PERICLES - Promoting and Enhancing Reuse of Information throughout the Content Lifecycle taking account of Evolving Semantics

[Digital Preservation]

DELIVERABLE D2.3.4

Second Evaluation Report

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pericles
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Glossary

Term	Meaning
Evaluation campaign	The whole of the evaluation activities, from the start of the project until the end. In PERICLES, the evaluation campaign consists of three evaluation phases.
Evaluation phase	One phase in the evaluation campaign. In the PERICLES evaluation campaign, there are three evaluation phases, each culminating in an evaluation report.
Evaluation subject	The software, system, presentation, concept that is being evaluated.
Evaluator	An individual performing an evaluation. The evaluator gives ratings, comments and suggestions about the evaluation subject.
Focus group	A form of qualitative research in which a group of people are asked about their perceptions, opinions, beliefs, and attitudes towards a product, service, concept, advertisement, idea, or packaging.

DELIVERABLE D2.3.4 – V1.0
SECOND EVALUATION REPORT

1 Executive Summary

The second evaluation report is the second of three reports in the PERICLES commitment to evaluating its research and development activities and results. It presents the applied evaluation methodology and the rationale behind the selected approach. The evaluation campaign consisted of two focus group evaluation sessions, each focussing on a different main theme that was introduced to the participants by means of a workshop. Both workshops have been attended by a distinct and relevant set of evaluating experts.

The first focus group evaluation had "model-driven approach to preservation management" as its main theme and was attended by both internal and external preservation experts. The second focus group evaluation centred on "promoting reuse of science data" and was attended by science data and space operations experts both internal and external to the project.

Analysis of the feedback given by the evaluating experts resulted in a set of recommendations to the project that can be summarised as follows:

Originating from the first focus group evaluation session:

1. Articulate more clearly the relationship with other projects and how PERICLES relates to the current state of the art.
2. Demonstrate the potential value of PERICLES by creating end to end examples.
3. Examine the notion of a trustworthy model and express a vision for how models might be created, used and useful to different stakeholders.
4. Justify the model-driven approach, taking into account effort, resources and skills needed.
5. Articulate how creating ontologies allows for greater degree of automated knowledge creation.
6. Indicate clearly why companies, such as Xerox, are interested in the model-driven approach and how this might impact the future of digital preservation.
7. Articulate and demonstrate the relationship of the tools with the model driven approach.
8. Assess whether the models are domain-specific or can be reused in different domains.
9. Articulate what is essential for models to be useful depending on their different purposes.
10. Assess how different purposes might impact the development processes of models.
11. Establish a clear narrative about how to articulate the strong consideration and participation of the authorial intent and the different stakeholders in the work of the project.
12. Clarify the meaning of the word 'policy' in the project and its role and relationships within the models.

Originating from the second focus group evaluation session:

1. Make the PERICLES approach implementable by focussing on filling in the gap between theory and practice.
2. Connect to initiatives "instructing" the community on how to deal with their data.
3. Investigate how to prove the trustworthiness of services.
4. Integrate results with those of other projects and existing technology.
5. Try to establish different kinds of scenarios to get users involved.
6. Promote the LRM to the W3C standards group in order to extend the PROV-O model.
7. Help to convey the importance of preservation, policies and continuum of data management.
8. Work with other projects and disciplines to gain different viewpoints and experiences.
9. Try to connect with off-the-shelf technology.
10. Join initiatives to make people aware that it's important to use preservation technology and to put an effort into the preservation of data.

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2 Introduction & Rationale

2.1 Context of this Deliverable

This document is a Work Package 2 deliverable and contains the work that has been done in the context of the second evaluation campaign. This evaluation was preceded by the first evaluation documented in deliverables D2.3.3 Initial evaluation report. While the first evaluation attempted to carry out both a software evaluation and a formative evaluation in order to asses tools and concepts with the professionals of both case study partners TATE and B.USOC, we extended the group of evaluators to include external professionals and stakeholders. As a lesson learnt, we decided not to have tools evaluated in mid-development, as this proved not to be very helpful or insightful. However, on the basis of the review meetings and the formative evaluation, we understood the project would benefit from discussing our theoretical research approaches and key concepts that are driving the testbeds, the architectural framework and the tools and services development. Inspiration, new perspectives and discovery of misconceptions or gaps are more helpful in mid-stride than at the end of a project. This evaluation will be followed by a third and final evaluation which will be strongly informed by the outcome and lessons learnt from this present evaluation.

2.2 What to expect from this Document

The document provides a rationale for the evaluation methodology that has been chosen for this second evaluation phase. It describes the methods, the themes to be evaluated and how the evaluation was conducted. The document also contains an analysis and interpretation of the evaluation outcomes.

2.3 Document Structure

- Chapter 3 explains the conceptual approach followed
- Chapter 4 details the concrete evaluation sessions
- Chapter 5 provides an analysis of the material provided in the evaluation sessions
- Chapter 6 provides concluding remarks and a look forward to the final evaluation session
- Appendices provide material produced and used in the analysis of the evaluation activities outcomes.

3 Conceptual Approach

3.1 Motivation and Purpose

This research project sets out with different levels of evidentiary objectives, from distinct ideas for tools that require software development for their substantiation to bold hypotheses that need to be investigated in order to be verified and proven. Part of the investigation of the validity of these hypotheses on which the overall objectives of the project are based, requires the feedback from the practitioners and experts in terms of soundness and relevance for preservation workflows and management. With respect to the tangible results such as tools and components, to prove our hypotheses these tools often need not necessarily be more than prototypes or mock-up constructs. Hence, a conventional software evaluation would be inappropriate and unproductive as developing the tools to be production ready is outside the scope of the project budget. In the case of PERICLES, for project evaluation campaigns to be productive and beneficial for the outcome, it was decided to carry out iterative stakeholder evaluations during the project to act as a corrective and input for the work in progress. The first evaluation (see deliverable D2.3.3 Initial Evaluation submitted in M20) assessed basic concepts and first results with stakeholders from the case study partner institutions. The second evaluation was to address the preliminary outcomes of the research done with respect to the key concepts and hypotheses. The objective was clearly to both get informed input and inspiration, and understand if there were misconceptions or gaps to be dealt with in the next phase.

3.2 Chosen Methodology

As we were not looking at evaluating ready-for-use items or tools[1], but at the concepts, motivations and goals that drive our research and development, we looked at qualitative[2] rather than quantitative methods for evaluation.

> "Qualitative data methods capture more depth and provide insights as to the "why" and "how" of attitudes and behaviours, [...] and sometimes puts it into the context of people's lives and experiences. This makes quantitative data easier to understand, provides more details and nuances, and explains what the program means to the people involved."[3]

The focus group methodology[4] was found to lend itself as the most suitable for our purposes and evaluation objectives, as we are interested in the opinions of peers and domain professionals. A focus group seemed most apt to facilitate an open and honest exchange:

> "The goal of a focus group is to promote self-disclosure among participants. Because a group, rather than an individual, is asked to respond to questions, dialogue tends to take on a life of its

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[1] The lesson learnt from the first evaluation was that a conventional software evaluation at this stage is too early and doesn't provide beneficial results for the work within the project.

[2] See http://socrates.berkeley.edu/~pbd/pdfs/Evaluation_Methods.pdf, p.2 for list of qualitative methods: key informant or individual interviews; Focus groups; Open-ended questions on a survey or questionnaire; Logs, journals, diaries and/or essays; Stories/Case studies; Participant observations/field notes; Document review: examining written records such as logs, correspondence, meeting minutes, or news articles or other published accounts.

[3] See http://socrates.berkeley.edu/~pbd/pdfs/Evaluation_Methods.pdf p.5-11

[4] Liamputtong, Pranee (2011): Focus Group Methodology: Principle and Practice. SAGE Publications, Inc. Newbury Park: California, U.S.A.

own. Participants "piggy-back" on the comments of others and add a richness to the dialogue that could not be achieved through a one-on-one interview."[5]

3.2.1 What is a focus group?

Ideally, a focus group consists of 6-12 participants who meet to discuss a focussed issue, invited by a group that wishes to have their work, actions, projects evaluated by a specific group of people. The participants are members of a defined target group with a similar background or type of expertise required for an informed evaluation.

> *"A focus group is a special type of group in terms of purpose, size, composition and procedure. The purpose of conducting a focus group is to listen and gather information. [...] to understand how people [...] think about an issue, product or service."[6]*

The discussion is moderated by a facilitator who prepares open-ended questions to trigger a discussion, and encourages the participants to engage with each other and to voice their perspectives and opinions freely and confidentially, all the while keeping them focussed on the topic of the evaluation.

The group discussion usually lasts from 60-90 minutes.[7]

A focus group evaluation is typically structured in three phases:[8]

1. Preparation: you decide on the number of focus groups and participants, determine the subjects you want to have evaluated and according formulate the key questions, and determine general organisational parameters (location, date, facilitator/moderator, duration, invitation, recording means etc.) In our case, we also considered how to ascertain that all participants had a similar level of knowledge of the project concepts to be evaluated.
2. Conducting the focus group which includes the discussion, introduction and recording.
3. Analysis and interpretation of the discussion (= data input in form of a discussion transcript).

3.2.2 Why a focus group?

The focus group method is particularly interesting for our research results, as it is still on a theoretical level and oriented towards the future. It needs the combination of imagination, knowledge and experience to make informed conjectures about future scenarios where the PERICLES approach would be embedded in digital environments. At this point a qualitative evaluation provides ideas, insights, attitudes, practices, comments from different and perhaps neglected and ignored perspectives.

> *"The main purpose [of a focus group evaluation] is to elicit ideas, insights and experiences in a social context where people stimulate each other and consider their own views along with the views of others."[9]*

Questionnaires, statistics and surveys would be too limited and biased to the views and expectations of the persons conducting the survey. An open interaction amongst participants allows for also capturing the unexpected, and in a focus group *"Participants are asked to reflect on the questions asked by the interviewers, provide their own comments, listen to what the rest of the group have to say*

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[5] http://www2.ca.uky.edu/agpsd/Focus.pdf - Rennekamp, Roger A., Nall, Martha A.: Using Focus Groups in Program Development and Evaluation. Univ. of Kentucky, Lexington (USA). Extension Specialists in Program and Staff Development.
[6] Krueger, R. and Casey, M.A. (2008): Focus Groups: A Practical Guide for Applied Research, SAGE Publications, Inc. Newbury Park: California, U.S.A. p.2.
[7] http://ocw.jhsph.edu/courses/fundamentalsprogramevaluation/PDFs/Lecture11.pdf
[8] http://www.bc.edu/content/dam/files/offices/vpsa/pdf/assessment/focus.pdf
[9] http://goo.gl/yj8YGa - World Bank, Poverty reduction and equity, impact evaluation methodology.

and react to their observations."[10] At the same time, the opinions and statements are balanced, so the evaluator won't be left with extreme views: *"One of the main advantages of this techniques is that participant interaction helps weed out false or extreme views, thus providing a quality control mechanism."*[10] These aspects include that the researchers invite an honest debate which will bring critical responses out in the open. There is a risk that the whole group becomes then more critical than they might have been on their own. But usually it is social control mechanisms allow fair balance to govern the discussion.

3.3 Determining the Subject of Evaluation

Clearly, the topic or subject of the evaluation would be key concepts we are exploring, the bigger picture we are establishing and the methods we use to substantiate our approach. As we aimed at getting informed feedback and input, we focused on larger parts of the overall approach: the model-driven approach for change management and the management tools and methods to support reuse of data.

Looking at the first topic which was the evaluation subject set for the preservation experts, it was important to convey the notion of models as a valuable tool to understand risk by assessing their impact with the help of models. The approach certainly is interesting within mathematics, computer science, computer linguistics, semantics and social media studies, because models are part of these disciplines. However, preservation professionals do not normally create models themselves. And yet without their knowledge and their understanding of the benefit of a model-driven approach, it will be difficult to introduce this approach into the practice of preservation. It is a question of first overcoming the initial inhibition created by the impression that they would need to start building models themselves. And then induce them to have an open mind towards imagining how a tool they do not fully understand would function and could benefit their work. The motivation for choosing this topic for this group was that they are the stakeholders that would need to validate the benefit and the relevance for their field of practice, to ensure that our research doesn't remain purely of theoretical value. At the same time, we have come very far with that respective research and development in this area: the static LRM has been finalised, the dynamic LRM and the change language have seen very good progress, the domain ontologies have been created and the ecosystem model has evolved and instances have been created (see deliverables D3.3. Semantics for change management, D2.3.2 Data survey and domain ontologies, D5.2 Basic tools for digital ecosystem management).

The second group, experts from the science data domain, however, would not have been in a position to validate the relevance of the model-driven approach for long-term preservation, as they typically have less key experience in this area. For this group, reuse of findings and results is more common and the challenges are better understood than for the art domain as reuse is a consumer activity in the scientific community while for time-based media, the users are a small group of specialists who are in general responsible for the overall custody and maintenance of the artworks. As reuse has become a considerable cause for debate and research in science, it seemed appropriate to discuss this part of our research with evaluators. While we presented our concepts and arguments for including aspects of quality assurance for policies and appraisal into the change management as a way to support access and reuse of data, we were also enquiring about current practices and policies of data preservation, and challenges regarding reuse and the requirements for data availability in the long-term. As with the topic for the preservation group, we also presented results that had far progressed in the last year (see also D2.3.2 Data survey and domain ontologies, D5.2 Basic tools for digital ecosystem management).

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[10] http://goo.gl/yj8YGa - World Bank, Poverty reduction and equity, impact evaluation methodology.

3.4 Introduction Workshops

One of the criteria for performing a focus group evaluation is having a comparable understanding of the topic to be evaluated amongst the evaluators. This understanding might differ slightly from person to person. Ideally, participants have a similar enough background for all being sufficiently familiar with the topics but at the same time are different enough to allow for heterogeneous opinions and feedback. Naturally, the evaluators from TATE and B.USOC clearly had a knowledge advantage on the subjects of the evaluation, while other external evaluators will have heard of PERICLES and several will have either read or listened to a paper or presentation or poster, but not have been introduced as intensively as the TATE and B.USOC members to the topics. To remedy this mixed-knowledge situation, we decided to synergise our plans with WP7 and their task T7.2.3 Training event at partner organisation. WP7 is looking at different types of training and education profiles, but in particular at engaging with stakeholders and peers involved in preserving, archiving, managing, curating, creating and reusing data. As these criteria cover the background for the evaluator selection, we conferred with WP7 as to organising a training event[11] in London and in Brussels respectively that would serve both training purposes and input for training material, as well as briefing all evaluators on a specific focus of the PERICLES research. The gained knowledge base was at the same time then the trigger of the focus group evaluation proper which took place as a separate event in the aftermath of the workshop.

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[11] Details on the workshops will be reported by WP7 in the upcoming annual report

4 Preparation of the Evaluation

4.1 Choice of Evaluators

4.1.1 Guiding Principles for the Selection

Commonly, the criteria and best practices found across all literature for identifying participants are:

- The evaluators should form a homogenous group in terms of the type of experience targeted by the project and the specific object of the evaluation.
- However, their composition and backgrounds should allow for sufficient variation for contrasting opinions.
- They should be able to understand each other (in terms of specialised language, professional concepts etc.).
- The selection should ensure sufficient prior knowledge of the theme to avoid inhibitions to talk freely due to difference in knowledge of the theme and to be able to make informed comments.
- In the best case participants should not be familiar with each other and from a range of different organisations.

While the first evaluation round focused on members of the use case partners institutes, this second evaluation aimed for a mixed group, staff members from the use case partners and external partners from similar fields and backgrounds.

In principle, the evaluation could have taken place online in a web meeting room. But as we took the opportunity to synergise with WP7, we could optimise the session by meeting with the evaluators in person, which of course is much more conducive to a lively discussion amongst the group. For this reason, we included WP7 in the process. The type of professionals we were looking for converged with those professionals WP7 would have looked for to invite for a training session.

4.1.2 Art and Media

There were three main criteria that determined the selection of external evaluators for the model-driven preservation evaluation:

- involvement in repositories of relevant complex data (mixed data, audio, visual or audio-visual digital data)
- experience with preservation workflows in practice and/or preservation projects
- affinity/interest in theoretical discourse and research theories on LTDP

Due to the summer break, we needed to deliver invites to the evaluation workshop quickly for the invitees to be able to block their agendas for the proposed date. For this reason, we started looking at people in the field that were known to us. We also invited people who we weren't known to us in person, but who have a high renown in the community. Although the relevant communities are vast, the circle of practitioners engaging with theory and research, and the number of researchers engaging with practitioners is smaller in number. All members were peers. No intentional hierarchical subdivision was considered in the choice of participants.

The following senior practitioners and researchers from the below listed institutions accepted the invitation and were available on the relevant date:

- National Library, UK

- BBC, UK
- Open Preservation Foundation, UK
- Media Library Basel FH Basel, CH
- Digital Curation Centre, UK
- Ludwig Museum Budapest, HU
- London School of Hygiene & Tropical Medicine, London, UK

The mix was well balanced with backgrounds on preservation research project knowledge combined with professional practice in curation and archiving of audio-visual material and conservation of media art, and with an understanding of semantic models and ontologies. The names of the participants remain anonymous to the public version of this document.

The evaluation group comprised twelve people, including Pip Laurenson from TATE, who acted as moderator, and three TATE staff internal to the project from conservation, the archive, and information systems departments.

4.1.3 Science

The background we were looking for with respect to evaluating the PERICLES approach in support of reuse of scientific data covered research into how to make scientific reusable, and there are multifarious centres and initiatives investigating these challenges, data operators and scientists engaged in the discussions on preservation and open access of science data. The invitations were all well received and we managed a good mix of scientist's, science service facilities, operation centres and data management professionals.

We had senior members of following institutions:

- University of Torino, Physics Department, IT
- Environment Climate Data Sweden, SE
- Center of Competence in Aerospace and Biomedical Science and Technology, CH
- Berlin State Library, DE
- Data Archiving and Networked Services, NL
- CERN, European Organization for Nuclear Research, EU/CH
- Department of Geophysics, at the University of Oslo., NO
- Centre for Environmental Data Analysis at STFC, UK
- Software Engineering Group at STFC, UK

In addition to these external nine evaluators, we had two evaluators from the PERICLES use case partner B.USOC. The moderation was conducted by Christian Muller at B.USOC.

The mix in expertise comprised different science disciplines (earth and space observation, geology, climatology, nuclear science and neurobiology), different professional expertise from software engineering to physicists and research data managers. Only a few people had met before, although most have of course been aware of the institutions people worked for. This has to do that although the discussions are widespread, they are scattered and not reflective of an active community. There is a large research data community, but the interests are very diverse and multifarious. There is no distinctive (grass-root) discussion community on long-term preservation of research data, though it seems to be slowly entering the awareness of the research data community as a whole. As an example of this very low interest of the community, the European Geoscience Union of 2016 presents several hundreds of sessions, only three have preservation in the title: two on glaciology and one on the fossil record in geological layers. In particular, none of the 38 sessions on ESSI (Earth & Space Science Informatics) specifically addresses preservation.

We selected those people which we knew had engaged in different preservation projects, or whom B.USOC knew to be highly interested in open reuse of research data. However the former constituted the majority of the focus group.

4.2 Overview of Workshops and Evaluation Sessions

As indicated earlier, in section 3.4, each focus group evaluation session was preceded by an introductory training workshop, respectively focusing on the main topics to be evaluated in the focus group sessions. The workshop programmes of are summarised in sections 4.2.1 and 4.2.2 below. Both workshops featured both presentations and interactive sessions in small groups (such as small modelling games, group discussions and brainstorming activities) to ensure a common understanding of the topics amongst the evaluators (homogeneity of knowledge about the evaluation subject), to bring them closer together in order to facilitate an open and lively discussion in the focus group session. In addition, these activities gave us background to statements that came up in the focus group discussion. These sessions were planned for about 75-90 minutes, long enough to elicit sufficient different opinions and views while still short enough that a single no-break session could be held without the sessions getting too strenuous on the participants. The sessions were moderated by Pip Laurenson (TATE) for the preservation focus group, and by Christian Muller (B.USOC) for the science data focus group. The key questions can be found in Appendix A: Evaluation Session Material.

4.2.1 Art and Media Workshop

Roughly, the workshop had the following agenda:

- Presentation: introduction to the project as a whole and what the term "model-driven approach" means.
- Presentation: overview of LRM, its design decisions, potential uses and its limitations (T3.1-T3.3).
- Presentation: explanation of the digital ecosystem model and how change is captured (T3.5)
- Presentation: explanation, with example, of the interactive activity: modelling game (T3.5)
- Activity: modelling game wherein evaluators try, in group, to create a partial digital ecosystem, based on their area of expertise (T3.5)
- Presentation: introduction to domain ontologies, their uses and some examples (T2.2.3)

There were several Q&A sessions in-between the presentations.

4.2.2 Space Science Workshop

This workshop had the following agenda:

- Presentation: introduction to the project as a whole.
- Presentation: what are typical common data preservation and reuse problems encountered in the science domain? (WP2)
- Activity: small-group brainstorming session allowing the evaluators to think about preservation and reuse issues in their organisation
- Presentation: modelling the space science case study, the Space Science portal is used as an example (T2.3.3)
- Presentation: ingest: connectors and PET (WP4)
- Presentation: encapsulation and packaging (T4.2)
- Presentation: appraisal (T5.4)
- Presentation: creating and using dependency graphs (T3.1)

- Presentation: policy derivation and quality assurance (T5.3)

Activity: small-group discussions around three topics: dependencies, appraisal and policies

There were several Q&A sessions in-between the presentations.

5 Report on the Evaluation Sessions

5.1 Analysis Methodology

Basically, most interview analysis methodologies follow similar procedures. The one that we have used is focusing on content (topics/statements/opinions), rather than on discourse (how things were expressed) or relations (how topics/opinions/statements relate to each other).

In a nutshell, qualitative analysis dissects texts for their meaning. On the surface, the analysis is not as rigorous as quantitative (number-driven, survey and statistics based) analysis. To prove an unbiased analysis, direct quotes as substantiation of the analysis are commonly used. The results depend also on the open-minded attitude and creative mind of the analysing person(s). Qualitative analysis lends itself to capturing information which cannot be perceived with quantitative methods. Another advantage is that the analysis can be related to a certain objective. For example, a lot of interesting information regarding a topic might not be taken into consideration as they are of no relevance to the research objective and stemmed from either misunderstanding questions or discussion strands that went astray before returning to the actual topic of the focus group.

The common procedure for a qualitative analysis of interview transcripts follow these four stages which have been very well described by Alan Bryman[12], in one of many publications on the topic:

1. Coding or indexing: using a line-by-line reading, marking and assigning a plain-text code to all interesting text parts. This follows the initial reading of the complete text.
2. Conceptualising the codes: prioritising, grouping or even selecting (deleting some) the codes and labelling the groups.
3. Categorisation of the labelled codes: hierarching the groups by relevance for the research interest, describing their relevance for the research interest.
4. Conclusion: Support your categories with quotes and describe the results of the analysis in a descriptive text in an unbiased way. Add as a separate step the interpretation of the analysis from your research point of view.

The audio recordings from the focus groups were transcribed and these transcriptions are the main focus of the analysis. However, in addition, the Q&A sessions from the workshops preceding the focus group evaluations were also transcribed and were considered alongside the main focus group data. A content analysis framework methodology was used to identify the key patterns in the data, the key themes and the connections between ideas and concepts.

There are also software products to support text analysis. The Dedoose 6.2.21 software[13] was used as an experiment to process the transcripts of the media and art evaluation session. Using this software, interesting statements could be identified from the transcripts and these statements could be categorised using custom-defined codings. These codes (which can be found in Appendix A: Evaluation Session Material) were then themselves analysed and grouped together into a smaller but broader set of key themes. These key themes form the basis for the analysis part in this report by drawing conclusions from the codified statements that belong to this key theme. In the analysis sections, quotes (in blue text) from the evaluators are used to support or clarify the analysis material.

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[12] Bryman, Alan (2012): Social Research Methods. 4th Ed. Oxford: Oxford University Press, pp. 28-84 and pp. 520-563
[13] https://app.dedoose.com/App/?Version=6.2.21

5.2 Art and Media

5.2.1 Analysis of Responses

The following report will present the main findings of the analysis organised around key themes. The first section will present the findings, the second the interpretation and the final section some recommendations for the project. The quotes in blue are taken from the transcript and are the words of the participants of the focus group.

5.2.1.1 FINDINGS

The findings of the focus group are divided into the following themes:

- ontology development and the model driven approach
- from theory to practice and the different uses for the models
- the PERICLES definition of the term 'policy'
- PERICLES tools
- the relationship to other projects

These themes emerged as a result of the coding and analysis of the transcript.

Ontology development and the model driven approach

The focus group hosted a lively discussion around ontology development and the model driven approach which can be summarised around the following topics:

The power and use of models

"I think model-driven is absolutely essential. If you have a vast amount of data, like you do with archives, for example, or with space examples, you have no choice but to cluster information in a useful way to make sense of it" Focus group participant.

In general there was agreement regarding the potential power of the model-driven approach but there were worries about how much effort was needed to develop a model that can be trusted.

One facet of this approach which was highlighted as particularly powerful was in the ability to be able to explore the consequences of change and risk. However the power of a model was judged to be directly correlated to its trustworthiness.

During the focus group there was general consensus that the project should create an example that would prove, from end to end, that these models can be applied in a useful way. Even if this was demonstrated with a small example this was viewed as being important and useful.

Models were seen to be able to take advantage of semantic technologies to generate new knowledge, therefore having an ontology underpinning our understanding of our collections rather than a hard metadata scheme allows for greater degrees of automated knowledge creation.

One participant noted that models are not simply of value for preservation processes but also for other processes involved in managing collections of data, such as rights management.

One participant was interested in understanding the interest of Xerox in the model-driven approach. It was pointed out that Xerox were clearly strong proponents of the model-driven approach, and given their commercial interests this must mean that they thought this would translate in the future into software products; *"software products which we community might buy and which might help us to do our jobs better"*. It was felt that understanding Xerox's interest would be valuable in developing and communicating an understanding of how the model-driven approach might change digital preservation and data management in the future. It was felt that this had not, as yet, been brought out clearly enough.

How models might change the way we work and think

One of the participants noted that a good deal of good work had been carried out because people had got on and carried out preservation activities and then analysed what they had done. They may even have created informal models. It may be time to introduce a different way of approaching digital preservation. Models are not a prerequisite to preservation but they might change the way we approach the problems of preservation.

Practicalities of the model driven approach

"That's powerful when you have a model you can trust. I think what was very unclear to us from today is, how much effort is it, really, to construct one of those for some real world use cases?" Focus group participant.

A major topic for discussion within the group focussed on how much effort it takes to create a model and also what the skill level needs to be. It was also felt that in order for this research to be useful for the field at least some elements of the models would be specific to particular situations and therefore practitioners would need to be able to create models as part of on-going practice. Leading on from this, one participant asked whether it would be necessary for communities to reach consensus on particular ontologies, so that they could be reused across a particular community and between communities; to paraphrase adding an ontology where one already exists adds chaos, creating an ontology where none exists reduces chaos. Tools that are able to easily generate ontologies were seen as an important part of making the model driven approach successful. A question was also raised regarding whether the outputs of the PET tool could be mapped and used to populate a model.

The project must demonstrate that the model driven approach can be practically implemented and that it offers advantages over traditional analysis. It was felt that modelling a simple process was fairly complex, and once created a model would also need to be populated with data, implemented and kept up to date. If the process was not made easier by modelling then why would you not adopt a more traditional approach? Here a more traditional approach would be to work out what the characteristics of the digital objects are that you are trying to preserve, carry out a manual risk assessment and then design actions related to the outcome of that analysis. This would normally be followed by running a few tests to ensure that the significant properties of those objects are maintained. Monitoring of risks is usually done in a fairly ad hoc way drawing on current community knowledge and the expertise of the staff involved. The impact of changes is discovered by experimentation and analysis of the results of those experiments. Again, for comparison there was a call for at least one example to be developed that would demonstrate the effort involved should the model driven approach be adopted.

How general or specific should a model be?

"We can have the object ontology, but then if you have to plug in all the policy and organisational stuff, that's always going to be different between different organisations, even if they're doing the same job. I'm just wondering how much complexity that adds onto this idea of being able to share these ontologies…" Focus group participant.

It was recognised that the specificity of models was both a strength and a weakness. The fact that you could have as many different models as organisations or processes might act as a barrier to widespread acceptance. Developing a community around a model might offer a more sustainable way forward. For example one participant imagined that it may be possible even with one artwork that different institutions owning editions of that artwork might be able to share the model and adapt it to their circumstances where there were differences that were relevant. There was, therefore, a general call to see how applicable a model was across organisations and contexts.

"The models normally work best when they're more general. The more specific the model becomes, the more difficult it is to apply" Focus group participant.

A recurring recommendation to the project was to simplify the models and ensure that entities did not overlap and that there were fewer entities but more generalised. It was felt that it should be possible to identify some areas which would be generic and some which would be organisation specific. A useful test case would be to see if there was overlap between the art and media and the space science case studies, i.e. are there elements which are generalizable? Perhaps it is possible to compartmentalise - so that you could take an element of one model and re-use it in another?

Suitability of this approach to artworks

"…ontologies are definitely a really interesting way of looking at documentation, particularly for software-based art, expressing the relationships between components and artworks, and the nuances of dependency…" Focus group participant.

It was agreed that this is a useful way of approaching the conservation of complex digital artworks and that the models and the ontologies were perfectly suited to describing the production process as well as exhibition history and other important events that occur in the life of an artwork. However, finding the correct level of description was considered a challenge. It was not clear whether this would also be relevant to the artists to create documentation themselves.

Theory and practice

Linking PERICLES to practice

The focus group acknowledged that to date a number of communities have developed various practice-based approaches to the preservation challenges of the long-term storage and sustainable access to digital objects and collections. This practice-based approach, which includes a more manual workflow, generally was not considered by the focus group participants to be at odds with a more automated model-driven approach, but it can be difficult for practitioners to easily see the links between the theory and their practice. The model-driven approach of PERICLES is novel in the depth to which it is conceived, but many communities already have models and ontologies in some form. Therefore it was noted that the challenge for PERICLES is to transfer effectively the hows, whys and value of the project outputs in order to affect change in practice.

Understanding the target audience

It was noted that the inherent depth of the PERICLES models are certainly a strength but also potentially a barrier to uptake given their complexity, or rather the knowledge required at entry-level. However, there is also acknowledgement that aspects, if not the whole of the PERICLES approach, can be of value depending not only on the scale of the institution, or capacity of an individual, but also on the degree to which preservation plays a role in various practitioners lives. Valuable take-aways from a model-driven approach can be absorbed by content creators and artists as well as the eventual custodians of the final digital object. This relates strongly to the concept of preservation by design. The idea of partial uptake of PERICLES output also relates to the notion that the description and modelling of a preservation system per object may not always be needed as the field in which the object resides become better understood and more standard.

One of the participants noted that PERICLES has used challenges from the Art and Media domain that are highly pertinent to the field, including complex objects which have relatively recently begun to enter collections, for example software based artworks. It was noted that software-based artworks are all individual and more complicated or less understood, currently, than a basic numerical data file. This led to a discussion about how new knowledge has been developed in practice and how this related to the model-driven approach. It was noted, for example, that there will be a time in the future when challenges faced by practitioners working with software-based art have been faced before, the practitioner will simply know how to act, at which point modelling might become more automated and integrated into systems to manage change. This will still allow the specifics of a particular artwork to be considered.

From theory to practice and the different uses for the models

The discussions relating to the relationship between theory and practice focussed on questions of adoption and the relationship of the model-driven approach to existing practice and the usefulness of the models to practitioners.

'PERICLES producing realistic, honest to God, use cases, rather than saying, "I have this very complex ontology here, let me show you how I can use every possible facet of the ontology," I would like to see case studies that show this is what I, as the Tate, for example, actually would adopt, because it's realistic and needed, and supports the functions that I have. A lot of problems that people have with ontologies and standards are that they say, "They are so complex, surely nobody can expect me to produce information for all of these different possibilities," I think we, as a community, need to learn from each other what is realistic and actually needed. That's a nice output, too, to say, "We have this very complex ontology but really here are the facets of it that are of real use to our use cases. That's an honest delivery' Focus group participant.

What however, was unclear was the relationship in the discussions between the desire to simplify the models and what the different stakeholders might find the most useful and what might aid adoption. The participant who was most closely aligned to creating software felt the models were 'sprawling' and very difficult to write software around. He saw the models as being the basis for software creation. Whereas the practitioners referenced the models as providing tools for documentation and analysis that may also then lead to unpinning systems that would allow for greater automation.

'I always thought that the benefit of PERICLES, and the fact that it was focussed upon those specific communities of practice, that it wasn't just a preservation expert saying, "These are the things that we want preserved and this is the process we do it," it actually considers the authorial- author's intent …...and all the stakeholders within the whole process. Any report that was made for PERICLES should emphasise that quite strongly' Focus group participant.

The level of involvement of the specific communities within the project was thought to be a strength and to also to raise interesting questions about the relationship of practice to theory development and not only how specific or general the models should be but also what they might be used for by different communities.

One of the questions which was discussed within the focus group was the need for such complexity across domains. Participants acknowledged that while the flexibility of the model-driven approach allows change on a very granular level to be managed, the question was however raised regarding whether the approach can be effectively utilized on a much more generic level? How applicable is the model-driven approach across communities of practice?

'Now, taking a model-driven, conceptual approach is interesting, but it's quite hard to join the links between what we're doing, our practice-based approach, and this thing where you have to step back from principles, and start thinking about the underlying models.' Focus group participant.

It was pointed out that preservation policies and workflows are established to some degree in many institutions globally without the need for models as a starting point. This led to a discussion about the applicability of the model-driven approach to existing systems and institutions. It was acknowledged by the participants that communicating which outputs of the project might be taken up in different contexts was challenging, here again the worked example was seen as important.

'One clear worked example, a use case, that really is documented, laid out from start to finish, that for communication would be worth its weight in gold' Focus group participant.

PERICLES use of the term 'Policy'

What does 'policy' relate to within a model constructed of dependant entities?

The focus group directed the discussion towards what policy relates to in a model as set out by the project. Does a policy relate directly to an object or is it much wider, relating to processes and context?

This conundrum was left somewhat unresolved given the differing perspective between participants on what policy should seek to achieve. Within the project's very specific use-case scenarios, policies can relate directly to objects but as pointed out by one participant the ontology and policies within it may relate to the whole human organizational process.

PERICLES Tools

PERICLES' stand alone tools are powerful but require practice based-development and implementation

It was acknowledged that in the field of information science one of the key challenges is in managing massive information data sets and in understanding that data. Ontologies are an established method by which to manage domain data and thus the focus group was in agreement that any tool to aid ontology generation would be of significant value. The PERICLES Extraction Tool is very powerful in aiding ontology creation however the participants acknowledged that it was difficult to understand the tool fully when it is only placed in an 'approach' rather than a clear real world setting. Clear examples for specific communities as well as generic domain use would be very useful in the communication of the tool's potential in practice.

Relationship to other projects

Addressing long-term digital preservation has been an ongoing challenge for over a decade and other large centrally funded collaborative projects have sought to find solutions to practice-based issues. The projects which were mentioned by the focus group as particularly relevant to the model-driven approach were **TIMBUS**, **PREMIS**, and **Workflow for Ever**. Also mentioned was the work of the **iRODS** consortium. A number of participants supported the view that the project should compare and contrast what it is producing with other preservation models and also provide an account of how this work has been incorporated and built upon or how PERICLES is addressing a gap or different need. Both 'TIMBUS' and 'Workflow For Ever' have created ontologies however it was felt that there was space for PERICLES, at a high level, to contribute to the work needed to describe agents, events, objects, rights and processes. TIMBUS was cited as a good example of a project that had been careful to build on existing projects and standards such as PREMIS.

In addition, the participants in the focus group felt that PERICLES should consider what it could contribute back to other projects.

The Variable Media Initiative[14], Inside Installations[15] and GAMA[16] were also mentioned as project specifically relevant to the conservation of digital artworks.

5.2.1.2 INTERPRETATION

A general question arose during the focus group sessions regarding how theory is developed, where in this case the theory is the model. Does the practice have to come first or is there a way of linking the two within the model driven approach?

There was some potential inconsistency in the view that it was important to see specific worked-through examples in order to demonstrate the value of the models and also a desire to see the models described at a more generic level. This might be resolved by looking for generalizable elements and identifying different layers of the models or different components where generalizable elements and also specific elements can sit side by side.

Perhaps one of the reasons that there was so much discussion regarding how specific or general the models should be reflected the way in which the project has progressed and also the point that it was at when the focus group took place. In order to develop an end to end 'real world' example the project

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[14] http://www.guggenheim.org/new-york/collections/conservation/conservation-projects/variable-media
[15] http://www.tate.org.uk/about/projects/inside-installations
[16] http://www.gama-gateway.eu/

has, in art and media, been focusing on very specific challenges where the information is developed to populate the model, this in turn has shaped the model. However the next stage should look at which aspects of these models might operate at a more generic level. The focus group discussion was important in indicating the importance of this aspect of the work that is still to be carried out.

One of the things that became clear during the focus group discussion on the relationship between theory and practice was that different stakeholders had different requirements for the models and would find different things useful. It was clear that the software developer was keen to see the models simplified and to become more generic so that software could be written based on them. The practitioners on the other hand may find the complexity within the models the most useful element in documenting or analysing a particular artwork or particular preservation challenge especially where this challenge is new. Once a particular preservation scenario is better understood and more established the model might serve to underpin system development. The focus group served to highlight that the models might be able to serve all of these different purposes, however it would be useful to make this distinction explicit as it might help to clarify a current tension within the project. The key message here is that to be useful (i.e. the right tool for the job) the models will need to be operate at the level of specificity relevant to the particular application that it is being used for.

It was also the case that some of the participants were not accustomed to the level of individual detail and attention given to individual artworks within a fine art conservation context. Some participants may therefore have been surprised to see the application of the models at individual artwork level.

The focus group discussion suggested that the real potential benefit of PERICLES is more likely to be found in the uptake, development and implementation of discrete aspects or components from the project's collective output. This context takes the general approach of PERICLES, theory into practice and somewhat develops it, practice into theory. This is perhaps where the true value of research is borne out, in an almost continual, self-propagating transfer between knowledge and development.

It was clear from the focus group that an end to end example was required both as a proof of concept as well as a communication tool. Within the project the development of these examples is also serving to populate and shape the models. PERICLES is addressing the requirement for an end to end example by answering the request to take very specific example cases from the two case study partners and processing them through the tangible pathways of the model via our test-beds work package. Every project component may not be utilised in this demonstration but the challenge and example of change being managed will be covered from starting point to action point.

As with the other output tools from PERICLES the PET can be used immediately on some level but serves also as a basis from which to transfer technology to communities for further development. However it was noted that a link between the tools and the production of the models was not demonstrated. It was also noted that the development of tools to create ontologies and populate the models was an important part of realising the impact of the model driven approach on practice.

5.2.2 *Recommendations for the project*

Out of this evaluative focus group the following thirteen recommendations emerged for the project, in some cases work may have been done within the project but not clearly articulated in the presentations. In this case the focus group largely evaluated what they knew about the project through what had been communicated in the presentations from project members on the day. The recommendations arising were that PERICLES

1. articulate the relationship to other projects, what is being incorporated, what is being built on and how PERICLES is addressing any gaps or needs in the current state of the art.

2. create at least two end to end examples from the two case studies that articulate the value to the use case providers and other stakeholders of the models. For example this might include software developers as well as the conservators of software based art.

3. examine the notion of a trustworthy model and express a vision for how models might be created, used and useful to different stakeholders, for example creators, those responsible for the digital preservation of objects, those responsible for systems that support digital preservation and software/ system developers.

4. address concerns about the effort involved in creating a model that is useful for the different interests of the above stakeholders. Make a case for the model driven approach over current practice including consideration of resources, skill and ease.

5. articulate how the creation of ontologies (rather than hard metadata schemas) allow for greater degree of automated knowledge creation.

6. bring out clearly why a company like Xerox is interested in the model driven approach and how this might impact the future of digital preservation.

7. articulate the relationship of the tools to the model driven approach, where possible demonstrate this by a real world example.

8. identify the generic level of the models. Test whether they are applicable across domains within the project. Test the re-use of elements within the models in different domains.

9. identify and articulate what is essential for models to be useful depending on their different purposes. For example; part of a sheer curation strategy, the basis for software development and the automation of workflow; documentation and risk analysis at digital object level; documentation and risk analysis at digital collection level; systems development (where systems include institutional processes, protocols and workflows as well as software and hardware).

10. consider including a discussion with John Gerrard the applicability of the model driven approach to artists and creators as part of the software based art case study.

11. look at the implication of the idea that the models need to be developed differently for the different purposes - for example the need for a generic and simplified layer for software developers.

12. establish a clear narrative about how to articulate the strong consideration and participation of the authorial intent and the different stakeholders in the work of the project.

13. clarify the meaning of the word 'policy' in the project and its role and relationships within the models.

5.3 Science

5.3.1 Analysis of responses

5.3.1.1 FINDINGS

The findings of the focus group are divided into the following themes:

- Appraisal, risk analysis and supporting a business case for preservation
- The need to promote preservation practices
- Implementation issues
- Interesting points with the PERICLES approach

These themes emerged as a result of the coding and analysis of the transcript.

Appraisal, risk analysis and supporting a business case for preservation

The most lively and controversial part of the focus group discussion revolved around the question of what data to keep, how to assess the risks of "lost data" and how appraisal interrelates with a business case for preservation. These three topics are strongly interrelated. Though hardly any of the terms were being used during the discussion, this is what they basically refer to.

Appraisal - what data to keep

Though the term "appraisal" was hardly used, the discussion was about what we in PERICLES mean by that term: understanding what information and what data to keep, the effect change would have on the remit to preserve certain data and the impact the preservation would have in terms of resources needed.

"Sometimes you have to prioritise some data and others can be lost forever. […] We have to select, appraise, and many times we need to understand that something must be removed, must be deleted."

The discussion about preservation quickly turned to the most basic of questions relating to archiving: what to preserve? There were different views in particular concerning raw data. While some felt that raw data is useless after it has been processed by scientists (already *"brought it to a certain level of our understanding"*, it would suffice to *"keep just a summary and remove […] the raw data [because they] are too big or they are not providing much more."*, others maintained that this attitude does not take into account that *"you [might have] permanently embedded scientific assumptions [….] that may be wrong., "that whatever algorithm, the way to compute from that raw data […] that we have kept has some mistakes, which could be discovered only later." "[…] it's a high risk of [losing] perhaps potential knowledge that could be acquired later."*

The champions of keeping raw data feared the irretrievable decision of deleting the raw data and the lost opportunity of using this data with either new knowledge that would put into question former knowledge and processing of the raw data: *"If data is lost, it is lost."*

Appraisal – how to mitigate the risk of loss

The proponents of prioritisation of information and being prepared to lose data (*"You need to be prepared to understand your preservation value because many times you need to take a decision."*) argued that it does not make sense to keep data if you are not prepared to provide enough information to keep this data useful. Rather than just keeping it for the sake of keeping it, you might as well delete it immediately or else be prepared to document the processing of the raw data in a way to facilitate the investigation into the soundness of e.g. an algorithm or the replication of an experiment: *"Some knowledge you only know when you create it and you can never go back and get it again."* So unless you have captured that kind of information, the raw data in itself might prove useless. Different solutions were proposed based on examples from the film industries and the genome studies: in films you compress, as for viewing you need not have the extremely high resolution. Still key frames will always be kept in high quality, so not all information is lost. But it is a bearable loss compared to keeping *"high-quality 50 megabyte per second [which] is not affordable."*

Another idea was pruning information, e.g. readings from a satellite: *"If you're reading every microsecond then actually it's good enough. If you're at every 10 seconds, you could just as well prune that data."*

The results of DNA examination require about a terabyte or more. So there is a lot of researching how to compress this to some GB. However, as *"the main part of DNA evaluation of the sequence is just a matter of quality information of the sequence itself"*, the *"common agreement is that they are prepared to lose some part of this because probably 90% of the information is enough for discriminating between an individual and another one."*

Another idea was to evaluate on a short-term basis the results from processing the raw data. If the results are proven to be sound and correct, it would mitigate the concern of discovering mistakes later, and keeping the data just for that discovery that might then be highly unlikely.

Appraisal – who to assess the risk of loss?

Another issue within this discussion about deciding was "to lose" and what to preserve, was that of the best person to make this decision, who should *"[…] evaluate and identify what's the risk"*?

This was another question for which there seemed no straightforward consensus. Some argued the decision *"shouldn't be tasked under curator, but it should be tasked under the scientist who actually produces the data and actually can make sense of it […]."*

Others propose to not leave it to individual decisions but to rely on proven decisions and institutionalise these decisions in the form of policies enforcing a set of strategies. These could be based on the existing practices and experiences of institutions that already have such policies implemented instead of *"spend[ing] yet another time for inventing the wheel for evaluating".*

Though there was no easy solution, all seemed to agree that scientists need to take a large part in the responsibility: *"I don't believe in the idea that you can hand over all responsibility for curation to a repository. Usually it's the scientist who has to sit down and think, 'Can I actually compress this data in a meaningful way?' I do not lose, so it's not a lossy compression."*

An interesting observation was that the decision-making depends on "context", i.e. there are different scenarios of what is considered significant or not, or whether to delete, prune, compress etc. makes most sense and implies the lowest risk.

However, the strongest aspect with relation to deciding what to preserve seemed not to depend so much on the decision of the scientist, than on the question of financial viability or strategy.

Appraisal and the question of financial decision-making

The issue most addressed in conjunction with the question of what to preserve was the question of storage space and time investment, both an issue because it incurs costs. The financial aspect linked to the appraisal of preservation action. Interestingly, some argued that it has not been yet widely accepted that *"the impact of preservation has cost (…), either taking preservation action or not taking preservation action. […] if you don't take any kind of action for preservation, you will have to spend money for this decision […] something that usually is not well understood."*

There was a strong disagreement about costs incurred by storage space, the arguments ranged from *"the pace that we are creating data today, [for] many institutions it's not affordable to keep everything"* to *"[…] you have to look at the cost-benefit analysis. You can't make a simple statement. I think all too often people assume it will be too expensive without ever looking at the costs."*

On the other hand, all agreed that preservation requires a lot of effort and thus time, both incur costs. For the scientists who often have a limited contract, investigations in support of appraisal such as how data can be compressed in a meaningful way are time consuming and will not be feasible within the available time. At the same time, this type of expense has a potential for improvement as the institutions cannot themselves *"optimise much on the storage side [they] just [need to] wait for industry, but on the personnel side, you can optimise a lot."* Increasingly, there are best practises, guidelines and tools to optimise the investment of personnel.

There seemed a consensus that the cost-benefit analysis is lacking in current considerations.

"We look at the value of our data and we measure it in things like papers and PhDs where they're accepted numbers for the value. You see that the cost is just nothing compared to the value."

This is where the funding agencies could take a leading role. They are asking for the value of their investment, and this value should include indicators for preservation appraisals.

"The funding agencies can provide both stick and carrot because they are making global policies […] they […] provide the money, so they should be very motivated by different projects and disciplines sharing solutions."

The question then is: can one afford to delete data? If this decision is driven primarily by financial considerations, then the awareness of the importance of long-term preservation management and benefit of long-term re-use options needs to be increased in parallel to research done to facilitate preservation and enhance its practises.

The need to promote preservation practises

Not surprisingly with the group invited, first thoughts on preservation and re-use were linked to the increasingly salient discussions around open science and open access, of which long-term preservation is considered *"a natural complement […] because archiving of data is an essential part of open science"*.

Lack of awareness and understanding the benefit of preservation

However*, "the largest barrier is […] getting people to change the way they're doing things and raising awareness about archiving correctly."* For large parts of science data management, it might be correct to state that *"Preservation is something that usually nobody cares about."*

Even though, the awareness that a well-designed and managed repository and documentation in support of retrieval are the prerequisites of re-use of data, it yet needs a lot more efforts to actually convince people to invest the time into preservation and to use the existing models and tools.

From "awareness of preservation benefits" to actually implementing preservation into one's workflow is still a big step. Working with use cases has proven to already raise awareness within those specific partners. Networking and making use of existing tools and practises is part of the open science discussion and would apply to preservation as part of open science and open access as well.

"Similar astrophysics experiments can have probably more or less the same problem of preservation, about the preservation of data. Of course, you have to customise, but actually you can get some good advice."

Good examples as incentive to implement preservation workflows

To provide a convincing argument for the benefit of applying a preservation framework such as PERICLES, one needs to *"consider all of the business processes that occur […] to make sure that it can integrate systematically the things that people do"* and *"to convince others that they can also use it."*

Initiatives such as open science cloud[17] are based on the very notion of collaboration. While appraisal was considered to be the remit of the scientist, there is a strong call for collaboration in particular as the open science initiatives aim for *"networks of information across the archives."* In this spirit, data management should be considered already at the *"collaboration production stage, where you need to be bringing in data, reusing it, producing it, capturing it in big collaborations then for the analysis. […] It shouldn't be down to the individual researcher to actually decide on how to work with the data management."*

"There are things that the repository can do probably much better than lots of individuals doing it."

This ties back to the question of effort and time. If preservation becomes a natural part of data management and there are best practices that scientists could easily incorporate and with the help of tools do this without too much time investment, then this can only happen if there is an understanding and acceptance in the whole community. *"In scientific environments there are a lot of researchers that have a very, very short [time] horizon. They can just look at their fellowship, one year or something like that, and so they are not involved in taking care in what is happening to the data after they fellowship."*

The participants agreed that on the long run to implement preservation as a common practise within the scientific community *"the only sensible way to do this is actually to work with other projects and*

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[17] http://www.helix-nebula.eu

other disciplines because it's a complex problem and having different viewpoints, different experiences simply helps everybody."

A coordinated approach for preservation would facilitate understanding the propagated accessible information *"in a joint and coordinated way, which will also speed up the process of understanding as well".*

Implementation issues

Trust

The probably strongest resistance towards implementing new practices and tools is the question of trust. It starts with *"trust in data produced by others"* to trusting *"the places where the data is kept."* So it not only involves the question of trusted repositories but trust in the accuracy of information provided by tools. Automation is often anything but trivial, and implementing it is often conceived taking a big leap of faith.

"The main difficulty is the interface between the automation and people and their trust in what the automation tells them. It's all very well automating it if you don't actually believe what the system tells you."

It comes back to what had been stated earlier: convincing users of the benefits of the preservation framework and tools, *"that there's benefit and that they can trust what has been built or developed somewhere else."*

But too often, even if there are positive examples to prove the feasibility and benefit of preservation practices and technology, the experience is that you'll have to overcome the argument *"oh, but we are different because this and that."*

Integration

The idea of integration takes on several aspects: from networked data which implies integration in a system or networked repositories, to integration of technologies providing a preservation solution into existing systems and workflows. The first type sees the resistance described above, as demonstrated by the reserve towards trusting cloud technology or third party repository services. However, it is generally considered a short-term issue to be overcome soon by positive experiences to build on. There are currently initiatives to provide platforms as repository for science data. The questions that will still need to be dealt with is that of responsibility and trustworthiness of the data.

The second aspect of integration is about convincing through demonstrating how technology and solutions tie in with current applications, practices, workflows etc. A demonstration of *"a coordinated effort between the IT development and our [scientists'] data knowledge"* could form a good basis for trust.

There was a general consensus that too seldom project results are taken up and integrated, that too much is happening in isolation and therefore doesn't benefit from existing results or repeats efforts already invested in other projects. *"It's very important to connect the developments to other already-in-place real-world systems."*

"The only sensible way [...] is actually to work with other projects and other disciplines because it's a complex problem and having different viewpoints, different experiences simply helps everybody."

In particular one of the evaluators has extensive experience with using project results for their own systems and workflows instead of re-inventing the wheel:

"We have advanced our implementation by some years, maybe three years, by benefiting from other projects around."

Interesting points with the PERICLES approach

Policies

Like with "appraisal" the term "policy" did not come up a lot during the discussion. This might also relate to the fact that the question of policy had been widely discussed in the training workshop. But the discussion on appraisal and who should appraise and how to appraise was often close to the question of policies which seemed to be widely accepted as a productive way to create trust and facilitate preservation. However, and not surprisingly from the participants' perspective, "policy" remained within the area of appraisal. Policies are viewed as "guidelines" for implementing strategies. Since there is no wide practise, policies seem to be a question of the future, because you would first need an accepted strategy as the basis of any policy. But it was generally agreed that policies are needed and helpful, and that therefore the decision-making strategies and processes need to be identified, discussed and then determined in order to formulate policies. The central role of policies in PERICLES was seen as very promising and interesting.

"It's been really valuable […] to hear [about] the focus of policies, the importance of policies when it comes to reuse of the data."

Change and environment

The PERICLES focus on change management was also considered a valuable approach and addition to current preservation research. During the discussion on appraisal, the participants already pointed out that we might not ourselves see what our knowledge and interest might be in the future. Keeping information on data might be motivated not only be considerations of space or time efforts, but also by keeping information on data that currently cannot be read or analysed due to obsolescent software, you might still *"mothball it just in case it becomes scientifically very important in the future."*

The aspect of environmental and contextual information is seen as a *"contribution to open science".* If you promote building a *"network of data rather than an archive"* you need to provide context that later users will need to access, too, in order to understand the data. Therefore technologies that help you do that are of particular interest.

The importance of focusing on change has been well received:

"I think definitely having a project explicitly looking at these aspects of how to handle change is very important because it's simply too easy to ignore them or make assumptions which simply aren't true, that architectures won't change and languages won't change and hardware won't change, when we know from our experience that the exact opposite is the case. These changes are outside of our control."

Model-driven approach

The model-driven approach had not been at the centre of the evaluation and introductory workshop, however, it was of course mentioned. In particular those evaluators who are part of preservation of science data initiatives, were very positive towards the model-driven approach. Some had already worked with models in the context of networking the data, but not as a pervasive approach applied throughout the lifetime of the data.

"I actually really liked the approach that you have with this […] linked resource models. This is very interesting in the way it actually works, that it can actually describe itself. It works like introspection. It can describe the model by the same means as you describe the instances."

The potential power of the models for preservation management seemed to have been well explained:

"What I learned today is the importance as you've been showing the possibilities of modelling, this model-driven preservation of the management, […]"

It was also pointed out that most management plans developed today take a static look at processes and research life cycle, whereby the aspect of looking at the "lifecycle" as a continuum was well received, together with the dynamic aspect of the LRM.

5.3.1.2 INTERPRETATION

What this focus group discussion showed us was that there is a substantial need within this community to discuss the policy of what digital material to preserve. Concerns on how to preserve them over a long term seemed to come after that first question was solved. In contrast to communities where archiving and preservation is a natural part of their remit and where the question of how to keep the archived material accessible is possibly more salient than the question which objects to preserve. "Loss" for scientists is not yet related so much to "change" than to a policy of deletion and prioritisation, and a lack of understanding the need to preserve as much as you can. It was interesting to see the advocacy for keeping data that now seems "useless" on the grounds of potential future change in knowledge, which sounds like the reverse logic we apply in PERICLES: how to avoid data becoming "useless" (i.e. not accessible anymore) because of change, while in science data might become meaningful through change. Note that typically, no practical tools are currently available to keep data reusable over the long term, which is a problem that PERICLES is addressing. Therefore, the observation made does not imply that PERICLES is wrong. Instead, it is actually a justification for the scope of the project.

The discussions reflected that preservation policies is what the discussions in the community is currently focusing on, and for PERICLES this means that if we want our research results to take effect, it would be with the policy-makers. On the other hand, the preservation experts generally accepted our proposals because they complemented or answered issues that they are well aware of. They themselves work with models and frameworks, and different environment or metadata related tools, as solutions for data preservation and management. Hence both perspectives came to the same conclusion: that PERICLES needs to seek out the initiatives and key players in advancing the preservation of science data and collaborate with them to implement these results in a larger discourse and attempt to convince the policy-makers of enforcing preservation guidelines and policies.

This also ties in with the other big issue discussed: the question of trustworthiness of the services proposed. The services and framework proposed to facilitate the work being done and the decisions being taken, in the science community this is touching on work and decisions that is not (yet) part of the common workflow. This is in contrast to the communities where preservation is part of the workflow with special staff and expertise at hand. So while in the archiving communities, the services are being scrutinised for the effectiveness in "assisting the human to combat with the increasing volume of data and information", in science communities there is not so much a "critical" stance towards the effectiveness. To the contrary even as this seems to be quickly understood and accepted, as towards the validity of the service. Where the preservation experts have the knowledge that is being "automated" and they therefore can validate the service against their knowledge, the scientists feel that they have to rely on the service "knowing what to do" without them being able to corroborate this. It seems that if we could prove the trustworthiness and soundness of our tools and framework, there would be less hesitation in accepting them than perhaps in the preservation community.

5.3.2 Recommendations for the project

Out of this evaluative focus group the following 10 recommendations emerged for the project, namely that PERICLES

1. Focus on filling in the gap between the theory and the practice, to make the approach implementable.
2. Connect to initiatives "instructing" the community on how to deal with their data, e.g. the data carpentry community as an ally to convey data preservation literacy.
3. Investigate how to prove the trustworthiness of your services.

4. Integrate your results with those of other projects and existing technology (avoid re-inventing the wheel).
5. Try to establish different kinds of scenarios to get users involved.
6. Promote the LRM to the W3C standards group in order to extend the PROV-O[18] model.
7. Help convey the importance of preservation, policies and continuum of data management.
8. Work with other projects and disciplines to gain different viewpoints and experiences.
9. Try to connect with off-the-shelf technology, e.g. try to a so-called configuration management database.
10. Join initiatives to make people aware that it's important to use preservation technology and to put an effort into the preservation of data.

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[18] https://www.w3.org/TR/prov-o/

6 Outlook

The results of this evaluation campaign, and in particular the recommendations that it brings to the project will be processed by first disseminating them across the project partners. As it is likely that the consortium will deem certain recommendations more appropriate and realistic for implementation, the recommendations will be prioritized, taking into account implementation cost (considering effort and time required but also the potentially disruptive impact it has on ongoing activities) versus project benefit considerations. In a next step and where applicable, actions will be proposed and agreed on (for example in a PMB session or a dedicated consortium workshop session) on how to concretely deal with the recommendations, assigning them to particular tasks or partners/individuals.

The final evaluation, which will be held near the end of the project, will be more summative than evaluation 1 and 2. Its main focus will be on performing end-user and expert evaluations of concrete tools, technologies, approaches and knowledge that have been developed in PERICLES and how well these developments fit with the objectives of the projects and recommendations made by experts, stakeholders and reviewers that aimed at steering the project in the right direction. Already now, it is clear that the projects efforts are heavily influenced by the first evaluation session. For example, a few dedicated mini-projects will be developed and deployed on the testbeds, representing non-trivial scenarios and aiming at demonstrating (and addressing) some key challenges and change scenarios that have been developed to illustrate different forms of change impact. Also, communication overall, but in particular about the models, including how the domain ontologies can fit the bigger picture, has increased. In particular, it has been further elaborated with the consortium, how the underlying ontology that is provided by the LRM can drive the models and change management tools that can facilitate integration of the models into the overall architecture, or that aid in the management and assessment of impact of change. The overall architecture, and in particular the functional architecture related to the projects model-driven preservation approach has, in the scope of task 3.5.3, already been detailed as to allow for a better understanding of our model-driven approach to preservation.

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Appendix A: Evaluation Session Material

Workshop 1 – Art and Media

Focus Group Session Questions

The focus group questions were as follows:

Introductions

- Tell us who you are, your role/s and how it relates to digital preservation and a favourite digital thing from the collection you work with.

Transition questions

- This morning's talks outlined the approach to digital preservation being developed within PERICLES, for example the model driven approach. I would be grateful if you could share your immediate thoughts about this approach?
- How do you think this approach might differ from other approaches that have been or are currently in use? (Did this approach strike you as novel?)

Key questions

- How do you see this approach impacting the field and in what sort of context?
- What do you think the benefits might be for you in adopting this approach?
- What do you think the potential pitfalls might be in adopting this approach?
- What piece of advice would you like to communicate to the project partners to help inform their work in the final year of the project?

Ending questions

- We are using this session to help to guide the project. Is there anything which you think we should have talked about which we have not talked about? Anything we missed?
- Is there anything else you would like to add? (go round to each person)

Codes

1. General Feedback to the Project
    1.1. Important things about the project
        1.1.1. Change
    1.2. Problems for the project
2. A difficulty with the PERICLES approach
    2.1. Linking PERICLES to practice
3. Model Driven Approach
    3.1. Disadvantage of the model driven approach
    3.2. Advantage of the model driven approach
        3.2.1. Ability to predict change
        3.2.2. Commercial product development
    3.3. Use of Models
        3.3.1. Example - use of models
        3.3.2. Use - describing things
        3.3.3. Difference in applying models to existing collections compared to new collections
    3.4. Why Adopt the model driven approach?

17. Policy
    17.1.   PERICLES use of 'Policy'
    17.2.   What does it relate to?
    17.3.   No relationship between policy and object
    17.4.   Link to object
18. Scale
    18.1.   Scale : Organisation
    18.2.   Scale : Material
19. Dissemination and knowledge transfer
    19.1.   Commercial exploitation

Workshop 2 - Science

Focus Group Session Questions

The focus group questions were as follows:

Introductions

- What is your implication in data preservation?

Transition questions

- What have you learnt from this meeting and in what part it is relevant to your activity?
- Can you see a benefit to your concern from what PERICLES is proposing?

Key questions

- In your view, how would PERICLES contribute to aspect of open science and code searching?
- How could PERICLES contribute to creating awareness for preservation needs?
- Search is a big issue in the re-use discussion. From what you have heard today, how would you judge the potential of the PERICLES dynamic approach to sustain effective data retrieval?

Codes

1. General Feedback to the Project
    1.1. Policies
    1.2. Appraisal
    1.3. Automation
    1.4. Models
    1.5. Trustworthiness
    1.6. Relation to other projects
    1.7. Complex - still a lot to do
    1.8. Implement in or with existing technology
    1.9. Putting it into practice
2. Difficulty with preservation
    2.1. Lack of awareness
    2.2. Lack of practices
    2.3. Lack of policies
    2.4. Lack of guidelines
    2.5. Lack of support from policy-makers
3. Appraisal

3.1. Data to be preserved
- 3.1.1. Prioritisation
- 3.1.2. Deletion
- 3.1.3. Usefulness
- 3.1.4. Scientist is responsible for content appraisal
- 3.1.5. Compression
  - 3.1.5.1. Lossy compression
  - 3.1.5.2. Frames
- 3.1.6. Loss
- 3.1.7. Pruning
- 3.1.8. New knowledge
- 3.1.9. Scenarios

3.2. Cost appraisal
- 3.2.1. Storage space
- 3.2.2. Cloud
- 3.2.3. Petabytes and exabytes
- 3.2.4. Big data
- 3.2.5. DNA
- 3.2.6. Cost-benefit analysis
- 3.2.7. Cost of personnel

4. Re-use
  4.1. Open science
  4.2. Trusted data and repositories
  4.3. Networked data

5. Policies
  5.1. Funding bodies
  5.2. Guidelines
  5.3. Shouldn't be down to the individual researcher how to use data management

6. Use of Models
  6.1. It is good that PERICLES is taking up a dynamic approach
  6.2. Most data management models are static
  6.3. Models for different parts of the research cycle, but not for the whole lifecycle
  6.4. Considering the complete picture: processes and decision points
  6.5. LRM
  6.6. Very promising
  6.7. Novel approach