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Investigating virtual enterprise models: literature review and empirical findings

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ABSTRACT

Despite the increasing academic interest in the virtual enterprise (VE), there are still two main lacunae in our understanding: conceptualisation of VE models and empirical research investigating real VE cases. This paper seeks to address these two gaps. In relation to the first, the paper provides a systematic literature review, showing six shared issues in the VE research (which may be considered the common foundations of the theoretical concept of the VE) and five non-shared issues (which may be considered as a framework to identify different forms of VE). On the basis of shared and non-shared issues, two VE types are identified (the hierarchical and the holarchical). In the hierarchical VE, a leader company acts as a product integrator and is responsible for the final product/service. In the holarchical VE, partners act as a single business entity and the self-organisation approach is the main coordination mechanism. The second gap is addressed through a questionnaire survey to explore the virtualisation process in 18 Italian companies participating in a network of firms characterised by a set of temporary peer relationships oriented to specific projects in which collaborative relationships are continuously formed and dismantled. Comparing the literature and the empirical evidence, a hybrid VE model some way between the hierarchical and holarchical models is evident. The hybrid model shares the relationships among peers with the holarchical model, and the presence of a coordinating firm with the hierarchical model. Similarities and dissimilarities of the above models are discussed together and future research directions are noted.

1. Introduction

In the last few years, the competitive scenario has experienced a large number of changes. Such changes include growing market globalisation and competition (which has increased the rate of new products being launched and reduced their life-cycles), new customer requirements (resulting from the demand for products with greater customisation, higher quality and lower delivery times), new social conditions (arising from increasing environmental awareness and legal pressures), technological innovation (reduction in the price of technology and a concomitant increase in performance, thereby reducing plant size and allowing small firms to implement production processes previously possible only for large firms), and acceleration in the rate of technology diffusion and adoption (with particular reference to information and communication technology—ICT).

In facing up to these changes, firms are exploring new inter-firm organisational relationship models that better fit the new conditions of the competitive scenario (Tapscott, 1996; Davidow and Malone, 1993). New organisational approaches may be developed following two complementary directions:

(a) flexibility: organisational structures need to be more flexible allowing swift adaptation to change (Pollalis and Dimitriou, 2008); and
(b) intensive use if ICT and knowledge management (KM): firms also need to adopt ICT tools for managing information (Preiss et al., 1996; Jin and Robey, 2008) and knowledge in order to exploiting innovation and collaborative relationships in a more efficient and effective way (Iandoli et al., 2012).

The virtual enterprise model has been indicated as suitable for addressing changing market conditions through flexibility, extensive ICT usage and KM (Blecker and Neuman, 2000; Choi et al., 2008; Pollalis and Dimitriou, 2008).

However, despite increasing academic interest in the VE, there are still shortcomings in our knowledge. The first concerns the

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literature: despite the vast amount of papers on the subject (Cunha and Putnik, 2006) highlighting a variety of VE forms, the features that such VEs have in common remain unclear, as do their distinctive traits. The second concerns empirical research. There is little empirical research investigating real cases of VEs (De Sanctis and Monge, 1999; Dowlatshahi and Cao, 2006; Bottani, 2010).

The main aim of this paper is to address the above two gaps. First of all, the work provides a detailed and comprehensive analysis of the existing body of knowledge in this field. This is used to trace the systematic evolution of VE thinking over the last two decades. On the basis of bibliographic evidence, major VE characteristics have been identified and an innovative VE taxonomy has been proposed. Secondly, a questionnaire survey was carried out in a network of 18 firms located in the eastern area of Naples city, Italy (hereafter ENTech—East Naples Technology network). On comparing the literature and survey results a further VE hybrid model was identified in which the relationship system and knowledge management play a significant role.

The paper is organised into six parts. This introduction is followed by a literature review on the virtual enterprise concept. Section 3 outlines the methodology used to carry out the questionnaire survey and describes the research context. In Section 4, the findings of the empirical analysis are presented. Section 5 jointly discusses literature and empirical evidence, while the final section provides conclusions and implications.

2. Virtual enterprise: a literature review

2.1. Selection of articles

The literature search aimed to identify the most relevant features of VE through analysing the evolution of academic thinking from the management perspective. This was achieved primarily by analysing journal articles which were searched on the Web of Science Academic database. The main reason for choosing this database is the comprehensive coverage of scientific output as it contains more than 8000 scientific journals, including many high-ranking journals.

A keyword search using the terms “virtual enterprise” identifies 1018 papers (journal articles, proceedings papers, reviews and editorial materials) from 1990 until 2012. The selection process in this step was based on extracting the papers presenting the word “virtual enterprise” in the title, abstract, or keywords. This results in selecting 357 papers of which 182 were journal articles already presented in international conference proceedings. A higher level of rigorousness of scientific products retrieved and control over quality of the search process was achieved by limiting the search to peer-reviewed publications alone (e.g. ISI journal articles). As a result, prefaces, editorial notes, book reviews and interviews, in addition to any articles from magazines or industry publications, were excluded.

2.2. Classification of VE literature

In this section, a classification scheme is proposed to review the literature on VE. Using the functionality of the Web of Science Academic database, it was possible to identify the distribution of 357 articles retrieved by 19 subject areas. These subject areas have been grouped into the following three macro topic areas: (a) Engineering (78 articles), (b) Information systems and computer science (195 articles), and (c) Operations research and management science (84 articles).

In a further step, the articles were sourced with the help of e-journal search engines available in the University of Naples Federico II electronic library. These include access to journals published by several publishers such as Elsevier, Emerald and Taylor & Francis. The two authors acted as reviewers for the 357 articles identified. Articles which individual reviewers were uncertain of were discussed until agreement was reached. The criteria for including or excluding papers in this step were: (i) provision of VE definition; and/or (ii) provision of VE characteristics. At the end of this step, 318 articles were excluded as they did not fit the above criteria. The final sample consisted of 41 usable articles (six articles from the Engineering area, 14 articles from the Information systems and computer science area, and 21 articles from the Operations research and management science area). Full bibliographic details of the articles selected for analysis are shown in the reference section in order to make our research processes transparent. The 41 articles were studied in detail and the results of the analysis are described in the next section.

2.3. Literature analysis and results

The term ‘virtual corporation' was first coined in the late 1980s with reference to invisible (virtual) links among companies supported by ICT. The concept of VE was mainly technology-driven and based on the sharing of information systems. One of the first definitions of VE was given by Byrne et al. (1993) who indicated the temporary nature of relationships in the network of independent companies belonging to VE managed through the information technology. The main aims of VE relate to sharing skills and costs, and to access to one another's markets.

Although Jagdev and Browne (1998) identified the same characteristics and aims, they stressed two additional important elements, namely the project-based approach and the relative shorter life span of VE. Zhang et al. (2000), Camarinha-Matos et al. (2001), Mikhailov (2002), Kim et al. (2006) and Weisenfeld et al. (2001) proposed a similar view.

Tuma (1998) interpreted the organisational concept of VE as an intermediate form between market and hierarchical structured enterprises. He used the transaction cost theory to define VE and distinguished between VE and other intermediate organisational forms such as long-term cooperation and cooperating enterprises. Process-oriented problems related to VEs were identified such as the profile of the coordination unit, partner selection and allocation of project tasks to processing units.

Mezgar et al. (2000) suggested that a VE may be considered as a holarchy given that it is a temporary and goal-oriented aggregation of several individual enterprises. The authors also underlined that a VE is created to pursue a specific business objective, and it remains in life as long as this objective is being pursued. Huang et al. (2002) share this view and they carried out a study to develop a framework for control mechanisms of virtual enterprises based on a holonic manufacturing paradigm.

Martinez et al. (2001) also found that the VE concept may be used to characterise the global supply chain of a single product in an environment of dynamic networks between companies engaged in many complex relationships. In their view, the main objective of a VE is to rapidly develop a common working environment and manage a pool of resources provided by the participating organisations toward the attainment of common goals. Hence, success of the VE depends on all co-operating as a single unit.

The resource sharing in the VE context is the focus of the works of Chen et al. (2007, 2008). They present a virtual enterprise access control model for managing collaborative operation among each companies participating in a VE. Such model allows resource sharing across projects and enterprise boundaries, secure collaborative operation among participating co-workers, increased information transparency and reduced information delays in a VE.