# Assessing the Drivers of Virtual Knowledge Management Impact in European Firms' Performance: an Exploratory Analysis

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**Abstract**: e-Business is a phenomenon that has progressed over the past decades at record speed, with considerable promise and hype. It has been embraced with varying degrees of enthusiasm and impact by both large and SME firms. Parallel with its development, E-Business has attracted research interests, seen in a plethora of new modules, programmes, models and tools. Knowledge Management (KM) is one tool that has seemed to gain a more relevant role, especially as managing knowledge becomes increasingly important to all companies. Appropriate KM practices within organisations can be seen as one of the prerequisites of enhancement of continuous performance improvement in the interne-based context. Thus, our aim is to develop a conceptual framework related to KM practices in a virtual context and to identify the nature of the relationship existing in those knowledge-driven elements and performance achievements. This paper aims to bridge the gap between the KM and e-business performance-related literatures from the viewpoint of European firms by establishing a model tested in European companies. For this purpose, we used a structural equation modelling analysis. The results show that KM has a positive impact on the maximization of e-business performance and that some elements individually have a positive influence on e-business performance. As limitations of the study, we consider the need for more research into this field and the inclusion of news elements such as technological readiness and management support to KM initiatives. The present study advances knowledge on the nature of the relative importance of different components of Internet-based KM as drivers of e-business performance and reinforce its importance as an integrated e-business tool.

**Keywords**: virtual knowledge management, e-business performance, European firms, information and communication technology

## 1. Introduction

In today's digital economy, rapid access to knowledge is critical to the success of many organizations (Liao, 2003). One of the major challenges that firms face is managing competitive advantage through the development of strong relationships with all stakeholders. In this context, Knowledge Management (KM) becomes an important part of the global solution.

However, as noted by Takahashi and Vandenbrink (2004) and Zhang and Zhao (2006), KM needs to be regarded as more than simple information gathering in order to take advantage of its competitive potential. Despite the academic research and organizational practices developed around this concept, there is still a lack of conceptual basis necessary to develop the measures of KM contribution in business success, especially regarding its contribution to Internet-based environments. The objective of this paper has been to gain a clearer understanding of the fundamental issues related to this topic.

In this line of research, the present paper discusses the results of an exploratory survey conducted among a large sample of European companies. Using a structural equation analysis, we explore the relationship between e-business performance and KM initiatives, trying to identify the main drivers of virtual KM.

This paper has six sections and is organised as follows. Section 1 contains a brief background for this research. Section 2 presents the definition and process of develop knowledge inside an organization. Section 3 defines virtual KM, its advantages and its differences from traditional KM.

A virtual KM evaluation framework is developed in section 4. In the last two sections we conclude our study, reiterate the major points and suggest avenues for further investigation.


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## 2. Data, information and knowledge

During the last decades there has been an ever-growing interest within the fields of databases, information systems, and knowledge-based systems (Aamodt and Nygärd, 1995). How should data, information, and knowledge be characterized so that their differences — and other relationships relevant for high achievements in the Internet environment — are identified?

The distinction between data, information and knowledge has been discussed for centuries in general, and within the database and information systems and marketing communities for several years. Nothing has resulted in a final conclusion. Between 2003 and 2005, a study titled "Knowledge Map of Information Science" tried to bridge this gap, collecting more than one hundred different definitions of data, information and knowledge. The conclusions present by Zins (2007) pointed to the existence of five different models (see Figure 1).

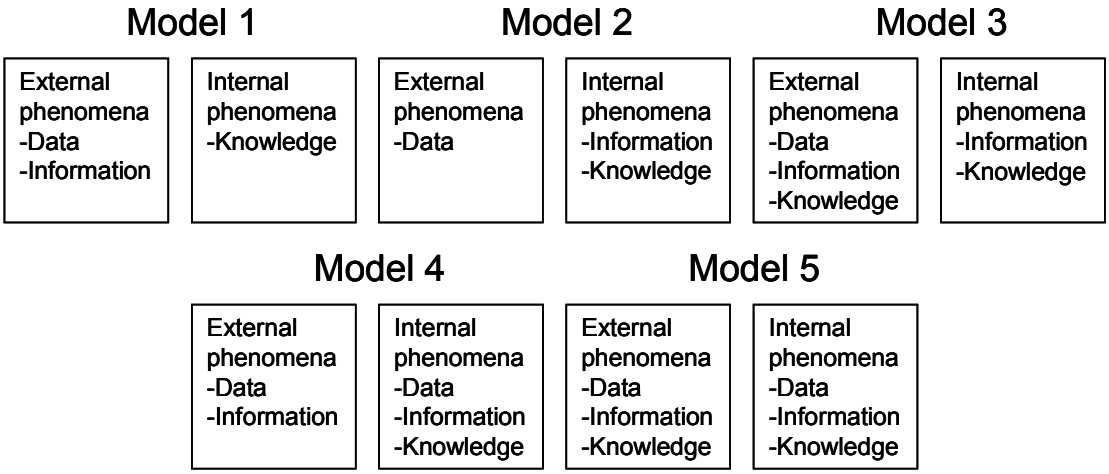



**Figure 1:** Five combinations of data, information and knowledge source: Adapted from Zins (2007)

Looking closer at each of these concepts, a base for our own model can be established. However, in describing these three concepts, it is not these researchers' intention to give a complete or historical review of the available literature. Davenport and Prusak (1998) have defined data as a set of discrete and objective facts about events. Using this definition, a crucial idea emerges: all firms need data, and to some of them, data can be critical. However, data only describes a part of the phenomenon without providing any kind of interpretation or support basis for actions. Even though data by itself has little or none relevance for firms, it is primordial material for information creation. The same authors note that people can transform data into information through the addition of value in diverse forms: contextualized, categorized, calculated, correct and condensed. Thus, information consists of those significant regularities residing in the data that agents attempt to extract from it. In this sense we can summarize that information is an extraction from data that, by modifying the relevant probability distributions, has a capacity to perform useful work on an agent's knowledge base (Boisot and Canals, 2004).

As pointed out by several authors (see, Table 1) the relation between information and knowledge is a source of much confusion and misunderstanding. For instance, Maholtra (2000) interprets knowledge in terms of its potential for action and its link to performance, as opposed to information as external phenomenon that only has potential for improvements.

According to Alavi and Leidner (1999), the concept of knowledge has its origin and use in the mind of people and circulated within organizations (Nonaka and Takeuchi, 1995), becoming integrated with internal process, norms and practices (Davenport and Prusak, 1998). Since Nonaka and Takeuchi's 1995 discussion of the distinction between explicit and tacit knowledge, which enforced Polanyi's 1966 discussion, researchers have tried to define KM.

Thus, this research paper relies upon the knowledge definition presented by Davenport and Prusak (1998), which considers knowledge as a "fluid mix of framed experience, values, contextual information, and expert insight that provides a framework for evaluating and incorporating new experiences and information. It originates and is applied in the minds of the knowers. In organizations,

it often becomes embedded not only in documents or repositories but also in organizational routines, processes, practices, and norms".

**Table 1**: Some definitions of knowledge and information source: Adapted from Stenmark (2002)

| Author(s)/ Year | Information | Knowledge |
|---|---|---|
| Wigg (1993) | Facts organised to describe a situation or condition | Truths and beliefs, perspectives and concepts, judgements and expectations, methodologies and know-how |
| Aamodt and Nygärd (1995) | Information is interpreted data | Knowledge is learned information |
| Nonaka and Takeuchi (1995) | A fluid of meaningful messages | Commitments and beliefs created from these messages |
| Spek and Spijkevet (1997) | Data with meaning | The ability of assign meaning |
| Davenport and Prusak (1998) | A message meant to change receiver's perception | Experience, values, insights and contextual information |
| Choo et al (2000) | Data vested with meaning | Justified, true beliefs |
| Le Coadic (2004) | Information is knowledge recorded on a spatiotemporal support. | Knowledge is meaningful content assimilated for use. |

Increasingly, companies will differentiate themselves on the basis of what they know, how they process information and how they collect the data. Several models have attempted to explore the issues of knowledge discovery, knowledge classification, knowledge acquisition, learning, pattern recognition, artificial intelligence algorithms, and decision support. In the last two decades, the Internet has shown its enormous potential as a tool for KM, revealing a new dimension that will be presented in the next section.

## 3. The virtual knowledge management

Many claim that knowledge is a major factor driving business-level capabilities. Hence it is the most important source of competitive advantage (Nonaka and Takeuchi, 1995). Awad and Ghaziri (2004) stated that information and knowledge are critical to companies' performance. However, these authors suggested that capturing and transferring best practices is not enough to achieve success, especially in an Internet-based context.

The expansion of Internet and e-commerce technology allows firms to establish new forms of creation knowledge, and provides them opportunities to improve their capability to manage and use knowledge (Siau, 2000). Through the Internet, vast amounts of information concerning customers, suppliers, markets, and supply chains can be effortlessly gathered, while information about company processes, products, and services can be easily disseminated to the public.

Takahashi and Vandenbrink (2004) suggested that the problem facing top decision-makers in the ubiquitous information society will be how best to organize the knowledge cycle. One of the challenges is to share the knowledge with inside entities who value it, and to do so organizations must create and deploy knowledge management systems (KMS).

KM is one of the leading strategic areas being explored and adopted by companies (Schwartz et al., 2000; Grossman, 2006), especially by those who have invested in the Internet as a new channel and marketplace.


**Figure 2**: Knowledge management impact source: adapted from Malhotra (2000)

According to Stojanovic and Handschuh (2002), the main function of a KM system is to capture and disseminate new sources of information. From this point of view, the Internet is a font of information. By using the Internet, companies implement a knowledge-acquisition and knowledge-sharing system, one that meets the requirements and specifications of unique and complex systems. It will match customer requirements to product characteristics (Ratchev et al., 2003) and allow the acquisition and maintaining of competitive advantages (See Figure 2). Furthermore, in this digital society, corporations need to adapt both knowledge management systems and business strategy in order to use digital information effectively and to take advantage of Internet possibilities (Takahashi & Vandenbrink, 2004).

Like many other information system implementations, KM is strongly linked in the literature to a sales and marketing perspective (Zhang & Zhao, 2006). For this research, we will consider KM as a combination of marketing tactics, knowledge-sharing, methods and technology. It can be used to gain and maintain competitive advantages in a global marketplace such as the Internet and simultaneously cut down organizational layers.

As Malhotra (2000) suggested, the traditional KM model emphasizes convergence and compliance to achieved pre-specified organizational goals. On the other hand and according to several authors, virtual KM emerged from the Internet, and web technology facilities are used to implement KM solutions. Nevertheless, the concept of use of information technology as the key enabler of KM is not a new idea.

From the literature review performed, we consider virtual KM as an Internet-based business strategy integrating every area that touches the data gathering. These areas include sales and support services, the overall consideration of enhancing performance of people and processes with major contributions from new electronic technology (Internet, email, chat rooms, e-forums), and data transformation into information, i.e., extranet and other internal process and knowledge-sharing (intranet, extranet, LAN, WAN, VPN). Table 2 presents the differences between KM and virtual KM).
In this context, online companies are embracing knowledge management as a major element of corporate strategy. Online technological applications allow a rapid and low-cost access to data, faster and easier processing of the information and, above all, a greater level of knowledge sharing. However, the adoption of KM systems by online organisations implies a complex restructuring of all organisational elements and processes. This in order to achieve the competitive advantages through the use of virtual KM systems. The virtual KM can be define has the incorporation of online technologies in the cycle of knowledge in order to enhance the KM processes.

The ubiquity era also gave another dimension to knowledge, decreasing the impact of several elements in the way firms use effectively knowledge, such as: size (Davenport and Prussak, 1998); industry; time and location. Through the presence online, any firm can achieve a global position and act in the global market, been the knowledge treatment a potential source of competitive advantages. Nevertheless, the application of KM in the traditional form is not enough to embrace all the challenges and opportunities that come along with Internet. Drawing from the literature on virtuality, we identified six discontinuities – geography, temporal, cultural, work practices, organization, and technology- that when fully applied to KM become the bases to the virtual KM. Thus, virtual KM can be considered as the convergence of a technology approach with a business value approach.

## 4. Evaluation framework and hypotheses

The digital era bring with it enormous challenges that firms can embrace, especially if we consider the facility associated with the gathering of information about customers, suppliers, markets, and supply — and the easy processing of information about company processes, products, and services, which can also be easily spread to the public. Even though academic researchers and practitioners alike praise KM adoption (Schwartz et al., 2000), perhaps the most significant gap in the literature is the lack of large-scale empirical evidence showing that KM makes a difference to organizational performance — in particular at an Internet-based organization. The assumption underlying the use of virtual KM is that by locating and sharing useful knowledge, organizational performance will improve, particularly in the digital environments.

Following the literature reviewed in the previous section, we developed a research model (see Figure 2). It proposes virtual KM that will be positively associated with a set of intermediate outcomes that we call “KM practices”, and will be positively associated with online organizational performance. For that

purpose we use a structural equation model with latent variables. This model consists of two sub-models: the measurement model and the structural equation model.

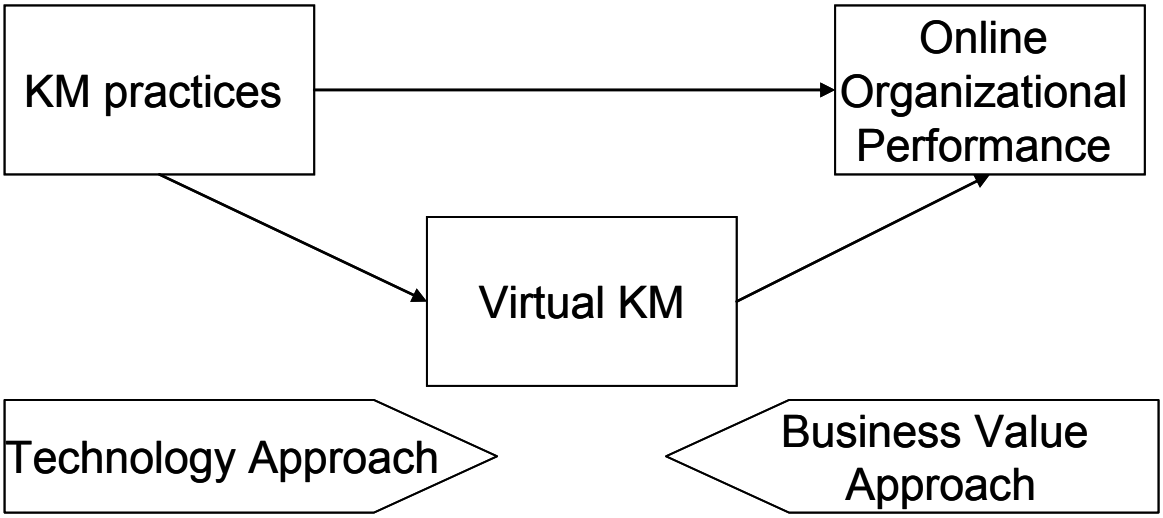



**Figure 2**: Research model

The primary research questions to consider are these: What is the degree to which an organization engages virtual KM — in particular, technological KM practices — has a positive impact in online organizational performance? And is virtual KM, in turn, positively related to online organizational performance? Besides measuring the convergence of a technological approach with a business value approach, our aim is to discover the direct nature of the relationship between KM practices and online organizational performance.

The validation of the measurement model is done by using Confirmatory Factor Analysis (CFA). We will see later that the observable variables (indicators) we selected are measures of three latent variables (factors). We assume that these three KM practice factors each have a direct effect on the virtual KM and upon online corporation performance. Therefore, we assume that the online corporation performance is explained not only by the virtual KM, but also by a general KM practices factor that is concerned with the gathering of data, information process and knowledge-sharing.

Therefore, it is postulated that the considered indicators measure three different and positively correlated latent variables or factors (hypothesis H1). Each factor is supposed to contribute directly to the determination of the online corporation's performance (hypotheses H2 and H3). Besides these direct effects, it is also assumed that there is an indirect effect via virtual KM (H4). In sum, the four research hypotheses are the following:

*H1: The indicators considered define three positively correlated factors;*

*H2: The KM practices factor positively and significantly determines the online corporation performance;*

*H3: The factor concerned with KM practices positively and significantly determines the virtual KM;*

*H4: The KM practices factor positively and significantly leads online corporation performance through virtual KM application.*

Awad and Ghaziri (2004) pointed out that KM awareness benefits the entire organization and that it relies on developing a KM environment inside and outside the firm — one that permits a generation of new knowledge, i.e. the transfer of existing knowledge and its application to new products, services and process. Davenport and Prussak (1998) considers that KM focuses on processes and mechanisms for locating and sharing knowledge possessed by an organization or its external stakeholders. Based on this, we define KM practices as the group of technological efforts carried out by the organization in three different dimensions: data gathering, information process and knowledge-sharing. In total, we identified twelve KM practices. Each has been suggested elsewhere as being

important for effective virtual KM (Gold et al, 2001; Malhotra, 2000; Awad and Ghaziri, 2004; Schwartz et al., 2000; McKeen et al, 2005; Tiago et al, 2007; among others).

In Internet-based practices, most traditional financial and accounting methods of evaluation are not suitable as the only forms of performance measurement. This is due to the fact that there are some intangible, indirect and even strategic benefits that need to be considered (Grembergen and Amelinckx, 2002). From the literature review, it is found that KM has been linked positively to non-financial performance measures such as quality (Mukherjee et al., 1998; McKeen et. al, 2005; Tiago et al., 2007), innovation (Francisco and Guadamillas, 2002), productivity (Lapre and Wassenhove, 2001), and sales (Tiago et al., 2007). In fact, the expected results are that KM simultaneously influences many different aspects of organizational performance. The work of Gold et al. (2001) presents a combination of two dimensions as enablers of effective performance improvements: knowledge infrastructure and knowledge-processing capacity. Other frameworks have been presented, but the specific interface between virtual KM and e-business has not been addressed from the organisational point of view. So we will follow in the last authors' steps, using as performance measures elements of both infrastructure and processing dimensions.

In identifying KM practices as antecedents to virtual KM and online organizational performance, we attempted to include factors that have been previously tested by others authors (see for example, Gold et al., 2001).

## 5. Methodology and results

The data used to test our research model comes from the e-Business W@tch annual survey (2005). This data was collected in a large survey about e-business in European enterprises. Considering that this study examines the status of adaptation of virtual KM by companies, the original sample was limited to firms having e-business activities and companies adopting KM practices. So, our work sample of 5.218 cases constitutes a heterogeneous sample of companies in terms of industries, fields, size, business model and country. The data covers 7 European countries (Czech Republic, France, Germany, Italy, Poland, Spain and the U.K.). Distribution of firm size, measured by the number of employees, shows that almost half of the firms are micro- and small-size firms (around 50,7%). The industry distribution of the responding sample is approximately similar to the original sample. The two less heavily represented sectors in the sample are the aerospace industry and manufacture of pharmaceuticals, with 3.1% and 10,2% respectively, closely followed by all the others. More information about the sample is presented in Tables 3, 4 and 5 in the appendix.

The model was estimated by the Maximum Likelihood method in the AMOS package. The model goodness of fit may be considered acceptable according to the values of some goodness-of-fit index, although the chi-square test statistic ($\chi 2 = 626,4$; df =117; p-value = 0,000) is significant, implying a bad fit. However, as is well known, this test has serious limitations — namely its dependence on the sample size and on the number of indicators. In general, for large sample sizes the chi-square statistic is significant, and in the present case the sample size is very large (n = 5,218). For that reason, it is usual to evaluate the goodness of the fit by a set of index, also presented in Figure 3.
After global model fit has been assessed, the numerical results were evaluated in order to test their support of the research question. The numerical results can be obtained directly from the path coefficients of the structural model presented in Figure 3. We refer to standardised coefficients that account for scale effects and serve as indicators of the relative importance of the variables.

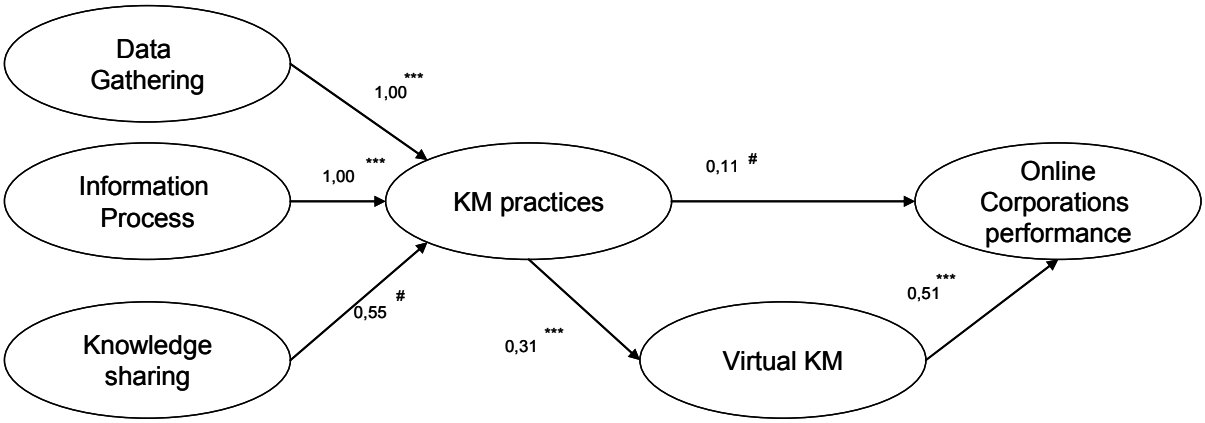
The measures for global model fit included in Figure 3 suggest that our model fits the underlying data well (Hair et al., 1998). All the paths were statistically significant.

A curious fact is related to hypothesis H2, where the results show that KM practices competencies explain 11 percent of the variance in online corporations' performance, in accordance with Hair et al. (1998). Thus, this finding gives no empirical support to the concept that online performance can be improved by the use of the three basic components of KM practices: data gathering; information process and knowledge-sharing. With this consideration in mind, hypothesis H2 is rejected.

On the other hand, the three dimensions used to compose the KM practices are all significant and explained 100 percent, 100 percent and 55 percent respectively regarding the variance in the KM practices construct. As a result, hypothesis H1 is not rejected. Nevertheless, a reference needs to be made regarding the relative lower value achieved in terms of knowledge-sharing.

The results also show that virtual KM explains 51 percent of an online corporation's performance, implying that our hypothesis H3 is confirmed.




Key for significance measures:

| | |
|---|---|
| * : | α >0.10 |
| **: | α >0.05 |
| ***: | α >0.01 |
| #: | for model identifiably, this path coefficient was set to 1 in the unstandardized case. |

| Measure | Value | Suggested |
|---|---|---|
| RMSEA | 0.033 | < 0.05 |
| NFI | 0.900 | >0.9 |
| IFI | 0.913 | >0.9 |
| CFI | 0.913 | >0.9 |

**Figure 3**: Structural equation model and estimation results

The data gathering, information processing and knowledge-sharing combined are not significantly important for the direct determination of an online corporation's performance. However, these items have an indirect effect on the performance via their positive influence on the virtual KM. So, hypothesis H4 is not rejected.

KM practices and virtual KM are only part of the equation; the construct of online corporation performance must also be measured. All of the non-financial factors used show a positive and significant relationship. This provides empirical support for the theoretical views that state that online performance needs to be measured using new criteria, and not exclusively finance-based criteria.

## 6. Discussion and conclusions

Knowledge Management has presented several difficulties in the traditional IT environment, basically related to the constrained form of sharing the knowledge. In the present ubiquitous information context, KM seems to be an easier and promising tool, especially when used in its global version. As the literature review showed, there have been only a few works examining KM practices and virtual KM contributions to online performance from a corporate perspective. Moreover, the majority of these works were confined to specific industries and confined to small data samples. The goal of the current study was therefore to answer the following questions: What is the degree to which an organization engages virtual KM — in particular, technological KM practices — has a positive impact in online organizational performance? And is virtual KM, in turn, positively related to online organizational performance? With this study, we attempt to contribute to bridging the existing research gaps. We do so by presenting results from an empirical investigation based on a cross-industry survey, which covers seven European countries.

The findings shown above, as reported by respondents in the case companies, demonstrate the kinds of applications they really need or value, how KM practices are used and valued, and the ways in which virtual KM can help to achieve higher levels of online performance, considering a new set of non-financials measurements. Considering the results, we can find evidence to confirm most of the hypotheses that we formulated regarding the impact of virtual KM in online corporations' performance. First, the data supports our conceptualisation for the KM practices construct: data gathering, information process and knowledge- sharing. Within this, all elements have a positive impact on the maximisation of KM practices. Secondly, the findings allow us to conclude that virtual KM has a positive impact on online performance, which was expected considering the existing literature on this

matter. There is no evidence of a threshold effect between the three KM practices components and online performance, something that has not been noted previously.

According to these results, the concept of virtual KM as an important e-business tool is reinforced. Thus, the relationship between virtual KM and online performance follows the positive relationship found in some earlier studies. One of the managerial contributions of this work is the discovery that managers should consider the use of virtual KM to improve everyday online processes — and should also be aware that the simple use of the KM practices is not enough to achieved higher performance levels. However, a cost–benefit analysis should be made to assess the return on the investments made in KM, since we only considered the upside of this initiative. Until KM becomes an ingrained and standard tool of e-business, the need to define measurement criteria will continue in order to support the corporate implementation and maintenance of such systems.

Further work is clearly needed to examine the interaction between virtual KM and online performance over time or in small sets of the sample. Doing so would allow us to find out if the relationship is equally strong in all countries and which contextual factors affect this relationship.

This research produces some useful insights, leaving still a number of issues for future research. One of these issues is related to the possibility of extending the study in order to consider the impact of other elements of virtual KM, such as technological readiness and management support. Similarly, this study could be expanded through the application of a panel data methodology that would determine the evolution of virtual KM contribution to online performance among European companies.

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## Appendix

**Table 2:** Distribution of the sample by country

| | France | Germany | Italy | Spain | UK | Czech Republic | Poland |
|---|---|---|---|---|---|---|---|
| Food and beverages | 80 | 80 | 86 | 82 | 75 | 85 | 83 |
| Textile industries | 80 | 76 | 81 | 81 | 75 | 85 | 83 |
| Publishing and printing | 80 | 80 | 79 | 82 | 75 | 84 | 83 |
| Manufacture of pharmaceuticals | 76 | 83 | 81 | 81 | 75 | 54 | 82 |
| Manufacture of machinery | 77 | 80 | 84 | 81 | 75 | 85 | 83 |
| Automotive industry | 80 | 80 | 81 | 81 | 75 | 85 | 83 |
| Aerospace industry | 39 | 38 | 23 | 15 | 25 | 20 | 3 |
| Construction | 80 | 81 | 80 | 83 | 75 | 84 | 83 |
| Tourism | 80 | 80 | 82 | 82 | 76 | 84 | 83 |
| IT services | 78 | 80 | 82 | 82 | 75 | 84 | 84 |
| Total | 750 | 758 | 759 | 750 | 701 | 750 | 750 |

**Table 3**: Distribution of the sample by size

| | Micro | Small | Medium | Big | NA | Total |
|---|---|---|---|---|---|---|
| France | 236 | 172 | 265 | 49 | 28 | 750 |
| Germany | 253 | 178 | 256 | 67 | 4 | 758 |
| Italy | 293 | 179 | 232 | 51 | 4 | 759 |
| Spain | 280 | 202 | 210 | 58 | 0 | 750 |
| UK | 249 | 183 | 228 | 41 | 0 | 701 |
| Czech Republic | 240 | 183 | 240 | 87 | 0 | 750 |
| Poland | 0 | 0 | 0 | 0 | 750 | 750 |
| Total | 1551 | 1097 | 1431 | 353 | 786 | 5218 |

 

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