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**TECHNOLOGICAL INNOVATION:  
A STRUCTURAL PROCESS VIEW**

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## **TECHNOLOGICAL INNOVATION: A STRUCTURATIONAL PROCESS VIEW**

### **Introduction**

The central aim of our research is to describe and explain how the introduction of a computer-based technology, which supports co-operative work in engineering departments, induces change processes. The employment of computer-based technologies in product development organisations to support co-operative work practices has become a major practical and theoretical issue over the last years. Although there seem to be many technological possibilities to realise this kind of support, in practice, outcomes of technological change processes are usually different from those anticipated by management. We aim at explaining this phenomenon by investigating the relationship and interaction among the two major components - computer-based technology and organisation – focussing on the interrelationship, rather than on the components themselves.

We use Anthony Giddens' structuration theory as an overarching framework for our investigation. The fundamental notion of Giddens' structuration theory (Giddens, 1984) implies that all social activity, that is, recurrent social practices and their transformation, can be viewed as both enabled and constrained by social structures which are continually produced and reproduced via human agents drawing upon understandings of interpretative schemes, norms, and power. This notion – called 'duality of structure' – can be applied to technological innovation processes in several ways. In our present study we made an effort to employ the idea of duality to co-operative work practices and their computer support, meaning that the human actors involved shape and reshape the structures materialised into the system-in-use, whilst on the other hand the system-in-use defines and redefines the possibilities and margins of the work practices concerned. We elaborate more on the background and direction of our present study in the next section. Also, we will go into the limits of this approach and suggest possible other fruitful directions to complement our present research framework. Our contributions to the ECSCW workshop are outlined in the last section.

### **Present study**

The overall methodological basis of our research is that the introduction of computer-based technologies in organisations should be studied as a social process, that is the behaviour of men over time. We adopt Pettigrew's view that organisation (or any other social system) should be explored as an ongoing system with a past, a present, and a future (Pettigrew, 1973). Research methods should therefore enable us to study technological innovation as a real life process. In our view this excludes quantitative methods like surveys and experiments, and supports qualitative methods like (participative) observation, interviewing and content analysis of documents. To be able to explore the process in all richness a triangulated research strategy should be employed.

### **EXPLORATIVE CASE AND FIRST ANALYSIS**

We conducted a long-term in-depth case study in the engineering department of a production firm before and during the implementation of a Product Data Management (PDM) system. The case design was based on real time observation and semi-structured interviews. Using Giddens' framework as a basis for our analysis we were able to systematically gather knowledge on the different, possibly conflicting, points of view of the actors involved in the design and use mode (Orlikowski, 1992) of the technology under scrutiny. We contributed to previous efforts to adapt a structuration theory perspective for studying the relationship between information technology and human action (DeSanctis and Poole, 1994; Lyntinen and Ngwenyama, 1992; Orlikowski, 1992), by being more specific about the functions of the technology. The earlier studies treated technology as a whole without taking the specific functions of the studied technology into account. In line with Monteiro and Hanseth (1995) we

argue that a computer-based technology consists of a large number of modules and a large set of often very different functions. We analysed the data in terms of 'intended' and (first signals of) 'actual use'. We showed that part of the unintended outcomes of technological innovation can be explained through the mismatch between existing work practices and the assumptions about the work materialised into the structures of the computer-based technology.

#### HOW TO CONTINUE?

After the elaboration of the first results of this case analysis we felt that our preliminary framework did not satisfactorily explain all the consequences and outcomes of the innovation process discovered in the case study. The framework was very focused on the idea of (the structures of) technology as a discriminate variable to explain the outcomes and unintended effects of technological implementation processes. We suggest – based on observations during the case study – that other variables besides technology and organisation have to be considered contributing to the explanation of the process under study.

According to Layder (1990) all forms of social action produce unintended effects. Defining technological innovation as a *process*, we propose that the social action performed by stakeholders during that process, lead irrevocably to a diffuse set of outcomes including unintended effects. This statement is also in line with Giddens (1984). Thus, although we notice that technology does trigger organisational change and organisational context does influence the outcomes and use of the technology involved, we advocate that seeking a complementary explanation for this relationship in a (causal) mechanism underlying this observable relationship between technology and organisation, could lead to a more comprehensive research framework. It is this mechanism of social action that we want to explore in further research, concentrating on political aspects of decision-making processes, where agents (try to) participate while drawing upon understandings of interpretative schemes, norms and power. In this way we will apply the structurational notion of duality, but in a different manner focussing more on social structures of the organisational context, than on the social structures materialised in the technology.

The central *research problem* can then be formulated as follows:

How can the outcomes of technological innovation processes in a R&D context be understood by taking the view of social action of stakeholders as an underlying mechanism of the innovation process?

#### **Contribution to workshop**

Although notions from structuration theory stand central in our research, we are open to discuss other – possibly relevant – social theories that could improve our framework.

On a more specific level we would like to discuss how the often quite vague concepts of meta-theories like structuration theory could be operationalised for empirical research. In our own analysis we must admit that the findings were – to a certain extent - speculative as a result of the insufficient operationalisation of the theoretical framework, before and after case-study, which made the interpretation of the data very difficult. An approach is needed to improve the translation of theoretical constructs into observational notions. Considering our own struggle, we suggest that this could be a difficult but interesting topic to conquer.

On a practical level we contribute by presenting our case-analysis of two social processes: (1) the confrontation between existing work practices and functions of technology and (2) the technological innovation process as a decision-making process. Both analyses use Giddens' notion of duality of structure as a starting point. But the conceptualisation of the duality of structure differs in both analyses.

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## Biographical Sketch Karen Fehse

After finishing the high school in 1991, I started studying Administrative Science at the University of Twente, The Netherlands. Administrative science consists of four disciplines: economy, sociology, law and politics. At the end of my study, I decided to specialise in sociology and law. The topic of my MSc-thesis concerned an exploration of the possibilities to support citizens in writing a juridical document (the ‘bezwaarschrift’ which is a kind of written protest against a public authorities’ decision) with help of an expert system. This research was part of a more comprehensive study conducted at the department of Administrative Science, regarding the implications of computer-based technologies in the area of public services. The notion that the introduction of computer-based technologies can have an enormous impact on social life triggered me to continue studying this research area. In October 1997 I started working as a Ph.D.student at the Faculty of Technology & Management, University of Twente. My research interests lie in the area of technological innovation and change in organisations, support of cooperative work practices in New Product Development, system design, and modern social theory.

Recently I finished my first (explorative) case study. At this time, I am focussing on the analysis of the gathered data and the implications of the analysis for a more comprehensive research design in the future.