E-ARK, Ten years and still going strong:

*Results, Use Cases And Benefits*

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**Abstract – The E-ARK Consortium has been working steadily over the last ten years to provide specifications, tools, and best practices for digital archiving across Europe and beyond. The E-ARK Consortium has grown over the years and the work has taken place under different auspices: first as an EC-funded PSP CIP pilot B project, then as the eArchiving Building Block under the Connecting Europe Facility (CEF) banner.**

**The CEF Programme has just finished and eArchiving will be continuing under the Digital Europe Programme (DEP). This paper comprises the eArchiving Building Block results, benefits, and Consortium member use cases as presented at the DLM Forum meeting in October 2021.**

**Keywords – E-ARK, Digital Europe Programme, eArchiving**

**Conference Topics – Innovation; Resilience.**

# Introduction

## The impetus for the E-ARK effort came in 2011 when the Slovenian and Estonian National Archives were faced with archiving their e-government records. They could not manage this new and daunting task alone and so they got together with DLM (Digital Lifecycle Management) members to lobby the European Commission for help to produce a pan-European, usable digital archiving suite of specifications and tools. The first E-ARK project ran from 2014 to 2017 [[1]](#footnote-1)to deliver this. In E-ARK, a broad consortium of members: archivists, researchers, software developers and membership organisations, pooled their expertise and products and produced the first tranche of specifications and software tools that could be used across Europe and beyond, for national, regional, local or cross-border digital archiving tasks. The E-ARK project focussed on archiving ERMS records, geospatial data, databases and also carrying out Big Data analysis on cross-border datasets.

## The next instantiation of E-ARK from mid 2018 to late 2021 was as a Connecting Europe Facility (CEF) eArchiving Building Block[[2]](#footnote-2), whose Owner was the European Commission’s (EC’s) Directorate General (DG) CNECT in Luxembourg, with stakeholder management provided by the EC’s DG DIGIT Stakeholder Management Office (SMO) in Brussels and with the E-ARK Consortium as the Solution Provider. eArchiving functioned alongside other building blocks including eSignature, eDelivery and Blockchain, together supporting the EC’s Digital Single Market. From 1st April 2021 to 31st October 2021 the newly-formed Health and Digital Executive Agency (HaDEA) in Brussels was responsible for the day-to-day administration of the eArchiving Building Block, together with the four eArchiving-dependent Generic Services projects which began in the autumn of 2021.

## The specifications and tools were further developed and harmonised as part of the eArchiving Building Block work, and substantial training and outreach was conducted. The scope of the work increased to encompass eHealth records, cultural heritage and research data, and a comprehensive Reference Architecture was created, together with a Maturity Assessment model. The CEF Programme has now concluded, and eArchiving will continue under the Digital Europe Programme[[3]](#footnote-3) (DEP).

## This paper will first delineate the various stages of E-ARK activity, then outline the E-ARK results: the specifications and tools etc. We will then move on to present a range of case studies from adopting organisations, followed by use cases from and benefits reported by the E-ARK Consortium member organisations, showing how it is possible to share the digital archiving burden.

# E-ARK Results

## Overall reflections

Overall, the eArchiving Building Block was highly successful. In 2021 there were several high-profile, very well attended events where eArchiving use was strongly recommended to EU businesses, agencies, and institutions. The events included “eArchiving in Action” in January 2021, the CEF’s “Trust Café” in March 2021 and the CEF’s “DigitAll” meetings in April 2021. Following this outreach there was a step change: a very noticeable increase in our onboarding contacts, with several key EC departments getting in touch for long-term help, for example.

In terms of strategic collaboration, in December 2020, the eArchiving and eSignature building blocks got together to discuss close collaboration in order to provide a joint offering to users. eArchiving also worked with the Archiver project [1] in the research infrastructure domain where the two winning tender organisations are both using E-ARK specifications to build a pan-European European Open Science Cloud (EOSC) research infrastructure. Other significant collaborations include working with experts in Digital Cultural Heritage sector and the Engineering Data Space.

## Specifications

Turning to the eArchiving outputs, the specifications are now the core foundation of all the E-ARK undertakings as everything is built upon these key standards, which are now mature and used in production environments.

Graphical user interface, text

Description automatically generated

#### figure 1

The specifications are maintained and developed by the Digital Information Lifecycle Interoperability Standards (DILCIS) Board [2] and the full specifications are available there, together with requirements, XML-schemas, Schematron code, guidelines and examples. In figure 1, the top four Information Package (IP) specifications are based on the Open Archival Information Standard (OAIS) [3] and include the Common Specification for Information Packages (CSIP); the Submission Information Package (SIP); the Archival Information Package (AIP); and the Dissemination Information Package (DIP). These are complemented by accompanying Content Information Type Specifications (CITS) which cover databases and the SIARD format (Software Independent Archival of Relational Databases); geospatial data; ERMSs; eHealth data; archival information for digitised material and lastly preservation data based on the PREMIS standard [4].

## Software and Validation

The E-ARK Sample Software Portfolio includes two mature, end-to-end, Open-Source digital archiving systems (RODA from KEEP Solutions and ESS Arch from ES Solutions (see below for more on the two SMEs)) plus many different Open-Source components and software libraries etc., all developed on a modular basis so that a mix-and-match approach can be adopted[[4]](#footnote-4). In terms of software, there was noticeably improved specification support: previously available sample software was extensively tested and improved to meet the v2.0.4 of the E-ARK IP specifications. All components are now on a next level of conformance. New software had also been created to support the specifications: a brand-new eHealth SIP Creator and an E-ARK IP Viewer. The new software components were available from the end of October 2021[[5]](#footnote-5). The sample software portfolio, and indeed every aspect of eArchiving, was covered by a dedicated Service desk which proved increasingly useful under the CEF Programme, even though eArchiving was not a hosted service. The Service desk provision ceased at the end of October 2021, but provision was made for the E-ARK Consortium to be contacted with any queries.

The eArchiving Building Block manages a large and diverse portfolio of components, including various specifications, tools, and services delivering support, training, and dissemination. The objective of release management is to sustain theoretical conformity and technical compatibility between the versions and revisions of the components of the eArchiving service portfolio. Release Management is an internal activity for the eArchiving team and end-users do not really have to see what guides the version numbering and release dependencies of the different eArchiving components. Here “no news” is really “good news”.

The Reference Architecture work on the other hand has been producing a lot of news. This was a new initiative at the beginning of the E-ARK3 project and we are immensely proud to have announced the first full version of the eArchiving Reference Architecture by the end of October 2021. In order to make the model easier to understand and use, a lot of example business scenarios and component layout views have been added to the pure ArchiMate diagrams, and an html based online version was created as well. The web-based application gives us the opportunity to add introductory sections about the background and scope of the model, about ArchiMate, a glossary, and a Download area. The online model is available at the DLM Forum Knowledge Centre [5].

In terms of validation, a new validator and validation REST API were released mid-October 2021 [6], and the validation input was for version 2.1 of the specifications. A validation strategy report was released in June 2021. The final test corpus was reviewed to ensure that the validation rules were functioning as expected, and the SIARD CITS was assessed to see how practical it was to validate it.

## Training

E-ARK training provides content to support existing E-ARK specifications, software, and tools. It has been delivered in the form of webinars, YouTube videos, modules on the Moodle platform, and supplementary online workshops and is an essential part of E-ARK’s support for onboarding. E-ARK developed an integrated approach to training, where the Webinars and videos have been closely linked to Moodle training with cohesive branding. In total, over 3,000 delegates have booked on the 17 E-ARK training webinars since 2020. The online YouTube training videos have seen an additional 2,900 views.

The training has been driven in part by the results of the ‘user needs’ survey which has proved to be an important tool for understanding user requirements, providing a conduit to the user communities, thereby encouraging open communication, and raising awareness of the eArchiving Building Block and its services.

## Outreach

Finally, Onboarding and outreach was one of the main priorities for the eArchiving Building block. This effort built on all the specifications and software components and systems to gather traction on the adoption of the outputs E-ARK created, enhanced, and maintained over the last decade.

Figure 1 – eArchiving onboarding evolution (2018 to 2021)

To put this effort in perspective, at the beginning of the Archiving Building block (Q3 2018) there were 14 organisations known to be reusing E-ARK specifications and software components many of whom are ‘multiplier’ organisations that are responsible for determining the standards that other organisations follow. Fast-forward to Q3 2021 we had 29 organisations reusing, six committed to reuse and 18 committed to analyse the use of E-ARK in their organisations. The evolution of these metrics is detailed in Figure 1. Moreover, there is a list of 300+ leads in our CRM ready to be onboarded (details on these leads are depicted in Figure 2). All these facts really demonstrate the interest in E-ARK for years to come.

These figures are also explained by the effort of the Consortium to broaden the horizons and expand beyond our original Archiving community to focus on other sectors, such as, Research Data, Digital Signature, Finance and Healthcare. This new avenue showed that the need and benefits of Digital Preservation are understood, but other communities are still taking their first steps in appreciating that data backups are not preservation and that there is a whole community ready to share the knowledge acquired over the last decades.

To better explain the benefits of digital preservation and guide new onboarding leads to adopt E-ARK, the Consortium focused on developing tools to aid in this effort, such as, the eArchiving Maturity assessment tool and the Reference Architecture[[6]](#footnote-6). The first tool can help organisations identify their level of maturity on the subject while the second tool can guide organisations on what tools and specifications to adopt in order to reach their target maturity level. Both tools were developed symbiotically to guarantee an integrated framework for assessment and improvement for organisations.

A good indicator of community interest in the eArchiving Building Block generated by our outreach activities was the great success of the first eArchiving Generic Services funding call, which received 13 applications, from 36 organisations. From these, four projects were eventually chosen for funding:

* *eArchiving of Engineering and Science Library:* The main objective of which is to adapt existing digital archives and repositories in the engineering and science domains to apply the Common Specifications for Information Packages established under the eArchiving building block;
* *J-Ark – European Jewish Community Archive*: This aims to deploy a community-driven approach to the long-term integrity and accessibility of heritage materials in line with the specifications provided by the eArchiving Building Block. The European Jewish Community Archive (EJCA) will bridge the gap between Jewish community archives and technology providers with the means to provide (digital) infrastructural service, support, and advice;



Figure 2 – Details on the CRM leads

* *Protecting Oral Histories Using Blockchain*: PROHUB will make use of the European Blockchain Services Infrastructure (EBSI) to implement a trusted data sharing approach together with the data archiving principles and standards provided by the eArchiving Building Block and the relevant E-ARK specification for information packages (CSIP);
* *One click eArchiving:* The goal of which is to build a simple to use one click solution which allows users to convert their existing CRM, CMS and ERMS exports into (an) E-ARK compatible SIP format(s) and to enrich/connect the metadata with existing data sources such as Europeana, Finna or other open data sources.

Finally, our outreach efforts also focused on providing case studies about organisations that adopted E-ARK. Five success stories were created during the CEF eArchiving period each focusing on a different sector:

* *The EU Publications Office (EUPO), (Belgium):* EUPO has the mandate to ensure the long-term preservation of all official publications produced by the European Institutions. The number of such documents that need archiving is ever growing. As of August 2019, their system EUDOR v3 stores over 90 million files with texts dating back to 1951 – years before the European Commission existed. The E-ARK products helped to (1) prevent vendor lock-in and facilitate future migrations, which are needed in order to preserve the content and avoid format or support obsolescence, (2) establish a common language to communicate within the archival community, and (3) enhance interoperability;
* *Saint John Hospital (Portugal):* Officials were acutely aware that clinical records in different formats and not always available in real-time made it harder to diagnose diseases and treat patients accordingly. The Clinical Records Repository project enabled healthcare professionals to access their ’patients’ clinical history in a digital format;
* *Rotterdam Local Authorities (Netherlands):* endow their existing digital archiving system with support for archiving databases by (1) setting a preservation plan for the new content, (2) selecting a preservation format, and (3) creating a service that would enable ’Rotterdam’s citizens to easily access the ’city’s archives;
* *State Archives (Italy):* have been looking after the ’country’s most important documents for the last 150 years. To make this precious heritage accessible to future generations, they were tasked with building a digital national platform. After looking for solutions both in and outside Italy, they found in eArchiving the answers they were looking for. They based their new system on the E-ARK specifications because of the strength of the E-ARK underpinning models, which were precursors to the Reference Architecture. In fact, the Italian State Archives joined in the work on the Reference Architecture;
* *National Customs (Sweden)*: This agency oversees collecting custom duties and monitoring international traffic across the Swedish border. It is also responsible for facilitating commercial links between Sweden and non-EU countries, while stopping criminals from smuggling illegal goods in and out of the country. The goal was to digitally archive all its records.

# E-ARK Use cases and benefits

In this section we present the use cases and benefits reported from each of the E-ARK Consortium partners. Several organisations participated in E-ARK via the DLM Forum (DLM).

The Danish National Archives (DNA), the E-ARK Coordinator during the CEF phase, reported widespread benefits from E-ARK:

a) cooperation with the Consortium and the EC, helping to promote eArchiving as EC policy;

b) adopting the specifications for the IPs – CSIP, with the advantages of scalability (segmentation), and the CITS for databases and the CITS for geospatial data;

c) using the Reference Architecture for eArchiving;

d) using the sample tools for creation, validation and presentation.

The DNA have been a consortium member and field leader in database archiving from the beginning of the E-ARK effort.

It is important to note that for a National Archive it can take many years from the start of the collaboration until the adoption of new standards and deployment of new software tools. This is due to the impact on public administration, and especially in the case of the DNA which, according to Danish law, can mandate that all public institutions (ministries, agencies, courts, counties etc) must use the DNA specifications, thereby covering  99% of all public institutions.

Poliphon is a Hungarian consulting and solution development company, participating mostly in business process and document management projects. They are used to modelling and automating business processes specific to one enterprise. In the E-ARK and eArchiving projects where they were involved via DLM, they gained another view on processes. Here they looked for the common not the specific and learnt that interoperability between organisations really means interoperability between the processes run by these organisations. But organisations cannot be compelled to adopt your processes, and organisations remain different in many ways even in the area of interoperability. This, of course, is why you need the specifications. They are the common fixed points where different processes can meet and around which processes should be built in order to achieve interoperability. This is why specifications are E-ARK’s main assets, and processes are the means to harness the interoperability opportunities of the specifications.

The Archives of the Republic of Slovenia (ARS) stated that eArchiving was needed to make their service better and they achieved this by working with the Slovenian Cancer Registry to develop an eHealth SIP which could then be used across the European Union (EU). ARS have been using the database tools for several years now, and the geospatial CITS and the Reference Architecture work also meet the needs of producers and stakeholders that ARS is responsible for, so it helped ARS to develop a better service for them. E-ARK was also one of the forms which ARS could use during the pandemic to exchange information and also answer some questions.

The National Archives of Finland (NAF) joined the E-ARK consortium in 2019 via DLM and they were able to benchmark their practices in the areas of Database preservation and Geoinformation where they carried out case studies. They benefitted from the Reference architecture work and found that E-ARK participation had broadened their ways of thinking and forged a transition from a local to a European way to manage information. Networking with professionals, NAF gained a huge amount of information and top-level skills around digital preservation possibilities, including to develop their next generation of services.

NAF experienced a quick start with open-source tools, support testing, and adapting practices without having to carry out their own software development. The E-ARK training and learning provided NAF with food for thought. They received encouragement to work with multinational teams and to change ideas for the common good. This led to opening eArchiving possibilities for a broader audience and a better understanding of the CEF Building blocks.

KEEP Solutions, a Portuguese SME, participated in E-ARK since its early stages and were able to cross all stages of evolution from research and innovation, up to commercial exploitation. They stated that their clients could be ensured that KEEP software is compliant with international specifications and best practices as these are backed up and validated by an EU Building Block. Working with large international organisations allowed KEEP to expand their knowledge, understand different realities and develop their tools to cope with more advanced use cases. The Building Block gave them international visibility, which was key in reaching certain markets and certain types of international clients.

In support of the wider DLM Forum mission, DLM’s involvement with E-ARK gave them an opportunity to play a leading role developing Open-Source tools and services for the Digital Preservation Community. They facilitated the participation of many of their member organisations, who would not otherwise have been able to take part. They were able to contribute to community knowledge by supplementing the training programme initiated within E-ARK with their own series of related webinars. As a result of their participation in E-ARK, DLM has increased its membership, broadening the community for the benefit of all.

Kommunalförbundet Sydarkivera, a Southern Sweden municipality association acting as the archive authority for its members, contributed to E-ARK via DLM, and through their participation in the E-ARK webinars, their knowledge and outreach have been extended. The tools developed within E-ARK have proved to be valuable to their members in helping them create SIPs. Two concrete examples of this are the eHealth1 specification used for the creation of SIPs with patient medical journals, and the facilities provided by the update of SIARD and the creation of CITs.

The Swiss Federal Archives (SFA) participated in E-ARK via DLM and their collaboration with the E-ARK projects has contributed substantially to the development of the SIARD Format and Suite 2.2. It has provided valuable opportunities for knowledge exchange, mutual support, commitment to success, and inspiration.

Gabinete UMBUS SL, a Spanish independent consultancy in information and records management stated that E-ARK has given them the chance to work in a multinational environment and has shown them a holistic approach to digital preservation that can be applied to their projects. A clear benefit in working with people from different “archival environments” is that they have been able to share different approaches with their client base. Their work on the eArchiving Building Block has opened up for them a new range of opportunities and has helped them develop their business.

Geoarh, a Slovenian SME said that E-ARK had a significant effect on their company, enabling them to identify and exploit a whole new market. Through their collaboration, they have learned the needs of a new customer base, and they have gained both the experience and the knowledge to allow them to win new business.

Highbury R&D, stated that coordinating E-ARK with the Danish National Archives allowed them to network with many people across the Digital Preservation (DP) domain. As they are now based in Ireland they can continue to play a leading role in E-ARK. Concrete examples of the benefits they have enjoyed are being able to broaden their base of operations into areas the company was not previously working in, such as eHealth. They were also able to bid for the Generic Services project and were successful – this brought them into the new area of using eArchiving and Blockchain to preserve sensitive oral testimonies. For Highbury, leading training has been an important experience, and will continue to be a central part of their portfolio in the future.

The South-Eastern Finland University of Applied Sciences (XAMK) said their involvement with E-ARK has expanded significantly not only their EU-wide connections but has also opened up contacts in the UK and USA. Directing following from exposure gained on E-ARK3, XAMK now has an elected representative on the Executive Committee of the DLM Forum. Before their involvement in E-ARK3, they were well known within Finland, but now they have established themselves on the wider European stage. Finally, they have followed up their work in E-ARK3 and are now leading the HADEA-funded OneClick eArchiving Generic Services project.

The National Archives of Estonia (NAE) has been continuously involved with E-ARK since the establishment of the very first E-ARK consortium. They clearly recognise the relationship between the number of participants in developing digital preservation solutions and the quality of the final output. E-ARK has enabled them to work as part of a much larger and broadly-based group and achieve more than would have been possible otherwise. E-ARK has developed specifications and software that can be deployed in Estonia, without requiring these to be developed in-house. For them, the most useful output of E-ARK is the standardisation of database archiving: the solution currently deployed by NAE is around 90% dependent on E-ARK knowledge, and connections.

The National Archives of Norway (NAN) stated that working as part of the E-ARK consortium has given them access to different groups where they have been able to discuss archive challenges for the future, and how to solve them. They have found, in particular, that the Reference Architecture is a good framework for international cooperation and common understanding across organisations, and that SIARD has proven very useful for us. The principles developed within E-ARK represent very useful guidance for archives working in the digital age.

Easy Lean OÜ, an Estonian SME worked on E-ARK via DLM and gained knowledge and professional experience of the pre-ingest and IP specifications. As a direct result of this, ERMS content is now better organised and prepared. E-ARK exposed them to a wide range of contacts and ideas which led them to bid for a new project OneClick eArchiving which combines the benefit from existing E-ARK specifications and tools. E-ARK also provided inspiration to develop PhD work, in particular on how technological development and changed processes influence the creation and evolvement of preserved digital information.

The Technical University of Lisbon, Portugal (INESC-ID), said that E-ARK has given them a deep understanding of the Digital archiving community. It has helped their research data community (RDA and EOSC) engage with the Digital Archiving community. It has enabled them to participate in ISO committees on topics addressed within the project (Enterprise Architecture and Business Process Management).Furthermore, it has opened up further funding opportunities.

The Austrian Institute of Technology, Vienna (AIT) stated that working on E-ARK has helped them learn more about the archiving needs of companies and organisations. As a result, they now have a better understanding of how the CEF building blocks can help them to work more closely together at a European level. They bid successfully for a Generic Services project “PROHUB” through which they are making use of the eArchiving and Blockchain building blocks. They have expanded their network to now include the archiving community.

PIQL, a Norwegian SME, said that in E-ARK they learned ‘best practice’ in writing (eArchiving) specifications, which they regard as an important expansion to their skill set in producing a well-documented specification. They also gained greater depth of knowledge in eHealth and gained experience of running a very focused software development project with very specific outcomes for low cost and in limited time. Their experience in E-ARK put them in a position to bid successfully for two follow-on projects: Science and Engineering and OneClick.

The Open Preservation Foundation (OPF) stated that participation in E-ARK has enabled them to develop a deeper understanding of the needs of their archive members. It has allowed them to forge connections with a community focused on addressing interoperability between archival systems and organisations, and it has given them the chance to work on Free and Open-Source Software (FOSS) [7] for information package validation. This, in turn, has allowed them to improve METS validation in general. The E-ARK validator has proven flexible enough to enforce other Metadata Encoding and Transmission Standard (METS) profiles [8] with minimal development, and they see this as a major advantage.

ES Solutions (ESS), a Swedish SME has increased their knowledge of international conditions regarding digital preservation and gained valuable experience through various collaborations with expertise within the E-ARK projects. They have connected to a very valuable network with expertise in various areas within digital information management. They have attracted the attention of others internationally, which has led to a developing exposure to other markets. Their software portfolio has matured through the E-ARK projects and now provides through its comprehensive functionality an overall E2E solution for digital preservation.

# Conclusions

The E-ARK offerings have now come to maturity and are being deployed across Europe in many different ways and extents. There are many more use cases and success stories than are reported here where we have just concentrated on how the E-ARK Consortium members have used and benefitted from the E-ARK outcomes. Working as part of an EC CEF Building Block has brought real benefits to the E-ARK Consortium members but what is noteworthy is just how long it can take for large organisations to scope out, design, implement then deploy a digital archive (see the DNA experience above). Another hindrance is the lack of EU legislation on digital archiving: even though E-ARK products can be used across different national legislatures, there is still the tendency for countries to go it alone.

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4. https://github.com/E-ARK-Software [↑](#footnote-ref-4)
5. https://github.com/eark-project [↑](#footnote-ref-5)
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