Collaboration to Clarify the Cost of Curation

D4.1—A prioritised assessment of the indirect economic determinants of digital curation

Deliverable Lead:	NLE
Related Work package:	WP4
Author(s):	Jaan Krupp (NLE), Raivo Ruusalepp (NLE)
Dissemination level:	Public
Submission date:	07 Aug 2013
Project Acronym:	4C
Website:	http://4cproject.eu
Call:	FP7-ICT-2011-9
Project Number	600471
Instrument:	Coordination action (CA)—ERA-NET
Start date of Project:	01 Feb 2013
Duration:	24 months

Project funded by the European Commission within the Seventh Framework Programme		
Dissemination Level		
PU	Public	✓
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	

Version History

Version	Date	Changed pages / reason	Modified by
0.95	20 Sep 2013	Review version	RR
1.00	01 Oct 2013	Changes based upon comments. Added conclusion	RR
1.01	07 Oct 2013	Minor edits. Published version.	PLSS
1.01	07 Mar 2014	Update logo	PLSS

Acknowledgements

This report has been developed within the project “Collaboration to Clarify the Cost of Curation” (4cproject.eu). The project is an ERA-NET co-funded by the 7th Framework Programme of the European Commission.

The 4C participants are:

Participant organisation name	Short Name	Country
Jisc	JISC	UK
Det Kongelige Bibliotek, Nationalbibliotek og Københavns Universitetsbibliotek	KBDK	DK
Instituto de Engenharia de Sistemas e Computadores, Investigacao e Desenvolvimento em Lisboa	INESC-ID	PT
Statens Arkiver	DNA	DK
Deutsche Nationalbibliothek	DNB	DE
University of Glasgow	HATII-DCC	UK
University of Essex	UESSEX	UK
Keep Solutions LDA	KEEPS	PT
Digital Preservation Coalition Limited by Guarantee	DPC	UK
Verein Zur Forderung Der IT-Sicherheit In Österreich	SBA	AT
The University of Edinburgh	UEDIN-DCC	UK
Koninklijke Nederlandse Akademie van Wetenschappen	KNAW-DANS	NL
Eesti Rahvusraamatukogu	NLE	EE

Author(s):	Jaan Krupp, Raivo Ruusalepp (NLE)

Table of Contents

Acknowledgements 3
Table of Contents 4
Figures 5
Executive Summary 6
1 Introduction 7
1.1 Direct versus indirect costs 7
1.2 Measuring indirect costs 7
1.3 Modelling the benefits of digital curation 8
1.4 The 4C project contribution 9
1.5 Indirect economic determinants 10
1.6 Goals of the report 11
2 Indirect economic determinants 13
3 Conclusions 30
References 31

Figures

Figure 1—Indirect economic determinants in relation to other components of an economic model. 10

Executive Summary

This deliverable discusses indirect economic determinants of digital curation. It defines them as generic management tools that can be applied in any organisation to help ensure sustainable digital curation.

Indirect economic determinants are similar to indirect costs in that they usually support more functions within the organisation than just the digital curation function. The indirect nature of these cost factors derives from the multitude of ways that the digital curation function can be embedded in the business models of organisations. The constellation of digital objects, the purpose of preservation, the intended target audience of the preserved objects and the type of organisation all determine how these cost factors can benefit the organisation.

The indirect economic determinants are also presented here as high-level concepts comparable to indirect long-term benefits that curating digital objects can yield. Implementing these instruments is more likely to lead to indirect benefits, such as negative impacts avoided (such as avoiding the cost of recovering objects) or reducing long-term costs (for example through risk assessment).

The report describes fifteen indirect economic determinants that are significant for digital curation today. These 15 were selected through consultations with experts and stakeholder groups, and ranked according to their importance to the stakeholders identified by the 4C project. The list includes topics such as benefit and value, efficiency and impact, quality and trustworthiness, reputation and risk, and so on.

A selection of these determinants will be further explored by subsequent tasks in work package 4 of the 4C project, and their cost-benefit model will become a component of the Economic Sustainability Reference Model[1].

[1] http://4cproject.eu/community-resources/outputs-and-deliverables/esrm-summary

1 Introduction

Digital curation is a complex task that involves a variety of techniques, skills, software and hardware. In practice these are combined and implemented in different ways based on the purpose of preservation, and the nature and target audience of the preserved objects. This intrinsically complex task with variable cost factors determines the total cost of owning and managing a digital preservation service and makes the costing of digital curation non-trivial.

As yet there are no standardised ways of breaking down and accounting for the cost of curation activities, but several cost models have been developed for specific content types (for example research data) or institutions (such as national libraries) (see the soon to be published 4C deliverable *D3.1 Evaluation of Cost Models & Needs & Gaps Analysis* for further details). The primary focus of the existing cost models is on the measurable, direct costs that running a preservation service entails. The indirect costs involved in digital curation, despite having received less attention in the cost modelling exercises so far, are by no means less significant. This report is looking at a selection of essential indirect cost factors in digital curation to help bridge the gap in digital preservation cost models.

1.1 Direct versus indirect costs

Every business function has direct costs that can be clearly associated with specific activities or products. These typically include staff salaries, travel, materials, supplies, equipment and software. Direct or fixed costs can usually be measured and planned ahead in the budgeting period.

Indirect costs are costs that are not directly associated with a single activity, event, or other cost object. Such costs are frequently aggregated into an overhead cost pool and allocated to various activities.[2] Indirect costs represent the expenses of doing business that are not readily identified with a particular function or activity, but are necessary for the general operation of the organization and the conduct of activities it performs. Expenses like utility costs (heat, light), management, accounting, IT and human resources staff salaries are usually included in the overheads category and charged as indirect costs. Other examples of indirect costs include office supplies, telephone calls, postage, membership fees, consultants' fees, audit and legal, security, and the like.

1.2 Measuring indirect costs

The share of indirect costs in the overall costs incurred by organisations has been rising and, in many domains, now make up the bulk of total cost. The direct costing methods used in the past can no longer yield results that avoid loss-making in the long-term because they do not factor the indirect costs into financial planning. Different methods for calculating the indirect costs have been developed.

One method favoured by production companies is using the cost-sharing bases. The indirect costs are allocated to client orders using an agreed factor. Indirect cost thus becomes cost that is required for the execution of an order but cannot be directly attributed to it. The typical indirect activities that are shared by all orders are: research and development, supply, logistics, scheduling, planning and production management, quality control, marketing, development of contracts and orders, accounting, finance, and so on.

[2] http://www.accountingtools.com/definition-indirect-cost

A more widely known method for including indirect costs in the financial planning is the ABC-model or Activity-Based Costing (Cooper & Kaplan 1988). Activity-based costing is a method of assigning costs to products or services based on the resources that they consume.[3] Activity-based costing looks at all business activities broken down into their discrete components (events or transactions involved in obtaining a product or service) and allocates costs to them. The ABC method with its focus on what is done instead of what is spent was an attractive alternative to traditional costing methods, but proved to be time-intensive to implement.

The Time-Driven Activity Based Costing (TDABC) method was developed to enhance the ABC-method (Kaplan & Anderson 2007). This method identifies the capacity of each department or process and allocates the cost of this capacity of resource groups over the cost object based on the time required to perform an activity. The TDABC is based on time consumption and unit time has to be calculated for each activity.

These costing methods have not yet been fully applied to digital curation, but some adaptations do exist. The *Keeping Research Data Safe* project (KRDS[4] and KRDS2[5]) developed its own high-level activity model based on the OAIS reference model and collected cost data through surveys based on this model (Beagrie et al. 2008; Beagrie et al. 2010). The Netherlands Data Archiving and Networked Services (DANS) developed a digital preservation cost model based on the ABC method and combined it with the balanced scorecard (Palaiologk et al. 2012). The model has not yet been fully applied outside the DANS. The TDABC model has been applied in academic libraries (Kont 2011) but not specifically to digital archive departments.

In the absence of a standard (or even best practice) method, indirect costs involved in digital curation are at present usually calculated and budgeted according to institutional accounting practices.

1.3 Modelling the benefits of digital curation

The recent APARSEN project report on cost models notes that "A cost model only describes the relationship of activities to costs, and does not cover all aspects of the full business case, such as scope, constraints, assumptions, benefits and measures of success, quality management, options appraisal, value for money and risks" (APARSEN 2013, p. 32). But how in a given business case is the relationship between costs and benefits conceptualised and qualified, and how is the relationship defined within the overall business case? "Cost analysis should be accompanied by a framing of the benefits from preservation—in other words, the value that is anticipated to emerge from the investment in maintaining the long-run existence and accessibility of research data" (Beagrie et al. 2010, p. 53).

Benefits are the primary reason for making an investment, financial or otherwise. "It is clear that in talking about information resources we are, for the most part, talking about intangible assets and that value based simply on financial measures is inadequate. Whilst it is in theory possible to convert all value to a monetary value, doing so can be misleading, time-consuming, unrepresentative and counter-productive. This was the painful lesson of the dotcom boom. How best then to communicate the benefits and thereby attract investment?" (Currall 2006, p. 3).

The benefits and their relationship to costs of digital curation have not been systematically analysed in digital preservation literature. The KRDS2 project report summarises the situation aptly: "Much of the literature addressing economic issues related to digital preservation focuses on the cost side of the

[3] Cf. http://www.economist.com/node/13933812

[4] http://www.jisc.ac.uk/publications/reports/2008/keepingresearchdatasafe.aspx

[5] http://www.jisc.ac.uk/publications/reports/2010/keepingresearchdatasafe2.aspx

cost/benefit equation. Comparatively little attention is paid to articulating the benefits to stakeholders arising from the preservation activity. Instead, the benefits conferred from investment in digital preservation often are either assumed to be common knowledge, or are expressed in terms far too generic to be of practical use for decision-making purposes (e.g., 'preserving society's digital record for future generations', etc.)" (Beagrie et al. 2010, p. 53). A parallel discussion of incentives to preserve digital objects has some overlap with benefits but has so far not been connected with cost models (see for example Lavoie 2003).

A summary overview of how existing digital preservation cost models discuss benefits is provided in chapter 4.3 of the APARSEN project report *Testing of Cost Models and Further Analysis of Cost Parameters* (APARSEN 2013). It highlights three cost models—BRTF, KRDS2 and DANS—as the only three that correlate costs with benefits. It is also these three cost models that are the primary sources for the benefits described in this report. The KRDS project developed a small taxonomy to describe indirect benefits arising from preserving research data that separates: direct versus indirect benefits, near-term versus long-term benefits, and internal versus external benefits.

1.4 The 4C project contribution

This report is a result of the Enhancement work package (WP4) of the 4C project that aims to support economic planning with a specific focus on sustainability. The remit of WP4 is to think more widely and holistically about the topic of costs and it does so by addressing the topic of sustainability through an economic rather than a costs perspective. The resulting Economic Sustainability Reference Model (see *D4.2 Draft Economic Sustainability Reference Model* which will be published towards the end of the 4C project) will combine many cost concepts into a workable framework that organisations can use to test the sustainability of their digital curation efforts.

The economics of digital curation is clearly not based only on direct costs but significantly also on indirect factors and determinants. The 4C project identified some of these from the outset—quality, risk, trust, impact—as indirect economic determinants that clearly have a role in the digital curation exercise but are difficult to quantify.

The first task (Task 4.1) of the Enhancement work package looked at indirect economic determinants of digital curation with the aim of evaluating and ranking them according to priorities of stakeholder communities. Given the diversity of ways that organisations manage curation of their digital assets and combine the curation function with the rest of their (business) functions, it is impractical to seek a universally applicable model or quantification of indirect cost factors. It is clear, for instance, that a large corporate entity engaged in the manufacture of aviation components will have a very different perspective than, say, a university research department. What Task 4.1 aims to arrive at is a list of indirect economic determinants that is understandable across a wide variety of domains and becomes an initial checklist of high-level concepts against which economic planning of curation can take place.

To ensure wide applicability across different organisational business models the indirect economic determinants are linked to benefits they are likely to yield. Benefits are used here, essentially, as a substitute for 'quantified indirect costs'. The actual cost of carrying out, for example, a risk assessment or a quality standard compliance test will vary according to the organisation size and purpose of its curation function, but the outcomes of such exercises should generate similar benefits for organisations of all shapes and sizes.

1.5 Indirect economic determinants

This report discusses indirect economic determinants that organisations need to consider when designing and planning their digital curation activities. Indirect economic determinants are here defined as generic management tools that can be applied in any organisation to help ensure sustainable digital curation.

Indirect economic determinants are similar to indirect costs in that they usually support more functions within the organisation than just the digital curation function. For example, an investment into making digital curation principles and processes more transparent will accrue benefits for other functions of the organisation through improved documentation, analysis of risks, higher reputation or new clients.

Indirect economic determinants

Indirect economic determinants are management tools that can be applied in any organisation to help ensure sustainable digital curation.

The indirect nature of these cost factors derives from the multitude of ways that the digital curation function can be embedded in the business models of organisations. The constellation of digital objects, the purpose of preservation, the intended target audience of the preserved objects and the type of organisation all determine how these cost factors can benefit the organisation.

The indirect economic determinants are also presented here as high-level concepts comparable to indirect long-term benefits that curating digital objects can yield. Implementing these instruments is more likely to lead to indirect benefits, such as negative impacts avoided (for example avoiding the cost of recovering objects) or reducing long-term costs (for example through risk assessment). Investment applied to indirect factors is more likely to lead to long-term benefits as opposed to immediate positive impacts.

Figure 1 shows how indirect economic determinants can be linked with other components of an economic model.

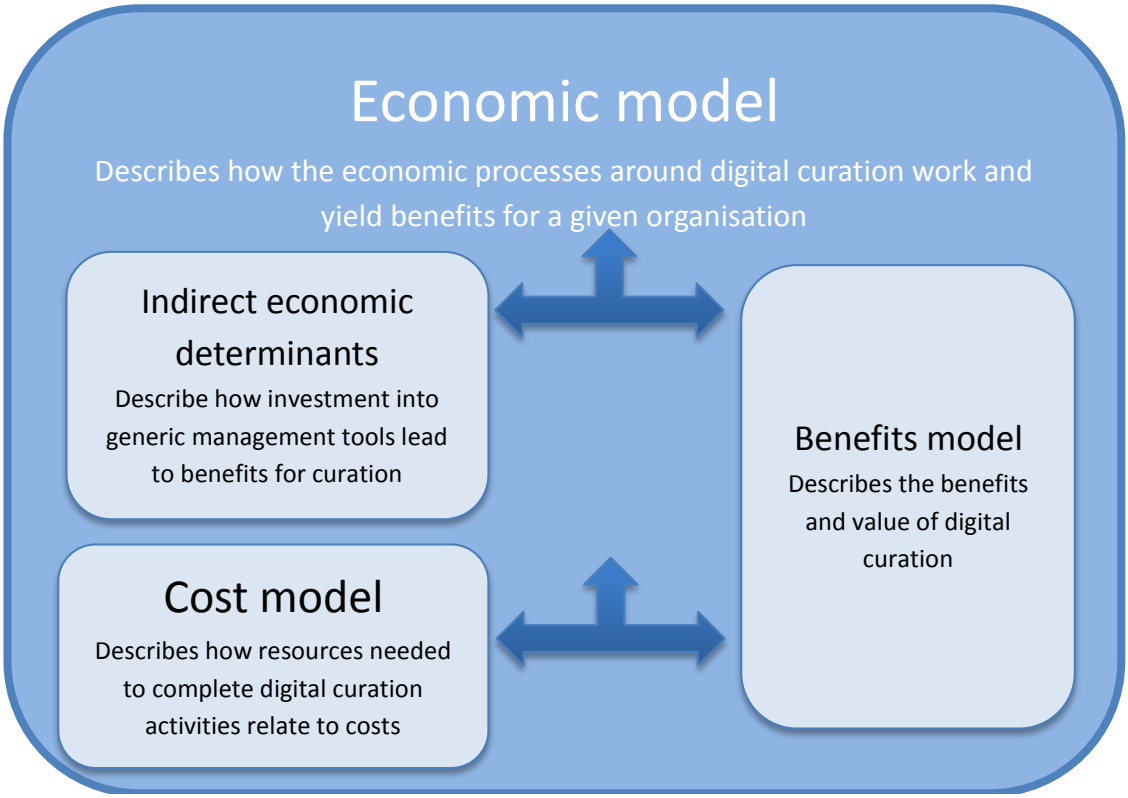

Figure 1—Indirect economic determinants in relation to other components of an economic model.

1.6 Goals of the report

The goal of this deliverable is to provide an initial input to the other tasks in work package 4—Enhancement. Three case studies (tasks 4.3, 4.4 and 4.5) are later going to look further into some of the more significant indirect determinants like risk, quality and business models.

The initial list of indirect economic determinants was compiled through consultation with experts from the project consortium and has in the course of work been expanded through discussions with stakeholder groups and the project advisory board. As a result of these activities, this report defines 15 indirect economic determinants:

1. authenticity
2. benefit
3. efficiency
4. impact
5. innovation
6. interoperability
7. quality
8. reputation
9. risk
10. sensitivity
11. skills
12. sustainability
13. transparency
14. trustworthiness
15. value

The determinants are presented in alphabetical order but their relative importance to stakeholder groups of the 4C project is also given in the tables that follow. The initial list was considerably longer, but several concepts were collated to come under one definition and related terms are also indicated in the descriptions in the next section.

The ultimate goal of this list is to indicate that if any of these concepts are important, then their degree of importance will influence the amount of care (and consequently the level of investment) that will be required to ensure that they are adequately addressed by the organisation that is considering its on-going curation requirements. This in turn should inform attitudes towards designing sustainability into organisational activity and so consequently should feature (or more precisely, should be representable) within the Economic Sustainability Reference Model (ESRM) (deliverable D4.2).

As it was impractical to approach the target stakeholder groups chosen by the 4C at an early stage of the project with an abstract and complex set of questions, it was decided instead to “crowd-source” the project consortium to highlight the importance of the chosen economic concepts. This provided evidence that different roles connected to digital curation view the significance of these determinants very differently.

A stakeholder consultation was designed and implemented at the iPRES2013 conference to help rank the indirect economic determinants. Focus group participants were asked in an on-line exercise to rank the determinants based on their institutional preference. The resulting ranking is provided in the tables in the next section. From the discussions at the focus group meeting it became evident that further analysis of the indirect determinants will have to take into account different roles or positions of respondents within their organisation. hence , the on-line ranking environment will be updated to allow for the collection of several parameters, including: the role of the respondent; the purpose of preservation; and the type of objects their institution is preserving. The stakeholder consultation will continue beyond the deadline of Task 4.1 in the project and the 4C partners are committed to invest *pro bono* effort to complete this exercise. Hence,

this report will continue to develop as a living document that will be updated in the course of the project and as an on-line list.

This report is aimed at managers and other decision makers who are responsible for planning and budgeting digital curation activities in organisations. It can also be used by digital preservation specialists to define business cases for investment into digital curation. The references to literature at the back of the report can be used to gauge further examples of economic determinants and their benefits for digital curation.

2 Indirect economic determinants

Each indirect economic determinant is described in a table structure using the following characteristics:

- Definition—definition of the term as applicable in the economic model of digital curation
- Cost context—what are broader implications of the investment into the given determinant
- Typical cost components and drivers—what typically is being costed when investing into the given determinant
- Potential benefits—typical benefits an organisation can expect when investing into the given determinants
- Examples of the economic model—explanation of how the cost and benefit models correlate
- Synonymous determinants—other determinants often used in the same meaning
- Related concepts—other determinants that have an overlapping effect
- Priority for 4C stakeholders—results of a stakeholder consultation exercise to rank the importance of indirect economic determinants.

The stakeholder consultation resulted in the following ranking of the determinants:

Rank	Determinant	Score
1	Risk	34
2	Trustworthiness	30
3	Benefits	29
4	Sustainability	29
5	Efficiency	29
6	Value	28
7	Transparency	26
8	Reputation	26
9	Confidentiality	26
10	Interoperability	24
11	Flexibility	21
12	Sensitivity	21

The ranking was obtained through an on-line exercise where participants expressed the views of their organisation and its current needs. The participants were asked to mark the importance of each determinant as high, medium or low. The score in the above table represents the mean of total scores calculated from the rankings given in the exercise where high = 3, medium = 2, low = 1. When determinants received an equal score, the one with the largest number of 'high' scores was ranked higher. Some determinants did not receive a ranking.

The results of the ranking exercise show that significance of determinants is relatively equally spread across the list with risk and trustworthiness forming the top group and issues around sustainability the second grouping. Determinants that are more related to data protection issues received less attention. This testifies that curation organisations are in need of tools that assist them in overcoming risks and thus ensuring their continuity.

Indirect determinant	Authenticity
Definition	Authenticity can be defined as the degree to which a person or system regards an object as what it is purported to be. Authenticity is judged on the basis of evidence. (Authenticity 2012, p 6) Digital preservation requires that a copy (or representation) of any preserved digital object survives over the system's lifetime, which is usually unknown, but may be as long as decades or even centuries. This can be defined as a reliability requirement. Therefore, a digital preservation system must be designed to store data indefinitely without suffering any data losses. (Antunes et al. 2009, p 2)
Cost context	The authenticity requirements for a specific type of objects constitute a significant cost factor. Consider, for example, a text document. Preservation of this will be a relatively simple task when only the plain text (the content) needs to be preserved. Highlights can also be preserved, at a slightly increased cost. However the costs will increase if the exact position of each character on the page and the exact colour must to be preserved. This will also complicate the preservation tests for the approach. For this reason it is important that the authenticity requirements are determined in as comprehensive and realistic manner as possible. (Slats, Verdegem 2005, p 5)
Typical cost components and drivers	Preservation planning
Potential benefits	Ensuring authenticity will guarantee the integrity of the preserved files and thus increase trustworthiness and reliability of the organization and its repository. Owners and creators of digital assets can trust that their assets are being preserved the way they were intended to be. Verification of research / research integrity.
Examples of the economic model	The more an organization invests in preserving files as close to the original as possible the more authentic they will be.
Synonymous determinants	Reliability Integrity
Related concepts	Trustworthiness
Priority rank for 4C stakeholders	9

Indirect determinant	Benefit
Definition	Benefit: Desirable and measurable outcome or result from an action, investment, project, resource, or technology. (Kejser 2009, p 9)
Cost context	Benefits of preservation may be interpreted from different perspectives. At a high level benefits may be perceived as the value that preservation of cultural heritage brings to humanity, among other things in the forms of identity, knowledge and discovery. At other levels benefits may be seen as the value of having the opportunity to access and use (copies of) source materials; and thus indirectly also the value of repositories for long-term preservation. Thus preservation of cultural heritage may represent benefits not only to users, such as researchers and scholars, public and private businesses and the general public, but also to non-users, for example those motivated by altruism or bequest. Furthermore, copies of source materials may in addition represent a certain market value, and institutions may charge users for providing copies of these materials in different manners. (Tanner, Deegan, 2003) Benefits of securing endangered information are also related to the quality of the repository and the quality of the preserved information. In order to sustain preservation activities it is important that memory institutions describe all benefits as explicitly as possible and use them to justify the costs. (Kejser 2009, p 95) The costs of preserving digital materials need to be considered in light of the relative benefits. Digital preservation will inevitably be about trade-offs. As with investments of any kind, what you put in tends to be reflected in what you get out. (Russell, Weinberger 2000) It is always more difficult to identify and quantify benefits than costs. Benefits may accrue in a variety of ways, including cost savings, efficiency gains, and new opportunities to create value through doing things in new ways and doing new things. These are, successively, more difficult to quantify: not least because they often emerge over time and can only be realised in the future. An obvious starting point is to begin with the most direct and directly measurable, namely cost savings. (Fry et al. 2009, p 10)
Typical cost components and drivers	Analysis of benefits that the organisation expects from its preservation function Ensuring efficiency in work processes Maximising the impact of benefits for the organisation or its clients
Potential benefits	The KRDS project has divided benefits as follows: direct benefits, indirect benefits, near term benefits, long-term benefits, private benefits, public benefits.
Examples of the economic model	One of the main purposes of investing in the indirect economic determinants listed in this document is to gain benefits. The concrete benefits will depend on the business model of the organisation.
Synonymous determinants	
Related concepts	Impact, quality, efficiency, value
Priority rank for 4C stakeholders	3

Indirect determinant	Efficiency
Definition	The comparison of what is actually produced or performed with what can be achieved with the same consumption of resources (money, time, labour, etc.). (Efficiency n.d.) In general, economic efficiency—resources being used in the places that maximize the return to society—is achieved more effectively if individuals who demand products or services bear the cost of supplying them. (Costs… 2004, p 4)
Cost context	The term "efficiency" refers to a situation in which one is producing a product or service at the lowest cost possible, everything else being equal. The "everything else being equal" clause is quite important. If, for instance, the price of one of the resources used to produce the product goes down, the resulting cost decrease does not indicate an increase in efficiency. Likewise, if one is able to reduce the cost of production by reducing the quality of the product, this is not an increase in efficiency. If, however, one can find a new technique that allows one to produce the same, identical product at a lower cost, (with no changes in the price of inputs in the market having taken place) an increase in efficiency will have occurred. Efficiency is not the same as "cheap." In many cases, the most efficient way to produce is still very expensive. (BRTF 2010, p 22) Resources should be used as efficiently as possible. Efficiency in this sense does not mean cutting corners, but rather getting the most value out of the resources allocated to curation. For example, we should strive to leverage economies of scale by spreading costs over higher volumes of curation activity. We can also attempt to leverage economies of scope by spreading costs over different yet related services: e.g., locating curation and end-user access services on the same repository platform. (Rusbridge, Lavoie 2011, p 9)
Typical cost components and drivers	Ensuring efficiency in work processes Ensuring cost-effectiveness of processes and services
Potential benefits	Increasing productivity
Examples of the economic model	Investing in efficiency means that an organization will be able to get the most value and benefit out of its resources. For example through better deployment of information technology and automation
Synonymous determinants	Flexibility
Related concepts	Impact, quality, benefits
Priority rank for 4C stakeholders	5

Indirect determinant	Impact
Definition	Impact refers to the higher order effects, generally medium and long-term, produced by a project or program. The impacts can be intended or unintended, positive and negative. (Impact n.d.)
Cost context	Indicators that allow one to show what impact a particular investment might have need to give decision makers an idea of what they will get for their money, and also allow them to see whether or not the benefits have been delivered. Such indicators must be: (Currall 2006, p 4) • Meaningful in strategic terms • Measurable in some appropriate way • Controllable in the sense that value can be increased or decreased by management action They do not have to be: • Defined in or reducible to financial terms • On measurement scales—they can be ordinal (A>B) or rather fuzzier(A≡B or A≥B) Impact of digital preservation is typically manifested in higher re-use figures of the preserved content, increased user numbers, higher citation figures, and similar.
Typical cost components and drivers	Analysing the factors that will maximise impact to clients of the organisation Changing the work processes Marketing and user services
Potential benefits	Improved visibility, reputation and social capital of the organisation
Examples of the economic model	Long-term preservation of, for example, research data confers benefits to both the researcher and the institution in terms of maximising research impact and cultivating reputation. Securing persistent access to an important research data set increases the likelihood that it will be utilized in future research, which in turn elevates the impact and visibility of the original research from which the data emerged. (Beagrie et al. 2008, pp 17-18)
Synonymous determinants	
Related concepts	Benefit, value
Priority rank for 4C stakeholders	N/A

Indirect determinant	Innovation
Definition	Innovation refers to the use of a better and, as a result, novel idea or method [and is about] doing something different[ly] rather than doing the same thing better. (Wikipedia)
Cost context	Systematic, large scale programmes of digital preservation may be seen as an innovation requiring significant expenditure, the benefits of which will accrue well into the future and are currently difficult to estimate. Digital preservation is, of course, dependent on technological developments but the management and organisational conditions are equally vital. Both dimensions matter and will interact with each other. (Hunter 2006, pp. 17-18)
Typical cost components and drivers	Research and development projects Implementation of innovative technologies, processes Early adopter costs
Potential benefits	Cost savings through automation More scalable, automated, user-friendly digital archive system Stimulating new networks/collaborations Early adopter advantages (such as reputation, market share)
Examples of the economic model	Investment into a research project leads to the organisation adopting a new technology solution that automates hitherto manual process and as a by-product increases the reputation of the organisation within its stakeholder community
Synonymous determinants	
Related concepts	Impact, benefit
Priority rank for 4C stakeholders	11

Indirect determinant	Interoperability
Definition	The ability of two or more systems or components to exchange and use information. (Costs… 2004)
Cost context	Digital preservation stresses the time dimension of interoperability, focusing on the requirement that digital objects must remain authentic and accessible to users and systems over a long period of time, thus maintaining their value. (Antunes et al. 2009, p 1) At the same time interoperability of technology solutions that a digital archive deploys is vital for automation, development of new e-services and customer-centric user interfaces.
Typical cost components and drivers	Ensuring: • Organisational interoperability where necessary • Semantic interoperability that will allow for consistent e-services • Technical interoperability between computer systems
Potential benefits	Cost savings through automation Improved services to customers
Examples of the economic model	An organization willing to make itself more interoperable by working together with other organizations can reap benefits by cutting down on costs thus also becoming more cost efficient (for example, making joint investments/procurements), becoming more flexible by creating better policies (exchange of ideas and practices). Cooperation with other organisations may lower costs through synergies and economies-of-scale. Cooperation can be achieved by collaborative research, joint ventures, sharing technical tools, infrastructure, as well as knowledge. A more commercial approach is to outsource activities. (erpaTool 2003, p 6)
Synonymous determinants	Availability, efficiency, flexibility
Related concepts	Sustainability
Priority rank for 4C stakeholders	10

Indirect determinant	Quality
Definition	An encompassing term comprising utility, objectivity, and integrity. (Quality… 2012, p. 218)
Cost context	Digital assets, whether individual objects, or groups of objects, may represent documents, books, images, films, web pages, etc. in various qualities. Here quality is used as a collective name for different properties of the assets relating to their content, context, appearance, structure and behaviour as well information security, including authenticity, confidentiality, integrity and availability. On a more detailed level quality also relates to format types, a book may for example be saved as a PDF or Word document, or as tiff images; preservation strategies, whether based on migration or emulation; and how the repository is organised, for example as a distributed or centralised system. (Economic… 2011, p. 2) Various standards exist for ensuring quality of processes and products in an organisation, ISO 9000 series of standards being the best known of these. Applying such standards will provide an organisation with methods for controlling the quality of their operations, services and products. Using quality standards is often perceived as contributing towards higher reputation of organisations.
Typical cost components and drivers	Tools for verifying quality of digital objects during the digital archive workflows Applying standard methods for quality assurance Auditing of quality systems
Potential benefits	Higher confidence in reliability and authenticity of the digital objects that the organisation is providing to its clients Higher confidence in services that the organisation is providing to its clients Improved work processes through application of quality procedures Increased reputation of the organisation Competitive advantage on the market through audited and certified quality management systems
Examples of the economic model	By applying the ISO 27001 information security standard to the entire organisation's IT infrastructure and undergoing a formal audit process, a digital archive was qualified to bid for hosting a national service. Quality assurance increases the chances of re-using the data. (Beagrie et al. 2010)
Synonymous determinants	Integrity
Related concepts	Sustainability, Efficiency
Priority rank for 4C stakeholders	N/A

Indirect determinant	Reputation
Definition	Reputation is a component of identity as defined by others. Reputation is a tool to predict behaviour based on past actions and characteristics. (Economic… 2011)
Cost context	Memory organisations such as libraries and archives will have an interest in being recognised as gateways to specific sources of information: this recognition will reflect professional esteem and reputational value from the provision of a useful service (Hunter 2006, p. 11) Reputation of an organisation that preserves valuable digital assets can derive from different sources. In the public sector, reputation is often connected with the statutory position of the organisation—for example a National Archives will have high reputation because of its foundation in legal acts and long history. In the non-profit sector an organisation may have high reputation because it is pro-active, collaborative or provides good services or similar. In the commercial sector reputation tends to be perceived as a competitive advantage based on good quality of services or products delivered. Reputation management of an organisation's "public image" on the internet is increasingly popular.
Typical cost components and drivers	Maintaining high reputation through success stories, client testimonials, and so on. Contracting on-line reputation management services
Potential benefits	Sustained or increased trust in the organisation. More likelihood of engaging new stakeholders/users/customers.
Examples of the economic model	Maintaining a collection of widely-accessible data sets can help an institution cultivate a reputation as a centre of research in a particular discipline. This increases the appeal of the institution for prospective faculty and students, as well as to external research partners in academia, government, and private enterprise. This appeal will only increase over time as the research data continues to be used and re-used by researchers and students from the local institution and beyond (Beagrie et al. 2008, p. 18) The more reputable a repository is the more willing the creators are to trust them with their assets. (Beagrie et al. 2010)
Synonymous determinants	
Related concepts	Trustworthiness, quality, impact
Priority rank for 4C stakeholders	8

Indirect determinant	Risk
Definition	Risk is an effect of uncertainty on objectives. (ISO Guide 73:2009)
Cost context	Risk management is an integral component of good management and decision-making at all levels. All organisations manage risk continuously, whether they realise it or not—sometimes more rigorously and systematically, sometimes less so. More rigorous risk management occurs most visibly in the areas of protection of the environment and public health and safety, business continuity, and security of information systems. Over the years risk management has evolved into a well-defined discipline. By adopting risk management strategies organisations, large and small, private and public, have learned to prevent losses and improve their business performance, quality of products and services, and safety. Risks faced by organisations can be about things happening or not happening. This might be categorised in terms of threats whereby the risk (and associated negative impact) is of occurrence; and of opportunities, where the risk is associated with non-occurrence. Internal risks are characterised by their placing, and are both posed and manageable at the level of enterprise, archive, collection or item and are subject to further subdivision. External risks are those that originate from beyond these controllable parameters and, although they can be mitigated to some extent, they are generally surrounded by increased degrees of uncertainty, a consequence of the lesser extent to which they can be controlled. The issue of risk has been considered from a number of perspectives within the context of digital curation. A variety of work has sought to analyse the risks associated with file formats, perceiving the risk as something intrinsic to what a digital repository does, based upon the technical challenges associated with maintaining the usability of digital files and storage media. Other works have described digital repository's core task as identifying and assessing surrounding uncertainties, transforming them into measurable risks and defining and implementing means by which they can be effectively mitigated. It is easy to see that the risks are not only technological but also organisational, staff and systems related, and connected with the external factors arising from the environment where the digital repository operates. Like any organisation, digital repositories can benefit from risk analysis and risk management techniques to support both their general management and their core business of digital preservation. (Hofman et al. 2007, p. 21) A following classification of threats to digital preservation has been suggested by (Barateiro et al. 2010, p. 10): • disasters • attacks • management • legislation Management failures are the consequences of wrong decisions that produce several threats to the preservation environment. Disasters and attacks correspond, respectively, to non-deliberate and deliberate actions affecting the system or its components. Legislation threats occur when digital preservation processes or preserved data violate new or updated legislation.
Typical cost components and drivers	Introducing risk analysis and risk management practice in the organisation. Defining and deploying a risk treatment plan. Preservation planning exercise.
Potential benefits	Improved business continuity and sustainability. Disaster preparedness with clear tasks and division of responsibility for action. Timely preservation action that prevents the risk of digital assets becoming obsolete.

Indirect determinant	Risk
Examples of the economic model	If some or all of the indirect determinants were to be ignored they would be potential losses for the organization. If an organization invests in risk management then in the process they would automatically invest in some indirect determinants thus avoiding risks and possibly gaining benefits and value instead.
Synonymous determinants	Business continuity
Related concepts	Quality, benefit
Priority rank for 4C stakeholders	1

Indirect determinant	Sensitivity
Definition	Confidentiality and assurance that information is held in confidence and protected from unauthorized disclosure.
Cost context	Worldwide legislation on protection of data and privacy has a significant effect on how access to archived digital assets needs to be controlled and managed. The ability to protect, for example, the anonymity of data subjects, the rights of owners of a digital assets (such as copyright), the confidential information contained in the digital assets (for example business secrets in digital records), and so on, is directly related to the reputation and trustworthiness of the organisation that preserves digital assets.
Typical cost components and drivers	Investment into developing policies, procedures and technologies that ensure the protection of data that should not be disclosed. Application of information security principles and audits.
Potential benefits	Increased reputation and trustworthiness. Avoidance of legal action against the organisation when confidential information has been disclosed.
Examples of the economic model	If an organization makes investments that help to protect the confidentiality and integrity of preserved digital assets then its repository can be reliable and trustworthy. It is a repository that can be trusted with sensitive content.
Synonymous determinants	Confidentiality, security
Related concepts	Trustworthiness, reliability, integrity
Priority rank for 4C stakeholders	12

Indirect determinant	Skills
Definition	Skill is a measure of the amount of worker's expertise, specialization, wages, and supervisory capacity. (Cowan 1997, p 179)
Cost context	People with their qualifications, knowledge, skills and experience are an asset of every organisation. Skills should be actively developed and managed. In the technology-dependent domain of digital preservation peoples' skills can deteriorate over time and require refreshing and updating. Professional development opportunities that are available to staff should ensure that staff will develop new skills and abilities over time. If organisational responsibilities are not shared and skills duplicated between members of staff, the organisation is exposed to the risk of losing skills that are vital to its operation when a member of staff is leaving the organisation. Digital preservation skills often have to be multidisciplinary (erpaTool 2004, p 3) and can be hard to replace at short notice.
Typical cost components and drivers	Implementing staff performance reviews to regularly determine skill levels and training requirements. Establishing means for staff training and for staff to employ skills of limited frequent value in test environment. Providing training facilities to reverse obsolescence of skills.
Potential benefits	Increased business continuity and sustainability. Better performance. Ability to participate in innovative developments.
Examples of the economic model	For digital preservation specific skills are required. Well trained, skilful and experienced people are expensive, but will reduce overall costs of the preservation function
Synonymous determinants	Competence, professionalism
Related concepts	Quality, risk, sustainability
Priority rank for 4C stakeholders	N/A

Indirect determinant	Sustainability
Definition	Sustainability is the capacity to endure. Economically sustainable preservation is a means of keeping information accessible and usable over time by ensuring the ongoing and efficient allocation of resources to its maintenance. (BRTF 2010, p 107)
Cost context	On the one hand sustainable preservation is a societal concern and transcends the boundaries of any particular content domain. (BRTF 2010, p 4) On an organisational level sustainability is closely associated with the concept of business continuity. Preservation can be seen as responding to a number of business risks, for example providing continuous access to digital assets that the organisation requires for conducting its business or for meeting statutory or compliance requirements. Sustainability of the preservation function within an organisation has several dimensions—technical, operational, human, and also an economic dimension. For public sector organizations the term sustainability has to be examined through the prism of fixed budget. For example in the case of data archiving the challenge lies in the fact that there are continuous, disproportionate increases in both the quantity of data and the complexity of datasets relative to the fixed funding. (DANS n.d.)
Typical cost components and drivers	Actions necessary for sustainable preservation include: • assessing the value of preserved information, selecting materials for long-term preservation based on that assessment of value, and articulating a compelling value proposition to community stakeholders; • providing incentives for stakeholders to preserve digital assets directly or provide preservation services for others, and tailoring those incentives to the prevailing community norms and to information policy regulations and privacy considerations; and • defining the roles and responsibilities of individuals and institutions in preservation, specifying how actors and stakeholders are organized and how resources flow among them to ensure preservation. (BRTF 2010) See also the future 4C project deliverable 4.2 “ESRM”
Potential benefits	Business continuity. Controlled costing of the preservation function
Examples of the economic model	Sustainability is something which should be achieved in the process of investing in the other indirect determinants discussed here. Thus achieving sustainability is a benefit in itself that comes from investing in indirect determinants.
Synonymous determinants	Continuity
Related concepts	Efficiency, quality
Priority rank for 4C stakeholders	4

Indirect determinant	Transparency
Definition	Disclosure of information required for verification, collaboration, cooperation, and collective decision making.
Cost context	The concept of a trusted digital repository has been promoted as a cornerstone of sustainable infrastructure for ensuring the preservation of digital information. Establishing the trustworthiness of a repository is a matter of transparency of its operations and their verification through audits. The ISO 16363 sets a requirement that "repository shall commit to transparency and accountability in all actions supporting the operation and management of the repository that affect the preservation of digital content over time". This is necessary because transparency, in the sense of being available to anyone who wishes to know, is the best assurance that the repository operates in accordance with accepted standards and practices. This can be achieved by disclosing reports of financial and technical audits and certifications; governance documents, independent program reviews, and contracts and agreements with providers of funding and critical services.
Typical cost components and drivers	Disclosure of information
Potential benefits	Increased reputation and trustworthiness
Examples of the economic model	By investing in transparency an organization would show that its repository is open to criticism and is not afraid of exposing its flaws. In return the repository would potentially gain some constructive feedback and make improvements. Communicating audit results to the public as part of transparency will engender more trust, and additional objective audits, potentially leading towards certification, will promote further trust in the repository and the system that supports it.
Synonymous determinants	Accountability, reliability
Related concepts	Authenticity, trustworthiness
Priority rank for 4C stakeholders	7

Indirect determinant	Trustworthiness
Definition	A trusted digital repository is one whose mission is to provide reliable, long-term access to managed digital resources to its designated community, now and in the future (RLG/OCLC 2002, p 5)
Cost context	Archival scholarship demonstrates that the trustworthiness (in other words, authenticity and reliability) of digital objects is important to users [6]. Quality criteria for repository operations include the requirements for object level authenticity (such as integrity and identity) to ensure that users can be confident that they are interacting with authentic digital objects. [10, p 20] The concept of trustworthiness is also applied to the digital repository operations and the organisational level. The concept of a trusted digital repository as defined by the RLG/OCLC task force lists the following attributes to establish the trusted status (RLG/OCLC 2002, p 13): • Compliance with the Reference Model for an Open Archival Information System (OAIS) • Administrative responsibility • Organizational viability • Financial sustainability • Technological and procedural suitability • System security • Procedural accountability. Trust in a digital repository is, thus, related not only to basic questions of trust in preservation methods applied at the digital repository, but also to broadest organisational issues like funding base, policy framework, staff training opportunities, existence of transferable skills, and so on. A trustworthy digital repository will understand threats to and risks within its systems. Audit and certification have become the primary means of establishing the trustworthiness of digital objects and archives that preserve them. Trustworthiness is effectively used to express accountability of digital preservation systems through audit and certification. [18] The underlying concept of repository audit tools is that a repository is trusted if it can demonstrate its capacity to fulfil its specified functions, and if those specified functions satisfy an agreed set of minimal criteria (which, ideally, all trusted repositories share). The critical aspect also is that this compliance can be demonstrated (a similar concept to transparency)—through this the acquisition of trust becomes largely synonymous with processes of audit and certification. Financial sustainability is an important attribute of a trusted, reliable digital repository. (Palaiologk et al. 2012, p. 1)
Typical cost components and drivers	Auditing repository operations. Disclosure and promotion of audit results.
Potential benefits	Increased reputation Competitive advantage
Examples of the economic model	By investing in trustworthiness an organization would guarantee that its repository is suitable and reliable for preserving someone else's digital assets. Making a repository's degree of trustworthiness explicit by investing in audit and certification could potentially increase revenues for a preservation service provider.
Synonymous determinants	Reliability, authenticity
Related concepts	Quality, transparency
Priority rank for 4C stakeholders	2

Indirect determinant	Value
Definition	Value is a measure of the benefit that an actor can gain from either a good or service.
Cost context	Long-term preservation as a concept entails the maintaining of value of information assets for the future generations. The value of digital assets depends on multiple factors, none of which are easy to define: stakeholders for digital materials are often diffuse across different communities. The interests of future users are poorly represented in selecting materials to preserve. (BRTF 2010, p 2) The incentive for preservation typically arises from some stakeholder or set of stakeholders who have a clear interest in (or see value from) the long-term curation of a particular set of digital assets. (Rusbridge, Lavoie 2011) Value is something that an information object can intrinsically have, but which may not have any currency with a funding organisation; it is seen through the eye of the beholder. Carrying enormous costs to preserve complex digital objects to which no one requests access is undesirable. This suggests a preservation strategy which is appropriate to the perceived value of the digital object. However, the long-term value of digital materials can be difficult to determine—particularly when rapidly changing technology requires decisions about long-term value before this has a chance to be proved through a period of use. (Russell, Weinberger 2000) Whenever changes in the quality of the digital assets occur they are likely to influence how stakeholders value the preserved assets and thereby their willingness to pay for it. A digitized book may for example gain value if the file is processed by an OCR program to make the text searchable. (Kejser et al. 2012, p. 5) In cases where future value is uncertain, choosing to preserve assets at low levels of curation can postpone ultimate decisions about long-term retention and quality of curation until such time as value and use become apparent. (BRTF 2010, p. 3)
Typical cost components and drivers	Establishing value criteria for the assets the organisation is preserving. Developing preservation value propositions for stakeholders. Promoting the value propositions.
Potential benefits	Increased sustainability through continuing funding from stakeholders.
Examples of the economic model	Other than benefit, one of the main purposes of investing in the indirect economic determinants listed in this document is that they would potentially add value to the repository of the organization.
Synonymous determinants	
Related concepts	Benefit, sensitivity, sustainability
Priority rank for 4C stakeholders	6

3 Conclusions

This deliverable is an early result from the work package 4—Enhancement and presents aspects of sustainable digital curation that managers responsible for curation in organisations should be aware of and consider. The costs of investing into generic management tools like risk assessment, quality assurance, data protection, transparency and so on, are balanced against the benefits these can yield in the context of digital curation. Fifteen indirect economic determinants of digital curation are described and their likely benefits-scenarios discussed.

The initial list of determinants has been discussed with the 4C project stakeholder groups and found both highly relevant and useful; the classification of determinants for an organisation is straightforward and easy. The stakeholder consultation also made it evident that further work is required to:

- widen out the benefits analysis across a range of roles within an organisation that all perceive digital curation differently
- allow for prioritisation of determinants based on the role of respondent within an organisation (e.g. general manager, operational manager, digital preservation specialist, etc.)
- elaborate and perhaps extend the list of indirect economic determinants; for example 'compulsion' was discussed as a likely candidate for the list
- keep the list updated with further benefits scenarios.

From the discussion of indirect economic determinants with stakeholders it has emerged that, as a community, we need to put a much stronger focus on modelling and describing benefits that digital curation brings. Digital Curation needs to break out of its silo within the organisation and become of wider concern to more people, particularly senior management, and widening of the benefits framework should assist in achieving this. The tasks within 4C work package 4 are, thus, all contributing to the same goal – building the strategic basis for sustainability planning in organisations. The results of the stakeholder consultation and ranking of indirect economic determinants confirms that the focus on risk, trust and quality that the work package 4 will be doing further work on, was a perceptive choice in the project plan. The benefits modelling will also provide inputs for the Curation Costs Exchange (CCEx) tool that will be developed in work package 3.

The next steps will be to integrate the results of this deliverable more coherently with the draft Economic Sustainability Reference Model so that combined together they become an effective and comprehensive checking tool for management (for example as a benefits and sustainability handbook for managers of digital curation).

References

1. Antunes G., Barateiro, J., Borbinha, J. (2009). *Addressing Digital Preservation: Proposals for New Perspectives*. Retrieved May 2013 from http://cs.harding.edu/indp/papers/barateiro7.pdf

2. APARSEN (2013). *D32.1 Report on cost parameters for digital repositories.* Retrieved July 2013 from http://www.alliancepermanentaccess.org/wp-content/uploads/downloads/2013/03/APARSEN-REP-D32_1-01-1_0.pdf

3. Authenticity (2012). *Trust Is Fundamental to the Working of Society.* [Brochure]. APARSEN. Retrieved June 2013 from http://www.alliancepermanentaccess.org/wp-content/uploads/downloads/2012/09/APARSEN-Trust-Brochure-Low-Res-Web-Version.pdf

4. Barateiro, J., Antunes, G., Freitas, F., Borbinha J. (2010). *Designing Digital Preservation Solutions: A Risk Management-Based Approach*. The International Journal of Digital Curation. 5 (1), 4-17. Retrieved April 2013 from http://www.ijdc.net/index.php/ijdc/article/download/143/205

5. Beagrie, Neil, Julia Chruszcz, Lavoie, Brian (2008). Keeping Research Data Safe: A Cost Model and Guidance for UK Universities. London: JISC. Retrieved April 2013 from http://www.jisc.ac.uk/publications/reports/2008/keepingresearchdatasafe.aspx

6. Beagrie, Neil, Lavoie, Brian, Woollard, Matthew (2010). Keeping Research Data Safe 2, Final Report. Retrieved April 2013 from http://www.jisc.ac.uk/media/documents/publications/reports/2010/keepingresearchdatasafe2.pdf

7. *Confidentiality*. Glossary of ADS Terms. Retrieved June 2013 from http://transition.usaid.gov/policy/ads/glossary.pdf

8. Cooper, R., Kaplan, R.S. (1988). *Measure the costs right: make the right decisions*. Harvard Business Review (September-October 1988) http://hbr.org/download/measure-costs-right-make-the-right-decisions/88503-PDF-ENG/88503-PDF-ENG.PDF

9. *Costs and business models in scientific research publishing: a report commissioned by the Wellcome Trust*. (April 2004). SQW Limited. Enterprise House, Vision Park. Histon, Cambridgeshir. Retrieved May 2013 from http://www.wellcome.ac.uk/stellent/groups/corporatesite/@policy_communications/documents/web_document/wtd003184.pdf

10. Cowan, R.S. (1997). *A Social History of American Technology*. New York: Oxford University Press

11. Currall, J. (2006). *I stand, they don't deliver: or why the highwayman approach to funding digital preservation doesn't work*. University of Glasgow. Retrieved June 2013 from https://dspace.gla.ac.uk/bitstream/1905/662/1/espida_highwayman.pdf

12. Currall, J., Johnson C., McKinney, P. (Aug 2005*). DLM Forum 2005*. University of Glasgow. Version 1.4. Retrieved April 2013 from https://dspace.gla.ac.uk/bitstream/1905/455/1/dlm+forum+2005.pdf

13. Currall, J., Johnson, C., McKinney, P. (2006). *The world is all grown digital.... How shall a man persuade management what to do in such times?* Version 3. University of Glasgow. Retrieved April 2013 from https://dspace.gla.ac.uk/bitstream/1905/690/1/espida_world_all_strange.pdf

14. DANS. *Costs of Digital Archiving vol. 2*. Retrieved May 2013 from http://www.dans.knaw.nl/en/content/categorieen/projecten/costs-digital-archiving-vol-2

15. Dingledine, Roger, Freedman, Michael J, Molnar, David, Parkes, David, Syverson, Paul (2003). Reputation. Retrieved April 2013 from http://freehaven.net/~arma/jean.html

16. Donaldson, D. R. (2011). *Users' Trust in Trusted Digital Repository Content*. University of Michigan. iPRES 2011. Retrieved April 2013 from http://archive-sg.com/sg/i/ipres2011.sg/2012-12-13_944568/

17. Hofman, Hans, McHugh, Andrew, Ross, Seamus, Ruusalepp, Raivo. (2007). *Digital Repository Audit Method Based on Risk Assessment*, retrieved in June 2013 from http://www.repositoryaudit.eu/downloadDRAMBORA

18. *Economic risks to sustainability (revised)* (13.09.2011). Retrieved May 2013 from http://unsustainableideas.wordpress.com/2011/09/13/economic-risks-to-sustainability-revised/

19. *Efficiency*. Retrieved May 2013 from http://www.businessdictionary.com/definition/efficiency.html

20. *erpaTool – Cost Orientation of Digital Preservation*. (2004). Retrieved June 2013 from http://www.erpanet.org/guidance/docs/ERPANETCostingTool.pdf

21. Fry, J., Lockyer, S., Oppenheim, C., Houghton, J., Rasmussen, B. (2009*). Identifying benefits arising from the curation and open sharing of research data produced by UK Higher Education and research institutes*. Loughborough University / Centre for Centre for Strategic Economic Studies. Retrieved May 2013 from http://hdl.handle.net/2134/4600

22. *Impact*. Glossary of ADS Terms. http://transition.usaid.gov/policy/ads/glossary.pdf

23. Kaplan, R.S., Anderson, S.R. (2007) *Time-driven activity-based costing: a simpler and more powerful path to higher profits*. Boston (Mass.): Harvard Business School Press

24. Kejser, U. B. (2009). *Modelling the Cost and Quality of Preservation Imaging and Archiving*. PhD Thesis. School of Conservation. Retrieved April 2013 from http://www.costmodelfordigitalpreservation.dk/contact/cmdp-1---preservation-planning-and-digital-migrations/documentation/UllaKejserPhDThesis2009.pdf?attredirects=0&d=1

25. Kejser, U.B., Nielsen A. B., Thirifays, A. (2012). *Modelling the Costs of Preserving Digital Assets.* http://www.unesco.org/new/fileadmin/MULTIMEDIA/HQ/CI/CI/pdf/mow/VC_Kejser_et_al_27_B_1350.pdf

26. Kejser, U. B., Nielsen, A. B. & Thirifays, A. (November 2009). *The Cost of Digital Preservation*. Project Report v. 1.0 A project funded by the Danish Ministry of Culture: Committee for Digital Preservation. Retrieved April 2013 from http://www.costmodelfordigitalpreservation.dk/contact/cmdp-1---preservation-planning-and-digital-migrations/documentation/Projectreport_CMDP_FINAL.pdf?attredirects=0&d=1

27. Kont, K. R. (2011). *New cost accounting models in measuring of library employees' performance.* Library Management. Vol. 33(1/2), pp 50-65

28. Lavoie, Brian F. (2003). The Incentives to Preserve Digital Materials: Roles, Scenarios, and Economic Decision-Making. OCLC. Retrieved July 2013 from http://www.oclc.org/research/projects/digipres/incentives-dp.pdf

29. *Quality*. Glossary of ADS Terms. (2012) Retrieved June 2013 from http://transition.usaid.gov/policy/ads/glossary.pdf

30. Palaiologk, A. S., Economides, A. A., Tjalsma, H. D. & Sesink, L. B. (Sept 2012*). An activity-based costing model for long-term preservation and dissemination of digital research data: the case of DANS*. September 2012, 12, (4), pp 195-214. International Journal on Digital Libraries. Retrieved June 2013 from http://link.springer.com/article/10.1007%2Fs00799-012-0092-1

31. *Report of the Blue Ribbon Task Force on Sustainable Digital Preservation and Access.* (February 2010). http://brtf.sdsc.edu/biblio/BRTF_Final_Report.pdf

32. *Risk*. Retrieved May 2013 from http://en.wikipedia.org/wiki/Risk

33. RLG/OCLC (2002). *Trusted Digital Repositories: Attributes and Responsibilities.* Retrieved in July 2013 from http://www.oclc.org/research/activities/past/rlg/trustedrep/repositories.pdf

34. Rusbridge, C., Lavoie, B. (2011) *Draft economic sustainability reference model*. Retrieved April 2013 from http://unsustainableideas.files.wordpress.com/2011/09/reference-model-0-6-clean.pdf

35. Russell, K., Weinberger, E. (31.05.2000). *Cost elements of digital preservation*. Retrieved April 2013 from http://www.webarchive.org.uk/wayback/archive/20050410120000/http://www.leeds.ac.uk/cedars/colman/CIW01r.html

36. *Sensitivity*. Retrieved June 2013 from http://www.businessdictionary.com/definition/sensitivity.html#ixzz2U16CR1pX

37. Slats, J., Verdegem, R. (2005). *Cost Model for Digital Preservation*. Nationaal Archief of the Netherlands. Retrieved April 2013 from http://dlmforum.typepad.com/Paper_RemcoVerdegem_and_JS_CostModelfordigitalpreservation.pdf

38. *Sustainability Factors*. Retrieved May 2013 from http://digitalpreservation.gov/formats/sustain/sustain.shtml#transparency

39. Tanner, Simon, Deegan, Marilyn (2003). Exploring charging models for digital library cultural heritage. Ariadne. 34. Retrieved June 2013 from http://www.ariadne.ac.uk/issue34/tanner

40. Transparency. Retrieved May 2013 from http://www.businessdictionary.com/definition/transparency.html#ixzz2U15vwS85