

full costs of a project when it was commissioned. There was already an existing analogy for this approach in the archives world. Museums had developed a system of box charges, levied when the physical archive was deposited, and based upon its volume.

The principle of a one-off deposit charge implied that all future costs had to be covered up front. The ADS preservation policy is based on migration of files to the latest formats, and it is impossible to predict how many times this might have to be undertaken (ADS 2009). This approach to digital preservation, based upon conversion of files to a sustainable preservation format and a dissemination version at the time of accession has become enshrined within the Open Archival Information System (OAIS) developed by NASA (ISO 14721:2003). The OAIS provides a framework for the understanding and increased awareness of archival concepts needed for long term digital information preservation and access and has been adopted by the ADS.

At an early stage, ADS was funded by EH to undertake the Digital Archiving Pilot Project for Excavation Records (DAPPER) project. The aims of the DAPPER project were to create two exemplar archives to allow ADS to gain an understanding of archiving costs, as well as to investigate the level of interest in re-use of the data. The two projects were the excavations at Eynsham Abbey, by the Oxford Archaeological Unit, and work at the Royal Opera House, undertaken by the Museum of London Archaeology Service (Austin et al. 2001). It was agreed that rather than creating an online interactive interface, access to the data should be via simple downloadable files in open formats. The implication of this was that the majority of the archiving costs were front-loaded.

The figures derived from the small sample of two projects used in the DAPPER project indicated that digital archiving costs would be within 1-5% of the total costs of a project. Economies of scale become a significant factor especially for larger projects. It has also become clear that the digital archiving costs can frequently be offset against savings in publication costs. Digital dissemination may provide the best means of making detailed data and information available, thereby reducing the scale of paper publications and providing a safer option to the inclusion of the CD in the back of the book.

The DAPPER project fed directly into the development of an explicit ADS Charging Policy, now in its 4th edition (ADS 2007). This was first introduced in 1999 and was based on a formula of fixed charges per file. Simply put, files were banded according to number

and complexity of format. Images, text, simple 'flat' spreadsheets, and tables cost less than CAD, GIS and relational databases.

Two factors led ADS to undertake a major revision of its Charging Policy in 2007. Firstly, the Big Data project led us to refine our thinking on preservation costs (Austin and Mitcham 2007). The Big Data project recognised that with the introduction of new technologies such as maritime survey, laser scanning and LiDAR, archaeologist's capacity to generate massive data sets was continuing to grow. This was exacerbated by the problem of distinguishing primary from processed data in many of these applications, and by the use of proprietary formats. Secondly, the AHRC announced that it was going to withdraw funding from AHDS and it has encouraged the development of an ADS business plan which aims to cover more costs by full charging for services.

Under the revised Charging Policy, the costs of digital curation are calculated on the basis of four elements, which are categorised in terms of staff time. Examples are provided online (<http://archaeologydataservice.ac.uk/advice/collectionsPolicy>).

a. **Management and administration:** This reflects the time spent in processing the deposit, including negotiation with the depositor, dealing with rights management issues and deposit licences, and issuing invoices.

b. **Ingest:** This cost reflects the time required to migrate the data to ADS preferred formats; the harmonization of filenames; the creation of delivery and preservation formats and their transfer to offline storage; checksum procedures; and creation of file level and project level metadata.

c. **Dissemination:** The ingest charges include an allowance to cover the creation of a basic archive delivery web page within the ADS catalogue and the delivery of data via simple file download.

d. **Storage and refreshment.** The term 'storage' encompasses the ongoing periodic process of data refreshment. In order to take advantage of technological advances, archives have to periodically upgrade systems. For example, the ADS has progressed through three generations of equipment during its 10+ years of existence, a five year upgrade cycle. This is expensive both in terms of equipment and staff time. The long term cost of storage is often difficult to conceptualize but a dataset maintained for 100 years would go through 20 refreshments based on the five year cycle.