Evaluation methods' matrix – a tool for customized IT investment evaluation

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Abstract:

This paper assesses the evaluation methods commonly cited in IT literature to test their suitability for complex, business-oriented evaluation of IT initiative. This assessment ends with the conclusion that for an in-depth evaluation, a set of methods should be used instead of just one. Furthermore, the analysis of different factors determining the choice of evaluation methods is also made. It is followed by a summary of all the factors determining the overall evaluation strategy, as well as specific evaluation techniques to be used in the IT initiative evaluation process. The initial design of a methods' matrix as a tool to help in the formulation of a customized IT evaluation methodology is presented at the end. The matrix relates the afore mentioned factors to the specific evaluation methods and techniques. By determining the factors relevant to the specific IT initiative, one can design a customized evaluation methodology suitable for that IT project.

Keywords:

IT investment evaluation, IT evaluation methods' matrix, customized evaluation approach

1. Introduction

IT literature describes many methods, tools and techniques for evaluating IT initiatives. They differ in the IT initiative aspects that are taken into account, benefit and cost representation and measurement and methodological approach to the evaluation process. The large number of methods available suggests that seeking the one that is objectively best is ineffective. The selection of the method or methods relevant to the specific IT initiative in the specific organizational environment is considered to be a big problem (Remenyi et. al. 2000). Many authors suggest that a set of methods should be used instead of one, to assess the IT project from different perspectives (Deschoolmeester et. al., 2004; Remenyi and Sherwood-Smith, 1997; Irani 2002). This paper presents a work-in-progress study of the factors determining the selection of evaluation methods, and the initial design of a tool to help in the selection process.

2. Assessment of existing IT evaluation methods

The aim of this section is to analyze the existing IT evaluation methods commonly cited in IT literature to test their usability for an holistic evaluation of IT investment from a business perspective.

T. Renkema and E. Berghout (1997: 3) divide IT investment evaluation methods into four categories:

- financial methods,
- multi-criteria methods,
- ratio methods,
- portfolio methods.

Literature analysis leads to the conclusion that the above mentioned classification is not complete, as it does not include strategic analysis (except Portfolio Analysis) nor probabilistic methods. It is also disputable whether or not separate ratio methods group should be distinguished, as ratios of different kinds are present in many methods from other categories. T. Mayor (2002) divides evaluation methods into three main groups:

- **financial methods** – which include traditional tools like Net Present Value and more modern approaches like Economical Value Added and Total Cost of Ownership,
- **qualitative (heuristic) methods –** to which all methods assigning quantitative measures to qualitative factors are assigned. Examples of methods included in this group are Balanced Scorecard, Information Economics and Portfolio Analysis.
- **probabilistic methods –** based on the application of statistics, probability computing, decision theory and expected value of information. Examples of methods of this type are Real Options Method and Applied Information Economics.

Recommended citation: Lech P. (2005) Evaluation Methods' Matrix – A Tool for Customized IT Investment Evaluation, in: Proceedings of the 12th European Conference on Information Technology Evaluation, pp. 297-306

Linking the above two divisions it is possible to propose the following general evaluation methods classification:

- **financial methods -** judging these aspects of IT project that have direct financial impact
- **qualitative methods –** which also try to evaluate non-financial issues. It is possible to distinguish the following subgroups:
    - **multi-criteria methods –** including both financial and non-financial measures, usually based on rankings,
    - **strategic analysis methods** – among which Balanced Scorecard and Portfolio Analysis are the most important,
- **probabilistic methods –** applying quantitative statistical methods and decision theory.

In this paper the methods will be assessed according to the following criteria:

- IT orientation – whether the method supplies the tools for identifying and evaluating IT specific benefits and costs,
- evaluation scope – whether the method attempts to evaluate all aspects of an IT project or concentrates only on one or some of them,
- level of observation – whether the method is designed to evaluate a single IT project, compare several projects or evaluate the overall IT impact on the organization,

For the holistic evaluation of IT investment the method should be IT-oriented, have wide evaluation scope and be designed for single project evaluation.

As all the methods mentioned here are well described in IT literature (Deschoolmeester et. al. 2004, Mayor 2002, Renkema and Berghout 1997, Renkema 2000, Remenyi et. al. 2000) they will not receive further description in this paper. Only their usability for the in-depth business evaluation of single IT project will be discussed further.

Most financial methods, like Simple Rate of Return, Payback Period, Net Present Value or Economic Value Added, were designed to evaluate "traditional" investments and thus they are project level methods and do not supply tools to deal with IT specific costs and benefits. They neither supply methods for identifying IT benefits and costs nor for assigning values to them. The evaluation scope of these methods is limited to financial benefits and costs. Some exceptions are Total Cost of Ownership (TCO) and Return on Management methods. TCO assesses all the costs of using a piece of IT architecture. It is IT-oriented, but deals only with one side of IT cost-benefit analysis. It is suitable for evaluating the cost side of a single project. Return on Management by Strassmann (1990) assesses the overall impact of management activities on the organization's productivity.

Multi-criteria methods like Information Economics (Parker and Benson, 1988) or the method presented by T. Murphy (2002) try to evaluate all aspects of a single IT project. They are thus IT-oriented, have wide evaluation scope and single project level of observation. It predestines them to be suitable for EAS evaluation. The problem with multi-criteria methods is their high subjectivity (Remenyi et. al. 2000), as they are based on ranking.

Among strategic analysis methods the two most commonly cited in the literature are Portfolio Analysis and Balanced Scorecard. Portfolio methods are suitable for the comparison of several IT projects competing for limited funds. The evaluation of each project must be performed with the use of other methods. The use of Balanced Scorecard to evaluate the strategic readiness of IT is presented by its creators (Kaplan and Norton 2004). As the authors indicate, BSC is suitable for evaluating the strategic aspect of IT infrastructure use. This method is thus partially IT-oriented, suitable both for evaluating a single project and all of the IT in the organization, but it concentrates only on one aspect of IT impact on the organization – supporting the strategic goals.

Among probabilistic methods the ones that receive attention in IT literature are Real Options Method, Expected Value of Information and Applied Information Economy. Real Options method takes its origin from Options Theory that deals with financial options evaluation (Black and Scholes, 1973). Real options transforms the methodology of valuating financial options into the real investment world (Putten and Mac Millan, 2004). IT evaluation based on Real Options Method assumes that an investment in one IT initiative might open other lucrative investment possibilities in the future (Dos Santos, 1991; Kumar, 2003). A project valued by using this method will usually be worth more than by using traditional financial methods .

As B. Jong et. al. (2001) argue, Real Options Method rather adds problems to IT evaluation than solves them. The problem of reliability of financial data (benefits and costs) input into the model is the same as for traditional financial methods, and additionally, an assessment of the value of investment distribution and variance is necessary.

Expected Value of Information (EVI) –is not actually an IT evaluation method but a part of Decision Theory (Lawrence, 1999). It lets the evaluator calculate the value of the decision with or without having access to additional information about the decision subject (Schell, 1999) . Value of Information approach can be used to evaluate benefits from "informate" systems according to S. Zuboff's classification of IT impact on the organization (Zuboff, 1988).

A possibly holistic IT evaluation approach, basing on deterministic models and decision theory, is Applied Information Economics. Developed by the commercial Hubbard Decision Research it uses methods from Economics, Actuarial Science, Decision Theory, Options Theory and Modern Portfolio Theory (Hubbard, n.d.). Unfortunately it is not described in enough detail to be able to assess its usability for evaluating EAS implementations.

The classification of the described methods, according to the three criteria, is shown in Table 1. (IT-oriented methods are marked with a star).

Table 1: Project methods according to evaluation level and scope

		Level of observation		
		Single project level	**Project comparison**	**Organization level**
Evaluation scope	**All aspects**	Information Economics* Murphy's method* Applied Information Economics (?)*	Portfolio	Return on Management Economical Value Added Balanced Scorecard
	Selected aspects	ROI, NPV, IRR Economical Value Added Total Cost of Ownership* Balanced Scorecard Real Options Method Expected Value of Information		

It becomes clear that for complex IT investment evaluation one can use multi-criteria methods and possibly Applied Information Economics. As has been mentioned before, multi-criteria methods have the disadvantage of being highly subjective. Another problem is that they may be too general for big and complicated IT initiatives that have a multi-dimensional impact on the organization. The result of multi-criteria methods is the overall project score obtained by assigning ranks both to tangible and intangible benefits and costs. Such an approach may be relevant to "general" IT projects' evaluation and for comparing several projects. It may, however, be too simplistic for an "in-depth" evaluation of IT initiative, with a high impact on many organizational aspects.

3. Factors determining IT evaluation approach

Some researchers suggest that different aspects of IT initiative, (Deschoolmeester et. al., 2004) and different benefits and costs, (Remenyi and Sherwood-Smith, 1997), should be measured using several measurement techniques. The analysis of the existing types of evaluation methods performed in the previous section suggests that it is hard to find one comprehensive method suitable for in-depth IT project evaluation. It becomes clear that for detailed evaluation of IT initiative a set of methods should be used instead of one. The selection of methods most appropriate for the particular organization's circumstances is one of the biggest problem in IT evaluation (Remenyi et. al., 2000; Willcocks and Graeser, 2001).

Remenyi et. al. (2000) postulate relating evaluation measure to the investment purpose. For example, according to these authors, if the purpose is to improve efficiency– a cost-benefit analysis should be performed, whilst for strategic investments – strategic analysis would be the suitable tool (Remenyi et. al., 2000: 66). The relation of evaluation measure to the investment purpose determines the overall evaluation strategy, rather than the specific tools to be used. Irani (2002: 13) suggests that evaluation criteria should be dependent on the IT element (e.g. ERP system) that is implemented. Shang and Seddon (2002: 273) present seven questions from Cameron and Whetten (1983) from which the ones that determine the evaluation methods are:

- from whose perspective will the evaluation be done? (line managers, business managers, CEO, external entities),
- what is the level of analysis? (functional, organizational),
- what is the purpose of the evaluation?

Deschoolmeester et. al. (2004: 125) present the relation between evaluation techniques and the question that is to be answered which is similar to the evaluation purpose mentioned above.
Remenyi and Sherwood Smith (1997: 105) relate the evaluation technique to the level of measurability and tangibility of benefits and costs. Parker and Benson (1988) perform project evaluation in two domains: business and technology. This natural division is present in most evaluation methodologies. So the factors determining the choice of the evaluation approach, mentioned in IT literature are:

- purpose of evaluation,
- level of analysis,
- perspective of evaluation,
- investment purpose,
- domain (business, technology),
- benefit/cost measurability and tangibility,
- IT element to be implemented.

The aim of this paper is to determine the optimal way of evaluating IT investment from the business perspective. The purpose of evaluation can thus be defined as to determine the overall business impact of the specific IT initiative on the organization. The two factors: level of analysis and the person from whose perspective the initiative will be evaluated can be linked together. The level of analysis will determine the person from whose perspective the evaluation should be made -this will be the person responsible for that organizational level. So the perspective of evaluation can be fix-linked to the level of analysis. As the evaluation is to be made from the business perspective, the domain to be evaluated will be the business domain. The technology domain should then be evaluated only in the aspects that affect the business domain. The evaluation method should also be dependent on the type of business impact of IT on the organization. One IT initiative can cause benefits and costs of strategic, tactical and operational kinds (Irani, 2002) which can be named as Business Impact Level. Benefits at each of the levels can relate to one of the IT functions (Zuboff, 1988) in the organization which are automate, informate and transformate. The other types of benefits that can occur are of an organizational and qualitative type. Organizational benefits will include, for example, better communication of a company's objectives, knowledge dissemination and better communication among employees. Qualitative benefits will include the prestige of using cutting-edge technology, articles in industry newspapers, promotion through the software-vendor's success stories etc. The IT costs are divided into two main groups (Love and Irani 2001): direct and indirect. Both benefits and costs can be classified as tangible and intangible, measurable and unmeasurable. Benefit and cost tangibility and measurability certainly affect the evaluation method with which they should be evaluated (Remenyi and Sherwood-Smith, 1997). The important component of IT initiative evaluation is the risk assessment. The methods used for this purpose will be dependent on the risk impact type. The risk can be observed as project cost increase, project benefit decrease or partial/total project goals' misachievement. Risk of cost increase and benefit decrease can be incorporated into cost-benefit analysis by estimating standard deviation, whilst risk of project goals' misachievement might be reflected in BSC or the ranking/scoring evaluation element.
From the perspective of this paper's main objective, which is the in-depth evaluation of IT investment from the business perspective, some of the factors listed above can be treated as fixed, while others will vary from IT project to project. Still others will appear simultaneously in the project and will require the use of several evaluation methods in parallel. The factors determining the evaluation approach can thus be divided into three groups:

- fixed – from the perspective of business-oriented IT project evaluation the factor has always one, fixed value
- project level variable – the factor can change depending on the IT project to be evaluated,
- project aspect variable – the factor can have several values within one IT project, depending on different project aspects to be evaluated, e.g. benefit and cost types.

The summary of the factors affecting the choice of evaluation technique is shown in Table 2:

Table 2. Summary of factors determining evaluation approach

Factor	Factor group		
	Fixed	**Project level variable**	**Project aspect variable**
purpose of evaluation	in-depth evaluation of IT investment from the business perspective		
domain	business and limited technology		
investment purpose		determines the overall evaluation strategy	
IT element to be implemented		determines the types of benefits and costs that will occur	
level of analysis			functional, organizational
perspective of evaluation			fix-linked to the level of analysis
benefit/cost tangibility and measurability			tangible/intangible measurable/unmeasurable
benefit/cost level			operational tactical strategic
benefit type			automation, information, innovation, organization, qualitative, infrastructure
cost type			direct indirect
risk type			cost increase benefit decrease project goals' misachievement

After the discussion performed in this section it becomes clear, that for in-depth evaluation of IT investment several methods and tools should be used to evaluate different aspects of the IT project. These methods should be selected based on the specific values of the factors mentioned above.

4. Evaluation methods' matrix as a tool for helping in customized evaluation methodology formulation

If the assumption made in the previous section is accepted, the search for one uniform evaluation method becomes unjustified, and a customized evaluation method should be designed for each IT initiative. Bannister and Remenyi (1999) call it a 'meta approach' and argue that this orientation is not structured and vary from case to case. Serafeimidis and Smithson (1999) state that the choice of evaluation approach should be based on project characteristics, such as evaluation organizational context, content (benefits and costs) and time frame and that it should change dynamically when new circumstances occur. Farbey et. al. (1992) propose to relate evaluation methods to the role of evaluation, decision-making/cultural environment, project level (tactical/operational), project role in the organization, benefit and cost type and predictability.

Meta-approaches described in IT literature are based on the assumption that each evaluation case is unique and requires a customized set of evaluation techniques. They also try to identify some of the factors determining the choice of these techniques but they do it in a very general way. It seems reasonable to follow the route of matching specific evaluation techniques to the IT project characteristics mentioned in the previous section in more detail than it was done till now. Some of the general characteristics mentioned by Farbey et. al (1992) should be then treated as fixed and detail matrixes should be developed for lower level factors. The customized evaluation methodology could then be developed by determining the value of each factor, and choosing the relevant evaluation method from the matrix.

The creation of a customized evaluation methodology can be described in the following steps:

- investment purpose determination,
- general evaluation framework creation,
- detailed evaluation methodology formulation,
- execution of the evaluation for the project.

Each of the steps is described in more detail below.

4.1. Investment purpose determination

The first question that should be answered before the evaluation process begins, is for what reason the IT investment is being made. This is the purpose of implementation that determines general evaluation strategy. The proposal of purpose – evaluation technique mix is available in (Remenyi et. al. 2000, p. 66), but as was stated above, investment purpose should first determine overall evaluation strategy, rather than specific techniques. The relation between investment purpose and aspects that should be subject to evaluation can be seen in table 3. .

Table 3. Investment purpose – evaluation strategy

Investment purpose/type	**Evaluation strategy (evaluation aspects considered)**
business survival (must do investments)	cost measurement, goal achievement
business improvement	cost-benefit analysis, performance measurement, future options analysis
competitive advantage	strategic analysis, cost-benefit analysis, future options analysis
capacity improvement (infrastructure)	cost measurement, goal achievement, future options analysis, benefit analysis

based on: Remenyi et. al. (2000)

Investment purpose first of all determines **what** should be measured. If the investment is a must-do – which means that it is either required by law or is an industry standard, then the main benefit is staying on board. The optimizing criterion for such investment should be to obtain the desired goal at minimum costs. The factors to be measured are the degree to which the desired goal is achieved and the costs of investment. The business improvement IT investments should be evaluated against the criterion to which degree they really improve business. Ratio performance measurement can be used for that purpose. Business improvement should result in measurable benefits, so cost-benefit analysis is indispensable. If the purpose of investment is to obtain a temporary competitive advantage, then strategic analysis is a suitable tool for verifying the degree to which the IT supports that goal. Benefits and costs, both tangible and intangible should be measured too. If the investment has the purpose of increasing technical capacity, then the main benefit will be the option for further development and this should be assessed carefully. Cost measurement should be performed, as in all other projects, and if some benefits are expected (e.g. cost reduction resulting from infrastructure integration), they should be taken into consideration as well, although it might not be reasonable to expect direct positive ROI from that type of investment.

4.2. General evaluation framework creation

After clarifying the investment purpose and identifying corresponding evaluation aspects, it is possible to determine the overall evaluation approach for each of them. This step answers the question of **how** each of the aspects should be evaluated. There is usually more than one method available for the evaluation of each aspect of IT initiative. For example cost-benefit analysis could be done with ROI, Direct Payback, NPV or EVA method. Strategic analysis can be done with the help of Balanced Scorecard or some other KPI measurement technique, etc. The methods selected for the specific project should be relevant to the measurement habits of the organization in which the project takes place. Exemplary methods for each of evaluation aspects are shown in table 4:

Table 4. Investment purpose – evaluation aspect – measurement methods

Investment purpose	**Evaluation aspect**	**Exemplary methods**
business survival (must do investments)	cost measurement	TCO
	goal achievement	Ranking/scoring
business improvement	cost-benefit analysis	TCO, ROI, NPV, EVA, EVI, Activity Based Costing
	performance measurement	Ratio analysis, Ranking/scoring,
competitive advantage	strategic analysis	Balanced Scorecard, Strategic readiness report, ranking/scoring
	cost-benefit analysis	TCO, ROI, NPV, EVA, EVI, Activity Based Costing
	performance measurement	Ratio analysis, Ranking/scoring,
	future options analysis	Real Options
capacity improvement (infrastructure)	cost measurement	TCO
	goal achievement	Ranking/scoring
	future options analysis	Real Options

After this step the general framework for evaluating the IT project is ready.

4.3. Detailed evaluation methodology formulation

The general framework should then be decomposed into a set of detailed evaluation methods. As was explained in the previous section, these methods are dependent on benefit, cost and risk level, tangibility and type. The matrixes linking those values are shown in tables 5,6 and 7.

Table 5. Benefit type, level and tangibility to benefit measure matrix

Benefit type	**Benefit level & tangibility**	**Benefit example**	**Measure**

automation	tactical/operational – tangible	operational cost reduction resource usage reduction	ROI, NPV, EVA
information	tactical/operational – tangible	stock reduction, shorter operational cycle, less bad debt due to better information	EVI -> ROI,NPV, EVA
	tactical/operational – intangible	Planning & simulation	EVI or ranking/scoring
	strategic – intangible	Planning & simulation, strategic goal achievement measurement	ranking/scoring, BSC, strategic readiness report
innovation	tactical/operational – tangible	business process improvement (cost reduction, profit increase)	Activity based costing, ROI, NPV, EVA
	tactical/operational – intangible	business process improvement	performance measurement, ranking/scoring
	strategic – tangible	flexibility, future options,	Real Options
	strategic – intangible	process improvement, new process design	BSC, ranking scoring
organization	tactical/operational& strategic – intangible	knowledge dissemination, better workflow,	BSC, ranking scoring
qualitative	strategic – intangible	prestige, image	BSC, ranking scoring
infrastructure	tactical/operational – tangible	IT administration cost reduction	ROI, NPV
	strategic – tangible	future development options	Real Options

Table 6. Cost type and tangibility to cost measure matrix

Cost tangibility	Direct/indirect	Cost example	Measure
tangible	direct	license cost, consultancy cost, hardware cost, cost of IT staff additional work	ROI, NPV, EVA
tangible	indirect	cost of non IT staff additional work,	ROI, NPV, EVA
intangible	direct	resistance to change	BSC, ranking/scoring
intangible	indirect	staff rotation, longer customer service time	BSC, ranking/scoring

Table 7. Risk type to risk measure matrix

Risk type	Measure
cost increase	variance, standard deviation
profit decrease	variance, standard deviation
partial or total project goal misachievement	BSC, ranking/scoring, reaction matrix

The evaluation framework designed this way can then be confronted with the expected project benefits, costs and risks.

4.4. Execution of the evaluation

The hitherto performed steps have resulted in the design of a customized evaluation methodology that takes into account an organization's habits in using specific measurement techniques, IT project purpose and possible types of benefits, costs and risks that can appear in it. This methodology should then be 'filled in' with real data concerning the project being evaluated. Execution of the evaluation process can be performed in the following steps:

- identification of project benefits, costs and risks,
- classification of benefits, costs and risks according to the criteria used in the methods' matrix,

- benefit, cost and risk input to the evaluation model,
- result presentation.

Identification of project benefits, costs and risks can be supported by the catalogue of those elements constructed for the specific piece of IT, like CRM, ERP, business warehouse, help desk etc.

The formulation of such catalogues will be the subject of further research.

After being identified, the benefits, costs and risks should be classified according to the criteria used in the methods' matrix: organizational level, tangibility, type. This will answer the question to which of the evaluation methods the given element should be assigned. The next step would be to perform a separate evaluation for each of the evaluation aspects, using the method or methods assigned to it in the evaluation model. The effect would be at least one result for each of the aspects, for example: financial ROI, strategic match, future options. It could be satisfactory to end up by relating these results to the standard values required by the organization. If one unified measure is required for the project, the results could be ranked according to the guidelines of IE or T. Murphy's method.

5. Summary

This paper follows the idea of meta-approach to the IT evaluation and presents work-in-progress findings concerning identification of the factors determining the selection of IT evaluation methods, and the initial design of a tool to help in preparing a customized IT evaluation model of one IT initiative form business perspective. As methods' selection is considered to be one of the biggest problems in IT evaluation, it seems reasonable to put effort into creating tools and techniques supporting this process. The concept of the evaluation methods' matrix presented in this paper is a proposal of such a tool. It will be the subject of further research and more detailed design.

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