Rajanen, M. (2003) *Usability Cost-Benefit Models – Different Approaches to Usability Benefit Analysis*. In proceedings of 26th Information Systems Research Seminar In Scandinavia (IRIS26), Haikko, Finland.

USABILITY COST-BENEFIT MODELS – DIFFERENT APPROACHES TO USABILITY BENEFIT ANALYSIS

Mikko Rajanen

Department of Information Processing Science, University of Oulu
mikko.rajanen@oulu.fi

Abstract

There are few development organizations that have integrated usability activities as an integral part of their product development projects. One reason for this is that the benefits of better usability are not visible for the management. In this paper the author analyses the characteristics of some published usability cost-benefit models. These models have different approach for identifying, approaching and categorizing the benefits of. All of the analysed models approach the usability benefits through a cost benefit estimation of user centred design, but none of the models document every of the three steps of cost-benefit analysis method. The author argues that none of the analysed models document the usability cost-benefit analysis method fully. The author also argues that none of the models identify the business type of development organization and developed product as a variable to be taken into account when analysing the benefits of better usability.

Keywords: usability benefits, cost-benefit models

Rajanen, M. (2003) *Usability Cost-Benefit Models – Different Approaches to Usability Benefit Analysis*. In proceedings of 26th Information Systems Research Seminar In Scandinavia (IRIS26), Haikko, Finland.

1. INTRODUCTION

The usability has many potential benefits to the development organization such as increased productivity and customer satisfaction. But even today there are quite few product development organizations reportedly having incorporated usability activities in their product development process. Bringing usability activities into product development life cycle has been a challenge since the beginning of usability activities over fifty years ago (Ohnemus 1996, 46). One reason for this is that the benefits of better usability are not easily identified or calculated. Usability engineering has been competing for resources against other project groups who do have objective cost-benefit data available for management review (Karat 1994).

The topic of this paper is to identify what kind of approaches do the usability cost-benefit analysis models have for estimating the benefits of better usability. This broad topic is approached through two research questions:

1. How do the usability cost-benefit models identify the benefits of better usability in four different categories: product development, marketing and sales, customer support and customer and end users?
2. How the steps of cost-benefit analysis method is identified and documented in usability cost-benefit models?

The cost-benefit analysis is a method of analysing projects for investment purposes (Karat 1994). The method has three steps and it proceeds as follows (Burrill and Ellsworth 1980):

1. Identify the financial value of expected project cost and benefit variables.
2. Analyse the relationship between expected costs and benefits using simple or sophisticated selection techniques.
3. Make the investment decision.

The development management is often seeing the usability activities as a potential risk to the deadline of their projects. It is difficult to implement the usability activities in development projects without the support of the business management. The management level support for usability activities in the development projects is only achieved if the benefits of better usability can be identified and calculated. In the usability cost-benefit analysis of the usability activities the expected costs (e.g., personnel costs) and the benefits (e.g., lower training costs) are identified and quantified (Karat 1994).

There are many published models for calculating the usability benefits and as many ways of identifying the benefits. Business benefit is a positive return that the development organisation expects to obtain is a result of the investment. There has been some discussion in publications about the potential business benefits of usability, but most of them are focused in case studies of usability benefits or overall aspect of usability cost-benefit analysis. In this research the author analysed the differences and characteristics between some of the published usability benefit models and their approach to usability business benefits.

Calculating the cost of better usability is fairly straightforward if the necessary usability tasks are identified (Mayhew and Mantei 1994). The actual cost of usability can be divided into initial costs and sustaining costs (Ehrlich and Rohn 1994). How the usability cost-benefit models identify and calculate the costs is not discussed in this paper.

2. OVERVIEW OF USABILITY COST-BENEFIT MODELS

There are surprisingly few published models for analysing the benefits of usability in development organizations. Most of the existing usability benefit models analysed in this paper were selected from the book Cost-Justifying Usability by Bias and Mayhew. This book was published in 1994, but it is still the best source of different usability cost-benefit models. The analysed models from Cost-Justifying Usability were selected into this report because the author feels that they represent the variety of different views for usability benefit analysis.

Bevan has published one usability benefit analyse model in TRUMP-report. The model was selected for this analysis because it was the latest published benefit model and it has slightly different point of view for different business benefits of usability. The model also estimates the potential usability benefits in four different product life cycles while other analysed models do not have that clear point of view about benefits in product life cycles.

2.1. Ehrlich and Rohn

Ehrlich and Rohn analyse the potential benefits of better usability from point of view of vendor company, corporate customer and end user. They state that by incorporating the usability activities into product development project both the company itself and its customers gain benefits from certain areas. When compared to other usability benefit models analysed in this paper, Ehrlich and Rohn present the most comprehensive discussion about different aspects of usability cost-benefits. They do not clearly present an overall formula for calculating the value of usability benefits.

According to Ehrlich and Rohn the vendor company can identify benefits from three areas:
1. Increased sales
2. Reduced support costs
3. Reduced development costs.

In some cases the link between better usability and increased sales can be found, but usually it can be difficult to relate the impact of better usability directly to increased sales. One way to identify the impact of usability to sales is to analyse how important role does the usability have in buying decision.

The cost of product support can be surprisingly high if there is a usability problem in important product feature and the product has lots of users. Better usability has direct impact to the need of product support and therefore great savings can be made through less need for support. By focusing for better product usability and using usability techniques the vendor company can cut development time and costs. The corporate customer can expect benefits when more usable product reduces time the end users need training. In addition of official training there are also hidden costs for peer-support. End users often seek help from their expert colleagues, who therefore suffer in productivity. It is estimated that this kind of hidden support cost for every PC is between $6.000 and $15.000 every year (Bulkeley 1992).

End users are the final recipients of more usable product. According to Ehrlich and Rohn the increased usability can result higher productivity, reduced learning time and greater work satisfaction for end user. The end-user can benefit from higher productivity when the most frequent tasks take less time.

2.2. Bevan

Bevan estimates the potential benefits of better usability to the organization during development, sales, use and support. The vendor can gain benefits in development, sales and support. Customer can benefit in use and support. When system is developed for in-house use the organization can identify benefits in development, use and support. In each category, there are a number of possible individual benefits where savings or increased revenue can be identified. The total amount of benefit from better usability can be calculated by adding all identified individual benefits together. Bevan discusses mainly about usability benefits through increased sales, less need for training and increased productivity. Benefits through decreased development time are identified but they are not discussed in detail.

2.3. Karat

Karat is approaching the usability benefits through cost-benefit calculation of human factors work. This viewpoint is different from other analysed usability benefit models. There are some examples of identified potential benefits. The benefits are identified as:

1. Increased sales
2. Increased user productivity
3. Decreased personnel cost through smaller staff turnover.

The development organization can gain benefits when better usability gives competitive edge and therefore increases product sales. Customer organization can gain benefits when end user productivity is increased through reduced task time and when better usability reduces staff turnover. Karat describes a usability cost-benefit analysis of three steps. In the first step all expected costs and benefits are identified and quantified. In the second step the costs and benefits are categorized as tangible and intangible. The intangible costs and benefits are not easily measured, so they are moved into separate list. The third step is to determine financial value for all tangible costs and benefits. Karat also links the usability cost-benefit analysis into business cases. Business cases provide an objective and explicit basis for making organisational investment decisions (Karat 1994).

2.4. Mayhew and Mantei

Mayhew and Mantei argue that cost-benefit analysis of usability is best made by focusing the attention on the benefits that are of most interest to the audience for the analysis. The relevant benefit categories for the target audience are then selected and benefits are estimated. Examples of relevant benefit categories are given for vendor company and internal development organization. Vendor company can benefit from:

1. Increased sales
2. Decreased customer support
3. Making fewer changes in late design life cycle
4. Reduced cost of providing training.

The benefits for internal development organization can be estimated from categories of increased user productivity, decreased user errors, decreased training costs, making fewer changes in late design life cycle and decreased user support. To estimate each benefit, a unit of measurement is chosen for the benefit. Then an assumption is made concerning the magnitude of the benefit for each unit of measurement. The number of units then multiplies estimated benefit per unit.

Rajanen, M. (2003) *Usability Cost-Benefit Models – Different Approaches to Usability Benefit Analysis*. In proceedings of 26th Information Systems Research Seminar In Scandinavia (IRIS26), Haikko, Finland.

3. THE CHARACTERISTICS OF USABILITY COST-BENEFIT MODELS

Every model is compared against benefit categories to identify different characteristics. The benefit categories are based on the categorization of cases from literature (Jokela and Rajanen 2002). These benefit categories are identified as:

1. Product development
2. Marketing and sales
3. Customer support
4. End users

3.1. Benefits for product development

Three different categories of usability benefits are identified in existing models: less need of resources, prioritisation of product features and less need of future redesign. By focusing for better product usability and using usability techniques the vendor company can cut development time and costs. There are reported anonymous cases where development time has been cut by 33 50% (Bosert, 1991), but there are no there identifiable cases where usability techniques did have apositive impact on development time (Jokela and Rajanen 2002). From the analysed existing usability benefit models, Ehrlic and Rohn, Bevan, and Mayhew and Mantei identify the need of fewer resources as one potential benefit. Resources can be development time or personnel to be used. Benefits of less late changes were also identified in this category. Available resources should be used in optimal way. Ehrlich and Rohn, and Bevan identify the ability to prioritise the functionality that is important for customers as one benefit. Only Bevan identifies the reduced need for architectural redesign to make future versions of product easier to use as a potential benefit.

Benefit category	Ehrlich & Rohn	Karat	Bevan	Mayhew & Mantei
Less need for resources	XX	-	X	XXX
Priorisation of product features	XX	-	X	-
Less need of future redesign	-	-	X	-

XXX = The benefit is identified and well documented
XX = There is some discussion about the benefit, no documentation
X = The benefit is identified
- = The benefit is not identified

It is interesting to notify that none of the analysed models have a different approach for estimating the benefits of better usability for product development when the product is tailored or mass produced. It can be argued that there may be some difference in estimating the benefits of better usability for product development when the product is tailored or mass produced. One research identified the user-centered design in a key role in differentiating products and human factors improvements (Harrison et al 1994, 223).

Rajanen, M. (2003) *Usability Cost-Benefit Models – Different Approaches to Usability Benefit Analysis*. In proceedings of 26th Information Systems Research Seminar In Scandinavia (IRIS26), Haikko, Finland.

3.2. Benefits for marketing and sales

Two categories of usability benefits are identified in marketing and sales of the product: gaining competitive edge and increased customer satisfaction. It is very difficult to estimate the impact of better usability to product sales. However, there are some reported cases, where link between better usability and increased sales can be identified (Jokela and Rajanen 2002). In one reported case, the revenues grew by 80% when the most serious usability problems were fixed in the second release of a product (Wixon, Jones, 1991). The poor usability may have serious effect for company reputation and market share especially when the market is tightly controlled (Mauro 1994, 136). Also the product development usability can speed up the market introduction and acceptance (Conklin, 1991). The benefits of gaining competitive edge by marketing the product easier to use than other products is analysed in all models. Increased customer satisfaction can result more repeat customers and therefore increased sales. Ehrlich & Rohn and Bevan identify the benefits of customer satisfaction.

Benefit category	Ehrlich & Rohn	Karat	Bevan	Mayhew & Mantei
Gaining competitive edge	XX	XX	XX	XX
Increased customer satisfaction	XX	-	XX	-

XXX = The benefit is identified and well documented
XX = There is some discussion about the benefit, no documentation
X = The benefit is identified
- = The benefit is not identified

It is interesting to notify that none of the analysed models have a different approach for estimating the benefits of better usability for sales when the product is marketed as business to business or business to consumer product. It can be argued that there may be some difference in estimating the benefits of better usability for business to business or business to consumer product.

3.3. Benefits for customer support

There are two categories of usability benefits in support of the product: reduced cost of product support and less need for end user training. The difference between training for usability-engineered system and a system designed without usability engineering can be even several days (Karat, 1993). Training the end user includes official training conducted by development organization or customer organization and unofficial training by skilled peers. Ehrlich and Rohn, Bevan, and Mayhew and Mantei identify reduced cost of product support and less need for end user training through better usability as a potential benefits but those benefits are not documented further.

Benefit category	Ehrlich & Rohn	Karat	Bevan	Mayhew & Mantei
Reduced cost of product support	XX	X	XX	XX
Less need for end user training	X	-	XX	XX

XXX = The benefit is identified and well documented
XX = There is some discussion about the benefit, no documentation
X = The benefit is identified
- = The benefit is not identified

None of the analysed models have a different approach for estimating the benefits of better usability for customer support when the product is product is tailored for a particular customer or when the product is mass produced as a off the shelf product. It can be argued that there may be some difference in estimating the benefits of better usability for tailored and mass produced product. For example the development organization is much more likely to provide for users of the tailored product than when the product is sold in shrink-wrap off the shelf. It can also be argued that estimating the benefits of better usability is somewhat different when the customer is internal in development organization or when the support is part of the business of the development organization.

3.4. Benefits for customer and end users

Two categories of usability benefits are identified during products use: increased productivity and less need for support. The end user can benefit from higher productivity when the most frequent tasks take less time. It is estimated that productivity within the service sector would rise 4-9% annually if every product were designed for usability (Landauer, 1995). This benefit is also most identified in literature (Jokela and Rajanen 2002). Productivity is increased when using more usable products by decreased task time, less rework and greater work satisfaction. All models identify the increased productivity as one benefit. Some savings can be made if there is less need for active product support in development or customer organization. All models except Karat identify the less need for product support as a potential benefit. One possible sub-benefit could be the indirect effect of better usability when better usability in mission critical system reduces problems in other systems using it. The analysed models do not identify such benefit.

Benefit category	Ehrlich & Rohn	Karat	Bevan	Mayhew & Mantei
Increased productivity	X	XX	XX	XX
Less need for support	XX	-	X	XX
XXX = The benefit is identified and well documented XX = There is some discussion about the benefit, no documentation X = The benefit is identified - = The benefit is not identified				

3.5. Summary

Mayhew & Mantei have many example formulas for calculating usability benefits, but there is little discussion about the basis of how those formulas are formed. Only Karat does link the usability benefit analysis into organisational business cases. The benefit models do not separate the benefits to development organisation and development project.

There are some differences in the analysed existing models about who does conduct the usability cost-benefit analysis (Rajanen 2002). In some of the models it is clearly stated that usability person does the analysis, but Bevan, and Mayhew and Mantei do not bring that subject up at all. There is also variation in the target group of the usability cost-benefit analysis. Bevan mentions the development team as a receiver of the analysis. Karat, and Mayhew and Mantei state that the usability cost-benefit analysis is made for the management of the development organisation. Ehrlich and Rohn bring up both development team and management as possible target groups. The author therefore argues that it is important that the target group of the usability benefit

analysis is the management and therefore get the managerial support for usability activities in the development project.

All models have a cost-benefit analysis approach for usability benefits. None of the analysed models identify when the usability benefit analysis should be conducted in the product development project, who conducts the analysis and who is the target group of the analysis.

4. CONCLUSIONS AND DISCUSSION

The analysed models have a slightly different approach for identifying, categorizing and assessing the benefits of usability. Therefore it can be assumed that they are build from different basis and that they are made to fit different specific purposes (Rajanen 2002). Models also have differences in who does the usability benefit analysis and what is the target group of the analysis (Rajanen 2002).

All models addressed the increased sales of more usable product as one of the benefits but none of the models separate the benefits between business to business and business to consumer product. Only Ehrlich & Rohn and Bevan include the increased customer satisfaction as a potential business benefit. From all analysed models, only Bevan identifies the savings from reduced cost of future redesign of the architecture to fix usability problems for future versions of the product. None of the analysed models identified the easier tailoring of the product through human-centered design as a potential benefit.

The all analysed models approach the usability benefits through some sort of cost-benefit analysis. The identified benefits of better usability are put against estimated costs of usability activities. Every model analyse the costs and benefits of using the user centered design and not the over all benefits of better usability of the product. Some of the analysed models identified the three steps of cost-benefit analysis method (Burrill and Ellsworth 1980):

1. Identify the financial value of expected project cost and benefit variables.
2. Analyse the relationship between expected costs and benefits using simple or sophisticated selection techniques.
3. Make the investment decision.

None of the analysed models documented all of the three steps of cost-benefit analysis method fully. Most of the analysed usability cost-benefit models did not identify and document all the variables to be taken into account in the third step when making the investment decision. Therefore none of the analysed usability benefit models cover all identified areas of cost-benefit analysis of better usability. Also none of the analysed models identify and document the business type of product development organization as one of the variables to be taken into account when making the investment decision about usability activities.

Analysing the business benefits of better usability is not an easy task. Some of the potential benefits can be estimated quite easily. For example the benefit from less need of product support is rather straightforward to calculate. Some of the potential benefit areas are however quite abstract and therefore it is difficult to estimate those benefits. For example it is very difficult to estimate what impact better usability has on improved company reputation even when it is clear that poor usability hurts company reputation (Mauro 1994, 136)

Some of the existing models analyse the benefits of better usability also from the end user viewpoint. The potential benefits for end users are much more difficult to calculate than benefits

for development or customer organizations. Also the potential benefit areas for end users are harder to assess economically. Even when there is a link between poor usability and higher rates of absenteeism, less job satisfaction and increased turnover (Schneider 1985). Some of the analysed models include the increased work productivity as a benefit for end user. It can be argued that the benefits from increased productivity can be calculated more easily from the viewpoint of the customer organization.

In some existing usability benefit models the viewpoint for benefits are from point of view of a starting development project. This approach does seem to be a bit problematic because some of the potential benefits are clearly directed to whole organization and it may not be very usable to estimate those benefits from point of view of a development project. For example it is not very important to reduce support costs for a development project because they are not directly effected by the cost of product support. When the potential usability benefits are analysed from organizational point of view and the business type of the development organization is identified as a necessary variable in usability cost-benefit analysis, all possible benefits can be fully taken into account.

4.1. Limitations

There are some limitations to be taken into account when making conclusions about this report. First, the usability models were analysed on the basis of product development project. The type of the product and the nature of the business around the product may have effect for the areas of important usability benefits. These factors were not taken into account in this report when analysing characteristics of the existing models.

Second, one important function of the usability benefit analysis is to gain management support for usability activities in development projects. This function was not included into this analysis.

4.2. New research topics

There are some new research topics that we found during our research. First, one very interesting challenge is to identify the indirect effect of better usability when better usability in mission critical system reduces problems in other systems using it. The analysed models do not identify such benefits, but when author discussed with representatives of various development organizations it was clear that this kind of benefit could be identified in many cases.

Second, another interesting area of future research is to find formulas to measure the impact of better usability to development time and resources. The reduction of development time through better usability is reported in some case studies, but the analysed usability benefit models did not brought up any clear formula for calculating that impact.

Third, the existing models do not take into account that the product support can be important part of the business of the development organization. If the development organization can gain profit by providing product support for end users, the benefit of better usability in product support area is not that straightforward. The published literature does not contain example cases where the product support is part of the business of the development organization.

Fourth, the best time and conductor for the business benefit analysis are not quite clear. The analysis should be conducted before or during the early phases of the development project, because later it is difficult to include the usability activities into already running project. The analysis can be conducted either by a usability person, project member or organizational

management. Each of them has a slightly different interest about usability and that can have some effect in the results. It can be argued that the best effect for introducing usability activities in development project is achieved when requirements about better usability are handed down to development project by an organizational management.

5. REFERENCES

Bevan, N. "Cost Benefit Analysis" TRUMP report, September 2000.

Bosert, J. "Quality Functional Deployment: A Practitioner's Approach." ASQC Quality Press. New York. 1991.

Bulkeley, W. M. "Study finds hidden costs of computing." The Wall Street Journal, 2 Nov. 1992.

Burrill, C. and Ellsworth, L. "Modernm Project Management: Foundations for Quality and Productivity." Burrill-Ellsworth, New Jersey. 1980. pp 209-223.

Conklin, P. "Bringing Usability Effectively into Product Development." In Human Computer Interface Design: Success Cases, Emerging Methods, and Real-World Context. Boulder, Co., July 24-26. 1991. pp 367-385.

Ehrlich, K., Rohn, J. "Cost Justification of Usability Engineering: A Vendor's Perspective." In Bias, R., Mayhew, D. Cost-Justifying Usability. Academic Press. 1994. pp 73-110.

Harrison, M., Henneman, R. and Blatt L. "Design of a Human Factors Cost-Justification Tool." In Bias, R., Mayhew, D. Cost-Justifying Usability. Academic Press. 1994.

Jokela, T., Rajanen, M. "Usability Business Benefits – literature review 2, v0.2," KESSU Project Report, University of Oulu, Oulu, Finland. 2002

Karat, C-M. "Cost benefit and business case analysis of usability engineering." Tutorial presented at the ACM SIGCHI Conference on Human Factors in Computing Systems. New Orleans, LA, April 28-May 2. 1993.

Karat, C-M. "A Business Case Approach to Usability Cost Justification." In Bias, R., Mayhew, D. Cost-Justifying Usability. Academic Press. 1994. pp 45-70.

Landauer, T. "The Trouble With Computers," MIT Press. 1995.

Mauro, C. "Cost-Justifying Usability in a Contractor Company." In Bias, R., Mayhew, D. Cost-Justifying Usability. Academic Press. 1994. pp 123-142.

Mayhew, D., Mantei, M. "A Basic Framework for Cost-Justifying Usability Engineering." In Bias, R., Mayhew, D. Cost-Justifying Usability. Academic Press. 1994. pp 9-43.

Ohnemus, K. "Incorporating Human Factors in the System Development Life Cycle : Marketing and Management Approaches. IPCC96. 1996.

Rajanen, M. "Assessing the Business Benefits of Usability in the Product Development Project - Analysing the Existing Models." In proceedings of 25th Information Systems Research Seminar In Scandinavia (IRIS25), Bautahøj, Denmark. 2002.

Rajanen, M. (2003) *Usability Cost-Benefit Models – Different Approaches to Usability Benefit Analysis*. In proceedings of 26th Information Systems Research Seminar In Scandinavia (IRIS26), Haikko, Finland.

Schneider, M. F. "Why ergonomics can no longer be ignored." Office Administration and Automation 46(7), 1985. Pp 26-29.

Wixon, D., Jones, S. "Usability for fun and profit: A case study of the design of DEC RALLY version 2. " Internal report, Digital Equipment Corporation. 1991.