

“Unexpected utilizations of information technology: off interaction between users and EDI”

AUTHORS	Laguecir Aziza Massué Marie-Laure Colas Hervé
ARTICLE INFO	Laguecir Aziza, Massué Marie-Laure and Colas Hervé (2010). Unexpected utilizations of information technology: off interaction between users and EDI. <i>Problems and Perspectives in Management</i> , 8(3-1)
RELEASED ON	Wednesday, 14 July 2010
JOURNAL	"Problems and Perspectives in Management"
FOUNDER	LLC "Consulting Publishing Company "Business Perspectives"



NUMBER OF REFERENCES

0



NUMBER OF FIGURES

0



NUMBER OF TABLES

0

© The author(s) 2024. This publication is an open access article.

SECTION 3. General issues in management

Laguecir Aziza (France), Massué Marie-Laure (France), Colas Hervé (France)

Unexpected utilizations of information technology: off interaction between users and EDI

Abstract

This paper studies the interaction between a specific information system, namely, the Electronic Data Interchange (EDI), and its users. This interaction is addressed by arguing that EDI does not only have expected functions but also unforeseen ones. We assume that activity, e.g., everyday practice, is a relevant level of analysis for the interaction between users and EDI. This paper outlines a model of user-technological artifact interaction by drawing on the activity theory framework. This model, termed instrument-mediated and object-oriented activity, distinguishes the technological *artifact* from its users' utilizations. Furthermore, the model focuses on the dialectical relation between users and object-oriented activity, mediated by technology. These developments are illustrated with an empirical study carried out in a multinational enterprise using EDI. The results show different *EDI-in-use* and point out a double shaping between users and EDI.

Keywords: activity theory, technology utilizations, EDI.

JEL Classification: M15.

Introduction

Since the late 1990s, Electronic Data Interchange (EDI) has been widely adopted by large and medium-sized organizations across a number of industries and sectors. EDI refers to the computer-based exchange of standardized business-related information between buyer and supplier firms (Hart and Saunders, 1997). Many researchers have shown its various expected benefits (reduction in costs, supply chain improvement, etc.) (Mukhopadhyay et al., 1995). Other studies have highlighted that EDI's success is based upon some implementation conditions (Saunders and Clark, 1991). While the overwhelming focus of the literature on EDI to date has been on the expected benefits, adoption and process of implementation, relatively little attention has been paid to the effective utilizations of EDI.

We currently lack empirical research on the unexpected utilization of EDI, and on the role played by users in the utilization dynamics. This research aims to help fill this gap through the study of EDI's utilization in a large firm.

While early research took a technical perspective, recent debates have emphasized the social construction of technology and have sought to develop frameworks that acknowledge both the material and the social nature of these technologies. With the use of a variety of constructivist approaches, various models of technology have then been proposed, including Structuration theory (Orlikowski, 2000) and actor network theory (ANT) (Latour, 2005). Nevertheless, these approaches tend to either focus

on technology, ignoring agency, or focus on the actions of agents, ignoring the technology.

To overcome those limits, this paper employs the activity theory (Engeström, 1999; Blackler et al., 2000) framework, more particularly a model of *instrument-mediated object-oriented activity* imported from ergonomics (Rabardel, 2001) to examine different utilizations of EDI in a large firm, to find out to what extent the activity is shaped by EDI and how users shape EDI. This paper provides a descriptive analysis without any normative implications.

The paper is structured as follows. The first section reviews the literature on EDI, highlighting the overwhelming focus on issues of expected benefits, adoption and implementation, and noting the relative lack of attention given to social context. The second section provides a brief overview of some ways in which technology has been approached in various literatures, including the social construction of technology approach (SCOT), Structuration, and ANT. This section outlines the main features of the activity theory framework. The third section presents the case study and the research method. It is followed by the research results and discussion which are in Sections 4 and 5, respectively. The final section concludes the paper.

These findings suggest two main conclusions. First, the case study provides clear evidence that the impact of EDI in this firm was affected by the way users chose to enact EDI. This implies that researches on the EDI failure should pay greater attention to the role that social context plays in shaping the impact of these systems. Second, the case study reveals the relevance of the activity level of analysis and the significance of broader organizational fac-

tors in how users choose to enact EDI. Thus, it is argued that theories of technology in organizations might benefit from retaining an analytical place for *objects* as a collective shared motive for the social actors and for the materiality of technological *artifacts*.

1. An overview of the literature on EDI

In the field of EDI, many studies have focused on its adoption, diffusion, and implementation (Premkumar et al., 1994). Other studies have dealt with its tangible benefits (Srinivasan et al., 1994; Mukhopadhyay et al., 1995), such as specific reductions in order processing and inventory costs, elimination of labor-intensive tasks, enhanced speed and accuracy of communication, and increased market share (Teo et al., 1995).

EDI, a mature technology, was born in the United States during the 1960s (Roesch, 1991). EDI is defined as a computer-to-computer transfer, from application to application, of structured data according to pre-established messages standardized via a means of telecommunication. This technique allows for the automatic exchange of coded data according to a language previously agreed upon between the applications found on distinct and heterogeneous information systems. The exchanges are completed using various telecommunications networks (Jun et al., 2000). Even though EDI is used for internal communications, its main applications aim to facilitate the collaboration between organizations such as the company, its suppliers, clients, carriers, etc. (Vlachos, 2004). EDI offers an alternative to the traditional means of communication regarding the transfer of documents such as purchase orders, invoices, shipping notices, etc. (Vijayasarathy and Tyler, 1997). This structured data can be processed by computer-based information systems without any human intervention being necessary. Thus, the data transmitted by the emitting system can be directly recovered and interpreted by the receiving system (Jun et al., 2000).

Although the use of EDI presents many advantages (Lim and Palvia, 2001), the overriding reasons for its adoption are diverse and seem to have a bearing on its utilization. Many different typologies of reasons for EDI adoption exist and can be found in the literature (Masson and Ferguson, 1991; Vijayasarathy and Tyler, 1997). Client satisfaction would seem to be the main reason for its adoption, for an important client often imposes the EDI adoption onto its 'smaller' partners (Hart and Saunders, 1997; Vlachos, 2004).

EDI is also supposed to lower costs by reducing paperwork, eliminating the cost of data entry, improving accuracy, making possible the receiving of

timely information, accelerating cash flow, and reducing inventories (Vijayasarathy and Tyler, 1997). EDI plays a key role in the supply chain: it allows for improved stock management and optimal organization of deliveries (Vijayasarathy and Tyler, 1997) by directing the firm towards a fluid management practice geared towards responding to the real needs of the final consumer (Craighead et al., 2006). EDI facilitates better stock management and adds value to channel relationships through an increase in the efficiency of transaction processing and an improvement in coordination and communication systems (Hill and Scudder, 2002).

Finally, EDI can affect all corporate functions and in turn influence cash flow timing and levels throughout a corporation. Indeed, both buyers and suppliers perceive EDI benefits in the reduction of errors associated with paper-based manual systems. Error reduction is directly correlated to improved product and order cycle time, cost reductions, and cash flow improvement (Masson and Ferguson, 1991).

The conceptual and empirical literature enumerate a variety of factors that prompt firms to adopt EDI, including cost savings (Teo et al., 1995), strategic benefits and pressure from trading partners, and improved channel relations and management (Mackay and Rosier, 1996). The adoption can be motivated by several reasons. However, the adoption does not lead to successful EDI; there are many factors shaping EDI success (Angeles and Nath, 2003). Lummus and Duclos (1995) articulate the positive relationship between the ability to achieve significant benefits and higher levels of EDI implementation. The success of EDI depends also on its integration level (Eckerson, 1990). The benefits are also related to the fact that EDI is combined to another device, such as business process reengineering (BPR), a cross-functional team, and social factors such as human resources and culture.

Combining EDI with BPR can lead to the faster recovery of payments from customers and fewer order processing errors (Riggins and Mukhopadhyay, 1994). BPR is a prerequisite for EDI success as well as a consequence of EDI adoption (Grover et al., 1995). The importance of cross-functional teams to both the planning and the implementation of EDI system projects is reiterated in trade literature through anecdotal and prescriptive writings (Sanders, 1992). Culture is also a particularly critical factor in the process of introducing advanced computer automation in corporations (Baba et al., 1996). Finally, Hart and Saunders (1997) argued that a critical condition of successful EDI use over time is trust between different users, i.e. trading partners.

Although the literature on EDI is very rich, it mainly deals with the advantages gained from the use of EDI rather than its efficient usage (Vijayarathy and Tyler, 1997). Much has been promised from EDI but actual usage appears more limited, although DeLone and McLean (2003) argued that one of the main criteria for the successful insertion of an information system (IS) resides in its use, from the quantitative aspect (time and frequency) and the quality of its use (adequacy, effectiveness, etc.). The quality of its utilization depends on the users' intentions towards IS and its use (DeLone and McLean, 2003). Indeed, the success or failure of the computerization process largely depends on the perceptions, feelings and attitudes of the users (Paré and Elam, 1995). This paper aims to investigate the unexpected utilizations of EDI and the role played by users.

2. Theoretical perspectives on technology

2.1. Struggling between technology materiality and its social dimension. Different theories have been used to study the technology-user relationship. The technological determinism approach (Orlikowski and Iacono, 2001) considers technology to be independent of its implementation's social context. Recent debates on technology and organization have shed light on the importance of the social context and have sought to develop frameworks that allow the material and technical characteristics to be apprehended at the same time as the technology's social dimension.

Within this huge body of research in the field of technology-user relationship, two extreme positions on technology can be taken theoretically (Volkoff et al., 2007). One extreme is notably represented by the social construction of technology approach (SCOT) (Pinch and Bijker, 1984). Taking a human agency perspective, SCOT argues that technology can be redefined by users through their actions, hence, the role of technology in affecting the behavior and activity of actors is weakened. This approach has been criticized notably for its tendency to make the technological artifact disappear by focusing mainly on the processes of social construction (Button, 1993). The other extreme is embodied in researches based on institutional theory (Gosain, 2004) that argue that technology actively constrains human agency. Technologies are objects of institutionalization during configuration and carry the institutional logic during use.

In between these two extremes, we can find various researches employing a variety of approaches, notably based on structuration theory and actor-network theory (ANT). Studies inspired by Gidden's structu-

ration theory have tried to overcome the limits of SCOT while keeping the key elements of the social constructivist approach. The characteristics of the technological artifact are re-introduced, by recognizing that "*a technology's material properties influence agency*" (Orlikowski and Barley, 2001, p. 149). Still, technology is considered as interpretively flexible (Orlikowski, 2000). Technology is, thus, enacted and defined when it is used. Indeed, far from being considered an artifact, technology is considered as "technology-in-practice" (Orlikowski, 2000, p. 409). Users constitute emergent technology structures through their actions. This approach ignores the inherent materiality of technology (Jones, 1999) by focusing attention on the actions and interactions of individuals. Technologies as information systems are not considered as infinitely interpretively flexible (Volkoff et al., 2007).

This lack of importance given to the technology artifact has been challenged by various researches analyzing the technology-actor relationship. Among them, the most notable is the ANT perspective. ANT holds a conception of human and non-human action as symmetrical (Latour, 2005). Technology is not considered differently from individual actors. Hence, there is no distinction between structure and agency in the extent that technology and actors are participants in a network of heterogeneous components (Mutch, 2002). The actor's perspective can be crystallized in technology. This is relevant for the study of design and implementation stages, but it is not for the everyday utilization of technology (Volkoff et al., 2007). Thus, ANT fails to handle the active role of technology in activity. While acknowledging the material aspects of the technology, the ANT conflating model of agents and structures does not allow analysis of how technology mediates activity (Mutch, 2002).

2.2. Technology as an instrument. Taking a similar *double-interact* perspective on technology than the previous Structuration and ANT, activity theory (AT) has the potential to address the shortcomings identified above. AT argues that there is no symmetry between the user and the artifact and develops an approach that is fundamentally asymmetrical in nature (Rabardel and Beguin, 2005). This perspective arises through two main concepts: mediation and instrument.

This cross-disciplinary framework studying actors within a historical, socio-cultural context (Vygotsky, 1989; Leontiev, 1978) considers activity as the central unit of analysis. It focuses explicitly on the interaction between actors and their surroundings, including technological artifacts (Bannon and Bødker, 1991; Nardi, 1996). Activity is considered as tool-mediated activity (Leontiev, 1978). The Vy-

gotskyan concept of *mediation* is central to activity theory. At the lowest level, AT provides a framework of individual activity where subject and technological artifact interact, shaping one another, directed to an emerging object (Engeström, 1999). Objects differ from goals in the extent that goals are intentional and drive action. Rather, the object of the activity is the purposeful intended target corresponding to the collective motive for the activity (Leontiev, 1978; Engeström, 1999). Indeed, relations between the actor and the object are not direct, but mediated. Users act through the interface of artifacts that must not only be analyzed as things but also in the way in which they mediate usage.

The concept of *instrument* is also important while analyzing the technological artifact. An instrument encompasses a mixed entity of a physical artifact (tangible properties of technology) combined with schemes of utilization resulting from an autonomous construction specific to the actor or from an appropriation of social utilization schemes already formed (Rabardel and Beguin, 2005). The artifact is conceived as having intrinsic constraints linked to its physical properties and its affordance (Pea, 1993; Rabardel and Beguin, 2005). The different types of constraints and the shaping process do not automatically determine the actor's action and activity. They define an "open space of possibilities within which the actor develops his actions according to his objectives and motivations" (Rabardel, 2001).

There are different schemes of utilization related to their orientation (Rabardel and Beguin, 2005). On the one hand, *usage schemes* are related to the management of characteristics and properties specific to the artifact. Their distinctive feature is that they are orientated towards specific actions and activities directly related to the artifact. On the other hand, *instrument-mediated action schemes* are related to global activity oriented toward the object of activity and for which the artifact is a means of performance (Rabardel and Beguin, 2005).

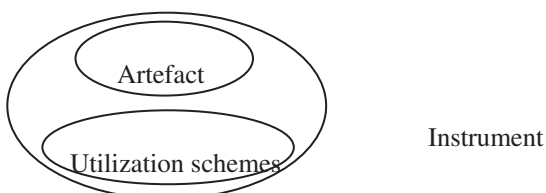


Fig. 1. The instrument consists of EDI artifact and its utilization schemes

This 'instrument-mediated activity' approach, developed by Rabardel (2001), proposes an intrinsic approach that distinguishes the actor's instruments as a psychological and social reality from artifacts (see Figure 1). Artifacts contain a set of constraints that

the subject must identify, understand and handle. However, the aim of the intrinsic approach to instruments is primarily to account for people's use of artifacts and the modifications they may bring to them to adjust them to the needs of their actions (Rabardel and Beguin, 2005). This is crucial to this research as its objective is to analyze unexpected utilization of EDI and more specifically how the technological artifact (EDI) is transformed for activity, playing a mediating role between actors and objects of activity and between actors. The study of the effective utilization of EDI (i.e., its instruments) will be done in relation to its surroundings, e.g., the object, the user and the whole activity.

Other researches provide a collective dimension to activity (Leontiev, 1978) leading to two kinds of models: on the one hand, an *artifact-mediated and object-oriented* activity systems (Engeström et al., 1999; Nardi, 1996); on the other, an inter-collective level termed *Interconnected Activity Systems* (Engeström, 2001). As Activity Systems (AS) are a conceptual device, as well as a methodological device (Blackler et al., 1999; Jarzabkowski, 2003), it is more deeply developed in the following research method section.

3. Research context and method

3.1. Context. A case study framework has been used (Lofland and Lofland, 1984) to observe the EDI technology-user interaction. We studied a large multinational industrial firm called HeCo (thus, named here for the sake of confidentiality) with 7,000 employees and turnover of 2.1 billion dollars in 2007. Our study focused on Western Europe (one of the three business zones) which covers 15 sites (headquarters, factories, and trading subsidiaries) spread over 8 countries (including France, Germany, Great Britain, Sweden, and Spain). The market of this business zone supported by EDI is the general public market. Intermediary companies (specialized supermarkets, retailers, etc.) distribute HeCo products that account for 60% of the turnover.

Ten years ago, an important client requested HeCo for EDI implementation in order to dematerialize the commercial transactions process, via a routing and communication process between the two companies. EDI is a relatively mature technology that avoids adoption stage peculiarities. Supported by the senior management, we asked the Information Systems Project Manager for permission to observe the different actors involved in the EDI utilizations for a three-year period in order to gain a deep understanding of the whole process (Lofland and Lofland, 1984). We were present in the firm at least twice in a month, from 2005 to 2008. Interviews

were conducted with the staff at the different sites involved. The staff encompasses the project manager, the team leaders, the users and members of the Management Control and IT department of the different services. We had complete access to the EDI desktop environment, and all papers and electronic documents were available thanks to the senior management support. Finally, several observations were made at all the sites involved.

At the beginning, we followed the EDI project manager, the objective of which was to make a diagnostic of EDI practices and software. Other problems not directly linked with the EDI rapidly appeared. The financial control department had important difficulties with cash flow management and the company struggled with treasury problems.

3.2. Method. In order to avoid a lack of selectivity (Siggelkow, 2007), we adopted an AS framework for the case analysis (Holt and Morris, 1993; Blackler et al. 1999). Developed by Engeström (1991), AS is a socially distributed system and a holistic unit of analysis that studies relations among actors, communities and artifacts, by highlighting the factors through which these relations are mediated (Blackler et al., 1999).

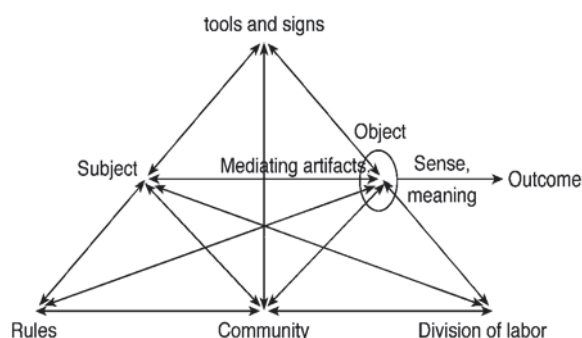


Fig. 2. Second generation: The structure of a human activity system (Engeström, 1987, p. 78)

The first mediation triangle focuses on the utilization dynamic of artifact and its object. The second triangle resituates this utilization in a broader framework and represents the belonging of individuals to a community. The relation between the subject (that we prefer to call actor since she is actively involved in activity) and the community – sharing the same object as the actor – is made public by rules such as standards, conventions, and social relations. The relation between the community and the object is made by the division of labor that is the way in which the community will organize itself to transform an object into a result. The notion of ‘object’ is considered here as an enduring, constantly reproduced purpose of a collective activity that motivates and defines the set of the possible goals and actions (Engeström, 1999). Whereas goals are conscious and relatively short term, they correspond to some finite aims of individual action (Leontiev, 1978).

This framework has an expanded version: the Interconnected Activity Systems (IAS). This third generation of activity theory investigates collective, *artifact-mediated* and *object-oriented activity* in its *network relations* to other ASs (Engeström, 2000, 2001).

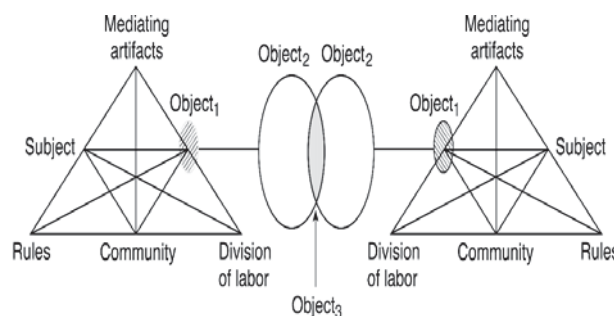


Fig. 3. The third generation of activity theory (Engeström, 2001, p. 136)

IAS puts the emphasis on understanding multiple perspectives and networks of interacting ASs (Engeström, 2001). Figure 3 represents two of the many ASs involved in practice, that hold "a potentially shared or jointly constructed object" (Engeström, 2001, p. 136). Nonetheless, activity within the different IAS has been considered as finalized but not as sharing, *a priori*, the same object. Activity is considered as object-oriented in order to attain one or more goals, which are not always evident, and which we try to identify. Therefore, we distinguished different activity situations, within the commercial transaction process, that we analyzed through the IAS framework. In order to highlight their interconnections, these different situations of EDI usage are analyzed linearly following the commercial transaction process. Nevertheless, the analysis of these IAS has been done by considering them as the locus of the dialectical interplay between different faces of the same process.

4. Findings

We tracked down the cash flow and treasury problems all along the commercial transaction processes from the orders to their delivery and payment. These problems were essentially due to client payment: unpaid order or delayed payment. According to the client revolving service, it appears that many "big" clients do not pay their due on time. One of them was contacted, and one of the interviewed people in charge with the client revolving told us "... they argued that they don't receive their order, (...) therefore, they do not want to pay for something they don't have". We then met the supply manager who commented: "(...) we know that we were delivered...but we cannot prove it!"... Based on these elements and in order to understand the origins of this failure, we decide to investigate the whole commercial transaction process.

The commercial transaction process involves many heterogeneous contributors, both internal (Sales Services, Administration) and external (different clients) spread over different geographical sites (Sweden, Germany, England, France, Spain, etc.). The more meaningful stages involved in the transactional process (e.g., sales, the sales administrative department, and then the clients) are analyzed within the adopted conceptual methodological framework.

In HeCo, we observed an increasing volume of sales and a decreasing margin. This high volume of sales is achieved by misleading the price policy (decreas-

ing prices with discount practices, decreasing, thus, the margin) while short-circuiting the EDI database. The sales staff mobilizes time to sell and not to update EDI data. Indeed, sales staff salaries are partly variable based on the volume of sales realized. We observed that these “commissions” are not paid when effective payment is received but as soon as the order is registered. In this context, the sales staff is willing to develop opportunist practices. Their principal motive for activity becomes to realize high volumes of sales. The object of activity for the sales staff is the turnover level due to the existing incentives.

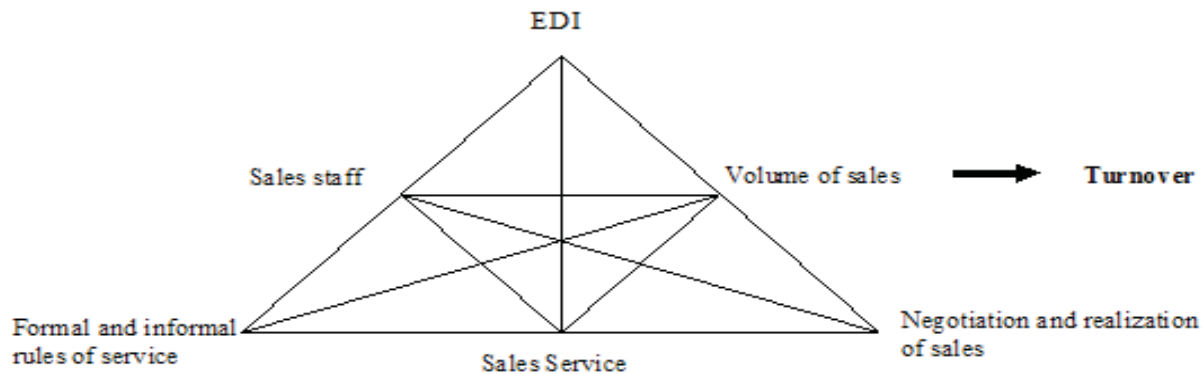


Fig. 4. EDI situation by sales staff

This incentive policy leads the sales people to be less demanding on the solvability of the clients. The client risk management level (client credit delay and unpaid order) is not integrated. These two elements lead to a common element: decreasing the incoming cash. More than just short-circuiting the EDI database, the sales staff is not committed in its updating. The opportunistic behavior of the sales people is a cause, as well as a result, of the data irrelevancy. The EDI database is neither updated nor consulted, then commercial practices (discounts, promotions, etc.) can be opportunistically developed.

Once done, the transaction is followed by the sales administrative service dealing with the previous elements. Functional or legal constraints can require the printing of documents stemming from EDI data (e.g., delivery order as a functional and legal obligation for control reasons, for the invoice to respect unavoidable local regulations). Nonetheless, observations showed that, when no local context obliges the printing of EDI data, orders arriving at trading subsidiaries are almost always systematically printed and treated like ancient orders (before EDI implementation, they arrived in the form of faxes). They are then kept, most often literally glued, inside notebooks.

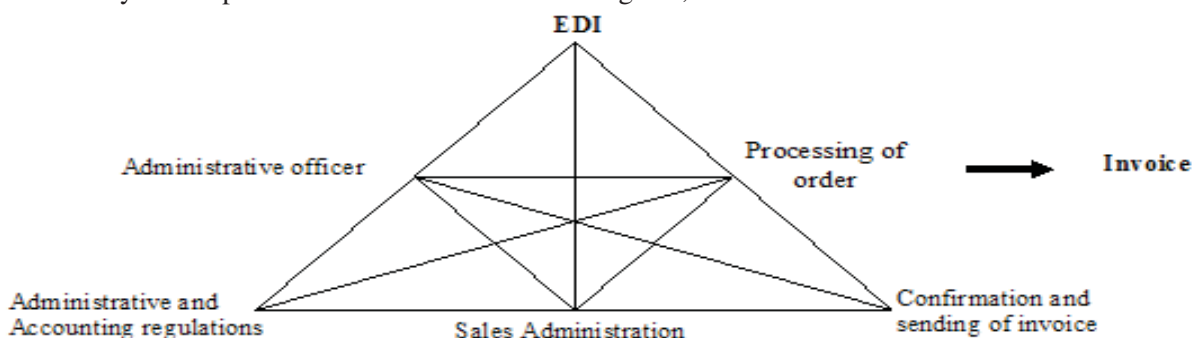


Fig. 5. EDI utilization by the Sales Administrative Services

Users justify this working method by the fact that they consider the EDI system to be unreliable in terms of archiving in contrast to a printed document which they view as a more secure way to store commercial data. Moreover, we observed that they use these printed

documents as “follow-up” documents of their activity (e.g., as a written record of work to be done and of the degree of completion of the tasks involved) and as an internal communication element, able to be physically transferred to the other actors concerned.

For the English client, we hardly discovered an absence of client order follow-up. No one knows whether the client receives the delivery, or when,

or for what kind of products. No one was able to provide any delivery order and no one was in charge of monitoring the logistics service.

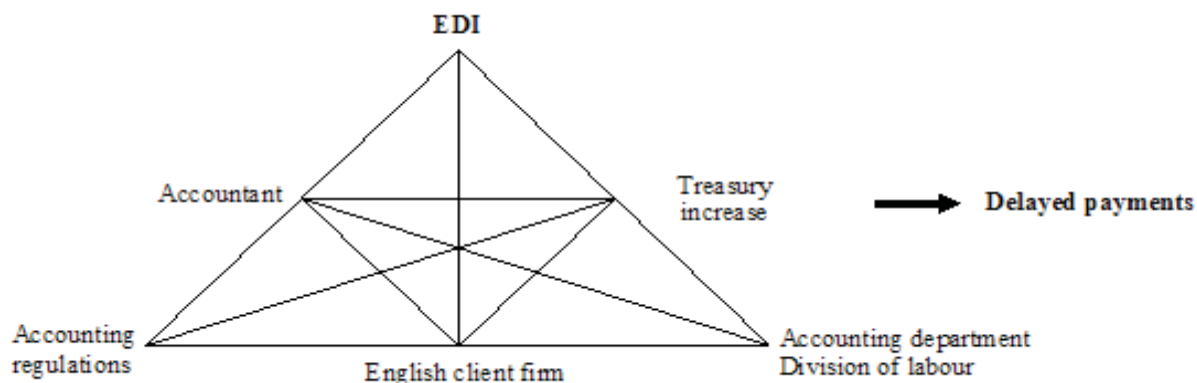


Fig. 6. EDI utilization by English clients

This often leads to long delays in the recovery of unpaid client invoices, as some clients exploit the weaknesses and loopholes in the process (such as the absence of a delivery order) and take advantage by retarding their payment delays. For example, in 2007, one client owed one million Euros in unpaid invoices arguing that his order was not delivered, and suggested that HeCo gave him some proof as a delivery receipt. Facing this huge problem, the EDI

project manager discovered that the EDI system was not able to provide such document.

The commercial transactions with German (as well as with Scandinavian) clients is marked by a lack of reciprocity of the order/invoice, especially in Germany. EDI invoices do not systematically have EDI orders and vice versa. To receive EDI invoices eases their management, but they let their shops (retail units) place their orders directly with the trading subsidiaries of HeCo.

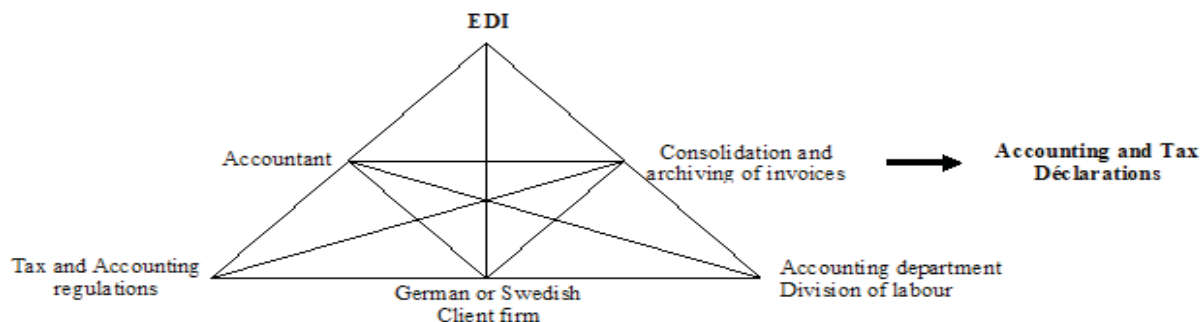


Fig. 7. EDI utilization by German or Swedish clients

This significant EDI invoice development in Germany is reinforced by the legal constraint that imposes the drawing up of a document summing up the invoices (50 orders per page). The allowed delegation of the management and the receipt of invoices also contribute to this significant EDI development.

5. Discussion

It has been argued that the commercial transaction process can be considered an Interconnect Activity System. The results highlighted various elements related with EDI utilization and the mobilized methods and concepts.

First, among the various reasons for EDI adoption (Vlosky et al., 1994; Vijayasarathy and Tyler, 1997), the results confirm Vlachos' (2004) argument that most often, it is an important client that imposes

the EDI adoption. Indeed, client satisfaction would seem to be the main reason for its adoption at HeCo (Banerjee and Golhar, 1994).

Second, the results do not confirm all the functions described in the literature. EDI is supposed to allow the improvement of client service by reducing communication time (Iacovou et al., 1995). At HeCo, the EDI-in-use of the sales staff helps neither to better know the clients, nor to have updated client data available. The required involvement is time consuming, and is not encouraged by the incentives systems. They are encouraged to sell, which is incompatible with the need to take time to update the EDI data base. Furthermore, the very characteristic of commercial activity – 80% of orders are made directly by clients via the tool and 20% consists in the search for new clients or in the development of

new products – does not encourage a mobilization around the information updating. The transactional process, therefore, is not helped by the correctness of the sales information.

EDI does not strengthen partners' business links as argued by Fraser and Khew (1992). On the contrary, these links are asymmetrical, with English and German clients dominating the relation. The German and Swedish clients provoke EDI failure by not offering reciprocity in EDI flow: asking for EDI invoices without providing EDI orders. This imbalance harms data traceability and does not allow for an efficient management of stocks, deliveries, etc. English clients, on the other hand, exploit the system's weaknesses, benefiting by retarding their payment delays and, thus, increasing their free cash flow. These malfunctions are due to a lack of visibility in supply chain matters.

EDI plays a key role in the supply chain, but it far from allows for a greater refinement of stock management and an optimal organization of deliveries (Vijayasarathy and Tyler, 1997). EDI produces a barely legible coordination of the actors within the supply chain and does not cover all the stages of the transactional process adequately. Here, the optimal organization of deliveries, improvements in the coordination of the actors involved in the transactional process, the traceability of actions and products, or even an increase in cash flow cannot be achieved. EDI is far from directing HeCo towards a fluid management practice geared towards responding to the real needs of the final consumer (Craighead et al., 2006). In contrast to Hill and Scudder (2002), the results show that EDI does not facilitate better stock management at HeCo.

The sales administrative EDI-in-use clearly shows that the expected benefits linked to reduced paperwork and cost of data entry, improved accuracy, receiving of timely information, accelerating cash flow, and reducing inventories (Vlosky et al., 1994; Vijayasarathy and Tyler, 1997) are not realized. The EDI-in-use of the administrative staff is reduced to the 'spreadsheet' function, allowing monitoring of administrative officer activity and the recap of commercial data. Faced with this usage, the advantages of EDI are reduced and the reduction in the paperwork volume is far from achieved. Furthermore, this practice does not help improve the coordination of internal communication systems (O'Callaghan et al., 1992) and decrease the number of data errors and the amount of data entry (Craighead et al., 2006).

On the contrary, it produces a risky cohabitation between computer and paper data. One of the pri-

mary functions of EDI, i.e., updating in real time thanks to the electronic format, is not used. Apart from a reduction in the tool's potential, here the risk lies in the rapid obsolescence of information followed up using the paper format. Indeed, the EDI-in-use by administrative officers essentially consists of an improved version of a spreadsheet tool, already familiar to administrators, which they, therefore, find reassuring. This lack of confidence (partly due to the data irrelevancy caused by the sales staff short-circuiting) in the transmission and archiving of data using EDI makes the users little disposed towards a broader use of EDI applications.

Hence, cash flow improvement, which is a consequence of many of the expected benefits of EDI (Masson and Ferguson, 1991), is far from being achieved at HeCo. In fact, as it negatively affects all corporate functions, EDI negatively influences cash flow timing (Vlosky, 1994).

The *instrument-mediated object-oriented activity* approach used here lays emphasis on the understanding of these disturbances and unforeseen uses in EDI. In contrast with Engeström's (2001) IAS, the results do not show any shared object; rather we observed that these IAS have a shared artifact (see Figure 9). The five AS have different objects and, thus, different outcomes, but they share the EDI.

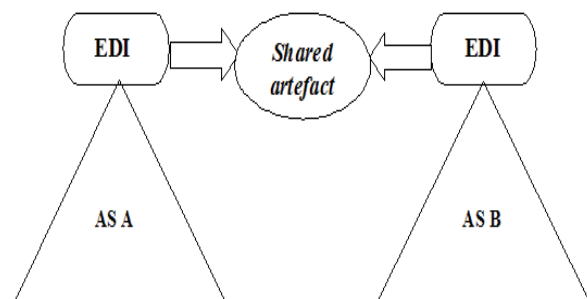


Fig. 8. Interconnected AS and shared artifact

If the tool is shared, the findings lead to distinguishing different instruments. The instruments, termed **EDI-in-use** [adapted from "the artifact in use" of Bannon and Bødker (1991)], do not have the same configuration in all the observed IAS. The instrument is shaped according to the scheme of utilization holding the experience of the users, their interpretations, and their object. It also depends on the EDI's potentialities (Rabardel and Beguin, 2005). The observed EDI-in-use present other unexpected functions such as the spreadsheet, the performance indicators of follow-up tasks, a means of fulfilling client obligations (fiscal, legal, regulatory) or even as a means of satisfying its own objectives (as in the case of English clients). Different communities (clients, administrative sales officers, etc.) have constructed different instruments oriented towards their own

emerging objects. These objects are not always evident, and they emerge within the development of activity (Engestrom, 2001). The results do not support actors' utilization behavior as a reaction to events that arise but rather as an interactionist system.

The instrument (i.e., EDI-in-use) cannot be understood only in terms of the normal uses stipulated by management or by designers (Daniellou and Rabardel, 2005); rather, it is a specific construction for given actors, according to a specific context (Rabardel, 2001). These elements handle the observed inter-organizational and the intra-organizational variability (Daniellou and Rabardel, 2005). The inter-organizational variability is coherent with Gin et al.'s (2001) distinctions between external and internal usages of EDI. In contrast, internal variability is not considered in EDI literature.

Moreover, EDI internal malfunctions are often considered in the literature as an absence of success conditions. There are many factors shaping the success of EDI (Angeles and Nath, 2003): the implementation level (Lummus and Duclos, 1995); the integration level (Eckerson, 1990); the combination to BPR (Riggins and Mukhopadhyay, 1994); the participation of those affected by the new system, both in the design and implementation stages, and the cross-functional teams in both the planning and the implementation of EDI system projects (Sanders, 1992; Trent and Monczka, 1994); and the culture (Baba et al., 1996).

These elements are considered in a specific linear perspective. Our study tried to overcome the action-reaction dynamic and tended to highlight the double interact existing between the elements of activities such as EDI, users, and object of activity. Hence, a prerequisite for EDI success, such as BPR, could be seen as a consequence of EDI adoption (Grover et al., 1995). Moreover, our results focus more on the use of EDI and its efficient usage rather than on the EDI success conditions mainly treated in the very rich literature on EDI (Vijayasarathy and Tyler, 1997; Maingot and Quon, 2001). Those conditions are themselves in interaction with activity elements.

For instance, if an optimal functioning of EDI requires transparency and trust (Hart and Saunders, 1997), once installed and used, EDI faces different objects and different user constraints. HeCo clients from the retailing sector impose an imbalanced relationship, imposing their interests and their point of view (Vlachos, 2004). The EDI installation fulfilled the client satisfaction objective (Banerjee and Golhar, 1994) but it did not allow both partners to gain from the expected benefits associated with EDI. Therefore, these conditions are part of the activity and then evolve through it.

In contrast with DeLone and McLean (2003), our results show that the quality of EDI utilization does not depend on the users' "good" disposition towards IS and its use (DeLone and McLean, 2003), but rather on their interpretation of EDI, and on the mediating role of EDI.

Conclusion

This paper makes various contributions, both on the level of Activity Theory and to the advance in EDI utilization. Before considering the implications for activity theory in organizational studies, the relevancy of observing EDI and its dynamics needs to be highlighted.

Implications for EDI

First, we extended the important body of researches on EDI. The literature lacks empirical research on the actual utilizations of EDI and the unexpected utilizations of EDI. Studies on users (Banerjee and Golhar, 1994) usually deal with adopters and non-adopters without any focus on the actual utilization of EDI within the activity.

In response to this, this research studied the actual utilization of EDI, invoking the *instrument-mediated object-oriented activity* approach in order to understand disturbances and unforeseen uses of EDI. The various EDI-in-use observed do not embody all of the expected benefits described in the literature. These expected benefits are instituted by designers and represent collective expectations in the sense that they are widespread whereas they only represent a small part of EDI potentialities.

EDI's utilization is finalized. Each community's activity is object-oriented in order to attain one or more goals. These goals are not always evident, and only some of them have been outlined here. The individual's behavior of utilization is not described as a reaction to events that arise but rather as an interactionist system where the objective of the activity is distinguished from the use of the EDI.

Different communities (clients, administrative sales officers, customs, etc.) have constructed, throughout their history, different EDI-in-use that still share some aspects (Rabardel and Beguin, 2005).

Second, this paper highlighted the double interaction between EDI and users. EDI shapes users' activity and in return EDI-in-use can be shaped by the activity – i.e. the context, the object of activity and the users. The first level of analysis provides insights on how EDI technology has been appropriated by individuals or communities. The results of this appropriation, the different EDI-in-use, led to consider that the EDI did not reach all the expected

benefits exposed in the literature. Despite this, it provided some unexpected benefits but also many unexpected effects generally considered as misuses.

The second level of analysis highlights that if EDI is appropriated by the individuals while performing their activity, this activity and those individuals have been changed in return. For instance, EDI introduction changed activities such as paperless auditing and accounting performed in Scandinavian and German clients. The use of EDI creates a more efficient and reliable accounting as well as reduces its costs, and then changes the nature of the bookkeeping activity (Gullkvist, 2001). However, these activity changes are not predictable and homogeneous (such as with the English client).

Implications for AT

This paper also makes contributions to the role of AT in organizational studies. These appear to be twofold. First, although AT is widespread in computer science, ergonomics and technology, it is also well acknowledged in organizational studies (Blackler, 1995; Engeström, 2000; Jarzabkowski, 2003). Still, it lacks empirical applications in organization sciences. Second, there is a lack of interest in the artifact, and a lack of theorizing this artifact's dynamics. In order to overcome the relative neglect of the technological artifact, we used an instrumental perspective of EDI. Drawing on the concept of instrument, well spread in ergonomics and developed by Rabardel (2001), we pro-

pose an intrinsic approach to the actor's instruments distinct from artifacts. Artifacts contain a range of constraints and oppositions which the subject must identify, understand, and handle. However, the aim of the intrinsic approach to instruments is primarily to account for people's use of artifacts and the modifications they may bring to them to adjust them to the needs of their actions.

The instrument avoids separating the EDI from its utilization, and takes into account the utilization context (i.e., the activity). Rather than seeing EDI as a hybrid, i.e., an assemblage of human and non-human elements glued together (Latour, 2005), or as embedded knowledge and routines (Orlikowski, 2000), AT distinguishes conceptually the artifact EDI from its schemes of utilizations within the concept of *instrument*. Hence, AT distinguishes itself from approaches in which actors' behavior is described as a reaction to events and from interface-oriented approaches where there is no distinction between the object of the activity and the use of technical devices (Daniellou and Rabardel, 2005).

Activity theory seems to be the richest framework for studies of context of everyday activities. However, AT should be extended in many directions (Thompson, 2004). Drawing on the instrumental approach, future research should be focused on management artifacts.

References

1. Angeles, R. and Nath, R. An empirical investigation of the level of electronic data interchange (EDI) implementation and its ability to predict EDI system success measures and EDI implementation factors // *International Journal of Physical Distribution and Logistics Management*, 2003. – 28 (9-10). – 773-793.
2. Baba, M.L., Falkenburg, D.R. Hill, D.H. Technology management and American culture: implications for business process redesign // *Research-Technology Management*, 1996. – 39 (6). – 44-54.
3. Banerjee, S. Golhar, D.Y. Electronic Data Interchange: Characteristics of Users and Nonusers // *Information and Management*, 1994. – 26. – 65-74.
4. Bannon, L.J. Bødker, S. Beyond the interface: Encountering artifacts in use in Carroll J.M. (ed.) Chap.12, *Designing Interaction: Psychology at the Human Computer Interface*. Cambridge: Cambridge University Press, 1991.
5. Blackler, F. Knowledge, knowledge work and organizations: An overview and interpretation // *Organization studies*, 1995. – 16 (6). – 1021-1046.
6. Blackler, F., Crump, N., McDonald, S. Managing Experts and Competing Through Innovation: An Activity Theoretical Analysis // *Organization*, 1999. – 6 (1). – 5-31.
7. Blackler, F., Crump, N. McDonald, S. Organizing Processes in Complex Activity Networks // *Organization*, 2000. – 7 (2). – 277-300.
8. Button, G., editor. *Technology in Working Order: Studies of Work Interaction and Technology*. London, Routledge, 1993.
9. Craighead, C.W., Patterson, J.W., Roth, P.L. Segars, H. (2006) Enabling the benefits of Supply Chain Management Systems: An empirical study of Electronic Data Interchange (EDI) in manufacturing // *International Journal of Production Research*, 2006. – 44 (1). – 135-157.
10. Daniellou, F. and Rabardel, P. Activity-oriented approaches to ergonomics: some tradition and communities // *Theoretical Issues in Ergonomics Science*, 2005. – 6 (5). – 353-357.
11. DeLone, W.H. McLean, E.R. The DeLone and McLean model of information systems success: a ten-year update // *Journal of Management Information Systems*, 2003. – 19 (4). – 9-30.
12. Eckerson, W. EDI Efforts Progress Slowly in U.S. Firms // *Network World*, 1990. – 7 (24). – 23-24.
13. Engeström, Y. *Learning by expanding: an activity-theoretical approach to developmental Research*, Orienta-Konsultit Oy, Helsinki, 1987.

14. Engeström, Y. Developmental work research: Reconstructing expertise through expansive learning', Nurminen and Weir editors, *Human Jobs and Computer Interfaces*. Amsterdam: North-Holland, 1991.
15. Engeström, Y. Innovative learning in work teams: analyzing cycles of knowledge creation in practice', in: Y. Engeström et al. (Eds.) *Perspectives on Activity Theory*: 377-406. Cambridge: Cambridge University Press, 1999.
16. Engeström, Y. Activity theory as a framework for analysing and redesigning work // *Ergonomics*, 2000. 43 (7): 960-974.
17. Engeström, Y. Expansive Learning at Work: toward an activity theoretical reconceptualization // *Journal of Education and Work*, 2001. – 14 (1). – 133-156.
18. Engeström, Y., Engeström, R. Vähäaho, T. When the center does not hold: The importance of knotworking, in S. Chaiklin, M. Hedegaard, U.J. Jensen (Eds.) *Activity theory and social practice*: 345-374. Aarhus: Aarhus University Press, 1999.
19. Fraser, A. Khew, Y. 'Telecom-streamlining supplier trading relationships in the cable industry using EDI // *Telecommunication Journal of Australia*. 1992. – 42 (2). – 37.
20. Gin, V., Grenier, G. Martin, C. French working-group traceability in arable-crops: Development of a complete EDI chain between in-field and Agribusiness industries, in 3rd conference of EFITA Montpellier-France: 397-402, 2001.
21. Gosain, S. Enterprise information systems as objects and carriers of institutional forces: The new iron cage? // *Journal of Associated Information Systems*, 2004. – 5 (4). – 151-182.
22. Grover, V., Jeong, S.R., Kettinger, W.J., Teng, J.T. The implementation of business process reengineering // *Journal of Management Information Systems*, 1995. – 12 (1). – 109-44.
23. Gullkvist, B. Towards Paperless Accounting and Auditing Frontiers of e-Business Research // *eBRF conference proceedings*, 2001. – 87-98.
24. Hart, P. Saunders C. Power and Trust: Critical Factors in the Adoption and Use of Electronic Data Interchange // *Organization science*, 1997. – 8 (1). – 23-42.
25. Hill, C.A. Scudder, G.D. The use of electronic data interchange for supply chain coordination in the food industry // *Journal of Operations Management*, 2002. – 20 (4). – 375-387.
26. Holt, G.R. Morris, A.W. Activity Theory and the Analysis of Organizations // *Human Organization*, 2002. 52 (1): 97-109.
27. Jarzabkowski P. Strategic Practices: An Activity Theory Perspective on Continuity and Change // *Journal of Management Studies*, 2003. – 40 (1). – 22-55.
28. Iacovou, C.L., Benbasat, I., Dexter, A.S. Electronic data interchange and small organizations: adoption and impact of technology // *MIS Quarterly*, 1995. – 19 (4). – 465-85.
29. Jones, M. Structuration theory in W. Currie, B. Galliers, (eds). *Rethinking Management Information Systems: An Interdisciplinary Perspective*: 103-135. N.Y.: Oxford University Press, 1999.
30. Jun, M., Cai, S. Peterson, R.T. EDI use and participation models: from the inter-organizational relationship perspective // *Industrial Management and Data Systems*, 2000. – 100 (9). – 412-420.
31. Latour, B. *Reassembling the Social: an Introduction to Actor-Network-Theory*. Oxford: Clarendon, 2005.
32. Lave, J. *Cognition in Practice, Mind, Mathematics and Culture in Every Day Life*. Cambridge: Cambridge University Press, 1988.
33. Leontiev, A.N. *Activity, Consciousness, and Personality*, Englewood Cliffs, NJ: Prentice-Hall, 1978.
34. Lim, D. and Palvia, P.C. EDI in strategic supply chain: Impact on customer service // *International Journal of information Management*, 2001. – 21. – 193-211
35. Lummus, R.R. and Duclos, L.K. Implementation of EDI systems // *Journal of Systems Management*, 1995. – 45 (5). – 42-48.
36. Lofland, J. Lofland L.H. *Analyzing social settings: a guide to qualitative observation*, Belmont, CA, Wadsworth, 1984.
37. Mackay, D. Rosier, M. Measuring organizational benefits of EDI diffusion: a case of the Australian automotive industry // *International Journal of Physical Distribution and Logistics Management*, 1996. – 26(10). – 60-78.
38. Maingot, M., Quon, T. A Survey of Electronic Data Interchange (EDI) in the Top Public Companies in Canada // *Information & Management*, 2001. – 39 (3). – 317-332.
39. Masson, D.J. Ferguson, D.M. Important Trends in North American EDI // EDI Forum, No. 2, EDI Group, Oak Park, IL: 10-13, 1991.
40. Mukhopadhyay, T., Kekre, S. Kalathur, S. Business value of information technology: a study of electronic interchange // *MIS Quarterly*, 1995. – 9 (2). – 137-56.
41. Mutch, A. Actors and networks or agents and structures: Towards a realist view of information systems // *Organization*, 2002. 9 (3): 477-496.
42. Nardi, B.A. Studying Context: A Comparison of Activity Theory, Situated Action Models, and Distributed Cognition, in Nardi B.A. (Ed.), *Context and Consciousness: Activity Theory and Human-Computer Interaction*: 35-52. Cambridge, Massachusetts: MIT Press, 1996.
43. O'Callaghan, R., Kaufmann, P. J., Konsysksi, B. R. Adoption Correlates and Share Effects of Electronic Data Interchange Systems in Marketing Channels // *Journal of Marketing*, 1992. – 56. – 45-56.
44. Orlikowski, W.J. Using Technology and Constituting Structures: A Practice Lens for Studying Technology in Organizations // *Organization Science*, 2000. – 11 (4). – 404-428.
45. Orlikowski, W.J. Barley, S. Technology and institutions: What can research on information technology and research on organizations learn from each other? // *MIS Quarterly*, 2001. – 25 (2). – 145-165.
46. Orlikowski, W.J. Iacono, C.S. Desperately seeking the "IT" in IT research: A call to theorizing the IT artifact // *Information Systems Research*, 2001. – 12. – 121-134.

47. Orlikowski, W. Robey, D. Information technology and the structuring of organizations // *Information Systems Research*, 1991. – 2 (2). – 143-169.
48. Paré, G. Elam, J.J. Discretionary Use of Personal Computers By Knowledge Workers: Testing of a Social Psychology Theoretical Model // *Behavior and Information Technology*, 1995. – 14 (4). – 215-228.
49. Pea, R. Practices of Distributed Intelligence and Designs for Education', in Salomon (Ed.), *Distributed cognitions: Psychological and educational consideration*, Cambridge: Cambridge University Press, 1993.
50. Premkumar, G., Ramamurthy, K. Nilakanta, S. Implementation of Electronic Data Interchange: An Innovation Diffusion Perspective // *Journal of Management Information Systems*, 1994. – 11 (2). – 157-186.
51. Pinch, T.J., Bijker W.E. The Social Construction of Facts and Artefacts: Or How the Sociology of Science and the Sociology of Technology Might Benefit Each Other // *Social Studies of Science*, 1984. – 14. – 399-441.
52. Rabardel, P. Instrument mediated activity in situations, in: Blandford, A., Vanderdonckt, J., Gray, P. (Eds.), *People and Computers XV—Interaction Without Frontiers*, 2001. 17-30, London: Springer-Verlag.
53. Rabardel, P. Beguin, P. Instrument mediated activity: from subject development to anthropocentric design // *Theoretical Issues in Ergonomics Science*, 2005. – 6 (5). – 429-461.
54. Riggins, F.J. Mukhopadhyay T. Interdependent benefits from interorganizational systems: Opportunities for business partner reengineering // *Journal of Management Information Systems* 1994. – 11 (2). – 37-57.
55. Roesch, E. EDIFACT // *CIM Management*, 1991. – 4. – 23-27.
56. Sanders, N.R. Merging EDI with JIT: the impact on US manufacturing // *Journal of Applied Business Research*, 1992. – 8 (2). – 133-7.
57. Saunders, C. Clark, S. EDI Adoption and Implementation // *Information Resources Management Journal*, 1991. 5: 9-19.
58. Siggelkow, N. Persuasion with Case Studies // *Academy of Management Journal*, 2007. – 50 (1). – 20-24.
59. Srinivasan, K., Kekre, S. Mukhopadhyay, T. Impact of Electronic Data Interchange technology on JIT shipments // *Management Sciences*, 1994. – 40 (10). – 1291-1304.
60. Teo, H.H., Tan, B.C.Y., Wei, K.K. Woo, L.Y. Reaping EDI benefits through a proactive approach // *Information and Management*, 1995. – 28 (3). – 185-95.
61. Thompson, M.P. Some Proposals for Strengthening Organizational Activity Theory // *Organization*, 2004.11 (5): 579-602.
62. Trent, R.J., Monczka, R.M. Effective cross-functional sourcing teams: critical success factors // *International Journal of Purchasing and Material Management*, 1994. – 30 (1). – 2-11.
63. Vijayasarathy, L.R. Tyler, M.L. Adoption factors and electronic data interchange use: a survey // *International Journal of Retail and Distribution Management*, 1997. – 25 (9). – 286-292.
64. Vlachos, I.P. Adoption of Electronic Data Interchange by Agribusiness Organizations // *Journal of Internat. Food and Agribusiness Marketing*, 2004. – 16 (1). – 19-42.
65. Vlosky R.P., Smith P.M. Wilson D.T. Electronic Data Interchange Implementation Strategies: A Case Study // *Journal of Business & Industrial Marketing*, 2004. – 9 (4). – 1994-1995.
66. Volkoff, O., Strong D.M. Elmes, M.B. Technological Embeddedness and Organizational Change // *Organization Science*, 2007. – 18 (5). – 832-848.
67. Vygotsky, L.S. Thought and language Cambridge, MA: MIT Press, 1934/1989.