

A Cost-Benefit Evaluation Method for Web-Based Information Systems

Cécile L. Paris, Nathalie F. Colineau
ICT Centre – CSIRO
Building E6B Macquarie University Campus
North Ryde NSW 2113, Australia
(+61) 2 9325 3100

{cecile.paris; nathalie.colineau}@csiro.au

Ross G. Wilkinson
Australian National Data Service
700 Blackburn Rd.
Clayton, VIC 3700, Australia
(+61) 3 9902 0598

ross.wilkinson@ands.org.au

ABSTRACT

Most evaluations of web-based information systems are done with respect to their effectiveness in supporting users in finding and exploring the information they need. We believe (1) that we need to move beyond task effectiveness and look at the whole-of-system effectiveness, and (2) that we must balance benefits with costs. We propose a method that provides guidance in whole-of-system evaluations, explicitly considering all participants and both sides of the “bang for buck” equation.

Categories and Subject Descriptors

D.2.10 [Design]: *Methodologies*; H.1.2 [User/Machine Systems]: *Human information processing*; H.5.3 [Group and Organization Interfaces]: *Web-based interaction*.

General Terms

Measurement, Design, Experimentation, Human Factors.

Keywords

Evaluation, Cost-benefit analysis, Web-based information systems

1. INTRODUCTION

A number of disciplines (e.g., information retrieval, adaptive hypertext) aim at producing web-based systems to help users find information and to support them navigate within an information space. These systems are typically evaluated with respect to their effectiveness in supporting users in their task. In this paper, we propose a cost-benefit assessment method that explicitly examines *both costs and benefits* (the “bang for buck” equation) relative to *all stakeholders* involved. While cost-benefit analyses are not new, few have been done with respect to the evaluation of web-based information systems. We propose a method to assess the cost-benefit equation of such systems aiming at helping researchers think explicitly about the different participants involved in the construction, deployment, maintenance, and use of a web-based information system. It can help us understand to

what extent a system fits the intended purpose or not, at what costs, and for which task it is the most appropriate. In that regard, our method is also useful to compare and evaluate different models or approaches embedded in such systems, from a variety of perspectives, and help people choose what is likely to fit their needs best.

2. RELATED WORK

In this short paper, we only mention the most relevant work in information systems (IS), where there is a long tradition of evaluation, often taking a global view of evaluation. The work of Delone and McLean [2] is of particular interest to us, as it provides an integrated view for the concept of *information system success*. It introduces a comprehensive taxonomy with six major dimensions. (See <http://business.clemson.edu/IES/Index.html>) Interestingly, it recognises that both benefits and costs have to be taken into account to decide on the success of an information system (IS). This work represented a corner stone in the discipline. Later, Cornford *et al.* [1] proposed the Structure, Process and Outcome (SPO) framework to evaluate the efficiency, utility and impact of an IS. They recognised explicitly that there are participants beside the end-user.

3. A COST-BENEFIT METHOD

Our cost-benefit assessment method builds on [2] and [1]. We used it to evaluate our systems and believe it can be usefully applied to a large class of web-based information systems.

3.1 The Method Scope and Use

A key consideration in developing our method was that there are many attributes to consider depending on the perspective adopted, that system quality goes beyond output quality, and that it is useful to balance benefits with costs incurred to achieve them. The idea of considering different attributes (which may not all have quantifiable values) to evaluate a single object (or compare several objects) is akin to the type of evaluations done routinely in consumer reports. We believe that one of the compelling attributes of our assessment method is to allow researchers to characterise their system in terms of its strengths and weaknesses, its benefits, costs and impact on all stakeholders affected by the system. Our method provides guidance to think explicitly about the different stakeholders involved in the construction, deployment, maintenance, funding and use of a system.

3.2 Evaluation: a Cost-Benefit Perspective

Any web-based information system involves different actors who have different goals. A system evaluation must thus consider all the participants. We have identified four main *participant roles*:

- The information seeker, traditionally the end-user or consumer of the services offered by the system;
- The information provider, responsible for the content to be searched, explored and delivered;
- The information intermediaries. They can be categorised into two groups: The resource builders and the exploration partners;
- The system provider, responsible for the development and maintenance of the technology.

The costs and benefits of a system are likely to differ for each participant. The main benefits for the information seekers are related to the task effectiveness and their satisfaction in using the system. Their costs relate to the time needed to complete the task, the amount of effort required (i.e., the cognitive load) and, potentially, the necessary learning curve.

For the information provider, the benefits concern mostly the audience targeted – to what extent does the information reach a wide or desired audience? The costs here are the costs of providing the information in a form required by the system.

For the information intermediaries, we consider separately the resource builders from the exploration partners. The resource builders are responsible for creating the appropriate set of required resources (e.g., ontologies). Their benefits can be measured in terms of how easy it is to create the required resources, and their costs are related to the time needed to create them, include them in the system and maintain them if required. For the exploration partners, the benefits are comparable to those of the information seekers, i.e., related to the task performance and the quality of search and exploration support. Their costs include the time spent in capturing the information relevant to the information seekers' situation.

Finally, the benefits for the system provider are related to the system usage, with its possible corresponding revenue or corporate value, while costs are the cost of system implementation, maintenance and integration with other systems.

This explicit identification of what might constitute a benefit and a cost for whom (see Table 1) can guide researchers and developers in asking appropriate questions about a system and in

identifying the relevant evaluation studies to conduct. This in turn helps understand where the technology fits in a larger picture and evaluate different approaches, characterising their strengths and weaknesses, thus allowing one to choose the approach (or system) best suited to one's needs. It also often becomes apparent that providing a benefit to one participant usually comes at a cost (sometimes to another participant). This is the key “bang for buck” equation. This can raise questions such as: to what extent can we trade the benefits of improved user experience with data and system provision costs?

4. CONCLUSIONS

We have briefly presented an evaluation method aiming at guiding researchers in evaluating their web-based information system, looking at benefits *and* costs for *all* participants. Our cost-benefit method provides the means to evaluate different approaches or systems to make an informed decision as to which costs we are willing to pay to obtain which benefits. Note that this type of evaluation can be done both for a new or an existing system, but also, for proposed components of a system, to decide, for example, whether it is worth implementing them or not. We believe that our method also enables the framing of research questions that may not be immediately obvious otherwise. The interested reader is referred to [3] and [4] for case studies of this method.

5. REFERENCES

- [1] Cornford, T, Doukidis, G.I. and Forster, D. (1994). Experience with a structure, process and outcome framework for evaluating an information system, *Omega, International Journal of Management Science*, 22(5):491-504.
- [2] DeLone, W. H. and McLean, E. R. (1992). Information Systems Success: The Quest for the Dependent Variable. In *Information Systems Research*, 3(1):60-96.
- [3] Paris, C., Colineau, N. and Wilkinson, R. Evaluating Web-Based Information Systems from a Cost-Benefit Perspective: A Case Study. CSIRO ICT Centre Technical Report 09/165. 2009.
- [4] Wu, M., Thom, J., Turpin, A., and Wilkinson, R., *Cost and Benefit Analysis of Mediated Enterprise Search*, Joint Conference on Digital Libraries, June 15-19, 2009, Austin, Texas.

Table 1. Cost-Benefit Assessment Method: identifying all participants, their benefits and costs

Participant	Information Seeker	Information Provider	Information Intermediaries	System Provider
Benefits	Task effectiveness Knowledge gained Accuracy of exploration Satisfaction	Audience reach Audience accuracy Message accuracy	<u>Resource builders:</u> Ease of knowledge creation & context modelling <u>Exploration partners:</u> Task effectiveness	System usage Reliability Response time Correctness
Costs	Time to complete task Cognitive load Learning time	Metadata provision Structured information Currency of Data	<u>Resource builders:</u> Time to create and integrate the resource <u>Exploration partners:</u> Time to capture contextual factors	Implementation hardware & software cost Syst. maintenance Syst. integration