

Modern Approaches and Methods to Evaluate Effectiveness of Information Systems

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ABSTRACT

This article reviews the issues involved in the evaluation of the business benefits of information systems (IS). Due to the prevalent use of IS in modern organizations nowadays, evaluation research in this field is becoming more and more important. It focuses on the use of some modern methods of the evaluation and appraisal of IS benefits. Moreover, different types of IS and different focusing perspectives of the evaluation require the selection and use of different evaluation approaches and methodologies. Evaluation of the business benefits is inherently problematic and why it is not usually possible to quantify those benefits in single, monetary terms. It then focuses on the evaluation of the business benefits itself and in particular on two main issues: how to identify the benefits in the first place and how to deal with the issue of intangible benefits.

Keywords

Information technology, information systems evaluation, investments, methodology

1. INTRODUCTION

The integration of Information Systems (IS) in organizations is certainly has a positive impact both on the organization's overall management and performance enhancement, but these investments are not always worthwhile because such kind of systems are very expensive. According to the experts' estimations, only 50% of companies could return the money spent for such systems' integration. The situation is getting complicated by the fact that to estimate the effectiveness of IS integration is problematic in itself. Meantime, there are a number of different approaches and methods for the evaluation of the IS integration and operation that allow to assess the intangible benefits, establish a real and measurable relationship between technology and strategy, as well as quantify risks.

2. APPROACHES AND METHODOLOGIES

The common approaches and methods of IS integration effectiveness evaluation are divided into four main groups and are given below (see Figure 1).

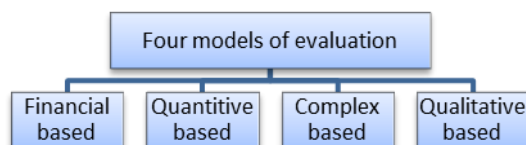


Figure 1. Four models of IS evaluation

As a rule the primary criterion of any economic activity is financial metrics, which also applies to the evaluation of information systems integration and operation efficiency. The **financial group** includes the following common methods of evaluating the IS's efficiency.

a) **Cash flow analysis methods** are the most frequently used methods for evaluating the IS's integration efficiency because they are clear both for company directors and IT managers. Cash flow analysis methods are Net Present Value (NPV), Internal Rate of Return (IRR), Return on Investments (ROI). It should be noted that to get NPV and IRR real metrics it is very important to have an appropriate discount rate which is calculated based on the alternative expenses and cost of capital usage ratio analysis, taking into account the risks. In practice this rate is defined by the experts who are well oriented in business environment [1]. ROI is the most popular method of evaluating the economic efficiency. ROI shows the ratio between the net profit and the investment volume. ROI metric is usually compared with the capital price metric, while the cost of capital stated for the organization may be different for various IS.

Economic Value Added (EVA) is another important financial metric used for evaluating the IS's integration and operation efficiency authored by the economist Stern Stewart based on the residual income concept by Alfred Marshall. EVA is calculated using the following formula:

$$EVA = NOPAC - WACC * CE$$

where NOPAC (Net operating profit after tax) is net profit after tax, WACC (Weighted Average Cost of Capital) is the average value of the cost of capital or the minimum rate of profit that investors are waiting for their investments, and CE (Capital Employed): EVA shows the company market-value and the evaluation of the company efficiency through its market valuation. Though Stern Stewart was not limited with the identifying new metrics, he also developed a new system called "EVA-management". If we consider the usage of this system from the perspective of exploiting IS, the directors, including IT managers, have to "pay" for that system just like they pay salaries to their employees. The fee for the capital usage provides the complete knowledge of information technology arguing that the business units will carry and use the assets more effectively by reducing the costs.

b) **Cost calculation methods** are another set of methods belonging to IS's evaluation financial group. Two approaches that often used for calculation of expenses spent on IT processes are considered here: Activity based Costing (ABC) and Total Cost of Ownership (TCO).

Activity based Costing (ABC) method is mainly used in managerial accounting. ABC method considers IT project as a sequence of separate tasks and allows managers to evaluate the project's tasks on a standalone basis and optimize them to increase the economic efficiency of the project. The disadvantage of the method is the high cost of building the primary model, which requires a huge work capacity.

Total Cost of Ownership (TCO) method is mainly used when it is necessary to buy a new IS or reorganize the used one. For the organization, the selection and purchase of IS depend on a number of criteria, the primary one being the

price. The price, in addition to the provider's reputation, the system's functionality and technical ability, is an important criterion for choosing IS. For this reason it is important to calculate the TCO, which essentially differs from the system's initial price (e.g., staff education and trainings may cost more than 60%) [2]. TCO is the expenses calculation methodology for all phases of the IS's operation lifecycle. This method is also called an IS lifecycle cost calculation method. The disadvantages of the TCO method are the lack of connection in unreasonable changes of money value over time, the lack of risk impact calculation, big labor and inaccuracy in forecasting indicators, mainly, in terms of indirect expenses.

Quantitative methods of IS evaluation

The most common quantitative methods to evaluate the effectiveness of IS are Applied Information Economics (AIE) and Real Options Valuations (ROV) methods.

a) Applied Information Economics (AIE) method is used for the analysis of intangible assets such as the level of customer satisfaction, service quality, and staff attitude. Thus, using the asset management portfolio theory and statistical methods, the value of information is calculated. This model is built based on uncertainty assessment methods and risk assessment information [3].

b) Real Options Valuations (ROV) method allows to the use financial options theory to evaluate management the flexibility under uncertainty. The traditional methods of IS evaluation (e.g., NPV) do not allow accurately evaluating the return on investment under uncertainty or in a rapidly changing environment. While estimating the project cost, the ROV takes into account the probability of random processes and their impact on the project. ROV includes five real options:

- delays
- investing in several stages
- changes in products and production
- leaving the project
- scope of changes

ROV can be calculated using the Black–Scholes formula or other alternative methods.

Complex methods of IS evaluation

The complex methods to evaluate the effectiveness of IS are Total Value of Opportunity (TVO), Total Economic Impact (TEI) and Rapid Economic Justification (REJ) methods:

a) Total value of opportunity (TVO) is a Gartner methodology for determining the overall business value expected to be created by IT-enabled business initiative. TVO is a quantitative and qualitative value methodology that applies a standard set of thought-leading concepts and models to answer the questions about a potential IT investment. It focuses on risk assessment and quantitative evaluation of every risk's flexibility. TVO is built based on the following four factors [4]:

1. Cost/benefit analysis (CBA)
2. Future uncertainty
3. Organizational diagnostics
4. Bets practice of measurement

TVO assumes that cost/benefit analyses capture most of the value in process improvement and renewal projects. TVO can be used as a rigorous methodology to quantify the value in these cases. Experiments and transformational projects require deeper analysis into strategic alignment, risk and future value estimations.

How We Take Into Account Future Uncertainty. A complete analysis must include the analysis of risk and time elements. In addition, the risk of the original investment can be roughly modeled by determining the proper cost of capital calculations for financial analysis. TVO incorporates a qualitative risk analysis as part of the five pillars methodology, and provides a real option approach to future value. Organizational diagnostic is a heart of TVO methodology which verifies the organization's ability to adapt to changes. There are three types of risks associated with these changes, and they need to be assessed. Business risk assesses the possibility that business or market conditions will change in ways that affect the value delivered from this initiative. Technology risk assesses the possibility that the technical, vendor, support or price expectations underlying the initiative will change during the initiative. Management risk assesses changes to culture, process or governance that affect the value delivered by this initiative. Gartner's standard TVO methodology includes what we believe are the "best practices" — applied methodologies for each of the value questions. These components of TVO allow for a complete view of an IT-enabled business initiative, from the capability inherent in the solution, based on a technology perspective, to the ability of an organization to convert that capability into business value.

b) Total Economic Impact (TEI) is one of the modern methods to evaluate the IT economic impact, developed by Forrester Company and aims to calculate the business value of IT project or IT solution [5]. While analyzing the IT projects, the TEI method uses three main factors: costs, benefits and flexibility. The flexibility is relating to the delayed or potential benefits that can be brought to the project and which are not measured by "cost-benefit" analysis. This method is more suitable for projects comparison (develop or buy software apps).

b) Rapid Economic Justification (REJ) is another modern commercial method of IS evaluation developed by Microsoft. As seen from the title, the goal of the method is to justify the need for IT investments using financial metrics. The method aims to justify investments in a language clear both to customer and IT professionals [6]. The method has a number of disadvantages, like focusing only on financial metrics and lack of infrastructure and strategic benefits.

Qualitative methods of IS evaluation

The qualitative methods to evaluate the effectiveness of IS are Balanced Score Card (BSC), IT scorecard and Information Economics (IE):

a) Balanced Score Card (BSC) method is developed in 1980 by Robert Kaplan and David Norton to create a new approach for organizations strategic management [7]. This methodology is based on identifying the cause-and-effect relationship factors of achieving strategic goals and expected results. BSC focuses on the effectiveness of non-financial metrics, the company's traditional financial metrics are "balanced" with evaluation hard to measure digital aspects like innovative potential of the company, employees' satisfaction level, used applications' productivity, etc. BSC allows to connect enterprise strategy and Key Performance Indicators (KPI).

b) IT scorecard method is created because of BSC idea development. This approach includes four key indicators:

- business development
- service quality improving

- decision-making quality of improving
- labor productivity growth

In every group the efficiency goals and activity main factors estimated by IT initiatives and projects are defined in [8]. BSC indicators applying for IT are described in the following diagram

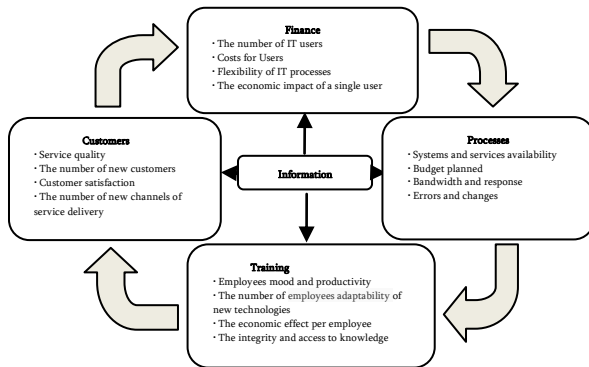


Figure 2. BSC indicators applying for IT

The disadvantages of this model, as in case of BSC indicators, are the same and require a well-designed business strategy, which is presented in the form of objectives and measurable metrics.

a) Information Economics (IE)

IE is the combination of IS evaluation financial and non-financial metrics. Overall it is based on traditional ROI financial metrics adding such features that cannot be measured financially. In terms of this model IT value for business can be described with 10 criteria showed in Figure 3 [9].

Return on investment	Alignment with strategy	Competitive advantage/need	Necessity (legal, organ.)	Reduces operational risks
Support management	Project and organiz. risks	Support future information architecture	Technical uncertainty	Functional uncertainty

Figure 3. Information Economics 10 criteria

According to this method each IT project should be evaluated by the above mentioned criteria from 0 to 5. The final score is summarized removing the risks, and the total result allows to compare IT projects. The disadvantage of this method is the focusing on the IT projects comparison.

3. CONCLUSION

IS are classified as strategy projects, therefore they are designed for longer periods and aimed to fulfill the organization's business strategy. The study of the above-mentioned methods allows us to come to the conclusion that there is no such method or formula that will make sure that this particular system is suitable for the organization, and the investment will bring the expected results. However, according to information systems' usage experience, the most popular are financial and qualitative methods, and the TEI method is also used by IT consultants for system evaluation to decide develop, order or purchase. It is worth mentioning that in recent years due to BSC development there is significant experience in IS management and evaluation using the BSC model.

REFERENCES

- [1] C.Walsh, "Key management ratios. The clearest guide to the critical numbers that drive your business", fourth edition, Companion Group, 2008, p. 257
- [2] Mayor, Tracy. "A Buyer's Guide to IT Value Methodologies." *CIO Magazine*, July 2002
- [3] Hubbard Decision research, "Applied Information Economics. A Powerful Method for Quantifying IT Value", 2014, p.5
- [4] A.L Apfel, "TVO Methodology: Valuing IT Investments via the Gartner Business Performance Framework", Gartner Research, 2003. – p. 6
- [5] C. Gliedman, "The Total Economic Impact Methodology: A Foundation for Sound Technology Investments" Forrester, 2008, p. 7
- [6] Microsoft REJ Framework: "Step by step Quantifying the Business Value of Information Technology (IT) Investments", Microsoft Corporation, 2003, p. 3
- [7] R.S.Kaplan, D.P.Norton, "The balanced scorecard Translating Strategy into Action", Harvard Business School Press, "Olymp-Business", Moscow, 2014, p.25
- [8] G.J.McFarlane, "IT and the Balanced Scorecard", *Computerworld*, 2000, № 42
- [9] Grembergen W.V," Enterprise governance of information technology: achieving strategic alignment and value", Springer, 2009, p. 48-49