A Holistic Framework on Information Systems Evaluation with a Case Analysis

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Abstract: This paper presents a framework for understanding IS evaluation in its broader context. The role of IS evaluation is emphasised on integrating the IS development process into business development process. The framework is applied to analyze a single IS project in details. The results show that sometimes formal IS evaluation might not be important or necessary, but rather it may be more important, with an informal and flexible evaluation process, to quickly gain experience of a new kind of business and system to maintain a leading position in the competitive market.

Keywords: information systems projects, IS evaluation, organisational context, holistic framework on IS evaluation

1. Introduction

It has been widely noticed in the literature that information system (IS) evaluation is a very difficult task involving a variety of dimensions (Smithson and Hirschheim, 1998; Irani, 2002; Peffers and Saarinen, 2002) and various stakeholders (McAulay et al., 2002). IS investments often include intangible benefits (Powell, 1992) and the benefits are often realised during a long period of time (Saarinen and Wijnhoven, 1994). Ad hoc practices for IS evaluation are frequently reported (Irani and Love, 2001) and only simple methods, like payback period, are used in evaluation (Lederer and Mendelow, 1993). This is in sharp contrast to management theory suggestions that IS investments should be evaluated using a covering set of criteria. For example, Peffers and Saarinen (2002) stated that evaluation of IT in financial terms may be biased toward the most easily measured benefits and prone to manipulation to justify predetermined investment decisions, resulting in systematic over or under-investment in IT. Some contingency models for selecting evaluation methods for IS investments have been presented in the literature. At organisational level, contingency factors may include, for example, the industry situation (stable or changing), and the leadership role of the organisation (pioneer or follow) (Farbey et al., 1992). At IS project level, contingency factors may include, for example, project types, project sises, the type of expected benefits (qualitative vs. quantifiable), the stages of the system's life cycle, and development and procurement strategy (see e.g. Farbey et al., 1992; Hochstrasser, 1990).

As a result of their study on IS evaluation methods, Peffers and Saarinen (2002) divided evaluation criteria into five broad categories as follows: Strategic value; Profitability; Risk; Successful Development and Procurement; and Successful Use and Operations. The above categories might be seen as universal for evaluation in any particular case. Moreover, Irani and Love (2002) presented a comprehensive frame of reference for ex-ante IS investment evaluation. However, the need for a better understanding of in-context IS evaluation still exists. This paper aims to provide an instrument for understanding IS evaluation in its broader context. The instrument is expected to be of value to both researchers and practitioners. In the next section, a holistic framework on IS evaluation is presented. Then the empirical research methodology is described and the presented framework is applied in a case analysis. Finally, the paper concludes with discussions and conclusions.

2. A holistic framework for analysing IS evaluation in context

The outset situation of the IS investment project consists of the organisational norms and values, project specific contextual factors and the resources given to the project. The actual outcomes of the IS investment project are produced in conjunction with the business development process, the IS development and procurement processes. The outcomes of the IS project are defined by the success of the system with respect to the investment perspective, the success of the IS project implementation and the success of the desired IS functionality. The basic idea in our analytical framework, presented in Figure 1, is the inclusion and integration of the IS evaluation process into business development and IS development processes. The evaluation categories defined by Peffers and Saarinen (2002) are suggested to be applied in all IS projects, and in projects with great uncertainty they should be applied frequently, to iteratively

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assess the system investment throughout its life-cycle. Furthermore, the IS evaluation process should also adapt to the possible changes in the assumptions that the IS investment is based on, thus in our conceptual framework there is a two-way relationship between the IS evaluation process and, business development and IS development processes. The components of the framework are discussed in more details.

2.1 Outset situation

2.1.1 Organisational norms and values

The investment characteristics and the organisational environment affect the way in which the evaluation is conducted (Huerta and Sánchez, 1999). Organisations operate and survive through organisationally accepted rules that are justified by goals or a hierarchical goal system. Within organisations, there are individual goals, objectives, desires, wishes, intentions, etc, as well as organisational goals, objectives, missions, etc. (Kivijärvi, 2004). As pointed out by Hallikainen et al. (2002), any strategic investment process employs individual and organisational values and preferences, goals and objectives as an input. At best, evaluation would help the organisation to understand its processes, problems and opportunities, thus facilitating organisational learning (Barrow and Mayhew, 2000).

2.1.2 Project contingencies

An information system can, on the one hand, be a small application supporting only one single activity, but on the other hand, it can be a wider system supporting the whole company, or it can even be an inter-organisational system. There is one additional type of information system that deserves special attention, namely infrastructure investments. Infrastructure investments are of high importance because they create the platform on which future applications can be built (see e.g. Dos Santos, 1991). Moreover, why the information system is actually built, depends on several factors. In some situations a company may be forced to build a new information system, e.g. because of legislation changes. Additionally, the senior management may perceive that the system needs to be built, for example, to support a business strategy. Finally, the arguments for building the system can be from the expected and clear quantitative or qualitative benefits from the investment perspective.

The nature of the investment varies according to the novelty of the system. An investment can deal with improving an existing system, replacing an old system or developing an entirely new system. The nature of the investment differs according to how common this type of system is in the field of industry where the company operates (see e.g. Saarinen and Vepsalainen, 1994). For example, investment in a routine system is different from an investment in an innovative system.

2.1.3 IS project resources

Both the material and the immaterial resources are crucial while developing information systems. The integrating role of evaluation includes detecting possible problems and as a result of evaluation it may be noticed, for example, that the project needs more system development resources.

2.2 Business development process

As information technology can make alternative operational designs possible, it in many cases plays a central role when developing the company's business strategy. Furthermore, IT enables new kinds of flexible inter-organisational arrangements (Venkatraman, 1994). Moreover, information technology can support the development of new business, or new products and services. Thus, IS projects are often connected to larger strategic business development programs and the role of IS evaluation would be to ensure that the IS project would deliver the required technological capabilities for achieving the strategic business objectives. The degree that an IS project is involved in business development can range from a system that supports the current business strategy to a system that creates competitive advantages and new business opportunities to the company. An information system investment is in many cases an important part of a business process re-engineering project. The actual aim of the system investment would be cutting costs, improving products or services, or serving a certain customer group better.

2.3 IS development process

In the ever-changing business environment it is very important to be aware of the possible changes that may, in some situations, affect the underlying assumptions that the investment is based on. Thus, it would be essential to conduct evaluation regularly during the development process. According to Burns and Dennis (1985) there are basically three development strategies: to use a system life cycle -based methodology, an iterative methodology (e.g. prototyping) or a mixed methodology. The choice of the development method obviously affects the way evaluation is conducted; for example, prototyping can be considered an evaluation methodology in itself.

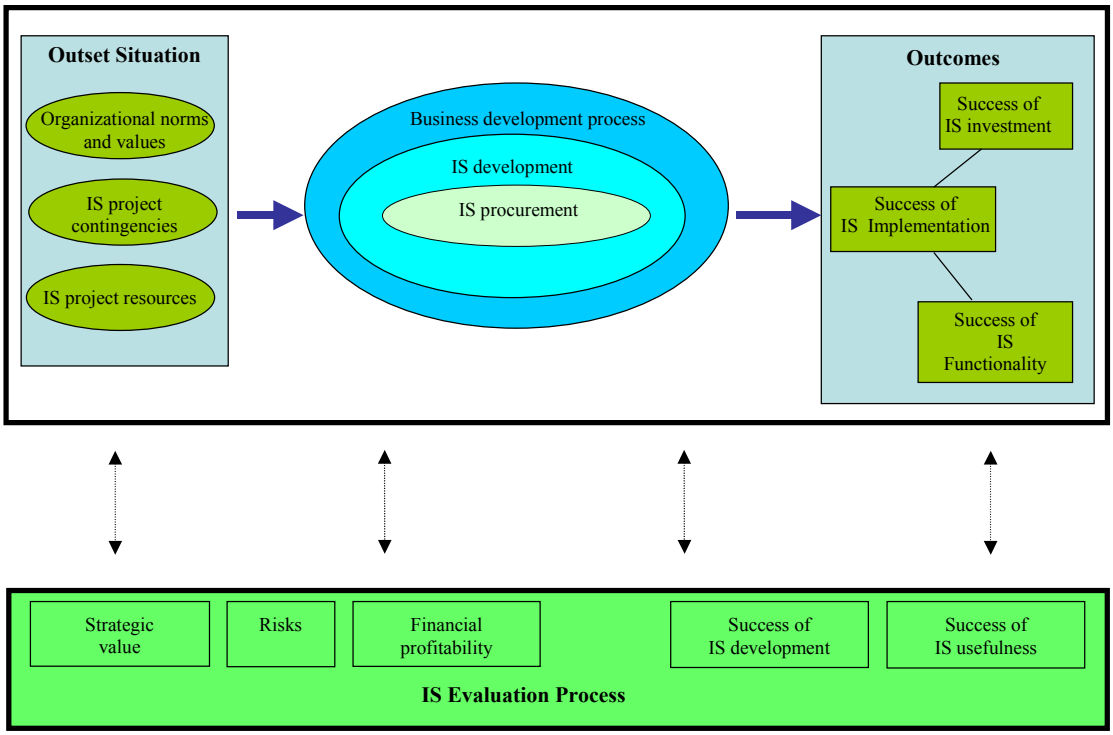

Figure 1 A holistic framework on IS evaluation

There are several factors that affect the risk of the development process. First, the risks would be decreased if parts of existing systems or existing knowledge can be exploited in system development (see Davis, 1982). Secondly, there are some factors related to project management (see McFarlan and McKenney, 1983): the knowledge and skills of the system developers and the representatives of the users affect the risks of the IS development project; the co-operation within the project group and between the project group and the users must be active in order to minimise the project risks; and the risks of the project could be decreased by using formal project management and control methods. In summary, Barki et al. (1993) presented the following factors affecting the risk of a system development project: 1. Technological newness; 2. Application size; 3. Expertise of development team and users; 4. Application complexity; 5. Organisational environment (e.g. conflicts, role definitions).

2.4 IS procurement process

Basically, an information system may be developed in-house, it may be developed by a software vendor, or the company may purchase a software package. Heckman (1999) described two recent trends in information resource acquisition: firstly, the process has changed from an internal to market-oriented; second, there is a more distinct focus on business processes. When using an outside vendor to develop the system, evaluation procedures should be explicitly designed for contracting purposes, since all individuals acting as clients for IS projects may not be knowledgeable about the technology related issues (Kirsch et al., 2002). While IS often plays a central role in developing new business processes, the choice of the IS procurement strategy is critical for company operations. For different kinds of systems different kinds of resources are needed and consequently different procurement strategies are applicable. According to the procurement principles for choosing the efficient procurement strategy, presented by Saarinen and Vepsalainen (1994), routine systems should be implemented by acquiring software packages from implementers, while standard applications require software contracting by analysts and possibly other outside resources for implementation, and speculative investments are best left for internal development by innovators.

2.5 IS evaluation process

The evaluation process should identify and control the critical areas of an IS project. Before selecting the evaluation criteria and methods and deciding who would be involved in the evaluation, it is important to identify all the relevant interest groups for the IS project (Serafeimidis and Smithson, 2000). A covering set of evaluation criteria should be used to make sure that all dimensions of the IS endeavour are taken into account and assessed. The IS evaluation process must be integrated into business development

process, the IS development process, and the IS procurement process.

Wen and Sylla (1999) suggested a three-step process for IS evaluation: 1. Intangible benefits evaluation, 2. IS investment risk analysis, and 3. Tangible benefits evaluation. The steps should be taken in this order, i.e. intangible benefits and risks should be evaluated prior to evaluating the tangible benefits. In our framework, the order of the evaluation categories "strategic value", "risks" and "financial profitability" reflects this suggestion. The "success of IS development" category is placed prior to the "success of IS usefulness" since the usefulness can only be observed after the IS has been used for a while. Ideally, IS evaluation would cover all the above categories, but, however, it is expected that the focus of evaluation is different depending on who conducts the evaluation and where the initiative for the evaluation comes from. Farbey et al. (1992) stated that the focus of evaluation changes according to the organisational interests, which may be on a number of levels, e.g. costs and benefits, organisation's competitive position or industrial relations. We argue, however, that whether the organisation's interests are taken into account appropriately depends on the knowledge and skills of the evaluator. Thus, the senior management should carefully consider who should be involved in the evaluation.

The result of the evaluation should be delivered to each person related to the project so that the information received from the evaluation can be employed in the decision making phase. Most likely, the decision itself would be continuing with the investment (maybe after some minor changes), changing the specifications, range or implementation method of the system, or 'freezing' the project. In addition, the changes might include e.g. schedule changes; reorganisation of the project (e.g. project management can be changed); or vendor changes. The reasons for these changes may be obvious mistakes, unexpected problems, a new experience about the project that changes the idea of the right course of action, or changes in the company's environment, that are beyond the company's control.

2.6 Outcomes

The outcomes of an IS project are identified as the success of 1) IS implementation, 2) IS investment, and 3) IS functionality. IS Evaluation should not work only as a justification mechanism but as a tool for experience learning. During the IS development process, feedback from the evaluation process should lead to corrective actions if necessary. These actions might include, for example, a change in the information system development or procurement strategy, or a change in the resources that are given to the project.

Evaluating the success of an IS implementation should consider at least two dimensions: the process and the product success (Saarinen, 1993). Evaluating the conduct of the IS development process would facilitate the learning for future projects. *The product success includes both the IS functionality and the realisation of the expected benefits from the IS investment.*

To learn conducting evaluation and managing information system projects more effectively, the perceived success of the evaluation process itself can be measured in terms of: evaluation efficiency, precision, and effectiveness (Hallikainen et al., 1998). Evaluation efficiency can be divided into efficiency of evaluation process and cost of evaluation. Evaluation precision can be further divided into satisfaction with evaluation criteria and methods used; and satisfaction with contents, usability and reliability of information produced by evaluation. Finally, evaluation effectiveness can be divided into usefulness of the results of evaluation when making decisions concerning this particular project; and evaluation supporting in aligning information technology and business functions.

3. Research methodology

We conducted a case study in a major Finnish insurance company to investigate how IS evaluation was conducted in an environment where information technology was extensively used in daily operations. The company covers the entire spectrum of insurance services with about 3 700 employees. Based on the above-presented framework (Figure1), we designed a research instrument, a questionnaire, to be used as a basis for interviews. A questionnaire was used, because this study was a pilot study for a survey to be conducted later and one objective was to test the research instrument. The original research instrument is in Finnish language, but the main issues addressed are listed in Appendix 1. Although the interview instrument was rather structured, we let the interviewee talk freely also about issues not mentioned in the instrument to get as rich a picture of the case as possible. We first interviewed the corporate IS manager to get an overview of the use of information technology in the company and to select an appropriate project for the detailed analysis. We selected a pilot project through which the company wanted to gain experience about a new kind of insurance policy and system. We believe this project

represents rather well a typical IS project in contemporary organisations where new business processes are frequently developed, information systems being a crucial part. Moreover, the case has revelatory power, because it is about entering a totally new business area, thus making it feasible to use a single case study research strategy (Yin, 1994). We interviewed the project manager because he was considered to have the widest knowledge of the project. The interviews were recorded on the tape, and the interviewee has checked and commented our written case report.

4. Findings of the case study

4.1 Project characteristics

The system takes care of unit-linked insurance policies, including both life assurance of endowment type and pension insurance. The yield on the unit-linked policies is determined merely in accordance with the return gained by the investment funds chosen by the client. The client is free to choose both domestic and foreign equity and bond funds. The system is characterised as a wide system supporting one business unit. There were about 15 persons who participated in the system development project. The estimated workload was about 30 person months and the estimated calendar time was about one year. It was difficult to define the benefits gained from the investment in monetary terms. The implementation of the investment was based on the senior management's vision of its necessity. The system was seen as an important source of competitive advantages based on a determined business strategy and product differentiation. It was expected that the system would create possibilities for new business. When the system was developed in 1993, this kind of insurance was not legal in Finland, but it became legal at the beginning of 1994. According to the project manager, the background of the investment was that it was known this kind of insurance policies represented in the USA about 30%, in Sweden 50% and in England 80% of all savings insurances, and the company believed that the development would be alike also in Finland. The company attempted to make sure that it could have this product in the market from the beginning. Since the project was about going to a new business area, even the product itself was developed during the system development process (work processes were re-considered). The basic idea of the project, actually, was that the company would gain a few-year experience of using this kind of a system. It was known when developing the system that it would not last long since it was implemented in PC-environment. Later the volumes would increase and more powerful computing would be needed. According to the project manager, this experience has been very valuable.

4.2 IS development/procurement process

There was no prior experience of exactly this kind of systems in Finland. That is why the company investigated a possibility to co-operate with a foreign company. However, this co-operation failed because of some political reasons. Also procurement of a software package was investigated but it was considered too expensive. It was decided that the system would be developed using external resources, i.e. a consulting company. This system was planned to be based on the so called "universal life" principle, which in practice means that the customer pays first an amount of money to an account and the insurance company then debits the account with transaction and other payments and credits it with compensations; the customer just follows the balance of the account. Because of the tight schedule, it was concluded that the most suitable way would be hiring the consulting company to develop the system, using as a basis another system that they had developed earlier, applying the similar "universal life" principle, in the company. So, existing knowledge and experience, and also existing parts of another system could be exploited in system development. This was expected to lower the risks of delayed schedule. An iterative method was used in system development (not actual prototyping though) because the desired system features were not entirely clear at the beginning. As to the project risks, all the people participating in the project were experts but most of the issues were completely new, which according to the project manager was actually a very rare situation. However, co-operation worked well and people were very active in the project. Formal methods were applied in the project management. The issues concerning the project were discussed about once a week in a steering group. The project manager had the general responsibility of the project. In addition there were meetings for discussing the business dimensions and issues related to, for example, marketing and personnel training. Some members of the board of the company also participated in these meetings. The technology used in the project was very new, but according to the project manager it was not considered a big problem. The project was considered medium sized and technically complex, but that was not considered to create uncertainty because the system was not supposed to handle large amounts of information and the system code was not very complex. Moreover, the system did not cause greater

changes in the company's functions, but rather the changes concerned the product range.

4.3 Evaluation process

The concepts presented in the theoretical framework in section 2 are developed into a more operational level in Figure 2 to describe the evaluation process of the case project. The evaluation process and the results for the case company are discussed below. The project was formally evaluated only in the investment proposal phase. The costs of both in-house development and outsourcing alternatives were assessed. A project overview is usually conducted after implementation in the company, but it was not conducted for this project. However, the costs were investigated after the project had been implemented. Moreover, the type of vendor agreement used was assessed. The agreement with the vendor was considered appropriate and the project manager believed that this project encouraged the use of outside vendors. The project manager stressed that the aim of this project was to engage in an entirely new business area. That is why evaluation had to concentrate more on the substance and not so much on the system investment itself. According to the project manager it was most important, in this case, to evaluate whether the business would be successful or not. The project manager and the representatives of the business management conducted the evaluation.

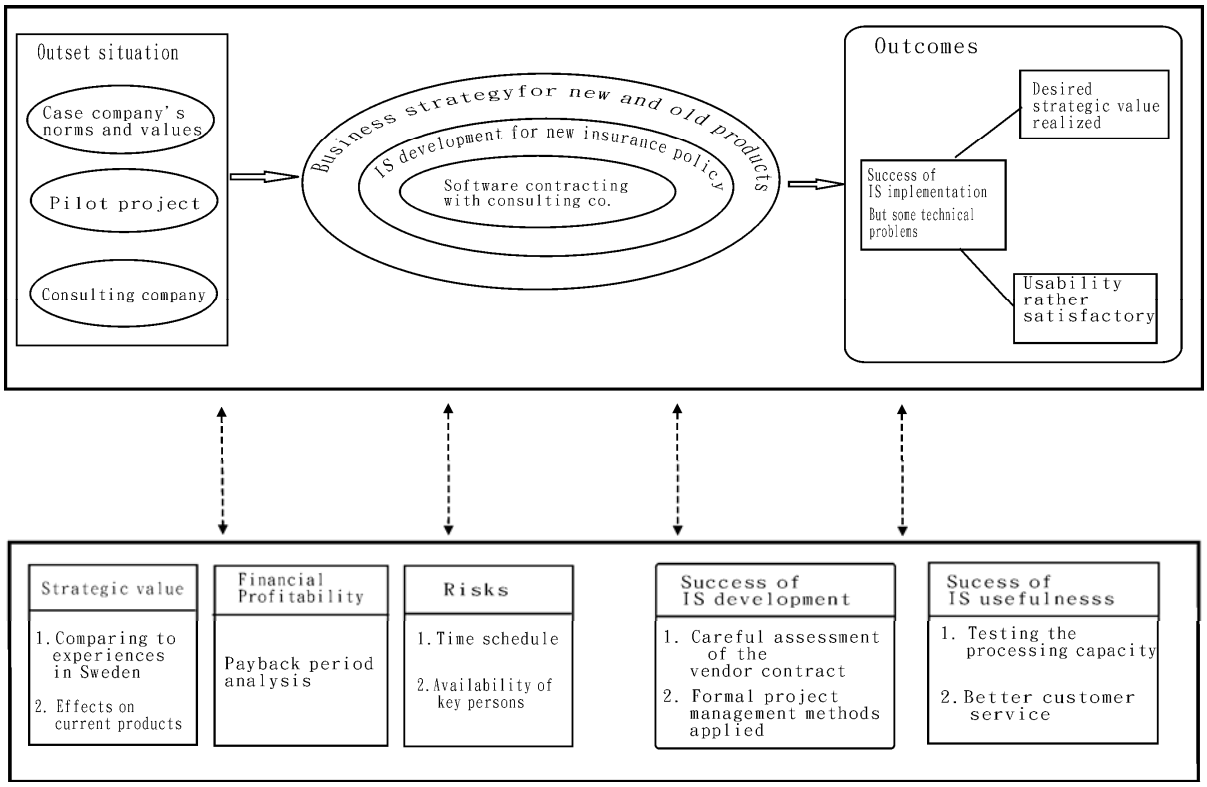

Figure 2 IS evaluation in the case project.

Strategic value was considered as a very important criterion in evaluation. Comparing to the experiences in Sweden assessed the volume of the business. It was important to the company to be in the leading position in the competitive market in Finland. The evaluation concentrated on the following issues: 1. Whether this kind of products could be successful (market shares were compared in different countries) 2. Whether this could be a way to expand to the banking area 3. . Whether this investment could bring new sales volume. During the evaluation process it was also investigated whether this kind of products would replace current products or affect negatively the sales volumes of the current products. Payback period was used while evaluating the financial productivity. The break-even point of costs and incomes was also calculated. The aim of this investment was not to create any big business but expressly to gain experience of this kind of business. Risk was evaluated on several dimensions. There was the risk that the sales of the traditional insurances would decrease because of these new products. Moreover, it was important that the system would be implemented according to the schedule. Further, there were a number of key persons who only had the knowledge and skills required in the project. The schedule affected the decision of choosing the procurement method a lot. Time schedule was a

problem because it was not known exactly when the new law would come into effect. Processing capacity was tested because pension insurance was one part of the system and it requires a lot of calculation. Otherwise, efficiency of use was not considered one of the most critical considerations. There were a lot of new qualitative objectives like transparency (information to the customer about how their money changes into benefits) and clarity; in other words, sufficient customer information, which was taken into account when evaluating the system. Although some technical problems could not be anticipated in the early stages of the project, the project manager was quite satisfied with the evaluation process as a whole. The costs of evaluation were not high. However, the project manager was only moderately satisfied with the contents of information produced in evaluation and the usability of the results of evaluation when making decisions concerning this project.

4.4 Success of the information system project

Generally speaking, the project has been successful. The estimate of the vendor's work amount was exceeded but no big surprises occurred. The strategic benefits expected from the system investment have realised quite well. The project manager considered financial profitability of the project sufficient enough. The procurement process was effective because the same vendor had worked with the company earlier. Only the problems related to the new technology should have been anticipated better.

5. Discussion and conclusions

In this study we have presented a framework for understanding IS evaluation in its broader context. Based on the operationalisation of the framework, we analysed one IS project in details. The first impression of the analysis is that evaluation is highly contextually specific. Although the literature of IS evaluation suggests the use of formal evaluation methods, sometimes it is important to quickly gain experience of a new type of information system or product with a rather informal evaluation process. Formal evaluation does not seem to be important or necessary in every case. Moreover, in the case presented in this study the evaluation process was more concerned about evaluating the business substance, rather than evaluating the information system investment alone.In the case investigated in this study, the evaluation did not cause any major changes in the IS project. There were no major unexpected changes in the business environment that would have caused a larger scale re-consideration of the IS investment. The interviewees were rather satisfied with the evaluation process, but on the other hand, based on our study, we are not able to detect the actual effects of the above IS investment on the business functions of the company. Only the improvements in the business processes would actually prove that the evaluation process has been successful in integrating IS development into business development process. Finally, we were not able to find any established practices for learning about IS evaluation itself. One of the challenges for the case company, and other companies, would be making the tacit evaluation knowledge more explicit so that it could be exploited in future projects. The investigation of how companies adjust their evaluation procedures to the rapidly changing business environment would be one of the interesting areas for future research. Taking the changes in the environment into account would require a continuous evaluation process over the information system life cycle. Another challenging area for future research is certainly the development of evaluation methodologies for new Internet technology based IS. In contemporary IS projects where development time is short, and modifications easy to make, collecting customer feedback efficiently would play the crucial role. Finally, the question how much IS evaluation should be formalised remains a contradictory issue and an interesting topic for future research. It seems that the formalisation of conducting evaluation might not be applicable in the rapidly changing business environment of today, but evaluation knowledge should rather be developed and managed as a continuous process.

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Appendix 1: The main issues in the interview instrument

1. General description of the information system under study
2. Specific characteristics and objectives of the system investment
3. Description of the IS development and procurement process
4. Description of the IS evaluation process
    a. Stages of evaluation
    b. Who conducted evaluation?
    c. What were the evaluation criteria and methods applied?
    d. What were the decisions made based on evaluation?
5. Was the evaluation process perceived as successful in terms of:
    a. Evaluation efficiency?
    b. Evaluation precision?
    c. Evaluation effectiveness?
6. Is the IS project considered successful?

