Post-Implementation Evaluation of Information Systems

Initial Findings and Suggestions for Future Research

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Abstract

Increasing share of corporate capital outlays are allocated to developing and maintaining information systems (IS). A respective need to establish and ascertain the cost effectiveness and positive return on funds used requires assessment by way of evaluation. This is performed in an environment that is more complex, demanding and discontinuous by day. In this explorative study, we focus on preliminary findings about production-phase evaluation practices in Finland.

This paper is an interim report of a study in progress that mirrors existing evaluation practices in Finnish companies against frameworks and recommendations developed for practitioner use.

Results of earlier research show that systematic use of formal evaluation means is rare. When performed in the first place, evaluations are targeted unevenly at different system life cycle stages. Furthermore, it is more of an exception than a rule to apply formal means of evaluation to systems after implementation. If applied, the focus is predominantly on operational measures. Consequently, we argue that some stakeholders' perspective may have been totally omitted. Finally, we bring forward suggestions for further research themes.

Keywords: IS evaluation, evaluation practice, production phase, IS conceptualization

1. Introduction

A modern business organization is increasingly dependent on smooth and reliable flowing of data and information, both laterally and vertically, and both within and across its boundaries. (We shall use the term "data" hereupon to refer to both data and information unless a specific reference is made to the user of data.) Data is also increasingly considered as a corporate resource, even having a critical effect on day-to-day operations. A modern basic textbook chart of a company's core processes would depict information process together with the traditional financial and material processes. Therefore, creation, accrual, manipulation, storing, distribution and use of data should be viewed as basic elements of fundamental corporate processes. This trend is enforced by business organizations that gather, manipulate and sell data as commodity thereby effectively merging material and data flows.

The constantly growing share of investments allocated to the area of information systems (IS) is evident from the growth of the supplier industries, be they hardware, software or

data communication vendors or consultants. Recent news in daily press also highlight the growing employment figures in IS and information technology (IT) professions. An accentuation of this trend is the emergence of different models and operating entities of electronic commerce, such as electronic banking systems, EDI-based procurement channels, electronic grocery stores, studied in recent research (Tuunainen 1999).

The scope of professed benefits of IS investments include:

- Added revenue
- Cost savings
- Improved productivity and process quality
- Enhanced management information
- More focused decision support
- Strengthening of competitive position

There are of course several such lists differing in length and emphasis depending on the author in question; an example of an earlier, authoritative one being that drawn by Michael J. Earl and quoted by Powell (1992). No matter how the list is construed, we feel safe to state that any single benefit aimed at may alone represent the sole purpose of the investment. Alternatively, benefits may be sought after in various combinations.

In comparison with investment preparations, especially in the form of feasibility studies, relatively little attention has been devoted to evaluation of the investment outcome. Such an inquiry would focus on the expected functioning of the system. Answers would be sought for a variety of questions, such as; is user satisfaction at an adequate or expected level, is the investment paying itself back as expected, is the quality of the end product satisfactory, etc. Essentially, an inquiry of this scope would involve evaluating the realization of a wide spectrum of expectations and divergent levels of analysis.

The significance of evaluation in production phase is intrinsic of the nature of information systems. Like organizations, they evolve over time both in structure and in behavior. This process begins the moment they have been taken to productive use (Land 1992). The underlying reasons are that although formally designed – inclusive of human procedures involved – they, firstly, are used in ways not anticipated by design, and second, they adopt attributes from informal information systems. The described evolvement that has very little by way of determinism poses two challenges to a business organization. For one, the contemplated benefits ought to be ascertained, and secondly, exploitation of accrued knowledge ought to be retrieved, stored and made available for future system implementations.

Hallikainen et al. (1997b) have recently reported on a study of a sample of the largest firms in Finland, representing a variety of industries. They were able to conclude that companies seldom evaluate IS investments after the initial project proposal; “If any evaluation is done, it is performed … only in the beginning of the development cycle”. The time, however, when the system is up and running, is the phase where the investment’s success is realized in the final analysis. If, however, an evaluation is performed during the production phase, it focuses on operational measures, like efficiencies as opposed to effectiveness.

In this study in progress, we have three basic goals. First, we aim to review relevant literature, specifically from the perspective of post-implementation evaluation. This we do paying close attention to conceptualization and perceived scope of an information system. Secondly, we try to identify practices and problems in production phase evaluation based on empirical data. Thirdly, we propose avenues for further research. In this effort we wish to avoid confining ourselves solely to the area of IS evaluation. In a tentative mind, we even try to

identify contextually nearby professional practices which would lend themselves to assessing the value of IS at large.

This paper is organized as follows. After introduction, we describe our research approach in Methodology. Thereafter, we review Information system evaluation conceptually, drawing heavily from literature review. An attached subsection illustrates in more exact terms evaluation problems encountered and presented in literature. Evaluation in production phase is where we look at our survey data and mirror it in the setting created up to that point. We close with Discussion and conclusions in two subsections; Theory versus practice and Ways forward, where we suggest directions for possible further research.

2. Methodology

We adopted a questionnaire-based self-administered mail survey as the basic research approach. We also supported the survey by performing a multiple case study that included three IS project subjects to test the questionnaire form. The results of the case study are reported in Hallikainen (1996), Viita (1996), and Hallikainen et al. (1997a). Some results of the mail survey describing the evaluation practices in Finland and the decision making based on evaluation have been reported in Hallikainen et al. (1997b) and Hallikainen et al. (1998).

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 evaluations
4. What decisions are made based on the evaluation information

The survey was conducted in two rounds. We decided to approach first the IS executives to get an overall view of the company and the evaluation practices adopted. We also asked the executives to single out and name recently completed evaluations for our study and, as a second round, contacted the respective project managers responsible for the development effort. We designed separate questionnaires for both respondent groups. The first questionnaire was addressed to the Information Systems Administration executive or another person responsible for corporate level IS in 300 largest companies in Finland. After written reminders and telephone 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 it. IS executives 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 in progress. However, only in two companies the IS executive judged the information we asked to be too confidential to be given out of the company. Finally, we were able to use 38 completed answers to the IS executive questionnaire (one answer contained too many missing values and had to be left out) and 31 answers to the project manager questionnaire.

2.1. Data used in this study

The basic characteristics of projects surveyed are enumerated briefly underneath; all figures are arithmetic averages.

- Total project cost budget, FIM 11 474 k
- Personnel resources, 624 man months
- Planned project length, 17 months
- Number of project resources, 29 persons
- Expected number of end users, 371 persons

In this study we focus on the data describing the projects with respect to production phase evaluation. We analyze answers to two pairs of open-ended questions. The first pair referred to the efficiency of use. They were formulated as follows. “What methods did you employ in evaluation?” and “What factors did you aim at?” The second pair referred to the effects on the conduct of business activities, and it was worded likewise. The references were stated as question headings.

As to the treatment of the empirical evidence, we refrain ourselves from making any sophisticated statistical analysis. Any extension to generalize our findings to the relevant population seems to us unjustified simply based on the sample size. Instead, we examine the data with a view to being able to arrive at preliminary findings. In other words, we pursue a study, which is more of qualitative than quantitative nature. We specifically endeavor to identify problem areas that are endemic to system in its entirety.

We shall next touch upon the scene where IS evaluations are performed.

3. Information system evaluation

Some twenty years ago an IS investment to automate a manual procedure may simply have been justified as a productivity tool to achieve cost containment benefits. The scope of IS evaluation could therefore be considered as having been rather narrow. The evaluation perspective would have been more or less confined to the financial domain. Additionally, the metrics employed in evaluation would have been adopted singularly from the sphere of capital budgeting.

Over these years, this picture has changed dramatically. Later adoptions of IS have had deeper organizational impacts (Smithson and Hirschheim 1998) accentuated by the recognition of the recursive relationship between information technology (IT) and business processes (Davenport and Short 1990). This recognition set off a wave and popularized the use of IT in corporate endeavors to enhance process efficiencies and effectiveness by what became known by Hammer (1990) as business process reengineering. In short, an information system is increasingly taken into focus and used actively as a vehicle to achieve, at times profound, multidimensional targets.

In a contemporary, conceptual view IS are recognized to comprise not only software – like user- and database applications at the core – but also hardware, use processes, use procedures, user roles together with the organization and its structural instances, not forgetting the data either. These components singly or in combination enable a company to actively pursue gains in competitiveness.

A reactive perspective, on the other hand, can be traced to research specifically

focusing on the interplay between IT and organizational change. Using the conceptions of technological imperative, organizational imperative and emergent perspective, Markus and Robey (1988) enumerate forms of these predicted changes. In crudely simplified terms, the first means treating IT as an exogenous, independent variable that has a constraining and determining impact on organization. The second treats IT as a dependent variable that is designed to satisfy organizational needs for information. The third "holds that the uses and consequences of information technology emerge unpredictably from complex social interactions".

A further contemporary view representing and arguing on behalf of this wider focus is research performed in the field of data - and/or information - quality (DQ), an example of which is that of Strong et al. (1997). In their report, they argue in favor of the information consumer who, at the end of the day makes a judgment on the quality from his or her fit for use angle.

Looking at our survey data this concept of wider focus is reflected in answers to questions relating to the corporate functions that have initiated or performed the evaluation. Intuitive reasoning suggests that a narrow scope - say user interface evaluation - would originate from within the domain of respective expertise, i.e. centralized EDP-function. Additionally it would be performed by an expert representing that particular domain. The initial observations as to both the initiators and performers give reason to suspect that evaluation function is carried out basically rather mechanically, following formal routines and procedures. The dominant role in initiation has been played by executive management, representing either a business function or centralized EDP. This may suggest permanent policies, which allow relatively little by way of freedom or incentive to act on own initiative. On the other hand we could establish that majority of evaluations had been carried out by project managers themselves. This we find surprising with respect to the role of evaluation; is it just a justification mechanism for project completion or a true assessment of the benefits sought after.

By way of a summary, we have touched above issues that have direct bearing on the challenges facing IS evaluation. Far gone are the days when an IS related procurement could be treated as a productivity enhancing, single-dimensional tool, the utility and benefit of which could be easily established with simple financial arithmetic. The issues today are more challenging against the above noted dramatic changes in the IS field.

Before proceeding to consider problems facing evaluation efforts, it is high time to articulate a state-of-the-art definition of evaluation. We cite a fresh research report (Farbey et al. 1999). "(IS evaluation is) a process, or group of parallel processes, which take place at different points in time or continuously, for searching and for making explicit, quantitatively or qualitatively, all the impacts of an IT project and the programme and strategy of which it is a part". In the context of this paper, the word 'all' is of particular importance.

3.1. Evaluation problems

Even without the above stated aggravations of wider scope, IS evaluation has been judged a "thorny problem" that is inherent to the exercise (Smithson and Hirschheim 1998). However, before proceeding to problems encountered we reiterate the basic functions of evaluation:

- To provide the basic feedback function to managers (Smithson and Hirschheim 1998)
- To support the organizational learning processes through single or double loop learning (Hallikainen 1999)
- To allow problem diagnosis, planning and reduction of uncertainty (Smithson and Hirschheim 1998)

- To offer an estimation of the expected value of the IS investment (Hallikainen et al. 1997b)

If the above are the generally acknowledged functions, what are then the factors that inhibit evaluations to succeed as expected? Numerous factors, as well as random items could be listed as causes. To create a setting, against which we can examine the empirical data, the following bullets offer a rough and, admittedly, short enumeration based on two recent research reports (Hallikainen et al. 1997b, Smithson and Hirschheim 1998).

- Even the most formal approaches to evaluations are characterized by subjective judgements of the people concerned
- Different stakeholder groups (internal as well as external) often hold conflicting views on goal setting
- A new information system has social, organizational and human impacts during a long period of time that generate practical difficulties in performing an evaluation
- Part of the benefits pursued are intangible and thereby difficult to measure in a manner that would gain wide acceptance
- Several developments may be under way simultaneously and might get entangled with each other
- Once committed into, the investments are irreversible

To complement the next to last bullet we wish to make an explicit reference to undesigned or informal information systems. By their very nature they may escape perpetually any formal administrative or formal control, or, as the case may be, be intentionally allowed to carry on with their lives. An illustrative example of the latter is presented by Strong et al. (1997), with an inventory system data being periodically updated by physical warehouse counts due to repeated inaccuracies.

Up to now we have - figuratively speaking - constructed the scene. It is time to move forward bringing along our survey data and mirroring it to the considerations that we have built up so far.

4. Evaluation in production phase

Earlier research (Hallikainen et al, 1998) is compelling in showing the evaluation frequency decreasing from ex ante investment decision through development process to production phase. When evaluations are performed towards later stages, they tend to emphasize operational measures, like response and down times.

In our opinion a fundamental difference between evaluating an IS investment at the outset and a system in use lies in the goals and expectations relating to the system. In this regard we temporarily adopt a natural system view (Scott 1998) of an information system as an organization. Such organization would have internal as well as external participants. They could respectively be users, planners and information consumers or suppliers, certified public accountants and representatives of a public authority. The logic in our reasoning is based on increasing number of participants, as the system progresses from an initial idea into a full blown, operational system. The number of participants in itself increases the potential of variations of goals and expectations. This in turn may easily lead to conflicting perceptions. Taken a step

further, towards system maturity, evaluation may become a highly political activity (Smithson and Hirschheim 1998).

We are able to conclude as results of our study the following points. In general, the production phase evaluation appears to be more challenging than earlier phases. There are unexpected variations, both in structure and in behavior, arising along system life cycle. The structural context of a production phase system is complex rendering measurement difficult. At production phase, the range of stakeholders is wider since the whole system cast is now on the stage.

Some of the major problems in evaluation, mentioned by project managers in our data, were due to adoption of too narrow a scope of evaluation. Problems included, among others, the effect of unanticipated exogenous factors in the outcome, and later difficulties in finding effective mechanisms for making the corrections suggested by evaluation. This clearly suggests a need to improve evaluation procedures themselves in the production phase.

Our data shows further that in many cases even the efficient operation of the system has not been ensured or evaluated. Responses clearly indicate that proper metrics have been difficult to find in order to track the effects of the system to business functions. The subtle successes have used traditional methods developed in another business area, mainly management accounting. In our data, only one single project manager explicitly stated that the project outcome was measured against a production scenario. A proper, comprehensive production scenario, naturally, encompasses all stakeholders. Our sample does not offer evidence of this, rather the contrary – neglect of a set of stakeholders.

5. Discussion and Conclusions

5.1. Theory versus practice

The basic propositions of the present theory of IS evaluation as presented by Smithson and Hirschheim (1997) rest on the argument that "evaluation is endemic to human existence". The authors further point to the need to enlarge the scope of evaluation "to be relevant throughout the life cycle". At face value, this would lead to companies engaging in a more dense sequence of evaluation efforts with longer chronological coverage.

Throughout this study in progress, we have come to suspect that information systems in use may have grown in both complexity and their organizational impacts to include a myriad of quantifiable and non-quantifiable features. These features, some tangible and some intangible represent such a variety of benefits, as well as stakeholder and data quality dimensions that a single, compact, post-implementation evaluation effort is increasingly suspect. We naturally allow for narrow investment focuses ceteris paribus – such as upgrades of hardware or switches from one packaged application program to another – and allow them to lend themselves to a focused but equally narrow evaluation. However, a full-blown, designed, computer based information system in daily use presents itself as a monumentally complex evaluation object. After all, such a system is made up of both concrete – also called artifacts - and abstract objects, people, rules, and norms as well as commands (Land 1992). This position is also supported in the IS science epistemology by Hirschheim (1992), who concludes, "…

information systems are, fundamentally, social rather than technical systems". Our initial empirical findings support this view.

Our explicit position supports the view of focusing on a system as the subject, the entity in question. A somewhat contradictory-in-scope position has been identified as being the focus of most of the literature, namely the application level, and the impact of a particular application (Smithson and Hirschheim 1998). This we interpret to be a special case connected to the view and angle adopted by the relevant evaluator. This interpretation of ours is supported by our findings, which have allowed us to conclude that post-implementation evaluations are focused selectively at various components – as an application as noted above - features, functions or combinations thereof, of IS. Not a single evaluation tackled the system at large.

We take this to suggest that perhaps the complex blur of uncertainties together with hard to grasp intangibles has rendered a compact, all encompassing evaluation exercise to nearly a mission impossible.

5.2. Ways forward

Some avenues of further research easily present themselves as a logical continuation of our reasoning thus far. A basic dualism between IS process and IS outcome is an interesting field to study, for instance, the relationship between their effectiveness and efficiencies respectively. These concepts relate closely to productivity at large, which as such has been argued by Smithson and Hirschheim (1998) to be a difficult beast to conceptualize. To further complicate the potential theme we refer to a statement by Davenport et al. (1996): "It is … difficult to separate a knowledge process from its outcomes". An example of such a difficulty might be a break-through product requiring inventing a new process.

Demographics of our data show a rather large average project size. There is a possibility of a correlation between the degree of formalism of evaluation methods and corporate, or project size. Part of the non-respondents in our study communicated that they did not employ any formal methods. This readily leads to a further question of whether, instead, they employ informal methods or omit evaluation activity altogether.

Throughout this study, we have repeatedly met with the notions of stakeholders, differing goals, organizational changes, political tensions, which, together revolve around the theme of wide scope of an information system, with complexity and multidimensionality as inherent features. In our opinion, this effectively renders a comprehensive evaluation of an information system in production phase a monumental, if not simply an impossible endeavor. We can only speculate at this point in time. One vision relates to a cross-disciplinary task force vested with a mission to evaluate one system after another from all conceivable perspectives. Another vision relates to expert domains, like data quality and user interface design, with individual experts evaluating the conformity of characteristics at issue to a predefined set of standards.

Whether or not one or the other of these visions ever comes true, they are worth a scientific pursuit. This would entail the following sequence in line with the recommendations of MIS research paradigm (Galliers 1992):

- Research question
- Survey research
- Theory building
- Case study/action research

- Theory testing (field experiments)
- Theory extension

The next step of our research might be to conduct an exploratory survey to map post-implementation evaluation practices in a more thorough and focused manner. One goal of the survey would be to identify advanced practices for conducting a series of in-depth case studies.

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