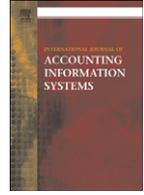




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Measuring the effects of business intelligence systems: The relationship between business process and organizational performance

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ABSTRACT

Business intelligence (BI) systems provide the ability to analyse business information in order to support and improve management decision making across a broad range of business activities. They leverage the large data infrastructure investments (e.g. ERP systems) made by firms, and have the potential to realise the substantial value locked up in a firm's data resources. While substantial business investment in BI systems is continuing to accelerate, there is a complete absence of a specific and rigorous method to measure the realised business value, if any. By exploiting the lessons learned from prior attempts to measure business value of IT-intensive systems, we develop a new measure that is based on an understanding of the characteristics of BI systems in a process-oriented framework. We then employ the measure in an examination of the relationship between the business process performance and organizational performance, finding significant differences in the strength of the relationship between industry sectors. This study reinforces the need to consider the specific context of use when designing performance measurement for IT-intensive systems, and highlights the need for further research examining contextual moderators to the realisation of such performance benefits. Crown Copyright © 2008 Published by Elsevier Inc. All rights reserved.

1. Introduction

Measuring the bottom-line contribution of information technology (IT) has long been seen as a major challenge for researchers and professionals (Kohli and Devaraj, 2003; Chan, 2000; Barua and

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Mukhopadhyay, 2000; Dehning and Richardson, 2002). Part of the challenge lies in the unique nature of different information technologies, their heterogeneous applications, and their subsequent qualitative as well as quantitative impacts. These characteristics require the use of performance measures that are specific to the technologies in question and consistent with management objectives and business plans regarding IT (Mooney et al., 1995). For instance, it may not be appropriate to use accounting measures such as firm profitability and return on investment (ROI) when measuring the business performance of a transactional IT tool such as transaction processing systems (TPS), or a typical decision support system (DSS) (Anderson and Lanen, 2002; Lucas, 1993; Liang and Tang, 1992; Weill and Olson, 1989). This is because such measures are often neither consistent with the firm's strategic intention regarding the technology, nor sufficiently close to the immediate influence of such systems.

In this study we develop a measure of business process performance and explore its relationship to an organisational performance measure, in the context of Business Intelligence (BI) systems. BI systems refer to an important class of systems for data analysis and reporting that provide managers at various levels of the organization with timely, relevant, and easy to use information, which enable them to make better decisions (Hannula and Pirttimäki, 2003). Examples of BI tools include those software and solutions which are provided by vendors such as COGNOS, Business Objects and SAS. Such BI systems typically require specialized IT infrastructure in order to function effectively, including query, analysis, and reporting tools (such as online analytical processing "OLAP", data mining tools, statistical analysis, forecasting, and dashboards), and the underlying specialized databases (such as data warehouses and data marts). BI systems are often implemented as enhancements to widely adopted ERP systems. IDC estimates that global spending on BI systems and related products is expected to reach \$US6.1 billion by 2008 (Elbashir and Williams, 2007). The scale of investment in BI systems is reflective of their growing strategic importance and highlights the need for more attention in research studies.

A fundamental question is *what* benefits are achieved by organizations that use BI systems. To address this question, we model the effects of BI systems on both business process performance and organisational performance. Consistent with both accounting and information systems (IS) perspectives on performance measurement of IT investment (Dehning and Richardson, 2002; Barua et al., 1995), we expect the effect on business process performance to be reflected in organisational performance. Furthermore, we examine in this paper the interrelation of the benefits at the business process and organizational levels, and the moderating effect of context on the strength of this interrelation. Specifically, following Chiasson and Davidson (2005), we consider the effect of industry on the strength of the association between business process performance and organizational performance.

More formally the research questions addressed in this paper are:

1. *What are the performance effects of BI system use at the business process and organizational levels?*
2. *To what extent are performance effects at the business process level reflected in organizational level performance? and*
3. *Does industry affect the strength of the relation between business process performance and organizational performance?*

To address these questions effectively, in context, requires the development of new measures, as the existing literature lacks systematic attention to BI systems (Thomas, 2001; Cottrill, 1998). There are some case studies evidencing benefits generated by organizations that are successful with the use of BI systems (Hesford and Antia, 2006; Edwards, 2001, 2002, 2003), but no prior empirically validated measures. Indeed there have been several studies calling for the development of a measure for evaluating the business performance effects of BI systems (Lönnqvist and Pirttimäki, 2006; Marin and Poulter, 2004; Davison, 2001; Herring, 1999).

This study makes several contributions:

- (1) *The development of a validated, reliable and easy-to-administer instrument for measuring the business process level performance impacts of BI systems.* Prior IT payoff studies, especially those which adopt the production economics approach, use aggregate measures (such as IT spending and pool of IT) to capture IT investments (Barua and Mukhopadhyay, 2000). Investigating IT investments as an aggregate neither allows researchers to engage in richer theories about IT use, nor understand the different impact of various types of IT included in that aggregate (Elbashir, 2007; Melville et al.,

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