Integration of E-Commerce by SMEs in the Manufacturing Sector: A Data Envelopment Analysis Approach

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ABSTRACT

SMEs (small- to medium-sized enterprises) in the manufacturing industry are impacted by enormous changes in their business processes. E-commerce-related developments have reduced the importance of physical branches and moved it toward more sophisticated and e-commerce-enabled supply chains for products and services. This article analyzes the differences among SMEs in the manufacturing sector in four countries based on empirical data collected via a survey. Best-practice cases of efficient e-commerce performance such as in Denmark or the United States are identified in contrast to firms in France or Germany by using a data envelopment analysis (DEA). Leading SMEs in the sample have implemented a wide range of e-commerce applications, resulting in higher satisfaction rates. The results of this cross-country and multi-dimensional DEA research approach contribute to the literature of e-commerce adoption, usage and impact among SMEs in the manufacturing sector.

Keywords: data envelopment analysis (DEA); diffusion; e-commerce; efficiency; innovation; SME (small- to medium-sized enterprises)

INTRODUCTION

The diffusion of IT and e-commerce infrastructures has received broad practical and academic attention (Cooper & Zmud, 1990; Dekleva, 2000; Kiiski & Pohjola, 2002), especially in the context of supply chain management, interorganizational cooperation, and the integration of heterogeneous partners including small-to medium-sized enterprises (SMEs; Beck, Weitzel, & König, 2002). Apart from theoretical deficiencies in the field of standardization theory and resulting network effects, there is a lack of comparable empirical data on business networks at the international level. One of the most challenging problems — not only within industries but also on a macro-economic level — is the frequent lack of the integration of SMEs within supply chains. This is largely due to the failure to diffuse IT standards, as even small firms could gain network benefits. In this contribution, SMEs are defined as enterprises with 25 to 249 employees that are using at least a material-management or ERP
system in connection with an Internet-usage strategy.

SMEs have to cope with a variety of problems that normally impede on the successful integration of e-commerce technologies such as inadequate ERP systems, the lack of IT know-how, or not totally automating internal business processes as a prerequisite to gaining benefits in exchanging business messages electronically (Willems, Hampton, & Ketler, 1997). In the pre-e-commerce era, SMEs were forced by large business partners to integrate technologies such as EDI (Tucker, 1997). Nevertheless, playing an active part in supply networks based on strategic planning holds additional benefits for SMEs (George, Wood, & Khan, 2001).

On the other hand, SMEs are predicted to be flexible and innovative in using new applications to conduct their business more flexibly than large manufacturers, but they are often not able to vie with large competitors due to the high setup costs of Web-enabled materials-management systems or Web-based shopping systems. Moreover, SMEs have more difficulties in attracting IT specialists for their business and mostly cannot benefit from economies of scale; they also do not have sophisticated distribution systems in comparison to large enterprises (König, Wigand, & Beck, 2003).

SMEs in particular are looking more carefully at the return on investment in IT spending after the Internet bubble burst. Therefore, it is important to identify successful integration approaches to learn more about the drivers of and barriers to e-commerce implementations in SMEs. Efficient combinations of IT implementations together with a positive impact on both the improvement of processes and market expansion are necessary prerequisites to the use of e-commerce technologies in a profitable and satisfying way, especially when operating on an international level.

This contribution provides empirical results based on a survey conducted during the summer of 2002 by the International Data Corporation (IDC) on behalf of the underlying research project. It analyzes the implementation and usage differences in three European countries (Denmark, France, and Germany), as well as in the United States. Although European countries have different demand drivers (industry structure, information infrastructure, financial and human resources, and social and cultural factors), they have to cope with the same productivity gap (Farrell, Fassbender, Kneip, Kriesel, & Labaye, 2003) and lack e-commerce readiness and diffusion rates (Kraemer & Dedrick, 2000; Kraemer, Dedrick, & Dunkle, 2000) in comparison to the United States (Gordon, 2000). Due to these national and industrial path dependencies in the diffusion of e-commerce, a comparison of the two largest economies on continental Europe (France and Germany) with e-commerce-leading countries such as the United States and Denmark, known as very innovation-friendly countries, were chosen to identify differences and best-practice cases.

In what follows, this article provides a short description of innovation-diffusion theories and their limitations. Next, important results of the empirical survey are presented together with a data envelopment analysis (DEA) to identify efficient SMEs in each country as an international benchmark. We conclude with a summary about SMEs’ behavior in the adopting of innovative technologies and the related impact on operational process efficiency.

DIFFUSION OF INNOVATIONS

The term diffusion is generally defined as “the process by which an innovation is
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