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The impact of ICT on market organisation – A case of 3D-models in engineering consultancy

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ABSTRACT

This paper analyses the impact of the use of ICT in production and delivery of technical engineering consultancy services on business structures with regard to industry convergence and transaction costs. The paper takes an empirical study on the introduction of 3D-modelling tools in the building section in a Scandinavian engineering consultancy firm as its point of departure. The discussion identifies three different structural aspects, which all are affected by the use of ICT: Internationalisation vs. Local markets, Outsourcing vs. Structural integration, and Division of work between actors within the value chain.

1. Introduction

The use of ICT based solutions in service and manufacturing industries provides an unforeseen flexibility in organisation of businesses both internally and externally, and at both national and international levels (DeSanctis and Monge, 1999; Fulk and DeSanctis, 1995; Majchrzak et al., 2000). Business-to-business applications provide technical possibilities to co-ordinate business-functions across different locations and across different organisations.

To accomplish the potential benefits, businesses have to reorganise in order to achieve the required flexibility and still reap large-scale benefits (Markus, 2004). However there is insufficient consideration on how these changes affect the structure in service industries (Miozzo and Yamin, 2007). Especially knowledge based service industries increasingly rely on ICT services in production and sharing of knowledge and information within the company, and in their interaction with suppliers and customers. This have implied substantial changes in the internal organisation an in the cost profile within the industry.

This paper analyses these challenges by the use of a case study on the use of 3D-models in production and delivery of technical engineering services in building construction. While amble research has been done in analysis of ICT and its impact on the organisation within the company, less studies have discussed the impact on the overall industry structure from an organisational perspective. This paper focuses therefore on the impact of how the use of ICT on relations between companies, and how changes in these relations may impact the industry at the meso level in a particular service industry (engineering consulting).

The paper aims to analyse the following research questions:

Q1. How does the use of ICT affect the business relations and the need for communication with other partners?
Q2. How does this affect the organisation of the value chain? Will there be an increasing use of oursourcing or insourcing?

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Q3. Will the use of ICT facilitate internationalisation of the industry? If yes, what kinds of internationalisation will be dominant (establishment of local affiliates or international trade)?

The paper aims to address these questions through an empirical study on the implications of the introduction of ICT systems in a specific engineering company (Ramboll), and in this way contribute to the foundation at the micro level for an analysis of the abovementioned trends affecting the meso and macro levels.

The paper will use the introduction of 3D-models in technical engineering consulting within the area of building construction as a case for an analysis of the impact of ICT on company and industry structure in knowledge based service industries. Delivery of knowledge services involves knowledge sharing between producers and users. The information delivered in relation to building projects is often complex and requires interaction between several partners including managing knowledge across organizational boundaries. These processes are explored in a case study of the building section in a Danish engineering consultancy company (Ramboll) in a period, where 3D-modelling is introduced as a supporting tool for both knowledge creation and communication.

In order to shed light on the structural aspects affected by ICT, the literature review is followed by a description of the working processes related to engineering consulting within the area of building construction. Second, examples of use of various ICT based applications supporting these processes are presented. Finally the implications for industry structures are discussed.

We will here build on a general framework developed in two early studies prepared for UNCTAD (Baark et al., 1993, 2002). These studies aim to analyse the potential for increasing trade in knowledge and information intensive services and have been used as inspiration for the three research questions. The framework includes the concepts of divisibility, transportability and tradability. These concepts relate to both final and intermediary services.

Transportability concerns delivery of final or intermediary service products over geographical distances for instance by use of the telecom network.

Divisibility implies that the production of a service can be splitted up into a number of subroutines, which can be carried out in different departments. Divisibility add to transportability as the least transportable components can be produced on location, while more transportable components such as calculations and 3D-modelling can be produced elsewhere (Baark et al., 1993). If some of these processes are transportable, the production can be divided between different locations. Finally tradability relates to the possibility to trade final or intermediary service products across international borders.

Today transportability is not so much about the ability to use telecom facilities as a transport infrastructure. Once information is stored in a digital format it can easily be made accessible from any location. The major challenge is therefore to codify and store knowledge and information in a way that it can be understood and applied by a different part of the organisation or even by other companies. Therefore the three questions relate not directly to the terms divisibility, transportability and tradability, but to how ICT affect the division of labour between partners (Q1), and trade with intermediary products (Q2) and international trade in final service products (Q3).

2. Literature review

2.1. ICT and business relations

Since the early days of digitalisation the relationship between ICT and organisational change has been evidenced by considerable litterature (Gurbaxani and Whang, 1991). At least two different interrelated avenues of research can be identified. While the literature on knowledge management provides important insights on how ICT affect the boundaries of the single firm, the transaction cost analysis is focused on market organisation on the industry level.

The management perspective explores the role of technology in knowledge creation and the use of flexible ICTs (Venters and Ferneley, 2009). A key question is here whether knowledge can be codified in an objective way by use of ICT or knowledge is inherently tacit and social and the role of technology therefore is limited to support of collaboration (Nonaka et al., 1996; Schultze, 1998).

Another avenue is based on the analysis of the technology impact on transaction costs. According to the transaction costs market organisation is determined by the relative advantages of hierarchical and market methods of organizing economic activity (Coase, 1937; Williamson, 1975; Malone et al., 1987). According to their analysis, the relative advantage of a hierarchical organisation is that coordination costs are lower than in a more market based structure, involving several partners e.g. through outsourcing of certain parts of the value chain. On the other hand a hierarchical organisation may increase production costs, as all processes are performed in-house – even if other companies are able to provide the same service at a lower cost. It can therefore be expected that sectors, where coordination costs are high compared to the costs of production will be more hierarchical in their organisation than industries where coordination costs are low.

A key determinant for shaping the business relations within a specific industry is therefore the level codification which can be achieved, and this again depends on the specific knowledge processes related to production and innovation within the company and its partners.

Carlile (2004) defines three distinct levels of knowledge processes. The first level (knowledge transfer) is the basis of all forms of communication providing an ability to transfer knowledge from one part to the other through the use of different