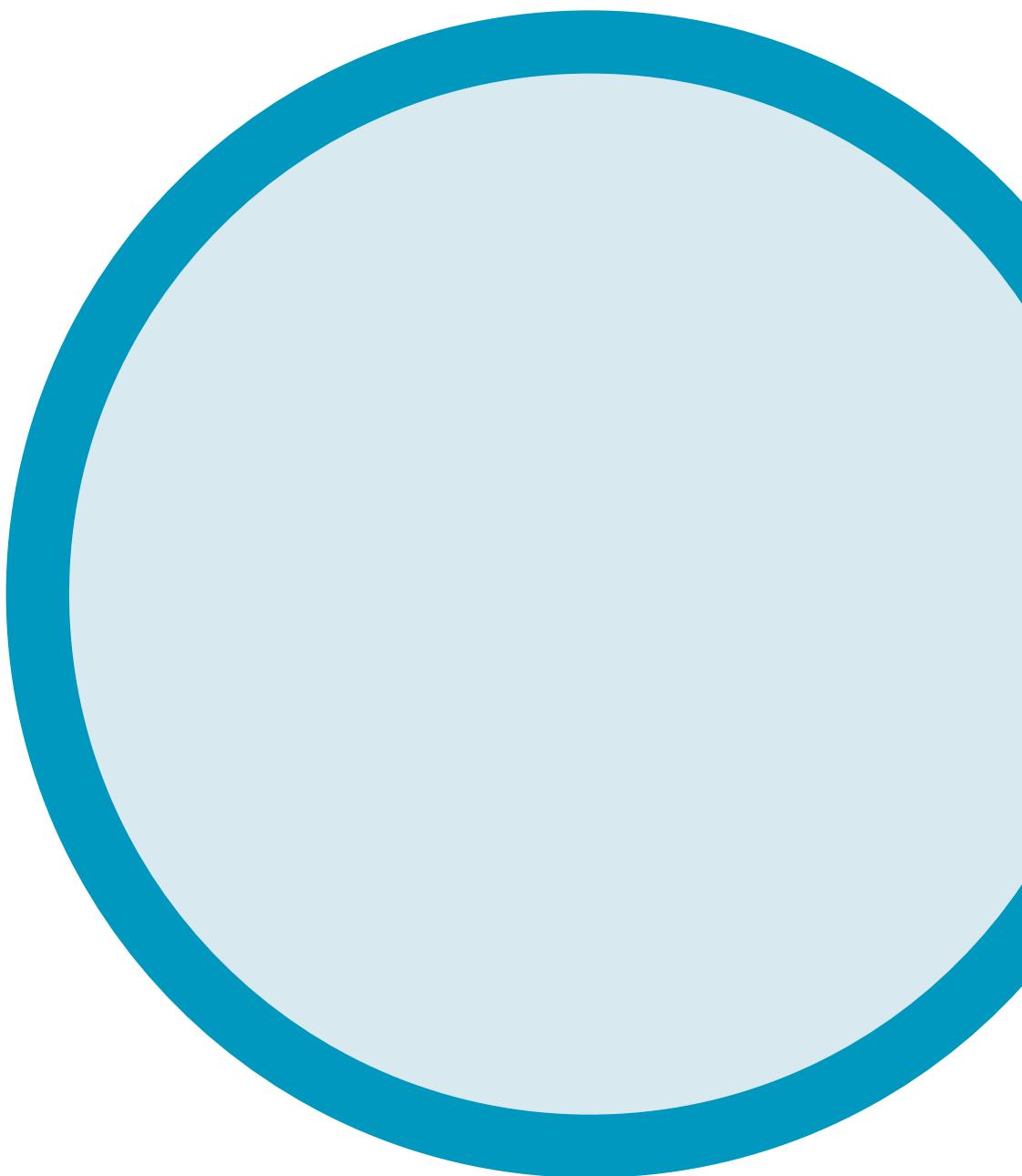


The Digital Divide

Assessing Organisations' Preparations for Digital Preservation



Executive Summary

Historically, information was recorded on paper, parchment and papyrus. Despite the apparent vulnerability of these materials, we can still read Egyptian scrolls, illuminated mediaeval manuscripts and early printed books today, hundreds or even thousands of years later. Nowadays, information is recorded digitally on hard drives, CDs and memory sticks. It has become much easier to produce, distribute and store information, and so there is more of it than ever before. It is ironic, though, that the more information we produce, and the more we can hold in a given space, the shorter the time we seem to be able to keep hold of it for. Given that within decades storage media decay and computer hardware and software become obsolete, a word-processed document written twenty years ago may turn out to be more ephemeral than a text created in ancient Egypt more than 5,000 years ago.

This white paper is based on the findings of a Planets survey of two hundred organisations, mainly European archives and libraries, to investigate their digital preservation activities and needs. It summarises the survey results, discusses key digital preservation topics, and highlights the steps needed to tackle the challenges of retaining access to our digital information in the medium and long term.

A Planets White Paper
by Pauline Sinclair, Tessella
www.tessella.com

Published March 2010

Key Findings

- The volume of digital content that organisations expect to archive will increase 25-fold over the next ten years.
- While seventy per cent of organisations hold less than 20 terabytes (TB) of data now, by 2019 seventy per cent of organisations expect to hold over 100TB.
- Digital information comes in a range of types, and while over 80% of organisations already need to preserve documents and images, by 2019 over 70% will need to preserve databases, websites, audio and video files as well.
- Only 27% of organisations think that they have complete control over the file formats that they will accept and store in their digital archives. Since the choice of format affects how easy it is to preserve digital content, producers need to be more involved in digital preservation.
- The digital preservation message has spread far and wide: 93% of respondents indicated that their organisation is aware of the challenges of managing digital information for the long-term.
- Organisations are taking account of digital preservation: 76% include it in their operational planning, 71% in their business continuity planning and 62% in their financial planning.
- By setting out a digital preservation policy, 48% of organisations are actively planning how to tackle digital preservation.
- Organisations are only starting to commit to funding digital preservation, as just 47% have allocated a budget to it.
- Maintaining the authenticity, reliability and integrity of records, checking they have not been damaged, and planning the preservation of content to deal with technical obsolescence are regarded as the most important capabilities of a digital preservation system.
- There is demand for tools and services to automate preservation planning, to characterise digital collections and to convert digital objects to more accessible formats.
- A policy is a vital first step towards tackling digital preservation's challenges. Articulating a policy helps to build a business case, which may lead to obtaining a budget and implementing a solution.
- Organisations which currently need to archive larger volumes, or a wider variety, of content are more likely to have a digital preservation policy in place. However, in ten years' time, all organisations, regardless of whether or not they currently have such a policy, expect to hold similar volumes and range of digital content.

Organisations must tackle the challenges of digital preservation. The first step for those who have not yet started, is to formulate a digital preservation policy. Those organisations with a policy need to work on implementing a digital preservation system, while suppliers need to respond to the demands of the market and provide componentised solutions.

The Disappearing Digital Universe?

Digital information is everywhere: from word-processed documents to the files used in data analysis, from computer-aided design to medical scans and from geographical surveys to still and moving pictures. Moreover it is growing at an exponential rate. According to the International Data Corporation (IDC) the amount of digital information in the world – the ‘Digital Universe’ – is doubling every 18 months¹.

Maintaining access to information in digital forms presents new challenges. Not only do we not have enough digital storage to retain all the digital information we produce¹, but the media we store it on and the formats we store it in typically last only a matter of years, rather than decades or centuries. Meanwhile, the pace of technological change quickly renders file formats obsolete, or leaves them inaccessible when the software required to read them, or the operating systems and hardware it runs on, becomes outdated.

Just as paper, audio tapes and films need protecting from extremes of temperature, strong sunlight and damp conditions, so their digital equivalents need regular, ongoing interventions to preserve them. These interventions must ensure that not only are the bits (the digital ones and zeros) that make up the files retained, but also that the content can continue to be accessed by users and that it is as meaningful today as it was when first created. Unless we take the actions needed to preserve our digital heritage we are in danger of losing large tracts of it to media decay and technical obsolescence.

Loss of digital heritage is not inevitable; there are actions we can take now to prevent it. These go beyond making regular backups of data (which preserves the bits, but not necessarily their meaning) and regularly refreshing the media (CDs, tapes etc) they are stored on (although these are good management practices). Digital preservation protects data from obsolescence, firstly by ensuring that it is adequately described and secondly by either migrating it to newer formats or by emulating the environment to access it on current computer systems. These are not just theoretical solutions, but practical measures that can be taken now. Yet how ready are organisations to implement them?

Why do we Need to Preserve Digital Content?

There are growing pressures on organisations to maintain access to data for longer periods. These pressures arise from factors such as:

- Legislation like the Freedom of Information Act 2000, and Legal Deposit Libraries Act 2003 in the UK, the US Sarbanes-Oxley Act 2002 and Basel II, and various Data Protection acts which have been enacted across the world.
- Requirements of regulatory bodies such as the UK Financial Services Authority, European Medicines Agency, and US Food and Drug Administration.
- Compliance with e-Discovery requirements in civil litigation cases.
- Meeting the electronic records management standards of best practice.
- Protecting Intellectual Property Rights and patents by providing supporting evidence.
- Ensuring business continuity by maintaining access to digital data in the long-term.
- Enabling future re-use of information, particularly scientific data, through data mining and re-analysis.
- Maintaining access to individuals' records, such as their medical or pension records, over their lifetimes.

There are also sector-specific pressures. Memory institutions³ need to preserve national cultural and scientific heritage. Governments must maintain the public record. Manufacturing needs to hold onto engineering designs and specifications. The media wants to retain nations' creative outputs. The healthcare industry has to preserve and share medical information over the lifetimes of individuals and medicines; the nuclear industry is obliged to preserve details of nuclear waste over decades, and the energy sector wants to hold onto seismological data to use as a basis for future oil and gas exploration.

According to the IDC, the volume of such ‘preservation-intense’ information will grow faster than the Digital Universe as a whole¹. They estimate that the proportion of the Digital Universe that is ‘subject to compliance’ will rise from 20% in 2007² to 35% in 2012¹.

¹ IDC Multimedia White Paper, *As the Economy Contracts, the Digital Universe Expands*, May 2009, sponsored by EMC.

² IDC White Paper *The Expanding Digital Universe*, March 2007, sponsored by EMC.

³ ‘Memory Institutions’ is the collective term for museums, archives and libraries.

Recent History Shows Progress

In 2005 the Digital Preservation Coalition surveyed 104 organisations in the UK. Their findings showed that there were already high levels of awareness of the need to preserve digital content. Two fifths of respondents said there was a need to keep digital information alive for 50 years or more, and half said they were committed to doing so. Despite this, just 18% had a digital preservation policy in place, and only 20% had funding. Half had not assessed the volumes of material they needed to preserve, half did not know the life spans of digital data, half were unclear about roles and responsibilities and half said they printed out hard copies as a means to preserve digital information.

In 2006/7 DigitalPreservationEurope surveyed 172 organisations in Europe. It found that three quarters of organisations considered long-term preservation to be a key strategic priority, yet just one third had implemented a digital repository.

Who did we Survey?

In 2009 Planets conducted an on-line survey to assess the state of readiness of organisations interested in digital preservation. Over 200 responses were received from around the world, with the majority from Europe. Fifty-six per cent were from EU countries, 11% from European countries outside the EU, 16% from Canada and the USA and 3% from the rest of the world. The remaining 14% were anonymous.

Libraries and archives, which have a mandate to preserve heritage for the long-term, formed the majority of respondents: 41% from libraries and 30% from archives. Respondents also came from government departments and the public sector (15%), commercial organisations (4%) and suppliers and vendors (7%) (see Figure 1).

There is evidence that digital preservation is emerging as a profession in its own right; where previously the work was carried out by IT and preservation or curation staff, now it is starting to be carried out by specialists. Fifteen per cent of respondents described themselves as specialising in digital preservation, while 16% work in preservation in general, 22% in curation (archivist, librarian, records manager) and 16% in IT. The survey also showed that digital preservation is attracting wider attention; 8% of respondents were directors, and 4% producers of digital content.

«Digital preservation is all the actions required to ensure ongoing, meaningful access to digital information for as long as it is required and for whatever legitimate purpose.»

Source: Mind the Gap

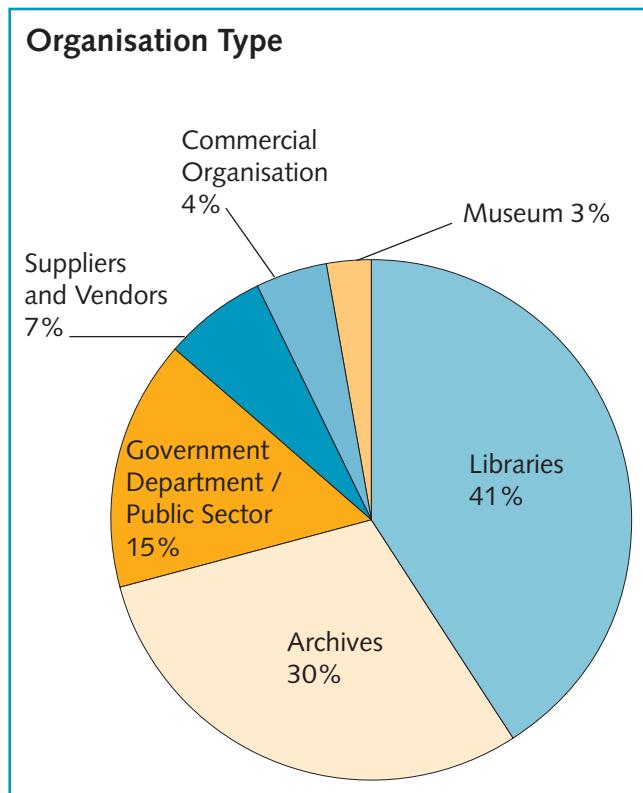


Figure 1:
Types of organisation survey respondents work for.

The Scale of the Challenge

Over the next ten years, the need to preserve digital content will become increasingly pressing. Between now and 2019, the volume of content that organisations need to hold will rise 25-fold, from a median of less than 20TB now to over 500TB in 2019. Currently 85% of respondents hold less than 100TB of content, whereas by 2019, 70% expect to hold more than 100TB and 42% expect to hold more than one petabyte (PB).

Organisations will also need to preserve a wider range of digital information types. Over 80% of organisations already need to preserve relatively simple digital objects, such as documents and images. Within a decade, over 70% will need to preserve video, audio, databases, websites and email. While some solutions exist to preserve the 'simple' forms of digital objects, solutions for preserving more 'complex' forms, such as databases, are still being developed. Demand for such solutions will increase as the proportion of organisations needing to preserve databases rises from 49% in 2009 to 85% in 2019.

There is also a need to take content from a broad range of source systems. Three quarters of organisations already take information that is stored on file systems and over half take information from document scanning programmes, the internet, electronic document management systems, email systems, and media digitisation programmes. However, less than a third need to archive content from niche or domain-specific source systems such as CAD and lab systems.

While it is the holders of digital information who must manage it for the long-term, content producers have a vital role to play in the solution. Producers are able to select the format in which content is provided and so aid its longevity. For many content holders the material they archive is created outside their organisation, resulting in a need for collaboration. Less than a third of organisations think they have complete control over the formats they will accept and enter into their archives. Two fifths work with content providers to influence the formats they will accept, and three tenths have little or no control and are obliged to accept the formats provided to them. While businesses and national archives have a high level of control over the formats they need to archive, libraries have far less control, making their digital preservation task much harder.

Figure 2: Growth in volumes of digital content that organisations intend to store over the next decade.

It all Starts with the Content Producers

The decisions producers of digital content make when creating new digital information determine how easy it is to preserve their output. The easiest file formats to preserve are those that are widely used, well supported, fully documented and that store data in an uncompressed form.

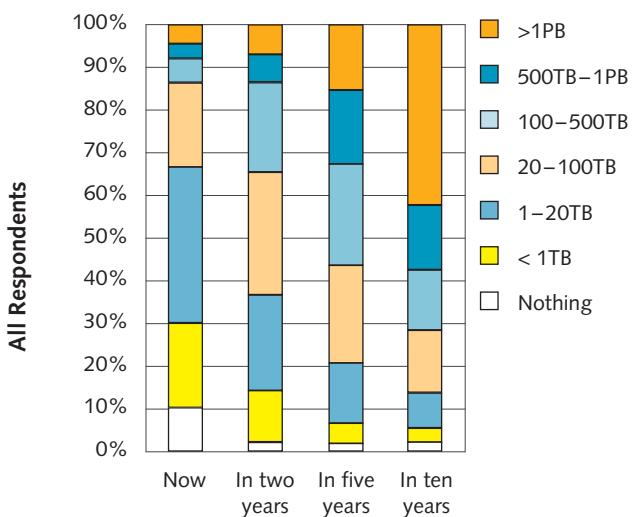
Reducing the range of formats that have to be preserved makes the digital preservation task easier as interventions need to be made less often and can be applied to a larger proportion of a repository's content.

Creators of digital content are also best placed to produce metadata describing their work and its context, which is vital to support future access. This applies to all digital content whether it is research data or business documents. For example, it is meaningless to preserve a table of numbers if there is no data to explain what the numbers mean and the context in which they were generated. The metadata must be written when information is created. By the time the decision is taken to preserve the information, it may be too late to contact authors to ask them to understand and interpret their work retrospectively.

But the digital preservation tail should not wag the business dog. Day-to-day business requirements will determine the formats in which data is produced. However, where there are equally appropriate solutions for a particular business, the need to preserve information for the long-term should steer the choice.

Ensuring ongoing and meaningful access to digital content requires cooperation between those who produce and distribute information and those who preserve it.

Digital Content Volumes Over Time



Tackling the Issue

Organisations are mindful of the need for digital preservation and are responding to it. Ninety-three per cent of respondents said that their organisation was aware of the challenges of managing their digital information for the long-term; 76% include digital preservation in their operational planning, 71% in their business continuity planning and 62% in their financial planning. Although 48% have taken the vital first step of putting a digital preservation policy in place, just 20% have established the habit of reviewing it yearly.

Organisations' recognition of the importance of preserving information for the long-term is reflected in their willingness to fund it. Almost half of respondents said their organisation has allocated a budget to digital preservation. However, budgets are more likely to be capital than revenue; 85% of those with a budget have a capital budget, whereas just 53% have an on-going revenue budget. Capital budgets are vital in the early stages of digital preservation to put the infrastructure of a solution in place. Over time, funding needs to switch to revenue expenditure to pay for the on-going maintenance of a digital repository, including ingest of new material and the management of ingested material. It is hard to budget for such on-going expenditure as there is little practical experience yet of what these costs will be.

Plans and Implementations

The majority of surveyed organisations are already taking steps to procure or implement practical solutions. Eighteen per cent of respondents said they were assessing their needs, 4% were tendering for a solution, 39% were developing one and 16% had a preservation solution in place. Just 13% said they had no plans to deal with the long-term management of digital content.

Those organisations that plan to invest in a solution will largely do so in the next two years. One third of organisations surveyed are currently investing in a digital preservation solution and two fifths are looking to make an investment in the next six to 24 months. Just one fifth plans to hold off for more than two years.

Open-source and proprietary software are used equally by respondents, and often combined in the same solution. In the future, respondents expect to continue using this pick and mix approach, with three fifths predicting that they will use a mixture of open-source and proprietary software. However, the proportion that will rely on purely proprietary solutions will decline seven-fold from 14% to 2%.

Organisations plan to follow a route of identifying, customising and integrating digital preservation components into systems that meet their specific needs. Two thirds are integrating components into a custom solution and the rest are split evenly between developing a custom solution and using an off-the-shelf package. Organisations are also opting to combine approaches. Half those developing a custom solution will integrate existing components into it and two fifths of those using an off-the-shelf package will integrate components into a custom solution. This sends a signal to suppliers and vendors that their digital preservation solutions need to be componentised with well-defined interfaces.

Migration or Emulation?

There are two generally accepted approaches to preservation of digital content: migration and emulation. Migration is the periodic conversion of digital material from one format to another, while emulation is the replication of hardware and/or software, including operating systems, to make it possible to view and use digital material in their original formats.

Emulation is particularly important for providing access to digital objects which have dynamic behaviour or where users need to interact with the object, such as databases, multimedia materials and geographic information systems (GIS). Despite the need to preserve such complex objects, there was much less interest expressed by respondents in emulation than in migration. Whether this lack of interest is because emulation is not yet seen as a practical preservation solution, due to the poor usability and accessibility of emulators and the complexity and perceived cost of implementing an emulation solution is unclear. However, it points to the need for education about the role of emulation as a preservation strategy

A Capable Digital Preservation System

There are common expectations about what a digital preservation system should do. Such systems must be able to maintain digital information for up to 50 years in such a way as not to damage or corrupt it and so that it can be accessed in future. Systems must also assist with preservation planning and adhere to established digital information management standards. Compliance with metadata standards is regarded as fairly important, but there is less agreement on which standards. The survey highlighted the wide range of metadata standards that are in use, with Dublin Core the most popular (used by 51% of respondents), followed by MARC (31%) and ISAD(G) (28%).

Given the anticipated rise in content volume, scalability to large volumes (petabytes) of data and to high ingest rates (millions of objects per year) is regarded as being important. Scalability to high access rates (hundreds of objects per second) is considered to be less important. This may reflect the fact that some organisations have restrictions on access, such as requiring researchers to visit in person, or embargoing records for an initial period of time. It may also point to a preoccupation with ingest and storage of digital content and indicate that organisations have not yet reached the stage where users are requesting access to large volumes of content.

Unfulfilled Needs

Although action is underway, it is constrained by the availability of practical tools and services to automate and support preservation. Currently digital preservation requires a high degree of skill and knowledge and is labour intensive. Practitioners need to be familiar with their collections and have the expertise to preserve specific formats. For example, preserving a digital object in an obsolete format requires experience to select the appropriate format to migrate it to and time to check that nothing important has been lost in the conversion.

There is clear demand for technological solutions to support and automate preservation processes. In particular, organisations need tools to support preservation planning, characterise digital collections and convert digital objects to more accessible formats. Planets will go some way to supporting this by offering a technological solution that provides access to a wide range of tools and services from Planets and from third parties.

Organisations also need information and advice. Respondents expressed interest in services that help them keep up with the latest developments in digital preservation, with over three quarters favouring getting that information from conferences and mailing lists. Planets can help here, too, through its training events and publications.

Capability	Mean Rating
Maintains authenticity, reliability and integrity of records	3.8
Checks records have not been damaged	3.5
Plans the preservation of content to deal with technical obsolescence	3.4
Complies with established data or digital information management standards	3.4
Ensures records are accessible for up to 50 years	3.4
Performs migrations to deal with technical obsolescence	3.4
Is able to store many different types of content	3.3
Handles a wide variety of file formats	3.3
Ensures records are accessible for more than 50 years	3.3
Adheres to metadata standards	3.2
Retrieves content by description	3
Characterises records by extracting technical metadata	3
Integrates with content delivery systems	2.7
Retrieves content using full text	2.7
Supports emulation to deal with technical obsolescence	2.5
Integrates with content producing and holding systems	2.5
Checks for duplicate items	2.3

«We are aware of the need, and have some solutions. Now, if we just had more time, and more money!»

Source: 2009 Planets survey participant

Figure 3: The important capabilities for a digital archive to have, as rated by the survey respondents (where 1 = not applicable, 2 = least important, 5 = critical)

The Importance of Having a Policy

While many organisations are making progress towards the long-term management of digital content, some are considerably further down the road than others. There exists a digital preservation divide between the policy haves and the policy have-nots.

Organisations with a digital preservation policy are more likely to include digital preservation in their operational, business continuity and financial planning. They are three times more likely to have secured a budget for digital preservation, four times more likely to be investing in a solution now and three times more likely to have a long-term solution already in place.

By contrast, organisations without a digital preservation policy are four times more likely to have no experience or be unaware of the challenges presented by digital preservation, three times more likely to have no plans for the long-term management of digital information, and more than twice as likely to put off investing in a digital preservation solution for more than two years.

The existence of a digital preservation policy is therefore a vital first step towards implementing a solution.

«We do not (yet) have a formal policy for long-term storage. But we ought to.»

Source: 2009 Planets survey participant

The Importance of Having a Digital Preservation Policy

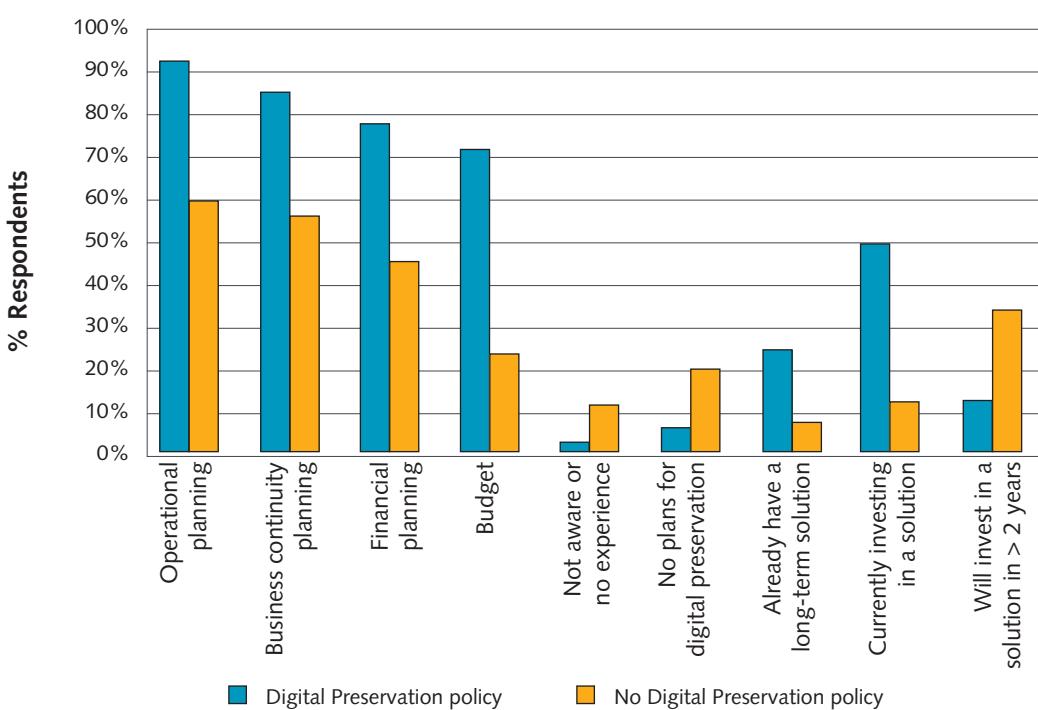


Figure 4: Differences between those with and without a digital preservation policy.

Where Memory Institutions Lead, Others Will Follow

Memory institutions, such as national archives and national libraries, lead the way on digital preservation. Not only have above average numbers of national archives and national libraries taken the critical early step of putting a digital preservation policy in place, but above average numbers of them also include digital preservation in their operational, financial and business continuity planning. Sixty-seven per cent of national archives and 55% of national libraries have a digital preservation policy. Eighty-one per cent of national archives and 65% of national libraries have a budget for digital preservation and 27% of national archives and 15% of national libraries (or two to four times the average) already have a solution in place. By contrast, just a quarter of government departments and the public sector in general have a digital preservation policy and only a quarter of them have a budget.

However, if other organisations think that digital preservation is only a memory institution problem, they should reconsider. Higher content volumes and variety appear to be the driving forces for implementing a digital preservation policy. Organisations with a digital preservation policy currently hold larger volumes and a wider variety of content than those without one.

Over the next ten years the median volume of content held by organisations will rise to over 500 TB, the mean to 1 PB and the mode to over 1 PB. While organisations with a policy currently hold larger volumes of content and more data types, in ten years' time there will be little difference. The increasing quantities of digital material needing preservation over the next decade will provide an impetus for organisations which have not yet considered the problem, to start to tackle it.

Digital Preservation Policies

A digital preservation policy should outline the high-level objectives, the philosophy behind the policy and the benefits that digital preservation will bring. In particular it should set out the roles and responsibilities of the staff involved, the remit for appraisal and acquisition, and guidance on retention. In addition it should specify the standards for storing, managing and accessing digital materials. This should include the metadata needed for each object, the practices for refreshing storage media, the procedures for assessing the risks involved with different file formats and how to handle obsolete formats.

Digital Content Volumes Over Time

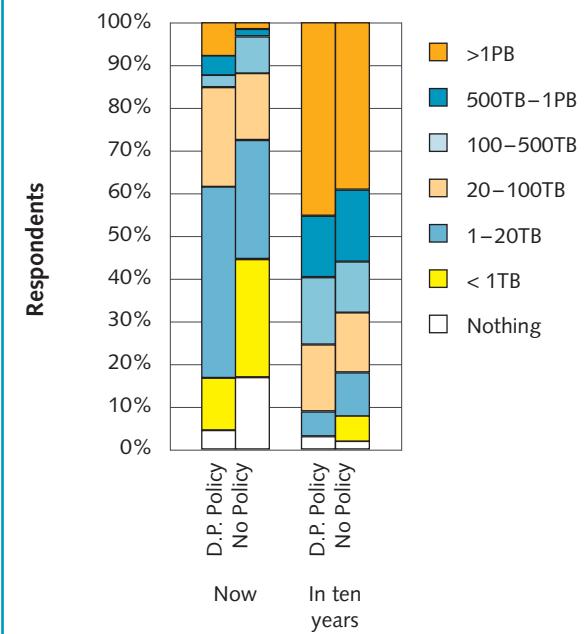


Figure 5: Content volume differences between those with and without a policy erode over time.

Where Next?

Digital information is growing in volume and value. More attention is being paid to it because of the demands of legislation, regulation and compliance. However digital data does not keep itself; it needs to be kept. Action must be taken to ensure it is available for as long as it is needed.

Over the past four years, significant strides have been made in tackling the challenges of digital preservation, but more still needs to be done. While organisations are starting to implement practical measures and solutions, their capacity to do so is constrained by the availability of preservation tools and services to automate the process. What is clear is that some organisations are further down the road to preserving digital content than others; by articulating a policy, they have put in place a catalyst for action. The work is being led by the memory institutions, which have been compelled to do so by the volume and variety of content they must preserve, as well as a legal and moral imperative. However, the growth in the volume of digital information organisations need to hold onto will increase the relevance of digital preservation to all organisations.

We are increasingly reliant on technology as a means to create, share and retain information. Yet our capacity to access it is diminished by the rate of technological change. To be certain information will be available in future means ensuring that the formats in which it is held, or the tools to read it, keep pace with developments. Despite our reliance on technology, it is planned and sustained human intervention that will ensure information created today can be used in the future.

Final Thoughts

to store, v.t.: put aside, put away, lay up, keep in reserve, deposit.

to preserve, v.t.: keep safe from harm or loss, keep alive, keep in existence, retain, conserve, defend, care for, maintain, protect against decay, season or otherwise treat for keeping.

The difference between the first and the second: the belief that something has long-term value and is worthy of the investment of time and effort to protect it.

Methodology

Planets conducted an on-line survey of long-term management of digital information in 2009. It was aimed at organisations and individuals with an interest in retaining and accessing digital content in the long term. In particular, the 96 national archives and libraries in Europe were targeted.

The survey was publicised widely. A news item was placed on Planets' website. Invitations to participate in the survey were sent to around 2000 individuals, whose role could encompass the long-term maintenance of digital information, in libraries, archives and other organisations across Europe; follow-up telephone calls were made to 120 of these individuals to encourage them to take part in the survey. The survey was announced on 30 mailing lists related to digital preservation such as PADI (Preserving Access to Digital Information), and specialist mailing lists targeting sub-sections of the digital preservation community, for example research institutes, government, and audiovisual archives. Intermediary organisations and projects in EC member countries with an interest in digital preservation were asked to disseminate the message to their members. These organisations and projects included Digital Preservation Europe, the Digital Curation Centre, and the Caspar, Shaman and Protago projects, the Council of European National Libraries (CENL), International Council on Archives (ICA) and the Association of European Research Libraries (LIBER).

Two hundred and six responses were received before the survey closed.

«Digital preservation will always be an evolving process.»

Source: 2009 Planets survey participant

Acknowledgements

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About Planets

Planets (Preservation and Long-term Access through Networked Services) is a four-year project co-funded by the European Commission under the Information Society Technologies (IST) priority of the Sixth Framework Programme for research, technological development and demonstration (IST-033789). Since 2006, Planets has been working to develop a suite of practical tools and services that will enable institutions in Europe to manage and access their digital collections for the long-term.

The project has used the OAIS-model, which is an international standard, as a basis for its digital preservation framework, methodology and vocabulary. Planets technology will provide access, through a single, open-source application, to a range of Planets and third-party digital preservation tools and services, which support and automate a range of processes. These processes include creating a preservation policy, planning to preserve specific content or collections, identifying the significant properties of collections and individual objects to be preserved, assisting with the identification and selection of tools and services, validating action that has been taken and determining the extent to which it has been successful. Planets' framework can be extended and its application scaled up or down to meet organisations' requirements.

In addition, Planets has developed a controlled experimental environment where tools, services and workflows can be tested using pre-defined, sample content to assess their suitability for use in digital preservation. The outcomes of such experiments will be used to update information available to Planets users about the tools' appropriateness to preserve particular content.

The technology is being delivered through the expertise of 16 national libraries, archives, research institutions and technology companies in Europe.

Further Information

For more information about Planets visit:

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You can email your questions to us at:

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