

# Improving the Success of Information Systems by Evaluation

## A Learning Approach

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### Abstract

*Information systems can offer companies various possibilities for increasing their revenues. The systems are often strategic in nature and may have a central role in developing the business functions of the company. In today's turbulent business environment managers should have proper tools for identifying the possibilities offered by information system investments and assessing their value to the company. This paper aims at analyzing the efforts of developing information systems evaluation practices in companies. Furthermore, we investigate whether developing the evaluation practices has led to an increase in frequency or thoroughness of IS evaluation. Moreover, we investigate the perceived satisfaction with the evaluation practice. The Organizational Learning approach is emphasized in our research framework. A surprising result was found in the category where evaluation practices had been changed and the frequency or thoroughness of evaluation had increased. In this category there were as many companies who were satisfied as who were dissatisfied with the evaluation practices of information systems in the company; when the companies in this category are not satisfied with the evaluation practice it might be interpreted as a double loop learning failure.*

**Keywords:** IS evaluation, organizational learning

**BRT Keywords:** EL, EF07

## Introduction

Today's companies are increasingly dependent on their information systems (IS). In turbulent business environments information systems can offer various possibilities to help the companies to succeed. Information systems can generate many kinds of benefits to a company, for example, by making the basic functions of the company more effective and thus creating a basis for cost leadership. Information systems can also help to manage and control business functions, and they often have a central role in implementing new business strategies. When developing these kinds of systems, it is essential that senior management actively participates in the planning process. To evaluate IS investments managers need tools that help to assess the effects and risks of the investments from both the strategic and the financial viewpoint.

Numerous different evaluation methods have been developed, but they are not used very often. Results of Saarinen and Sääksjärvi's (1992) study show that information system investments are very seldom evaluated using any formal methods. Only one third of the investments in their sample of 62 organizations were evaluated using the payback period and only 20 % using methods based on cash flow analysis. Information systems

are thus often evaluated using only subjective arguments and usually no risk analysis is conducted. In practice, only the simple methods, like payback period, are used (Mills 1988). If formal evaluation is conducted, financial profitability is usually the dominant criterion (Peffer and Saarinen, 1993). Furthermore, systematic organizational learning about evaluation does not tend to be found in organizations (Willcocks and Lester 1993). Consequently, many IS projects fail, and even if the information system would be build successfully, the business benefits are often modest.

Because the effects of IS investments are very difficult to express in monetary terms and the benefits are often realized during a long period of time, they should be evaluated using a covering set of criteria. A set of five criteria for evaluating IS investments have been proposed by Peffer and Saarinen (1993): strategic value, financial profitability, risk, successful development/procurement process, and efficient use/operations. The last criterion can be further divided into effectiveness of use and effects of use on business functions.

Hallikainen et al. (1998) investigated the evaluation of IT-projects among a sample of the largest firms in Finland from a variety of industries to determine when over the project life cycle firms evaluate IT and what the effects of these evaluations are on decisions made about the projects. Firms in their sample seldom evaluate IT investments after the initial project proposal and when they do the evaluation seldom results in substantial system modifications or abandonment. Explicit IT evaluation methods, i.e. methods or procedures specifically designed for evaluating IT investments, are associated with higher levels of evaluation follow-through during development, a greater likelihood that managers will make a decision to abandon a project, and with higher levels of some measures of perceived evaluation quality (Hallikainen et al., 1998).

To sum up, a sufficient control mechanism for information system investments is often missing and it is very difficult for management to control the progress of the investments. However, the firms applying explicit IT evaluation methods seem to benefit from it.

Using the data from 38 Finnish companies, the aim of this study is, first, to investigate whether companies have made efforts to develop the IS evaluation practices. By evaluation practice we mean the general policy in the company with respect to evaluation instructions, procedures, criteria and responsibilities determined for IS investments. Basically, the evaluation policy can range from subjective arguments made by experts to binding and written evaluation instructions specifically designed for IS investments. In addition, we investigate whether developing the evaluation practices has lead to an increase in frequency or thoroughness of IS evaluation. Moreover, we investigate the perceived satisfaction with the evaluation practice. Finally, we analyze the success of the change process when developing the evaluation practices.

In our database we had 24 cases where the evaluation practices had been changed and 14 cases where the practices had not been changed. A surprising result was found in the category where evaluation practices had been changed and the frequency or thoroughness of evaluation had increased. In this category there were as many companies who were satisfied as who were dissatisfied with the evaluation practices of information systems in the company.

The study is organized as follows. First, in section 2, we describe a learning approach to IS evaluation based on Argyris & Schön's (1978) ideas on 'learning in loops' and some recent applications of them in the domain of IT-development from organizational learning perspective (Saarinen & Wijnhoven, 1995). In section 3 we present our research framework and specify the research questions. The research

methodology is described in section 4. The results of the study are presented in section 5, and discussed in section 6.

## Organizational Learning Approach to IS Evaluation

According to Farbey et al. (1992) evaluation can serve four different objectives: first, evaluation may be used as a part of the process of justification of a system; second, evaluation enables an organization to make comparisons between different projects competing for resources; third, evaluation provides a set of measures, which enable the organization to exercise control over the project; and fourth, evaluation and the subsequent measurement and comparison with actual achievements provide the learning experience which is necessary if the organization is to improve its system evaluation and development capability.

Since the business environment of today's companies is changing rapidly, the evaluation methods themselves should be developed continuously. This is emphasized in a framework presented by Saarinen and Wijnhoven (1995) where evaluation is used as a means to create a shared organizational memory. Organizations should learn from experience, get prepared for future projects, and create favorable conditions for further learning. The basic idea of the framework is described below.

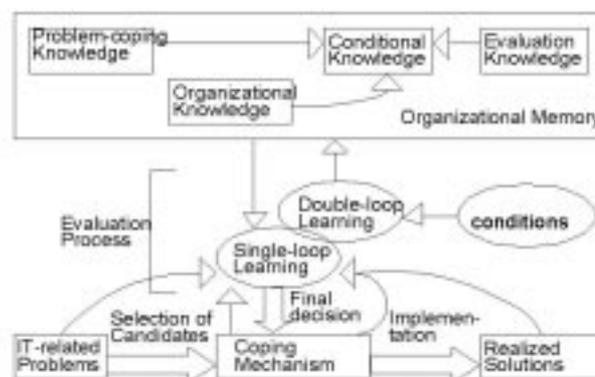


Figure 1. Organizational learning and evaluation of information systems (Saarinen and Wijnhoven, 1995).

The basic interest in the framework, illustrated in Figure 1, is in finding proper coping mechanisms for IT-related problems within the organizations. Saarinen and Wijnhoven emphasize on evaluating different candidate solutions for a given problem and on ex post assessment of the success of implementing the selected coping mechanism. The framework recommends that these decisions are contingent on the nature of the problems, possible coping mechanisms, and the organization itself. Effective learning requires that evaluation processes are well designed. The problems, the coping mechanisms, and the organization's memory (containing experiences and knowledge) are essential in designing effective learning designs. Furthermore, we assume that knowledge about evaluations is not only contingent, but also dynamic thus requiring the organization to establish explicit mechanisms to facilitate organizational learning

(OL) in this area in its full meaning.

When observing organizational learning it is important to distinguish between theory-in-use and espoused theory. Theory-in-use is frequently tacit, sometimes even for the individual that uses it. Theory-in-use motivates the individuals' actions. Argyris and Schön (1978) note that every individual in an organization can have another theory-in-use. In contrast to the theory-in-use, the espoused theories frequently lack a clear connection to the individuals' actions (Argyris & Schön, 1978; c.f. Wijnhoven, 1995).

In addition, it is useful to distinguish three types of learning useful to understand evaluation of information systems (see Argyris and Schön 1978). Single-loop learning means in this context that organizational memory is used to effectively evaluate information systems according to the norms announced by the organization (espoused theory). As Argyris and Schön state: "...members of the organization respond to changes in the internal and external environments of the organization by detecting errors which they then correct so as to maintain the central features of organizational theory in use."

While single-loop learning is oriented towards achieving existing goals and objectives and keeping organizational performance within the existing norms, double-loop learning is about modifying the organizational norms themselves. Argyris and Schön gave double-loop learning the following general definition: "We will give the name 'double-loop learning' to those sorts of organizational inquiry which resolve incompatible organizational norms by setting new priorities and weightings of norms, or by restructuring the norms themselves together with associated strategies and assumptions." In the context of evaluating information systems, double-loop learning means that problem coping knowledge and conditional knowledge stores are maintained to improve future evaluations. In practice this would mean developing the evaluation practices by, for example, searching for new evaluation methods or redefining the responsibilities in the evaluation process.

Finally, deutero learning is about organizations learning to carry out single-loop or double-loop learning. In the context of IS evaluation, deutero learning means that there is also a feedback loop to the organizational arrangements of the company allowing changes in the governance structures of the evaluation practices.

## **Research questions and model**

Our schematic research model clarifying the relationships between the below presented research questions is illustrated in Figure 2.

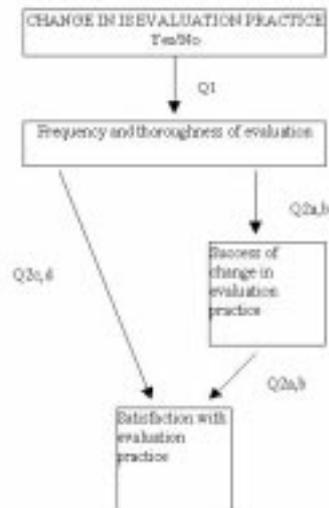


Figure 2. Research model.

More specifically our research questions are as follows:

1. Do the actions taken for improving the evaluation practices lead to more frequent or more thorough evaluation of IS projects?

It could be expected that more frequent or more thorough evaluation should lead to higher perceived evaluation quality, i.e. the more frequent conduct of evaluation throughout the IS development is a prerequisite for single-loop learning.

Then we separate the cases where evaluation practices have been changed during the last three years and the cases where the evaluation practices have not been changed. Thus, we can investigate the satisfaction with evaluation in four different occurrences.

2. a) If evaluation practices have been changed and this has led to more frequent or thorough evaluation, how well has the change succeeded and whether the organization is happy with the current evaluation practices?

2. b) If evaluation practices have been changed and this has not led to more frequent or thorough evaluation, how satisfied the organization is with the evaluation practices?

2. c) If evaluation practices have not been changed, but the members of the organization conduct evaluation more frequently or more thoroughly, how satisfied is the organization with the current evaluation practices?

2. d) If evaluation practices have not been changed and the frequency and thoroughness also remain unchanged or even decrease, how satisfied is the organization with the current evaluation practices?

We argue for analyzing all four logically possible outcomes, as it has appeared that the satisfaction with evaluation is highly context sensitive (Hallikainen et al., 1998); e.g., in a development backlog situation there is little time for evaluation development.

The two former categories are formed from organizations that have made an

attempt to change their evaluation practices; hence they have been facing both single loop and double loop learning challenges.

The two latter categories are to reveal the overall impression of the success of the single-loop learning practice in the situation at hand. There have been few attempts to engage in dual loop learning, only for single loop feedback.

Further distinction is due to the strategy-in-use and espoused strategy. It can be that strategy-in-use and espoused strategy have grown apart (single-loop failure); or that the espoused strategy implementation fails (double-loop failure).

## **Methodology**

### **MAIL SURVEY**

In 1996 we conducted an empirical investigation among large Finnish companies aiming to study how IS investments are evaluated in practical situations. We designed the research instruments as to address questions like:

1. at what stages of life-cycle IS investments are evaluated,
2. by whom and by what methods,
3. how satisfied companies are with their evaluation practices and
4. how the evaluation information is taken into account in the decision making

We decided to approach first the IS managers to get an overall view of the company and their evaluation practices. We also asked the IS managers to name recently completed evaluations for our study and contacted the project managers responsible for these investments. We designed separate questionnaires for both respondent groups. The first questionnaire was mailed to the IS managers or an other person responsible for IS at the corporate level of 300 largest companies in Finland. After reminders and phone calls we finally received 98 answers (32% response rate). Altogether 39 of the companies completed the full questionnaire, but 59 companies had different reasons why they could not complete the questionnaire. IS managers in 37 companies did not have any formal evaluation methods or guidelines, in 20 companies they were too busy, and in 10 companies they had various reasons, such as recently changed responsibilities or organizational arrangements. However, only in two companies the IS manager felt that the information we asked is too confidential to be given out of the company. Finally, we were able to use 38 completed answers to the IS manager questionnaire (one answer contained too many missing values and had to be left out) and 31 answers to the project manager questionnaire. This paper is based on the data received from IS managers.

### **RESPONDENT PROFILE**

The average turnover in 1995 of the responding companies in the whole sample (98 companies) was FIM 2597 million (FIM 1 is about USD .20) and average personnel 2274. In those companies who completed the questionnaire for IS managers (39 companies) the average turnover was FIM 3697 million and average personnel 2441. In those companies who gave some reason why they could not answer our questions the average turnover was FIM 1871 million and average personnel 2164. The corresponding figures for the whole population (300 companies) were: average turnover FIM 1875 million and average personnel 2158. Reflecting the above figures it can be seen that those

companies who completed our questionnaires are relatively large. Maybe the evaluation practices are more advanced in those companies, or evaluation issues in general are more relevant in large companies. About one third of the companies are from manufacturing, 29 % from retail and whole sales and 27 % from service sector. This is in line with the whole population of the 300 largest Finnish companies. If we go into a more detailed classification of industries there are obviously some differences. However, for our purposes we do not consider them significant.

## **VARIABLES USED IN THIS STUDY**

We separated the companies in our survey questionnaire into two groups by asking whether there have been substantial changes in the evaluation practice of information system investments in the company during the past three years. By evaluation practice we mean the general policy in the company with respect to evaluation instructions, procedures, criteria and responsibilities determined for IS investments.

Management theory suggest that IS investments should be evaluated in all phases of the systems life cycle (Lester and Willcocks, 1993) and that a covering set of criteria should be used in evaluation (Peffer and Saarinen, 1993). In our theoretical model an increase in frequency or thoroughness of evaluation indicates single loop learning.

To determine whether double loop learning has been successful we asked the IS managers their perceived satisfaction with the evaluation practice used in the company. Moreover, we asked how well the change process had succeeded if evaluation practices had been changed.

## **VARIABLE MEASUREMENT**

The change in the frequency or thoroughness of evaluation was asked using a scale ranging from 1 (substantially decreased) to 5 (substantially increased).

The measures for perceived satisfaction with evaluation practice and success of the change process were constructed for this study. The satisfaction measures are based on a review of literature about user information satisfaction and success of information systems (see Bailey and Pearson, 1983; Ives et al., 1983; Baroudi and Orlikowski, 1988; Saarinen, 1993). In the measures of success of the change process we included, in addition to the success of the change process in itself, measures about how the development effort of IS evaluation practices contributed to ensuring successful IS projects in the company. In both measures we used a scale ranging from 1 to 5.

Before conducting the mail survey the above measures were tested in case studies reported in Hallikainen (1996) and Viita (1996).

## **Results**

For our analysis we divided the companies into two groups according to whether the evaluation practices had been changed during the last three years or not. From both groups we investigate the change in the frequency and thoroughness of evaluation; satisfaction with evaluation practices; and, for those companies where evaluation practices have been changed, success of the change (see also research questions in section 3 above). We constructed an overall "satisfaction with evaluation" variable by computing the mean of all the satisfaction measures. Similarly, we computed an overall variable for

“success of the change process of evaluation practice” measure. The analysis is presented below separately for the two groups.

## GROUP 1: EVALUATION PRACTICE HAS CHANGED

From Table 1 it can be seen that in most cases both the frequency and thoroughness of evaluation have increased. This could be interpreted as single loop success when the members of the organization are adapting their actions to the new organizational theory-in-use, i.e. the new evaluation practice of IS investments in the company.

<i>Scale:</i>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>Mean</b>
Frequency of evaluation			2	18	4	4.08
Thoroughness of evaluation		1	3	14	5	4.00

Table 1. Change in the frequency and thoroughness of evaluation (Frequencies, scale 1=remarkably decreased, 5=remarkably increased)

Next we look in more detail at those cases where evaluation practices have changed and the frequency or thoroughness of evaluation has increased. We asked the IS managers how well the change of the evaluation practice has succeeded. We used the measures presented in Table 2, and a scale 1-5, where 1=Failed and 5=Succeeded very well. From the frequencies in Table 2 it can be seen that in most cases the change has succeeded rather well and also the desired effects have realized in most cases. The computed mean of all the dimensions of Success of Change in Evaluation Practice variable was 3.40.

<i>Scale:</i>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>Mean</b>
Implementation of change process		1	15	4		3.15
Effect on selection of investments			9	11		3.55
Effect on resource allocation		2	9	8		3.32
Effect on success of development projects			10	9		3.47
Effect on recognizing problem projects in time		2	10	6		3.22
Effect on aligning information technology and business functions			6	13		3.68

Table 2. Success of Change in Evaluation Practice (Frequencies, 1=Failed and 5=Succeeded very well)

However, from the results in Table 3 it can be seen that the amount of IS managers who are satisfied with the current evaluation practices is not much different from the amount of those who are not satisfied. The computed mean of all the dimensions of Satisfaction with Evaluation variable was 2.87. This result is not in line with the high success of the change process described above. This may be due to the rapidly changing environment, which requires organizations to change the evaluation practices continuously.

	<i>Scale:</i>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>Mean</b>
Conduction of evaluation process		2	9	8	3		2.55
Costs of evaluation			1	4	14	3	3.86
Evaluation criteria and their weighting			4	15	3		2.95
Evaluation methods		2	8	9	3		2.59
Information resulting from evaluation			10	10	2		2.64
Evaluation helping in decision making about IS investments		1	6	7	6		2.90
Evaluation helping in aligning information technology function and the needs of business functions			7	9	5		2.90
Evaluation as a means to recognize problem projects in time		2	6	12	2		2.64

Table 3. Satisfaction with evaluation (Frequencies, Scale 1=very unsatisfied, 5=very satisfied)

There were only two cases where evaluation practices had been changed but frequency and thoroughness still remained the same or even decreased. In these cases the IS managers reported that the change of evaluation practice succeeded only moderately or even somewhat failed (using the dimensions presented in Table 2). The computed mean of all the dimensions of Success of Change in Evaluation Practice variable was 2.83. Furthermore, in most cases they were only moderately satisfied or somewhat unsatisfied with the IS evaluation practices in the company. The computed mean of all the dimensions of Satisfaction with Evaluation variable was 2.75. In one case the IS manager was satisfied with evaluation helping in recognizing problem projects in time, although he was unsatisfied in terms of other measures.

## **GROUP 2: EVALUATION PRACTICE HAS NOT CHANGED**

From Table 4 it can be seen that in this group the frequency and thoroughness of evaluation have, as expected, remained unchanged in most cases. Nevertheless, below we analyze separately the cases where frequency or thoroughness of evaluation has increased and the cases where the both have remained the same or even decreased.

	<i>Scale:</i>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>Mean</b>
Frequency of evaluation			2	9	2	1	3.14
Thoroughness of evaluation			2	9	3		3.07

Table 4. Change in Frequency and thoroughness of evaluation (Frequencies, scale 1=remarkably decreased, 5=remarkably increased)

From Table 5 it can be seen that in those cases where frequency or thoroughness of evaluation has increased the IS managers are in most cases satisfied with the evaluation practice. The computed mean of all the dimensions of Satisfaction with Evaluation variable was 3.41. This may be due to the individuals' ability in the organizations to respond to the needs of changing environment.

	<i>Scale:</i>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>Mean</b>
Conduction of evaluation process			1	2	1		3.00
Costs of evaluation				2	1	1	3.75
Evaluation criteria and their weighting			1	2	1		3.00
Evaluation methods				3	1		3.25
Information resulting from evaluation			1	2	1		3.00
Evaluation helping in decision making about IS investments				1	2	1	4.00
Evaluation helping in aligning information technology function and the needs of business functions				2	2		3.50
Evaluation as a means to recognize problem projects in time				1	3		3.75

Table 5. Satisfaction with evaluation (Frequencies, Scale 1=very unsatisfied, 5=very satisfied)

From Table 6 it can be seen that in those cases where frequency and thoroughness of evaluation have remained the same or even decreased the IS managers are unsatisfied especially with evaluation criteria and their weighting, evaluation methods, and information resulting from evaluation. However, in some cases they are rather satisfied with the cost of evaluation, and evaluation helping in decision making about IS investments. The computed mean of all the dimensions of Satisfaction with Evaluation variable was 2.58. Nevertheless, the strong dissatisfaction with evaluation criteria, evaluation methods, and information resulting from evaluation indicates a clear double loop learning failure in developing IS evaluation practices.

	<i>Scale:</i>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>Mean</b>
Conduction of evaluation process		1	4	3	1		2.44
Costs of evaluation			2	2	4		3.25
Evaluation criteria and their weighting		1	6		2		2.33
Evaluation methods		1	6	1	1		2.22
Information resulting from evaluation			6	2	1		2.44
Evaluation helping in decision making about IS investments		1	4		3	1	2.89
Evaluation helping in aligning information technology function and the needs of business functions		3	3		2	1	2.44
Evaluation as a means to recognize problem projects in time		4	3	1	1		1.89

Table 6. Satisfaction with evaluation (Frequencies, Scale 1=very unsatisfied, 5=very satisfied)

## SUMMARY OF THE RESULTS

The four categories and the number of companies satisfied and dissatisfied with the evaluation practices are presented in Figure 2. Satisfaction is determined by the computed mean of all the dimensions of the Satisfaction with evaluation variable. When the mean is more than 3 a company is classified as being satisfied with the evaluation practice. Four cases had to be left out from analysis, since there were missing values in the Satisfaction with evaluation measures.

Evaluation Practice Changed	<b>10</b> (10)	<b>0</b> (0)
Evaluation Practice Not Changed	<b>4</b> (0)	<b>2</b> (0)
	Increase in Freq. or Thoroughness	No Change, or Decrease, in Freq. or Thoroughness

Figure 3. Satisfaction with evaluation in different occurrences. Number of companies satisfied with their evaluation practice is in bold print. The number in parentheses indicates the number of companies not satisfied with the evaluation practice.

We analyze each category in turn below:

**A. Evaluation practices have been changed and evaluation frequency or thoroughness has increased.**

In this category, when the companies are satisfied with the evaluation practice, it can be interpreted that both single loop and double loop success has occurred. When the companies are not satisfied with the evaluation practice it might be interpreted as double loop failure.

**B. Evaluation practices have been changed but evaluation frequency and thoroughness have remained the same or decreased.**

In the two cases where evaluation practices have been changed but neither frequency nor thoroughness has increased, and IS managers are dissatisfied with the current evaluation practice, it might indicate both single loop and double loop learning failure in developing the company's IS evaluation practices.

**C. Evaluation practices have not been changed but there has been an increase in frequency or thoroughness of evaluation.**

When the companies are satisfied with the current evaluation practice this might be interpreted as single loop success. It may be that there is no need to develop further the company level practice (espoused theory).

**D. Evaluation practices have not been changed and the frequency and thoroughness of evaluation have remained the same or decreased.**

When the companies in this category are not satisfied with the evaluation practices it might indicate both single loop and double loop learning failures in developing IS

evaluation practices. In the two cases where the companies are satisfied with the evaluation practice, it might be that the current evaluation practice is appropriate for assessing the value of information system investments for the company.

## Discussion and Conclusions

In this paper we constructed a framework for analyzing the development of information systems evaluation practices using the theoretical ideas about organizational learning presented by Argyris and Schön (1978). The framework was applied to analyze the development efforts in 38 Finnish companies.

A surprising result was found in the category where evaluation practices had been changed and the frequency or thoroughness of evaluation had increased. In this category there were as many companies who were satisfied as who were dissatisfied with the evaluation practices of information systems in the company. This result must be seen against the historical situation in which our mail survey was conducted. The economic recession in the beginning of 1990's created a lot of uncertainty for the companies in Finland. Furthermore, the liberalization of the financial market created new challenges for effective evaluation of investments. Today, IS investment evaluation often includes assessing the value of an entirely new and innovative system making new kind of business possible. In this kind of situation "traditional" evaluation procedures may be insufficient.

An interesting field of further research might be to investigate how firms in a dynamic environment develop the evaluation practices of information systems. Another interesting topic to study could be the relation between IS evaluation and networked IS-production. It is most likely that in a networked IS-production, partnership management becomes a key issue, hence creating new challenges to IS development evaluation. The evaluation criteria have to be derived from the utilizing organization's needs, and explicitly stated for contracting purposes.

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