EVALUATING THE BUSINESS BENEFITS OF INFORMATION SYSTEMS

N. Bakis, M. Kagioglou, G. Aouad,
Salford Centre for Research and Innovation, University of Salford, Salford, M5 4WT
E-mail: n.bakis@salford.ac.uk

ABSTRACT: In order to promote the use of new IT technologies in the construction sector, the research community needs to provide more empirical and specific evidence of the business value of these technologies to construction organisations. This paper reviews the issues involved in the evaluation of the business benefits of information systems. It focuses on the use of case studies for the evaluation of the benefits and favours a process oriented approach to evaluation. It explains why the evaluation of the business benefits is inherently problematic and why it is not usually possible to quantify those benefits in single, monetary terms. It then focuses on the evaluation of the business benefits itself and in particular on two main issues: how to identify the benefits in the first place and how to deal with the issue of intangible benefits.

Keywords: Information systems, Business benefits, Evaluation/Assessment

1. INTRODUCTION

The construction industry has been often criticised for its slow uptake of new IT technologies. In order to promote the use of such technologies, the research community needs to provide more empirical and specific evidence of their business value to construction organisations. The business value of an information system is determined by the system's benefits and costs (including purchase/development, user training, operating and maintenance costs). The element of risk is also usually taken into account when deciding the investment in an information system. Here we will focus on the business benefits and evaluation of those benefits.

There are three main empirical investigation methods that could be used in evaluating the business benefits of information systems: case studies, experiments and surveys (Kitchenham *et al*., 1995). Case studies, which do not require any level of replication, involve the examination of the use of a system in particular projects/organisations, placing emphasis on the context within which the benefits of the system accrue. Experiments on the other hand require appropriate levels of replication and experimental subjects and objects that are chosen in random within the constraints of an experimental design. Finally surveys examine the impact of a system across many projects/organisations at a broad level without examining the particularities of each individual project/organisation.

Among these three empirical investigation methods, the one that is more appropriate for the evaluation of the business benefits of new IT technologies is that of the case study. This is because, as we will see in more detail below, the impact of an information system depends on many different and complex factors which cannot be easily isolated and controlled for the purpose of a formal experiment. Surveys on the other hand are difficult to conduct for new technologies, as the number of projects/organisations using these technologies will be limited. But even if an adequate population could be established, a survey would not provide any insight on how the benefits are created and may not therefore help construction organisations judge whether those benefits will be applicable to their particular situation. As we will see in more detail below, in many cases, an information system, the business objectives and processes it supports, and the business benefits it brings, are too closely interrelated to be examined separately, the one independently of the other.

In evaluating the business benefits of an information system, the first thing that we should be aware of is that it is not always possible to express those benefits in single, monetary terms. Neither it is always possible to produce a definite statement of those benefits. As we will see below, it is not always possible to identify the business benefits with certainty and accuracy, neither it is always possible to express those benefits in absolute and universal terms, without any degree of subjectivity.

This paper proceeds as follows. Section 2 below examines one of the two main reasons why it is not always possible to produce a definite and universal statement of the business benefits of information systems, that is the fact that the assessment of the business benefits of an information system is impeded by several difficulties. Section 3 then examines the second reason, that is the fact that the business benefits of an information system are a matter of context and perception. Against this background the paper favours a process oriented approach to evaluation. It then examines the evaluation of the business benefits itself and in particular two main issues: how to identify the benefits in the first place (section 4) and how to deal with the issue of intangible benefits (section 5). The paper ends with the main conclusions drawn in section 6.

2. DIFFICULTIES WITH THE EVALUATION OF THE BUSINESS BENEFITS OF INFORMATION SYSTEMS

One reason why it is not always possible to produce a definite statement of the business benefits of an information system expressed in clear, e.g. financial, terms and without any degree of subjectivity, is the fact that the assessment of the business benefits of information systems is impeded by several difficulties, as any treatment on the subject would probably tell.

First, some of the business benefits of an information system might be intangible in the sense that they do not directly lead to identifiable performance improvements. For instance, an information system might

improve customer satisfaction. But how could one measure customer satisfaction in financial or any other terms? As they do not directly lead to identifiable performance improvements, intangible benefits are difficult to quantify. In some cases, it may be possible to assign a subjective value to them. But in some other cases, such assignment may not be possible or make any sense at all. Nevertheless, assigned with a value or not, intangible benefits do not stop being very important as they could make a critical contribution to the success of an organisation (Remenyi, 2000).

Second, the introduction of any substantial information system could bring significant changes in organisational terms (e.g. changes in organisational structure or procedures), social terms (e.g. social interaction, quality of working life, organisational culture) and management terms (e.g. information access and decision making) (Walsham, 1993). These changes might happen gradually and take long time to materialise, and might affect the organisation's performance in a positive or negative way. Trying to envisage those changes and the benefits they might bring is a difficult task. But even if those benefits could be identified, it is rather difficult, as Farbey *et al*. (1993) note, to isolate the factors that contribute to them and establish whether they should be attributed to the system or not.

Third, as Remenyi (2000) points out, the business benefits of an information system do not usually stay static but rather evolve over the system's lifecycle. An information system may provide the basis for additional functionality or be used in ways that have not been previously thought of. For example, the World Wide Web was originally developed as a system for disseminating information within the academic community and has now found application in many different areas. In short, as the role of the system within the organisation is gradually understood, refinements could be made and new benefits may arise. However, trying to forecast those benefits is almost impossible, especially in today's dynamic economic environment where businesses rapidly change.

Fourth, different stakeholders see the system from different perspectives and may have conflicting objectives. These conflicting objectives as well as the lack of a common baseline of definitions make the assessment of the business benefits problematic. For instance, in a case study reported by Smithson and Hirschheim (1998), the managers of an organisation wanted to outsource the IT function in order to reduce costs. The end users on the other hand wanted to maintain the existing IT department, which was providing high quality of service. At the end, the decision to outsource the IT function was taken, and while the managers saw this decision as successful, the users were highly disappointed by the quality of service getting from the outsourcing organisation.

Fifth, there is a danger of the evaluation becoming a political activity (Lederer *et al.*, 1990). The users might feel threatened by the introduction of the system, as they might see their jobs being at risk, and when asked to participate in the evaluation they may underrate the system in order to oppose its introduction. Or, as a classical case study by

Markus (1983) has shown, an information system might be used to shift power between different groups and the evaluation of the system might become subject to external pressures in order to produce results in favour of the various political ambitions.

Finally, in addition to the above problems, there are a number of practical difficulties. Brynjolfsson (1993) points out that an information system might not materialise all of its benefits simply because it is not used properly. For instance, learning difficulties may cause a lag in delivering the benefits. Smithson and Hirschheim (1998) note that modern information systems have become too complex and sophisticated, and their functionality and scope has increased dramatically. They also note that today's systems are much more frequently interlinked and it is rather difficult to disentangle a singe system for the purpose of evaluation. Finally, Renkema (2000) stresses the difficulty of assessing the business benefits of infrastructure investments which do not deliver any benefits directly but provide the basis for other applications to operate.

The above difficulties make the assessment of the business benefits of information systems problematic. However, as Bannister & Remenyi (1999) point out, there is not any reason for those benefits to be glaringly obvious. There are many types of investment where the benefits are really rather subtle, but are no less real for that. For instance, corporate head offices and prestige motorcars for executives could be mentioned as two of them. And as Powell (1992) points out, one should not forget that similar difficulties are encountered in many other areas of evaluation. For instance, the evaluation of other economic and social investments, such as education and training or research and development, faces similar problems.

3. IT VALUE AS A MATTER OF CONTEXT AND PERCEPTION

Another reason why it is not always possible to produce a definite and universal statement of the business benefits of an information system is the fact that, as several authors note (e.g. Farbey *et al*., 1993; Mooney *et al*., 1995; Remenyi *et al*., 2000; Soh & Markus, 1995), an information system has no direct value in its own right. Instead, an information system has a potential for derived value. This derived value depends on the reason for, and the way in which, the system is going to be used. For instance, integrated information systems aim to improve the information flow and collaboration between the participants in a construction project. However, with the traditional forms of procurement and sequential construction process, this improvement will be kept to minimum. Only within an environment that promotes collaboration and the open and freely exchange of information, such as partnering (Bennett & Jayes, 1998), the full potential of integrated systems can be materialised.

The fact that an information system has no direct value in its own right means that the business benefits of an information system cannot be

perceived directly or on their own, independently of the business objectives and processes the system aims to support. It is those objectives and processes that would primarily determine the contribution of the system to the organisation's performance, as figure 1 illustrates.

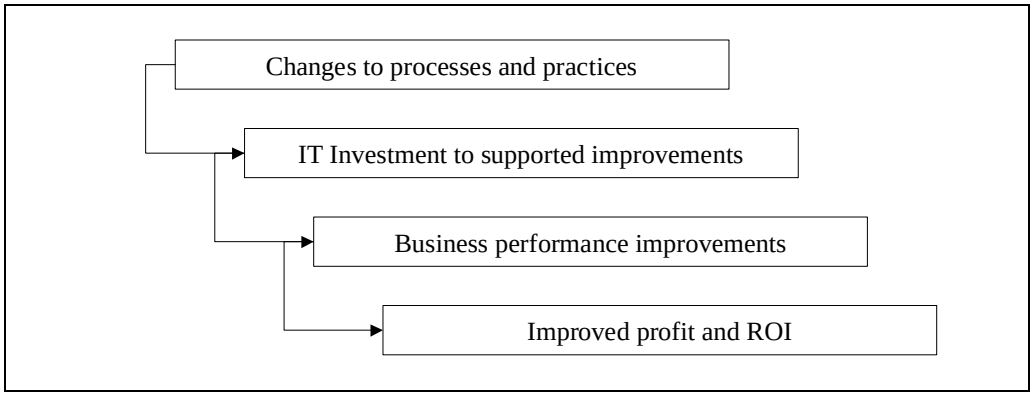

Fig. 1.The Soh and Markus (1995) model of how IT creates business value

The fact that an information system has no direct value in its own right also means that we cannot judge the success of an information system solely based on the improvement of the organisation's performance. As Soh and Markus (1995) note, the success of an information system should be ultimately judged on how well the system supports a specific business initiative and not on how well this initiative performs. If, for example, the information system has been deployed to achieve higher levels of customer service, it should be judged on whether those higher levels of customer service have been achieved and not on whether those higher levels of customer service have led to increased revenue.

3.1 The Need for a Process-Oriented Approach to Evaluation

Assuming that the introduction of an information system is associated with some process improvement or reengineering effort, since the biggest benefits of information technology do not usually come by assisting and speeding up existing processes but rather by redesigning the existing processes to take advantage of the opportunities offered by information technology, this interdependency between the business objectives and processes that an information system supports and the business benefits that an information system brings, has led many researchers to call for a process-oriented approach to evaluation (e.g. McKeen *et al*., 1999; Mende *et al*., 1994; Mooney *et al*., 1995; Mukhopadhyay & Cooper, 1993; Tallon *et al*., 2001). A process-oriented approach to evaluation provides a greater insight on how an information system creates business value than an organisation- or project- level evaluation does.

With the project-level evaluation, for example, one would try to examine the impact of the system to a construction project as a whole. S/he would use project-level output measures, such as the total time it

took to complete the project, in order to compare a set of projects that have been completed with the assistance of the system with a similar set of projects that have been completed without it. The differences between the two sets of projects would be then considered as an indication of the system's impact on the project's performance. With this approach, however, it is not clear whether any difference in performance is owed to the system or to any other factors. In addition, the method does not provide any insight on how and why the business value is created.

With the process-oriented approach to evaluation, on the other hand, one would take a more analytical approach and try to understand how the system creates business value by examining the impact of the system to each individual project process; how, for example, the system improves the procurement process, the design process, the construction process, or any other process, at this or any other level of detail. The greater that level of detail is, the more detailed the analysis is expected to be. By identifying the improvements that would be made, the evaluator could then establish and assess the business benefits that accrue from each improvement. By aggregating the benefits from all sub-processes, s/he could then acquire an overall view of the system's contribution to the project's or organisation's performance. The availability of the *as-is* and *to-be* process models, developed during the process improvement/reengineering effort, could assist in this effort. In addition, several of the system's benefits would have been already identified during the process improvement/reengineering effort, as it is the knowledge of those benefits (the capabilities of the technology) that would have driven the design of the improved *to-be* processes.

By analysing the impact of the system at the level where the system is deployed, that is the level of each individual process, this process-oriented approach to evaluation provides greater insight on how and why business value is created. As Mooney *et al*. (1995) note, such an approach "enables to move beyond correlation evidence to explanation of the technological features, process characteristics and organisational settings conducive to producing IT business value". Therefore, with such an approach, an organisation could get a greater insight on whether the documented benefits would be applicable to its particular situation. In short, as McKeen *et al*. (1999) note, in many cases, the information system, the business objectives and business processes it supports, and the business benefits it brings, are so closely interrelated that it makes no sense to see the one independently of the other and draw any boundaries around them for the purpose of evaluation.

4. IDENTIFYING THE BUSINESS BENEFITS

The first question that arises when evaluating the business benefits of an information system is how one could identify those benefits in the first place. Is there any method that could be used? And how one could be sure that all the benefits have been exhausted and there are not any

other benefits that s/he has not thought of. Unfortunately, the answer to those questions is that there is not any method per se and that one can never be sure whether all potential benefits have been identified.

The reasons for this have been already mentioned above. As we saw, an information system could bring many complex and unpredictable changes in organisational, management and social terms, and its use could evolve over time; today's information systems have become too complex and sophisticated and their functionality and scope has increased dramatically; in today's dynamic economic environment and rapidly changing world of information technology, it is rather difficult to make any long-term predictions.

As it was mentioned above, in the case of a process improvement/reengineering effort, some of the potential benefits of an information system would have been considered during the process improvement/reengineering effort, as it is the knowledge of those benefits that would have driven the design of the *to-be* processes. However, in addition to the obvious direct benefits, other indirect benefits may also arise. For instance, while the primary reason for using integrated information technology could be the increased productivity and reduction in design errors that are expected with the automatic transfer of information from one application to the other, the additional benefit of the "greater human focus on the critical issues due to the automation of routine tasks" (Ingirige *et al*., 2001) may also arise. Therefore, when evaluating the business benefits, the potential benefits must be carefully re-examined.

The identification of the business benefits of an information system is primarily a brainstorming activity which requires: (i) knowledge of the application domain; (ii) an understanding of the capabilities and limitations of the system; and (iii) an understanding of the business objectives of the organisation in the context of which the evaluation takes place (Farbey *et al*., 1993).

Of course, when trying to identify the business benefits, one does not have to start from scratch, with a clean sheet. First, a number of generic lists of the potential benefits could be found in the literature. These lists may refer to information systems in general or to the system under consideration in particular. For example, table 1 shows several publications providing lists of the potential benefits of information systems in general and integrated information systems in particular. Although these lists are quite generic and at varying levels of detail, they can nevertheless act as a prompt and provide an indication of whether all the potential benefits of a system have been identified.

Table 1. Lists of potential business benefits of information systems in general and integrated systems in particular

Publication	Description
The following publications provide lists of the business benefits of information systems in general	
Farbey *et al*. (1993)	Provides a list of over 130 benefits classified in five categories (functional, strategic, management, operational and support). The benefits are expressed at various levels of detail.
Mirani and Lederer (1994)	Provides a list of 35 benefits compiled from several publications. The benefits are expressed at a broad level of detail.
Parker and Benson (1988)	Provides a comprehensive list compiled from several publications that contains over 200 benefits in 21 different categories. The benefits are expressed at a medium level of detail.
The following publications provide lists of the business benefits of information systems in construction	
Construct IT (1998)	Provides a list of over 80 benefits classified according to their type (efficiency, effectiveness and performance) along one dimension, and according to the business processes they support along the other. The benefits are expressed at a medium level of detail.
The following publications provide lists of the business benefits of integrated systems in construction	
Chapman (2000)	Provides a list of over 110 benefits expressed at various levels of detail. The benefits are classified by stakeholder group.
Sulankivi *et al*. (2002)	Provides a list of over 90 benefits classified into *monetary, quantitative* and *qualitative* along one dimension and according to the main project processes in construction along the other. The benefits are expressed at a medium level of detail.
The following publications provide lists of the business benefits of integrated systems in manufacturing	
Ebel (1992)	Provides a list of 19 benefits expressed at a very broad level of detail.
Jones and Beatty (1998)	Provides five lists of the business benefits of EDI from five different sources. The benefits are expressed at a broad level of detail.

Second, there are some benefit classification frameworks that could act as a prompt by reminding the potential areas where the benefits may occur. For instance, Farbey *et al*. (1993) use Mintzberg's organisational model to classify the benefits into *functional*, *strategic*, *management*, *operational* and *support*. Similarly, Peters (1990) uses Porter's *value chain* framework, which divides the main activities of an organisation into *inbound logistics*, *operations*, *outbound logistics*, *marketing and sales*, *service*, and *support activities*. The higher level business processes of an organisation could be also used. For instance, Construct IT (1998), in its *Measuring the Benefits of IT Innovation* framework, uses the generic business processes of construction organisations which it identifies as *Business Planning, Marketing, Information Management, Procurement, Finance, Client Management, Design, Construction, Occupation and Maintenance,* and *Human Resources*.

4.1 Business Value Linking

The business benefits of an information system are usually derived through a web of intermediate causes and effects. For example, as illustrated in figure 2, one of the first order impacts of an integrated system is the automatic exchange of information between the design applications (shown in the rounded box). From a designer's perspective, this first order impact subsequently leads through a web of intermediate impacts to the two benefits that have direct impact on the firm's performance (shown in bold): the lower expenses and the increased likelihood of future investments by the client.

Establishing the web of the cause and effect linkages that lead to the business benefits of an information system is usually referred to as *business value linking* (Kauffman & Kriebel, 1988). Business value linking assists in identifying the business benefits and also provides a clearer picture of how these benefits are created. In addition, as Kauffman and Kriebel (1988) note, it could assist in spotting linkages between financial outputs and benefits originally though of as being intangible.

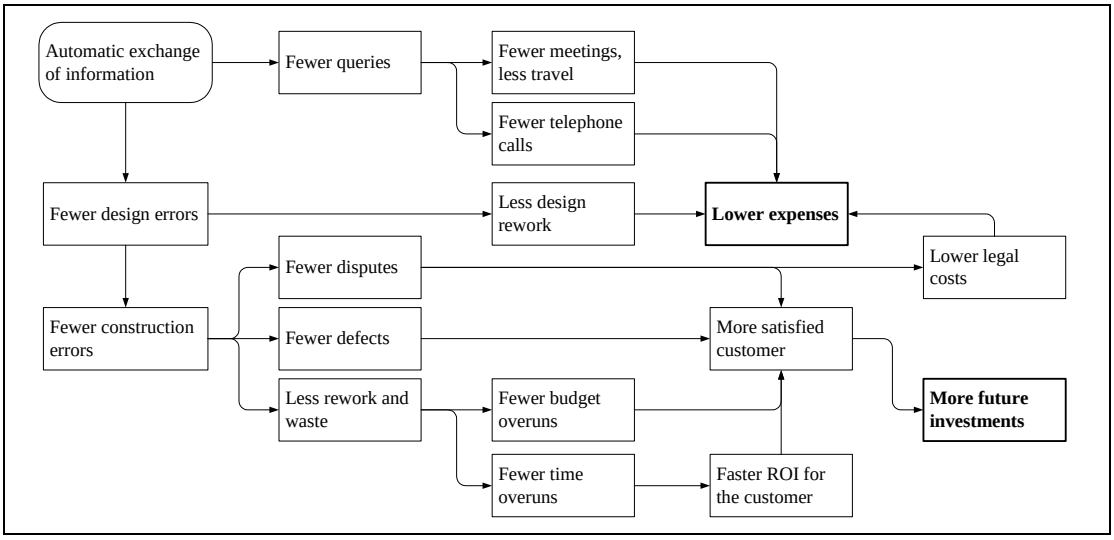

Fig. 2. A business value linking example

5. DEALING WITH INTANGIBLE BENEFITS

As mentioned above, one of the main difficulties in evaluating the business benefits of information systems is the issue of intangible benefits. Intangible benefits could be very difficult to quantify on the one hand and too important to ignore on the other. The question that arises then is how one could deal with intangible benefits. How one could assess the business value of an information system and decide whether to invest in the system or not?

One option would be to ignore the intangible benefits. Although it is generally agreed that intangible benefits could make a critical contribution

to the success of an organisation, there are several organisations that prefer an 'objective' but partial assessment of the business benefits of information systems (Ballantine *et al*., 1994; Ballantine & Stray, 1999). Those organisations opt to consider only those benefits that could be directly attributed to cost savings or the generation of additional revenue. They use standard cost accounting techniques to compare those savings or additional revenue with the costs of developing, implementing and operating the system. For example, standard Return on Investment (ROI) measures, such as Net Present Value (NPV), Discounted Cash Flow (DCF), or Payback Period, could be used to indicate the worthiness of the investment (Ballantine *et al*., 1994).

However, as Farbey *et al*. (1993) note, any organisation that claims to apply IT strategically but only considers quantifiable benefits is out of alignment. Accounting techniques and strict financial measures might be appropriate for systems that mainly automate clerical tasks. However, as over the last two decades the role of IT has dramatically shifted from the efficiency to the effectiveness and business transformation zones, there is a need for a broader view of evaluation.

As previously noted, one approach to deal with intangible benefits is to assign a subjective value to them. A weight could be assigned to each of the potential effects of the system, e.g., 'improved work conditions', in order to denote its importance. The potential impact of the system to each of those effects could then be rated, e.g., 'the work conditions would be probably improved by 70%'. Each rating could then be multiplied with the corresponding weight and the scores calculated could be added in order to get a numeric indication of the system's total impact. Such an approach is taken for example by Parker and Benson in their *Information Economics* method (Parker & Benson, 1988). The problem however with such an approach is that the calculated score does not provide any indication of the true value of a system. As Svavarsson *et al*. (2000) point out, such a total score might be useful in comparing alternative systems but is of little help in deciding the worthiness of a particular investment.

As we consider the intangible benefits – either by assigning a subjective value or not - we move away from the objective/formal approaches to evaluation towards the more subjective/informal ones. At the subjective end, many authors question the need for deriving a single measure that reflects the business value of an information system. Those authors argue that it is preferable to draw a more 'balanced' and overall picture of this value by presenting several different criteria and let the decision maker judge the worthiness of the investment in an instinctive and intuitive manner.

For example, Willcocks and Lester (1994) propose the use of the *balanced scorecard* approach of Kaplan and Norton to examine the contribution of the information system from four different perspectives: the *financial perspective*, the *internal business perspective*, the *customer perspective* and the *innovation and learning perspective*. The benefits from each perspective are listed separately, without any attempt to

aggregate them. In that way, a more 'balanced' view of the contribution of the system can be provided with the decision on the worthiness of the investment left to the decision maker. Similarly, Construct IT (1998) identifies three types of benefits. For the *efficiency* benefits, it calculates a financial value. For the *effectiveness* benefits, it assigns a subjective score. For the *performance* benefits, it does not attempt any quantification at all. It only lists those benefits and lets the decision maker to judge the worthiness of the investment.

As Bannister and Remenyi (1999) point out, to someone formalist, such an approach to decision making, based on instinct and intuition, might sound disturbing. However, as they argue, there is not any fundamental reason why this should be the case. As they point out, "instinct after all is a central part of many decision making processes and especially the management decision making process. … It is not something to be condemned but rather a different and more subtle kind of reasoning - a method of taking into account how the world really is rather than simply what the spreadsheets say. … It is something to be celebrated as part of not only that which differentiates man from machine but separates mediocre from top flight management." And as the literature indicates (e.g. Deitz & Renkema, 1995; Katz, 1993), there have been numerous examples where actual investment decisions were based on intangible benefits and the 'gut instinct' of the decision maker.

6. CONCLUSIONS

As information is key resource within any business activity, information technology provides significant opportunities for improving the performance of construction organisations. This improvement in performance however cannot be easily predicted or expressed in monetary or universal terms. This is because the evaluation of the business benefits of information systems is impeded by several difficulties. In addition, the business benefits of information systems cannot be always quantified and in many cases, as they are closely interrelated with the business objectives and processes the systems aim to support, they cannot be expressed independently, in a universal manner.

This close interrelationship between the business objectives, processes and benefits makes the case study a particularly suited method for the evaluation of the business benefits of information systems. As Yin (1994) points out, a case study allows an investigation to retain the holistic and meaningful characteristics of real-life events. Therefore, although case studies lack the rigour of formal experiments and cannot be easily generalised, they could nevertheless provide sufficient information to help practitioners judge whether a specific technology can be beneficial to their own organisation or projects. In addition, as Kitchenham *et al.* (1995) note, although case studies cannot show the effects of a technology in every possible situation, they can nevertheless show the effects of a

technology in a typical situation. Furthermore, while a case study might not provide conclusive evidence of the business value of a technology, it might nevertheless provide conclusive evidence of the limitations of this technology.

Since the biggest benefits of information technology do not usually come by assisting and speeding up existing processes but rather by redesigning the existing processes to take advantage of the opportunities offered by information technology, the evaluation of the business benefits should be performed at the process level, examining the impact of the system to each individual process. Such a process-based approach to evaluation can provide greater insight on how and why the business value is created. In addition it can assist in identifying the potential benefits of the system. The identification of the potential benefits can be also assisted by consulting the literature, using a benefit classification framework, or using business value linking.

Although the quantification of the business benefits is always beneficial, it might not be always possible. This however should not be a preventive factor in the use of evaluation. Many management decisions are based on instinct and intuition and the investment in information systems should not be an exception. And although it might not be always possible to identify all the potential benefits and form a complete and clear picture of a system's potential contribution to an organisation's or project's performance, the availability of some empirical and more specific evidence of this contribution is preferable to no evidence at all. The often criticised for its conservatism construction industry needs such evidence before investing in information technology.

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