sharing learnings from two events, which strongly supports the perception of our interviewees about increases in audience size and inclusion, with one seeing audiences in 15 different time zones and one with registration around four times larger than previous physical events. While loss of social connection and networking opportunities is a key concern, DiSSCo should be aware that virtual or hybrid events offer an exceptional opportunity to engage the widest possible audiences, for example, for dissemination.

Distributed working pilot

Part of the remit of this task was to examine a pilot of distributed team working in use for DiSSCo. The area identified for this pilot was the development of the DiSSCo Policy and Digital Maturity tools. This is relatively constrained in scope, but is a practical example of developing a new platform and approach across multiple teams and institutions, during the relevant time period for this task and report.

Approach to the DiSSCo digital tools

Under the scope of DiSSCo Prepare, two tools were prototyped:

- A policy tool which will help DiSSCo understand policy alignment across the consortium and will be used to develop a common set of policy principles for DiSSCo services; and
- A digital maturity self-assessment tool, for institutions or teams to consider their level of digital maturity and their priorities for improvement and to help DiSSCo central organisation to target training, support or other interventions.

The digital maturity tool was suggested and the requirements documented, through work to examine competencies for DiSSCo; however, this task had no development resources. Both tools were, therefore, developed within the policy tool task, the partners in which were The Natural History Museum (NHM, London); Naturalis (Leiden); The Consortium of European Taxonomic Facilities (CETAF); Luomus (Helsinki); Meise Botanic Garden; the Muséum national d'Histoire naturelle (MNHN, Paris); and the Royal Belgian Institute of Natural Sciences (RBINS, Brussels). This also had the benefit that a common platform and approach could be developed for these and any future DiSSCo tools.

Distributed working was, therefore, necessary to:

- Develop user stories and requirements;
- Develop the platform approach for the tools;
- Develop the specific tools and content;
- Test the tools and content;
- Align across the two relevant DiSSCo work packages; and
- Align with the separate project in SYNTHESYS+ (Smith et al. 2019 - NA2.1), which was developing the policy metadata schema that is central to how the Policy tool operates.

These interactions illustrate the importance of distributed team working even for a DiSSCo development task of a relatively modest scale and timeline - it is very common for DiSSCo delivery to span different countries, institutions, teams and work packages/projects, with high complexity and a need for good collaboration mechanisms.

The project has used the following tools and platforms to facilitate distributed working:

- Zoom and Microsoft Teams for virtual meetings.
- DiSSCo Teamwork and GitHub for project updates.
- Google Drive for collaborative documentation, including;
 - Google Docs for minutes of meetings and to draft milestones.
 - Google Sheets for initial user stories (shared doc for each task partner to record ideas) and for requirements.
 - Google Slides for presentations for meetings.
- GitHub for software code and to record and manage issues (e.g. from user testing).

Work with SYNTHESYS+ on the metadata schema

This development project has had to work closely with the DiSSCo-linked project SYNTHESYS+ (Smith et al. 2019) on the policy metadata schema which underpins the DiSSCo policy tool. This has been approached in the following way:

- The NHM Data Architect designed the metadata schema conceptual model - so, although this work was in a different project, there was a strong team connection that facilitated communications.
- The NHM Business Analyst attended relevant SYNTHESYS+ meetings. This ensured teams were kept informed on progress in each task and allowed the policy metadata schema team to feedback on the development of the policy tool.
- The NHM Business Analyst (for DiSSCo task) and CETAF Project Officer (for SYNTHESYS+) also had catch-ups about the project plans.
- The SYNTHESYS team held a workshop (21 - 22 September 2021) and all DiSSCo task members were invited to attend. This gave an opportunity to provide input into the content of the metadata schema and the discussions provided information about the user stories and requirements for the policy tool (workshop attendees included those who would be likely future users of the policy tool).
- The CETAF Project Officer (SYNTHESYS+ task lead) participated in user testing for the Policy Tool and the SYNTHESYS+ task group were shown the Policy Tool in an open session, prompting discussion and feedback about the implementation of their work.

DiSSCo tool development and delivery timeline

Work to develop the policy tool for DiSSCo ran from November 2020 to July 2022, with the task split into three distinct phases. The first phase, between November 2020 and April 2021, investigated user stories and requirements for the policy tool. During this phase, it became clear that the requirements for this tool were similar to that of the digital maturity tool and it was agreed that the same platform could be used for both tools. Phase 2 (May - December 2021) covered the technical preparation for development, including investigating options for platforms and integrations with other DiSSCo Services (such as the DiSSCo Knowledgebase). Phase 3 (January - July 2022) involved the development and user-testing of both tools.

Phase 1: User stories and requirements, November 2020 to April 2021

The initial phase of the task focused on developing user stories and requirements for the policy tool. All task members were invited to meetings to discuss requirements and contributed user stories, with meetings taking place on Zoom and Google Sheets used to collect user stories. The NHM Business Analyst also interviewed potential users of the

policy tool during this phase, which included users from outside of the immediate task team. User stories help to explain what an end user needs from a product and can be used to provide information about the requirements of the software tool. Updates were also provided as required to wider work package or business stream meetings.

The NHM Business Analyst conducted semi-structured interviews with potential users from NHM, Meise and Luomus (five interviews). Task members were asked to invite colleagues who would use the policy tool within their institutions to take part in these interviews. These interviews were conducted over Zoom. The distributed nature of the task meant that colleagues from across the consortium could be interviewed, meaning there was a wider variety of experience than if a single institution were involved. These interviews were used to create new user stories and to test that the user stories already gathered from task partners were mentioned when speaking with 'real' users.

The output from this phase was the Policy Tool Design Blueprint, which included a set of user stories outlining use cases for the policy tool and the functional and non-functional requirements for the tool. The functional requirements were mapped to the user stories and were written in the form of acceptance criteria (French et al. 2021).

Phase 2: Technical preparation, May to December 2021

In the first task meeting following the completion of the policy tool design blueprint, a project plan was drawn up for the rest of the task. This included a technical preparation phase, where the roadmap for development would be agreed, followed by a series of build and testing phases (Fig. 1).

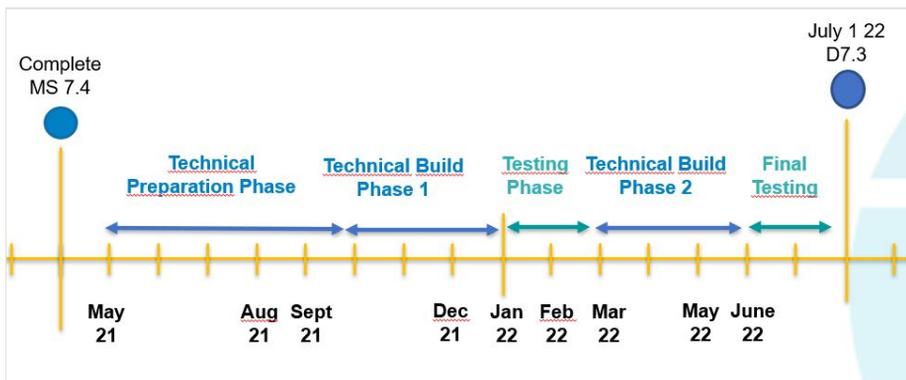


Figure 1. [doi](#)

Initial project plan for the development of the policy tool.

Task partners also discussed the similarities between the requirements of the digital maturity tool and the policy tool. A representative from the digital maturity work attended this planning meeting and it was agreed that one platform would be developed for both tools, allowing for consistent user experience and enabling work package 3 to focus on the

content of the maturity tool, rather than the technical development (which the work package was not resourced to cover).

It was also agreed the task would be split into three groups during the technical preparation and development phases to help task members focus on their areas of expertise:

- Developer Group: This group consisted of people with technical expertise, who would either be directly involved in the development of the policy/digital maturity tool or would be able to provide advice on technical aspects of the task;
- Business Group: This group was formed to provide a forum for the Developer Group to consult with business-related questions. Membership included task partners with knowledge of DiSSCo CSO requirements, as well as those with business analysis and project management skills. There was representation from both the digital maturity tool and policy tool tasks. It was intended to give developers a place to get quick feedback on user interface design and to get agreement over any issues or queries;
- User Testing Group: This group included people who were identified as likely users of the policy and digital maturity tool and they agreed to be involved in the user testing of the tools. There was some overlap in membership of this group and the business group.

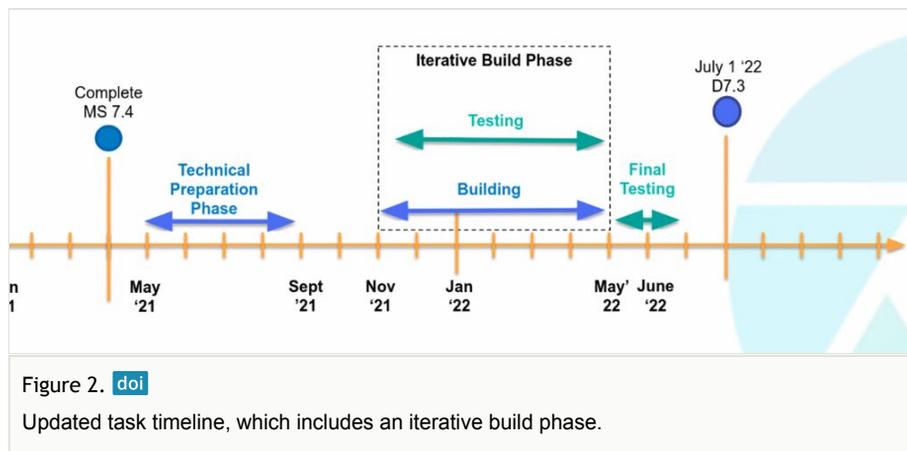
The Developer Group led on the technical preparation phase. They met to agree on development principles for the task, which were:

- to make code available through a public DiSSCo GitHub repository;
- to make an open source licence available through the repository;
- to donate Intellectual Property (IP) to the DiSSCo legal entity;
- to have a contact person/lead developer available for support;
- to display a privacy statement and version information.

This group also agreed to adjust the initial timetable (Fig. 1) to one which incorporated agile principles (Fig. 2). Rather than having distinct phases of development and testing, instead the task would have an iterative build phase where user testing took place on early versions of the tool to provide information for the next phase of development. This would allow for more flexibility and better aligned the project with current software development best practices.

The Developer Team consulted with the team working on the DiSSCo Knowledgebase to discuss the level of integration between that and the tools. The options ranged from a tightly-coupled integration, where the Knowledgebase would contain the metadata schema and policy tool, to a more loosely coupled approach where the Knowledgebase would host DiSSCo and institutional policy documents, but a separate policy tool would be developed. After discussions, this loosely coupled approach was taken. Primarily this avoided complicating the development of the Knowledgebase with additional, new requirements during the final stages of relevant work, but the Developer Group also decided that the

potential upsides of developing the forms and interfaces for the tools inside the Knowledgebase would likely be undermined by the complexity of actually doing this and then maintaining these customisations in the future.



Once these decisions were made, the Developer Team focused on practical questions regarding programming language and framework choices for the development work. After discussions, Python was selected, with the main backend of the web app being developed in the Django web framework (<https://www.djangoproject.com/>). The use of Python, aligned with the existing skills within the team, as well as making use of one of the more well-known and popular languages around today, thus ensured ongoing maintenance would be as easy as possible. The choice of Python also aligned with previous choices the DiSSCo Tech Team have made for other services, where Python and Java have predominantly been used. The frontend of the web app would be developed in VueJS (<https://vuejs.org/>), again in line with existing team skills, thus ensuring a modern, responsive experience for users of the tools.

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The development team used the available tools, most notably GitHub, to manage the work and work collaboratively in a mostly asynchronous manner. Virtual meetings were mostly organised ad hoc and called when there was a need for a wider discussion about a particular choice (for example, the initial choice of languages and frameworks). Given the fairly short timescales of the development work, it proved challenging to organise the development work of running a new project from scratch using only existing resources and skills, while working in a distributed environment. This was compounded with communication delays and holiday clashes, for example, where different countries have different schedules and traditional holiday patterns. These issues made collaboration harder.

The Business Group agreed to meet every 2 weeks for half an hour, which allowed the developers to bring urgent queries to the group for discussion. The Business Analyst and

Lead Developer met a few days before the scheduled meetings to set the agenda: if there was nothing to discuss the meeting would be cancelled. The meetings had only one or two items on the agenda, allowing for a short discussion and a decision to be made.

User testing sessions were arranged over Zoom, scheduled for 45 minutes. Users were given a login to the policy tool, asked to share their screen and talk through their thoughts as they used it. The Lead Developer and Business Analyst led these sessions. This helped to develop the policy tool, with feedback incorporated into the next phases of development. Feedback on the design was also sought at wider relevant task meetings within DiSSCo and SYNTHESYS+.

Reflections and lessons learned

All DiSSCo development tasks are likely to involve complexity and cross-boundary, distributed working of some kind. It is important not only to involve DiSSCo technical team(s) or resources in software development, but also to have representatives from the business and wider community. A project manager is essential to ensure the work is on track and also to facilitate conversations between the distributed teams.

It's helpful for project teams or groups who have to work together on distributed activities to have flexibility and agency in the selection of their tools and approaches, so that they can choose those that suit the specific people and purpose and can flex these if there is a need, as the project develops through stages for example. We, therefore, suggest that DiSSCo provide easily accessible information about tools and best practices, proactively making this available to projects, but do not prescribe a particular approach. In this case study, the project management timeline was changed to adopt a more agile methodology (Figs 1, 2) and the coding language used by the developers was only determined after discussions on the skillsets of team members. On the other hand, flexibility should be balanced by consistency and suitable re-use of tools, approaches and functionality, with appropriate controls in place to ensure there is consistency across projects where this is necessary and the DiSSCo Technical Team were, therefore, involved in these discussions.

It is important that there is coordination across the different elements of a distributed project. In the policy task, the task team had discussions with the DiSSCo technical team, the DiSSCo Knowledgebase team, colleagues working on tasks relating to competencies and the related SYNTHESYS+ task. Good communication between these elements meant the project was more successful, for example, integration with the Knowledgebase was considered at a relatively early stage and the communication with work on competencies meant that resources were used more effectively by combining effort.

In this project, it was beneficial to have a range of institutions involved in the task during the project discovery stage (Phase 1: User Stories and Requirements). The distributed nature of the work meant the task was able to draw on a wide range of experiences to gather user stories and could benefit from the different networks of each task partner in finding potential users to interview. The availability and improved take-up of video

conferencing platforms like Zoom meant users could be interviewed virtually even though they were not directly involved in the project.

Bootstrapping a development project (i.e. depending only on existing skills and resources rather than, for example, hiring new dedicated resources) is harder with a distributed team and some skills within the team will be drawn upon and required at different stages of the project's development. This will create natural ebbs and flows in demand for skills and time which must be accounted for and managed. This again makes the need for a project manager essential to ensure the development team's time is being used best, for example, limiting the time one individual spends on a problem without the input of other team members.

The inclusion of technical staff who are likely to do the development work of the project as early as possible is strongly recommended as it ensures continuity in thinking and allows for early feedback to be given around future development choices. The earlier iteration plans can be put into place with development milestones, the earlier the developer time (which is likely very much in demand at the hosting institution) can be lined up and secured, the easier managing the project will be.

Distributed team working and secondment in DiSSCo - conclusions and recommendations

As a distributed infrastructure, with considerable limits on the availability of resources and of skills including technical skills, it is imperative that DiSSCo make the most effective use of working tools and practices to enable construction and use, drawing on the distributed skills and competencies across the DiSSCo network.

This could involve secondments - where a member of staff is assigned to another institution for a fixed period. DiSSCo secondments will not only need to meet the needs of the individuals and institutions concerned, for example, for skills development and knowledge transfer, but will also need to deliver specific tasks for the DiSSCo infrastructure itself. This is a fairly complex balance, that would, therefore, likely need central incentivisation and coordination to overcome the barriers to organisations freeing up resources.

Secondment has the benefits of embedding an individual into a specific team and task, avoiding competition from their wider role during the relevant period and of offering skills development on all sides - however, it can be complex to incentivise and arrange. It is likely that many DiSSCo needs can be met more straightforwardly through distributed team working, building on the work already done throughout DiSSCo Prepare.

There is no 'one size fits all' approach to distributed team working or distributed infrastructure development that DiSSCo should adopt:

- Different individuals have different preferences and personal constraints, for example, from where they primarily work;

- Different institutions have adopted different practices and policies post-pandemic, for example, different requirements about on-site working time;
- A very wide range of free and paid-for software tools are available for all aspects of virtual collaboration, from sharing code and documents, to video conferencing, chat and task, time or project management;
- Different approaches to project management and to development have different pros and cons in different circumstances or teams, for example, may suit the skillsets of existing developers or may fit well with other relevant DiSSCo tools or platforms; and
- On occasion, distributed team working will also involve commercial suppliers or partners, who may have their own preferred approaches.

In this context, it is important that tools and practices work for teams, rather than the other way round. DiSSCo should aim, wherever possible, to allow flexibility for teams to specify the tools and approaches that they prefer. It is important, however, that teams are supported at the outset to discuss and agree their approaches and expectations in a structured way, so that, for example, work is shared in one agreed location and all team members and stakeholders are clear on where they can find information or how they can collaborate with each other. It is also important that tools and competencies are reused where possible, so, for instance, teams may be able to choose from a couple of options, but not a limitless list - cost, of course, may also be a consideration here.

On the project management side, there is extensive information and training widely available that this task has not attempted to duplicate. Again, flexibility to select the best approach for each project in DiSSCo is desirable, within whatever central approach is adopted to managing timelines, dependencies and resources. However, it is likely that, in setting up a distributed infrastructure in a constrained timeframe with a complex stakeholder network, Agile approaches that prioritise rapid testing, regular showcasing of emerging products and continuous improvement are likely to be most relevant, as reflected in the pilot above. It is also likely that product management type approaches (Wikipedia 2018) that think about the life cycle of DiSSCo products and services and engage multiple skills and stakeholders in this from the outset, will be beneficial.

While the challenges of DiSSCo infrastructure and service development are high, DiSSCo will benefit from the experience of many technical and other colleagues in collaborating remotely in distributed teams for DiSSCo Prepare and other projects. The programme is also already benefitting from the explosion in virtual working and the greatly increased familiarity with a wide range of tools during and following the pandemic, making distributed team working a reality for many people across our sector.

Annex 1 - Interview briefing, questions and list of interviewees

Brief provided to interviewees

What?

Part of the remit of DiSSCo Task 3.3 is to examine best practice for distributed teams to work intensively and collectively on common tasks; and to share expertise where particular skills may not be locally based. The Covid 19 pandemic also saw an explosion in remote and distributed working and events. We are now conducting some interviews to understand within the DiSSCo consortium what changes to working practices and tools have taken place and what the experience of this has been like for those involved - drawing out best practices and lessons learned to inform Task 3.3 analysis and recommendations.

Who?

In the first instance, we have asked members of the consortium who are working on Task 3.3 to nominate one or more people in their institution (including themselves if relevant) to be interviewed. We will also invite particular stakeholders, such as those working on the ELViS platform. We will seek to balance interviewees to represent insights from different communities including developers/technical; managers/leadership; and those coordinating DiSSCo centrally.

How?

Rather than providing a survey, Task 3.3 members will conduct interviews, usually virtually, to allow for discussion and follow up questions, as well as a consistent format of responses.

Interviews are expected to take up to an hour. Interviews will generally be conducted in English - however, if you prefer another language, we may be able to accommodate this and translate afterwards.

Your consent is requested to record the interview with you (if possible); to make notes or transcribe interview content; and to use this in the relevant Task 3.3 Milestone or Deliverable, either summarised as general themes or, from time to time, as a direct quotation. Please confirm in writing and/or raise any concerns with your interviewer.

Interview questions

Personal details

1. Name
2. Job title and short description of role and team
3. Institution

4. Country
5. Confirm consent to use responses

You and your team - where you work

1. Has where you work changed during the last two years? Tell us about your pattern of where you work(ed)? (e.g. at home/at institution/elsewhere how many days?)
2. Has this kind of change affected your team too? And other staff in your institution (if you know about them)?
3. Did any of your team or regular collaborators work at a distance (e.g. at different sites, places within the country or in other countries) from one another before the pandemic? Tell us about that.
4. Does your employer now expect a particular pattern, for example, of on- or off-site working? Is there a policy or guidance about this?
5. Did you work on DiSSCo or related projects with international collaborators before the Pandemic? If so, what is easier or harder about working on DiSSCo now?
6. Most DiSSCo distributed working uses English as a shared language - are you and your team comfortable working in English? How does this impact your involvement in DiSSCo or in distributed working?

You and your team and institution - work practices and tools

1. Has the work you and your team do changed during the last two years? How and why?
2. What hardware do you have for working remotely (e.g. laptop, keyboard, desk, chair, headset, phone etc.)? Is this provided by your institution or owned by you personally?
3. What software/tools do you use software for distributed/remote working (e.g. Zoom, Teams, Skype, Trello, GitHub, Teamwork, Jira etc.)
4. Besides tools, what other changes have you made to your or your team's working habits and practices? (e.g. times of day/working hours; more or fewer catch-up meetings etc.).

What has gone well or less well? What's next?

1. Which of the hardware and software you are using to support distributed working do you like best and why?
2. And which do you not like and why?

3. What would you say has been the best thing from your point of view about how work has changed during this period?
4. And the worst thing?
5. How might you and your team work differently going forward? Are there changes that you think have yet to be made?
6. Have you seen policies or changes that other organisations have made that you want to try?
7. Has the pandemic (or other factors) changed how you hire for any roles? Are any more likely to be offered as remote positions?
8. Have you had to change how you run inductions/onboarding for new staff?

Events and collaborations

1. Have you been part of or attended any virtual training or events (seminars, conferences etc.) during this period? Were they events that had 'moved' online or would have been online anyway?
2. What did you think worked well or less well about these for you?
3. What do you think is easier or harder about events, collaboration and distributed teamworking with others now?

Closing

1. Is there anything else you would like to tell us relevant to distributed working?

List of interviewees

From the Natural History Museum, London:

- Josh Humphries - Developer working on DiSSCo tools
- Peter Wing - Digitiser and SYNTHESYS Virtual Access coordinator
- Alex Ball - Imaging lab manager, supporting remote users

From the University of Tartu, Estonia :

- Villu Soon - Researcher and curator
- Allan Zirk - Lead developer
- Kadri Põldmaa - Head of collections

From Senckenburg, Leibniz Institution for Biodiversity and Earth System Research, Frankfurt:

- Hanieh Saeedi - Researcher and coordinator

- Thomas Winter - Developer
- Anke Penzlin - Data curator

From the Museum für Naturkunde, Berlin:

- Anja Blessing - Research coordinator
- Peter Giere - Curator of the Embryological collection

From the Finnish Museum of Natural History (Luomus), Helsinki:

- Anniina Kuusijärvi - Systems Analyst
- Jere Kahanpää - Digitisation coordinator

From Naturalis Biodiversity Centre, Leiden:

- Sharif Islam - DiSSCo Technical development & representative of the DiSSCo Coordination and Support Office

From the Consortium of European Taxonomic Facilities (CETAF), Brussels:

- Ana Casino - CETAF Executive Director and representative of the DiSSCo Coordination and Support Office

Funding program

[H2020-EU.1.4.1.1. - Developing new world-class research infrastructures](#)

Grant title

Distributed System of Scientific Collections - Preparatory Phase Project (DiSSCo Prepare).
[Grant agreement ID: 871043.](#)

Conflicts of interest

The authors have declared that no competing interests exist.

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