

VALUATION MODEL
FOR
PAPER CONSERVATION RESEARCH

This text has been published as a chapter in the book
"Preservation Management for Libraries, Archives & Museums"

edited by
G.E. Gorman and Sydney J. Shep

Published in 2006 by

Facet Publishing, 7 Ridgmount street, London WC1E 7AE

www.facetpublishing.co.uk

ISBN-13: 978-1-85604-574-2

ISBN-10: 1-85604-574-9

Abstract

Within the framework of the Dutch national program for the preservation of library and archival materials, Metamorfoze, three national institutions – Instituut Collectie Nederland (ICN, Netherlands Institute for Cultural Heritage), the Koninklijke Bibliotheek (KB, National Library of the Netherlands) and the Nationaal Archief (NA, National Archives of the Netherlands) – have been given the joint responsibility to co-ordinate a national program for paper conservation research for the years 2004 to 2008. A first step in the design of this program has been the development of a valuation model for paper conservation research. This model is primarily based on the idea that different research options can be evaluated and prioritised beforehand by quantitatively estimating their associated 'success' in improving the preservation of and access to Dutch paper-based collections in a most cost-effective way. In this article, the term 'collections' is used for groups of documents and/or other paper artefacts in libraries, archives and museums. The framework, elaboration and discussion of the Valuation Model for Paper Conservation Research ('Valuation Model', in short), will be presented in this chapter.

VALUATION MODEL FOR PAPER CONSERVATION RESEARCH

A new approach for setting research priorities

Henk J. Porck, Frank J. Ligterink, Gerrit de Bruin and Steph Scholten

[Preservation is]

the management of risks to collections to restrict the rate of loss of collection value to an optimum, low level (Waller 2003).

[Conservation is]

the management of resources, especially but not exclusively, material cultural resources, to prolong the lifetime of material culture, to enhance usability, and to clarify contained messages of various kinds for the continuance and betterment of humanity (Rosvall et al. 1995).

[Conservation Research is]

the generation of knowledge that can be applied to achieve a maximum effective collection value through optimisation of the combination of preservation of and access to a collection as a whole, under a given conservation budget (this report).

Introduction

Preservation and conservation of cultural heritage collections are core activities of libraries, archives and museums. They are recognised as important issues that require significant resources. Conservation research, carried out in many locations all over the world by a variety of researchers, forms an integral part of conservation policies. Knowledge generated by conservation research is necessary to underpin sound decision making. Actors involved in conservation research range from specialised conservation scientists and conservators to students of conservation colleges and professionals in related, sometimes industrial, research disciplines. Their work is condensed into an expanding body of literature and knowledge.

It must be recognised that the incentive for conservation research does not always originate from the objective of collection preservation only. The involvement in research of commercial companies may for example be motivated by public relations concerns. Non-commercial research institutes almost always act in political environments that may influence the conservation research agenda. We should be aware that these external forces do introduce a risk of biased research. In practice it can be difficult to recognise this potential bias. It is interesting to see, as an example, how and to what extent a major funding program like that of the European Union has influenced directions in conservation research by importing its political ambitions in research programs. An overview of several developments and certain 'trends' in conservation science is presented in Porck & Teygeler (2000). Another external motive for conservation research (i.e. not instigated by the goal of preservation), is pure scientific curiosity. Scientific curiosity is definitely a vital driving force for any research, but is

also difficult to control. At some point research may become an aim in itself and will get detached from its original goals. For instance, how many specialised analytical tools for the characterisation of cultural objects, have not been developed by conservation scientists without a clear and proper application purpose?

However justified these remarks may be, the role of conservation science as such should not be disputed. If serious amounts of money are spent on interventive or preventive conservation measures within local or national preservation programs, it is wise to reserve some part of the resources to review and evaluate the used strategies and to look for possible improvements and new directions. It is important that this reviewing, evaluating and searching is done in a rigorous, independent and objective manner, taking into account both the benefits and costs involved. This approach constitutes its scientific character and forms the basis for our definition of conservation science, that is the generation of knowledge to support the efficient use of resources in order to optimise the preservation of and access to our cultural heritage.

Within the framework of the Dutch national program for the preservation of library and archival materials, *Metamorfoze*, three national institutions – Instituut Collectie Nederland (ICN, Netherlands Institute for Cultural Heritage), the Koninklijke Bibliotheek (KB, National Library of the Netherlands) and the Nationaal Archief (NA, National Archives of the Netherlands) – have been given the joint responsibility to co-ordinate a national program for paper conservation research for the years 2004 to 2008. A first step in the design of this program has been the development of a valuation model for paper conservation research. This model is primarily based on the idea that different research options can be evaluated and prioritised beforehand by quantitatively estimating their associated ‘success’ in improving the preservation of and access to Dutch paper-based collections in a most cost-effective way. In this article, the term ‘collections’ is used for groups of documents and/or other paper artefacts in libraries, archives and museums. The framework, elaboration and discussion of the Valuation Model for Paper Conservation Research (‘Valuation Model’, in short), will be presented in this chapter.

Valuation Model for Paper Conservation Research

Scope

The focus of conservation research is traditionally determined by the universal and central importance attached by the field to the subject of material knowledge. This includes knowledge of historic materials, production processes and user’s practices, as well as modern conservation and restoration materials and techniques. Each new research program is based on the state of the art of current material knowledge and expertise. Against this background, the objective of paper conservation science – the generation of knowledge to support the efficient use of resources in order to optimise the preservation of and access to our paper cultural heritage – can be further elaborated. ‘Our paper cultural heritage’ primarily addresses the written, drawn and printed paper artefacts collected and stored in archives, libraries and museums.

Within this context, the crucial role of collection managers should be stressed. New research and new knowledge can only be of influence on the preservation of and access to collections, if collection managers actually apply research results in their policies and activities. Usually, a limited amount of free resources is available for preservation and access activities and

services. The 'freedom of movement' in the use of these resources mainly applies to the choice for certain specific activities and investments in the areas of (1) preventive conservation measures, (2) conservation and restoration treatments, and (3) valuation and selection for conservation. Conservation research should be aimed at generating strategic, applicable knowledge in these three areas, enabling collection managers to establish a more efficient and effective resource management. Research can be directed towards development of new methods, instruments and materials, but also towards evaluation and improvement of already existing facilities and working procedures. Whereas preservation and access of a collection are usually treated separately, often as conflicting factors, the scope of conservation research within the framework of the Valuation Model includes both aspects in a combined, integrated way.

Testing and prioritising

The field of conservation research as sketched above, is very broad and diverse. It includes an extensive variety of subjects, each with its own historical background, argumentation and research methodology. This wide spectrum involves studies that seem incomparable. For example a study on a technique to monitor the optical characteristics of archival documents during exhibition, appears to be of a completely other nature than research on a suitable deacidification method for coated papers. On first glance this seems to be an insurmountable obstacle in the development of a coherent conservation research program. However, the solution for this problem lies in keeping in mind the common goal – the generation of knowledge to improve preservation and access. Explicit valuation of research options in terms of their contribution to this goal, will allow for well-considered prioritisation as well as provide a guiding principle for the set-up of research proposals.

Designation and definition of success indicators

Conservation research can contribute to realising the desired objective in three distinct ways: research results can lead to an improvement of (1) preservation, (2) access and (3) economy (saving of expenses). By formulating and applying quantitative indicators for the success expected in these three aspects, a ranking score can be given to any research proposal. The actual judgement of the expected success of a certain research option, according to the Valuation Model, is done by an *ex ante* estimation of the effects that can be reached at maximum.

Of course, the true success, the eventual impact of research, can only be established after the actual implementation of the research results. Beforehand, the outcome of the research itself is uncertain, nor do we know in advance if collection managers will decide to apply the research results. Therefore, the maximum effect of a certain research option is estimated *ex ante* under the conditions that the research in question succeeds, that is generates the desired knowledge, and that this knowledge is also actually put into practice.

Preservation

An overarching conceptual framework for the quantification of the success factor 'preservation' is the Cultural Property Risk Analysis Model, developed by Robert Waller of the Canadian Museum of Nature (Waller 2003). This methodology provides a comprehensive system in which all possible threats for collections are expressed as quantitative risks. The system

distinguishes ten different generic risks: (1) physical forces, (2) fire, (3) water, (4) contaminants, (5) incorrect relative humidity, (6) incorrect temperature, (7) criminals, (8) pests, (9) light and UV radiation, and (10) dissociation, that is inaccessibility, loss of objects/data. An essential element in the calculation of the risks is the quantification of the (expected) loss of value of the collection materials as a consequence of specific damage processes connected with the various risk factors. This approach enables a mutual comparison of strongly different types of risk. The formula used in the risk assessment analysis is as follows:

$$MR = FS \times LV \times P \times E$$

MR: *Magnitude of Risk*, the quantitative measure of a certain risk

FS: *Fraction Susceptible*, the fraction of the collection that is vulnerable to the risk

LV: *Loss of Value*, the loss of value in 100 years, expressed as a fraction of the initial value

P: *Probability*, the likelihood that the risk occurs in the course of 100 years

E: *Extent*, how much of the potential damage connected with the risk actually becomes manifest

On the basis of the risk assessment methodology, the indicator 'preservation' (Π , pi) can now be defined as the fraction of the current collection value (set at 1) that is expected to remain after the lapse of 100 years:

$$\Pi = 1 - MR$$

Access

The second indicator for success of a research project deals with the improvement of access to the collection, which is achieved by the application of the knowledge generated by that research. Improvement of access can be reached in very different ways, for example by an increased physical resistance to handling or an improvement of the 'readability'. The latter may be literally the intensification of a faded writing ink on a document, but may also relate to the increase of material knowledge about an artefact, thus providing a more meaningful context.

Access to a collection depends of course on the organisation's facilities that allow for direct or indirect consultation of the collection. The access level of a collection can be characterised by a relatively universal set of five access facilities:

L: *Listing*, access via a catalogue or an inventory list containing basic data

O: *Online presentation*, access by means of electronic full-text/image files

D: *Display possibilities*, consultation through physical exhibition of collection materials

R: *Reading room service*, consultation of original documents in the reading room

I: *Intellectual retrieval*, access via reading aids or documentary and material information

Usually, these facilities are offered rather independently of each other. In the calculation, each facility will be given a value between 0 and 1, indicating to what extent (fraction) the actual level of this facility meets the desired optimum. The access level (*A*) of a collection, expressed as a figure between 0 and 1, can thus be calculated as the sum of the individual facility levels, divided by 5:

$$A = (L + O + D + R + I) / 5$$

Economy

The relevance of conservation research cannot be judged properly without considering the aspect of costs. In the Valuation Model, the costs considered do not refer to the costs of the conservation research itself, but specifically concern the expenses involved in the implementation of the research results in the conservation practice. In some cases, research is not directly aimed at improving preservation or access, but primarily concentrated on improving efficiency of already existing conservation activities. Conversely, if improved preservation or access is expected as an outcome when introducing a new conservation measure or method, the positive effect should be weighed against a possible increase in costs. These extra expenses include at least (1) the short term immediate costs of implementation of research results and, if the application of the research results needs to be maintained for a longer period, (2) the long term or structural costs.

Unlike the success indicators 'preservation' and 'access', the indicator 'economy' is not separately defined in the Valuation Model. As will be shown in the next section, the influence of the aspect of costs on the success of conservation research will be taken into account in an integrated manner.

2.4. Weighing of success indicators

2.4.1. Effective collection value

Our first experiences with the use of the valuation model have indicated that the three success indicators 'preservation', 'access' and 'economy' form a complete, comprehensive set. Discussing diverging arguments pro or contra certain research options, has shown us that all can be categorised under one of the three indicators. The problem that subsequently must be faced, is the question how improvements in preservation, access and economy should be mutually weighed and integrated. Is it possible to compare research that leads to improved preservation with research improving access or resulting in more cost-effective conservation treatments?

To answer this question, it must be made clear first of all that preservation *in itself* and access *in itself* are not individual goals. The value of a collection becomes only effective in its use, in the interaction with its intended audience. There is, or should be, no collection manager putting much effort in preservation, without imagining that happy user at the moment of discovery of that single valuable, long-wished document. On the other hand, access to a collection by for example exhibitions, can never exist without the basic precondition of

preservation of the collection. Adequate preservation, meaning the physical survival of a valuable collection, as well as proper access facilities allowing for sufficient consultation possibilities, are equal and necessary conditions for optimal direct and long-term use of a collection. Given the objective of conservation research, as formulated before, it is the *combination* of preservation *and* access that counts. Following this line of reasoning, we define the ‘effective collection value’ (V) as the product of preservation and access. V can thus be calculated by multiplication of the success indicators Π and A :

$$V = \Pi \times A$$

Nor is saving of costs a goal in itself. If, by implementation of research results, specific conservation treatments can be performed at half the price, and the saved budget can be used for budget cuts or higher salaries for senior management for example, this would mean a loss, not a profit from the viewpoint of preservation. The starting point for our model should be that savings flow back into the conservation budget. Conversely, new conservation measures demanding extra investments are also expected to come from that budget. Although conservation budgets will certainly vary in practice, the choice of a constant budget for our valuation model is considered to be a neutral, easily defensible simplification of a complex reality.

In summary, the proposed valuation model states an extended definition of the goal of conservation research: *the generation of knowledge that can be applied to achieve a maximum effective collection value through optimisation of the combination of preservation of and access to a collection as a whole, under a given conservation budget*. The extent to which this goal can be reached determines the success of that research. The *ex ante* estimation of the success of different research options, offers an instrument for setting research priorities.

Success of research

In the model presented, the valuation of research is linked to its effect, to the impact of a certain conservation measure connected with the research in question. The term ‘measure’ is used in this text as an umbrella for passive preservation measures, active conservation treatment methods and other conservation activities. Three scenarios can be distinguished according to the three different ways in which knowledge generated by research may be implemented:

- 1 by introduction of new conservation measures
- 2 by improvement of already existing conservation measures
- 3 by cancellation of intended or existing conservation measures

The introduction, improvement or cancellation of conservation measures will influence the effective collection value both in direct and indirect ways. The direct effect of a given measure can be defined as the change in effective collection value through a change in preservation and/or access directly associated with the measure itself. To quantify the direct change in effective collection value (V_{dir}) associated with a conservation measure (m), the initial values for preservation (Π_i) and access (A_i) and the new values (Π_m and A_m) need to be estimated.

$$V_{dir} = \Pi_m \times A_m - \Pi_i \times A_i$$

In association with the introduction, improvement or cancellation of a specific measure there is, however, also the aspect of a reduction or an increase in the costs involved. From the assumption of a constant conservation budget any increase or reduction in costs associated with a specific measure will lead to a shift within the total budget and thus a change in resources or costs used for all other conservation measures applied within an organisation. Hence, such a shift in the conservation budget will affect preservation and access indirectly.

The indirect effect of a given conservation measure can now be defined as the change of the effective collection value through changes in preservation and access associated with *other*, existing conservation measures due to a shift in the conservation budget. To quantify this indirect effect we have to know the mean efficiency (ϵ , epsilon) with which the total conservation budget (B) is utilised to maintain the current (initial) effective collection value (V_i).

$$\epsilon = V_i / B$$

The indirect change of the effective collection value (V_{ind}) due to a pressure on the total conservation budget by the extra costs (C_m) involved with measure (m) can now be quantified as follows:

$$\begin{aligned} V_{ind} &= - C_m \times \epsilon \\ &= - C_m \times (V_i / B) \\ &= - C_m \times (\Pi_i \times A_i) / B \end{aligned}$$

Note here the minus sign. If extra costs are involved with a measure (m), less budget will be available for the other existing conservation measures, which will have an indirect negative effect on the effective collection value. On the other hand, if a cost reduction can be realised for the measure, the value for the extra costs is negative, which implies that the indirect effect on the effective collection value will be positive.

The overall success (S_m) of a conservation research option, connected with a measure m , can now be expressed as the estimated net effect of that measure on the effective collection value:

$$\begin{aligned} S_m &= V_{dir} + V_{ind} \\ &= (\Pi_m \times A_m - \Pi_i \times A_i) - C_m \times (\Pi_i \times A_i) / B \end{aligned}$$

This final ‘formula of success’ may appear pure theory. However, it unambiguously codifies and specifies our convictions formulated in the objective of paper conservation science: the generation of knowledge that can be applied to achieve a maximum effective collection value through optimisation of the combination of preservation (Π) and access (A) of a collection as a whole, under a given conservation budget (B). In addition, this formula enables us to compare widely varying conservation research options in a single system, and enables objective decision making on research priorities.

Discussion

The interpretation of the primary goal of conservation research as elaborated in the Valuation Model presented in this paper, has far-reaching consequences. The setting of research priorities according to this model is not only determined by the expected direct impact of research, but also by its estimated indirect, cost-related implications on the collection's preservation and access as a whole. The final choice for a certain research option is therefore strongly dependent on the position and policy of the respective collection keeping institute. The introduction of a new conservation measure, including the costs involved, may improve the total cost-effectiveness for certain organisations, for example those having a large conservation budget, whereas for another institution, with a smaller budget, this same measure may lead to a reduction in cost-effectiveness. Although the incorporation of this kind of dependence in our Valuation Model certainly induces complications, it reflects the complex situation and kind of organisational differences that exist today.

The Valuation Model as an instrument to set conservation research priorities is principally based on the estimation of the 'success' of research options beforehand. These estimations should not be confused with the actual outcome of the research. It is not these estimations, but the results of the research itself and the conclusions that are drawn from these results that will be the sound basis of an adequate conservation policy. The estimated value of success only determines a 'ranking score' by which research priorities can be established in a well-considered way. The eventual research results may prove or disprove the correctness of these estimations. Ultimately, the decision whether or not to implement the generated knowledge, will determine the actual impact in practice.

Application of the Valuation Model necessitates that research proposals offer a clear insight into their expected contribution to the success indicators ('preservation', 'access', 'economy'). Of course, research options must be judged on normal scientific criteria as well. On the basis of all the characteristics of the Valuation Model, it is obvious that the use of this tool for setting conservation research priorities requires a good insight and a broad expertise regarding many different aspects of preservation and conservation. It is not intended to be a simple instrument to be used by anybody. The Valuation Model is an instrument that allows for responsible estimates of all parameters for prioritising of conservation research. It makes presentation and argumentation of choices transparent and verifiable.

In the set-up of the joint paper conservation research program in the Netherlands for the year 2005, the Valuation Model could not yet be fully applied. The concept of prioritising conservation research by means of estimation and combination of its impact on the levels of preservation, access and economy is new and sufficient practical experience with the use of the Valuation Model still needs to be gained. The Valuation Model will be further discussed within the Dutch field of conservators, conservation scientists and collection managers. Experts from other research disciplines can also offer valuable comments: Prof. Dr. J. van der Pligt (University of Amsterdam Social Psychology Program) is acknowledged for his recent suggestion to apply Multi-Attribute Utility Theory to aid the group decision making process. This discussion will be important for the acceptance of the Valuation Model as a meaningful instrument for making future choices in our national, joint conservation research agenda. Research priorities and cost-efficiency have been put forward as crucial issues by the

international conservation science community. The setting of conservation research priorities and the importance of cost-effect analysis were on the agenda at two international meetings in New York in 2003 and London in 2004 (see Bell et al., 2005). The Valuation Model described here, is presented with the objective to offer a contribution in this area, and to invite the readers to participate in the discussion on its merits.

Summary

In order to establish a coherent paper conservation research agenda, the setting of research priorities is necessary. For this purpose the Valuation Model for Paper Conservation Research is developed. Within the Valuation Model the 'ranking score', the potential 'success' of conservation research is formulated in accordance with a pronounced definition of the goal of paper conservation research: the generation of knowledge to support the efficient use of resources in order to optimise the preservation of and access to our paper cultural heritage. Following this line of thought, three quantitative indicators for the 'success' of conservation research are distinguished: 'preservation', 'access', and 'economy'. The magnitudes of these indicators are considered to be estimated beforehand. For the mutual weighing and integration of the success indicators, the term 'effective collection value' is defined as the combination (product) of 'preservation' and 'access'. Within the concept of the Valuation Model, the success of conservation research is linked to the estimated impact of a conservation measure on the effective collection value. This impact is twofold: the direct effect of the conservation measure, and the indirect effect due to a shift in the total conservation budget created by the costs involved in that measure. With the final 'formula of success', the expected net effect on the effective collection value is calculated. In spite of its theoretical features, the Valuation Model for Paper Conservation Research presents a practical, straightforward elaboration of a principle statement on the objectives of conservation research, and offers a useful instrument enabling the necessary objectivity in decision making on research priorities. The merits of the Valuation Model still need to be further discussed and must be verified in practice.

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Biographical notes

Henk Porck studied Biochemistry at the Vrije Universiteit (VU) in Amsterdam. His Ph. D. thesis was a biochemical–genetic study at the VU Medical Faculty Department of Anthropogenetics. In 1983 he was appointed conservation scientist at the Koninklijke Bibliotheek (KB), the National Library of the Netherlands in The Hague. Research projects in paper conservation include studies on deacidification, artificial aging, ink corrosion and discoloration. In 1991 he also took up the curatorship of the KB Paperhistorical Collection. His work in the field of paper history has concentrated on investigation of historical sources concerning the quality of nineteenth-century paper, and on classification and identification of handmade decorated papers. He is member of the Scientific Advisory Committee of the ECPA (European Commission on Preservation and Access), and visiting lecturer in conservation science and paper history at different training programs.

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Frank Ligterink graduated in 1989 as paper conservator at the Opleiding Restauratoren, Amsterdam. From 1989 till 1995 he studied at the Vrije Universiteit (VU) in Amsterdam, where he received his Master Degree in Physics with a specialisation in theoretical physics. In 1996 he received his degree as physics teacher. Since 1996 he is working at the Instituut Collectie Nederland (ICN, Netherlands Institute for Cultural Heritage) in Amsterdam as a conservation scientist on a variety of research subjects, including (i) transport phenomena related to indoor air pollution and moisture, (ii) colour and colour change, and (iii) the phenomenology of degradation of graphic documents and photographic materials. This work fits his general perspective of bridging the worlds of physics and conservation. In addition to research work, he contributes to the conservation training program at the ICN.

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Gerrit de Bruin works for more than twenty six years in the field of paper conservation and restoration at the Nationaal Archief (NA, National Archives of the Netherlands) in The Hague.

He was trained in book and paper conservation. He was appointed head of conservation at the NA and was involved in conservation policy development at the Central Board of the State Archives Service (1978–1994). Since 1994 he was head of the Department of Archive Conservation, and since 1998 head of the International Conservation Centre and head of Research at the NA. He is teaching conservation at the School of Archivists, is member of the ICA committee Preservation of Archives in Tropical Climates (PATC), and was co-organiser of the PATC Conferences in Jakarta (2001) and Curaçao (2003). He is organising workshops in tropical countries within the framework of the TANAP project. He is currently participating in the Thematic Network MIP (Transition Metals in Paper), and the SurveNIR and PaperTreat projects.

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Steph Scholten received his Master Degree in Art History at the Universiteit van Amsterdam (UvA, University of Amsterdam) in 1990. For two years, he also studied public administration at the UvA. He became a qualified gold and silversmith in 1984. From 1988, he worked at the Dutch Ministry of Education, Culture and Science. For 4 years he was one of the project managers for the famous Deltaplan project for the preservation of cultural heritage (1993–1997). During this time he commissioned and financed conservation research programmes. He was one of the co-founders of the Instituut Collectie Nederland (ICN, Netherlands Institute for Cultural Heritage) in Amsterdam, where he was appointed in 1997. First as policy advisor and in 2000–2002 as head of the ICN Conservation Research Department. At ICN he was responsible for the design and funding of a number of national and international conservation research projects for paper collections. He now combines project management at ICN with a job as collections manager at the National Museum of Antiquities in Leiden.

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