

ECONOMIC EVALUATION OF USABILITY OF PUBLIC ADMINISTRATION INFORMATION SYSTEMS

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Abstract: *In this paper an impact of usability engineering to software development life-cycle is discussed and a basic framework for economic evaluation of usability application to public administration information systems is developed. The suggested model considers particularities of this type of information system that are more discussed as well. As the most important variables the cost of usability and revenue of usability is identified and the impact of these variables to suggested model is analyzed and the concrete cases are figured.*

Keywords: *Usability, usability engineering. software quality, information systems, public administration.*

1. Introduction

There was not always accent on user's requirements on user interface and the end user was not always a center of software development in the history. Other functions were preferred, for example functionality, security and so on. Usability in the form of web-accessibility was discussed only in the case of access to public sources, because all users including anywise disabled users have right to public administration data [26], [27]. The reason was that users had not choice, because usually there was not software the users could compare to. But with increasing number of users, competitive software producers and growing software complexity the new fields occurred. These fields were known under names like computer-human interaction (CHI), human-computer interaction (HCI), user centered design (UCD), human factors (HF), ergonomics, etc. [20].

As a usability as one of quality aspects of software has become extraordinary important in today's informational age a new engineering discipline has emerged – usability engineering (in some papers called “Scenario Design” [28]). Usability engineering has become of fundamental part of software engineering [20]. The main goal of usability engineering is to construct computer systems that will be usable and used [22].

One of present definitions of usability defines usability as the extent to which users can use a computer system to achieve specified goals effectively and efficiently while promoting feelings of satisfaction in a given context of use [11]. Usability is traditionally associated with these five usability attributes found in [1], [20]: learnability, efficiency, memorability, satisfaction and errors.

Nowadays, usability engineering disposes of a lot of methods for acquiring relevant data, data analysis and conclusions drawing. The examples of these methods are cognitive walkthrough [16], pluralistic usability walkthrough [2], heuristic evaluation [18], [19], user testing [6], teaching method [29] etc. Unfortunately the mainstream of research in usability engineering is oriented to common commercial software (both desktop application and websites) and not to complex public administration information systems, mobile devices, cartographic tools [25] and other types of software. Some studies are focused on specialized software, e.g. geographic information systems [14], [15].

2. Problem Formulation

In reality an usability engineering is competing for resources against other project groups who do have objective cost-benefit data analysis available for managers that are responsible for resources allocation [13]. There is a general cost-benefit method formulated in [5]. This method consists of three basic steps that proceed as follows:

1. Identification of financial value of expected project cost and benefits variables.
2. Analyzing of relationship between expected costs and benefits.
3. Investment decision making.

In the recent time some cost-benefit models related to usability has emerged (e.g. [8], [13]). The main lack of these models is that they consider the common commercial software as desktop applications and websites only. However the author is convicted the variables that must be taken into account when the model of economic contribution of usability is developed are the business type of organization and the type of developed product. The sphere of public administration is certainly quite different from a commercial sphere.

The next lack of these models is that they were created with accent on development savings or on increasing of sale takings. But usability can be thought as an investment of customers. A customer can make a decision whether to buy cheaper software or more usability one.

Because in author's knowledge there is not work reported to with consideration of some different aspects of information systems of public administration (ISPA), the aim of this paper is to suggest a model for economic evaluation of usability of public administration information systems.

3. Model Formulation

3.1 *The crucial variables of model*

Different methods for evaluation of invesrment efficiency exists, for example:

- Net Present Value of Investment (NPV) [9],
- Internal Rate of Return (IRR) [9],
- Payback Metod [5],
- Return on Investment (ROI) [9].

In these methods except discount rate and number of project years, two crucial variables occur – the cost of investment and the revenue of investment. Both variables are different at the different stages of product life-cycle. For the reasons diskussed above these variables will be analysed at IPSA introduction and daily use only.

3.2 *The cost of usability investment*

From an investment point of view we can distinguish two basic situations:

1. The institution is deciding whether invest in a cheaper information system or invest in a more usability and more costly one.
2. The institution is deciding whether keep an implemented information system or substitute it by information system that is more usability.

In the first situation the cost of usability can by calculated by Eq. 1. Eq. 2 corresponds to the second situation.

$$C_{UI}^1 = C_A - C_N \quad (\text{Eq. 1})$$

where

C_{UI}^1 cost of usability investment when deciding between two information systems

C_A cost of information system in that usability engineering was applied

C_N cost of information system in that usability engineering was not applied

$$C_{UI}^2 = C_A \quad (\text{Eq. 2})$$

where

C_{UI}^1 cost of usability investment when deciding if change information system for more usability one

C_A cost of information system in that usability engineering was applied

Both C_A and C_N consist of acquisition costs, maintenance costs and other indirect cost. Sure, these equations are simple ones and Eq. 2 does not consider possibility of selling of the old superfluous ISPA. But ISPA represent products that are usually tailored and not mass-produced. Next Eq. 2 does not consider time-license instead of unlimited license. It is clear from Eq. 1 and Eq. 2 that $C_{UI}^1 \leq C_{UI}^2$ if $C_N \geq 0$. It results in general rule that it is economically more effective to get better information system immediately.

3.3 The revenue of usability investment

In cost-benefit model defined in [8] the potential revenues of better usability are analyzed from the point of the views of vendor company, corporate customer and end user. In our model the vendor company would be external or internal software supplier, the corporate customers would be public administration institutes and end users would be both employees of these institutes (internal users) and residents (external users).

The revenue for supplier is detailed discussed in [8]. Because we are creating a model from a buyer point of view it is not necessary to discuss this category of revenue. Customer is not interested in supplier's revenue but in the cost of usability investment that was analyzed formerly.

The important difference of public administration is that the business objective of public administration institutes is not revenue. Public administration institutes offer public services that can be thought as a form of a public property. It means a public administration institute has not customers in the original meaning. Therefore it is not effective to separate the benefits into corporate customer and end user categories. For this analysis the dividing into internal and external environment occurs as more reasonable. The internal environment will be formed by public administration staff interaction with ISPA. The external environment will be formed by denizen interaction with ISPA. Next, the overall revenue can be divided into two categories – expenses reduction and benefit increase. These components of usability investment revenue are depicted in Tab. 1.

Tab. 1: The components of usability investment revenue

	Internal environment	External environment
Expenses reduction	R_{EI}	R_{EE}
Benefit increase	R_{BI}	R_{BE}

Afterwards, the revenue of usability investment can be calculated by Eq. 1.

$$R_{UI} = R_{EI} + R_{EE} + R_{BI} + R_{BE} \quad (\text{Eq. 1})$$

where

R_{UI} Revenue of usability investment

R_{EI} Expense reduction in internal environment of ISPA

R_{EE} Expense reduction in external environment of ISPA

R_{BI} Benefit increase in internal environment of ISPA

R_{BE} Benefit increase in external environment of ISPA

Different expenses reductions and benefit increase can result from usability engineering activities. Some of them are listed in [17] but not all of listed items suit to ISPA. For example an increasing of purchases does not suit, because public administration does not sell any product, but offer public service. Next example is increasing of market share (competitive edge) that cannot be used as well because public administration does not have any competitor in original meaning. Therefore it is necessary to select from existing business case studies and research works adequate components of revenue of usability investment in ISPA and to suggest the own ones if some aspects are not published so far.

Expenses reduction in internal environment of public administration:

- Reduction of user errors, increase success rate – every user error costs organization money.
- Reduction of the number of employee as the result of productivity (time to complete a task) increasing – one study estimates that any investment in making an intranet easier to use can pay off by a factor 10 or more, especially at large companies [12].
- Reduction of qualified staff – well designed ISPA can be used less qualified staff.
- Reduction of training cost – training cost consists of instructors cost and time of trained staff.
- Decrease support cost – Organizations have both direct and indirect costs. These can be tracked both in technical support an in the hidden cost of coworkers helping each

other. In one study it is estimated that this extra cost is between \$6,000 and \$15,000 every year for every computer [4]. Usability improvements can reduce this cost.

- Decrease job turnover – survey [24] showed that less job satisfaction can result in increased turnover. In [23] there are cited data illustrating that total cost of employee turnover is 1.5 times an employee's annual salary.

Benefit increase in internal environment of public administration:

- Increase of learning – quicker learning curve results in quicker productivity increase.
- Security increase – usability tends to minimization of user errors that can result in security risk for whole information system.
- Increase efficiency of decision processes - ISPA can serve as support at predicaments. Wrong decision can have losses on lives.

Expenses reduction in external environment of public administration:

- Reduction of user errors, increase success rate – in one study of 15 large commercial sites users could only find information 42 % of the time. The websites of public administration present some amount of information as well [21]. Next, wrong filled up a tax return can lead to next superfluous activity.
- Decrease support costs – well designed electronic forms do not need calls to an office.
- Decrease cost of traditional customer service channels – website has relatively low operating costs compared with more traditional channels for service distribution.

Benefit increase in external environment of public administration:

- More leisure time as a result of productivity increasing – Users can save a time they would spend on non-usability user interface.
- Increase user satisfaction – in one study usability engineering methods raised user satisfaction ratings for a system by 40 % [10].
- Increase trust in system – Stanford University's Web Credibility Project showed that "ease of use" was the second highest factor contributing to a customer's overall perception of credible Web site [3]. If the user will trust in system he will use this system effectively. For example a lot of people do not trust in electronic tax return and therefore they visit offices.
- Increase trust in public administration – One study clearly showed that user's trust concerns can significantly be alleviated by providing relevant information when and where users need it [7].
- Learning increase – it is not easily possible to train external users. Besides, the external users do not often consume the same services of public administration. External end users are not readily accessible, and may not be known at all. Therefore external user interface must be extremely intuitive.
- Security increase – usability tends to minimization of user errors that can result in security risk for whole information system.

4. Conclusion

Economic evaluation of usability activities is important for two reasons, for demonstration of importance of usability engineering (for the cases when an organization has not integrated usability in its development process) and for effective usability engineering program planning (for the cases when an organization is mature in the sense of implementing of usability engineering).

In this paper, the basic framework for economic evaluation of public administration information systems was developed. The suggested framework considers variations of common commercial software and information systems of public administration. For that reason some expenses reductions and benefit increases that are specific for this type of information systems are discussed. Some of them are clearly tangible, but some of them are intangible.

When conducting economic analysis it is necessary to consider that the main objective of public administration institutes is not a revenue but offering of quality public services. Therefore it is necessary to consider intangible benefits as well. For example increase trust in public administration can lead to rising standard of living of inhabitant and it can results in social repose. The next aspect of ISPA is that it does not consist of computers only, but also of personnel, other types of communication channels, printed forms, analogue maps and so on. Therefore it is necessary to consider an investing in usability of these other parts of ISPA.

Although the framework for economic evaluation of usability of ISPA is developed, the next work is necessary. At this moment there do not exist any business cases in this field. The business cases that exist consider the common commercial software only and cannot be used for ISPAs. Author expects some business cases for ISPAs will occur in a future and they will be used for concretizing of variables of suggested model.

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