tages of EDI-related technology and therefore can better judge the potential of EDI. This might weaken the risk-averse attitude towards investment in complex and expensive innovation.

By analogy, we can sketch the same picture with powerful and innovative market players. The automobile manufacturing industry serves as a good example. There, a small number of manufacturers adopted EDI procedures and set de-facto-standards and so forced ('slaved') their suppliers to implement EDI as well. Not only did the suppliers have to adopt the latest state-of-the-art systems, but the still non-adopting suppliers had to act according to the increased pressure of competition. Consequently, later adopters were inclined to take over already established EDI standards. The utility of those standards increased and so did the attractiveness of adopting them.

Thus, applying resources to a small set of firms with order of power may be more effective than distributing a flat rate subvention to a large number of firms. The promotion of additional organizations with power of order is likely to break the negative feedback cycle because it limits the ability of single firms to refuse the given standard. In fact, it is realistic to assume that by targeting interest-specific communities, critical masses may be permanently exceeded. An extension of this procedure in several branches of industry may do the most to spur the cascading of critical masses and, in turn, to promote the diffusion of EDI. A formal model can be found in [4]. ■

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The Distribution of the Benefits and Drawbacks of EDI Use in the European Automotive Industry

The automotive industry has seen a steady movement towards more complex inter-organisational structures and co-ordination mechanisms between car manufacturers and their suppliers. Increasingly, manufacturers are engaging in long-term stable relationships with their suppliers as opposed to the traditional arm's length arrangements, characterised by conflicting interests. Changes in the competitive environment drove car manufacturers to restructure their supply chains and rely increasingly on effective co-ordination of their logistical activities.

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EDI can be seen as a prerequisite for these externally focused systems with its ability to provide fast, frequent and reliable information exchange [9]. But EDI does not only affect the efficiency of co-ordination, its impact may be even more fundamental on the power-dependency relationship. EDI can shift the balance of power and control between the supplier and the manufacturer, making for a possibly unhealthy dependence on either side. As EDI can increase the efficiency of an entire network of organisations, conflicting interests between organisations will often need to be resolved [3]. Organisational literature suggests that inter-organisational networks are likely to experience more conflict when organisations with different perspectives work together [1]. The objective of this study is to assess the distribution of benefits and drawbacks of EDI use between car manufacturers and their suppliers in two particularly advanced EDI user communities in Europe. German and British based car manufacturers were selected as focal firms together with a number of their suppliers for extensive interviews. The interview data were supplemented with information gleaned from annual reports and internal documentation.

Theoretical Foundations

Three theoretical perspectives were used to help guide this research: transaction cost analysis [2,6], resource dependence theory [5] and the network perspective [6]. Each of these perspectives has a unique emphasis that contributes to a broad understanding of the benefits and drawbacks of EDI use for inter-organisational co-ordination. Transaction cost analysis emphasises the organisational concerns with efficiency, resource dependence theory highlights the degree to which an organisation is dependent on other organisations for important, and the network approach makes the web of relationships more explicit. Drawing on the three theoretical perspectives, we extracted three key concepts in order to produce a multi-perspective framework to capture key elements of inter-organisational co-ordination. These are frequency, dependence and structure.

Trends in the Automotive Industry

The European automotive industry is an excellent example for interorganisational co-ordination. Rather than manufacture the whole car themselves and practise extensive verticalintegration, car manufacturers purchase many parts from suppliers [9]. Some of the most complex and sophisticated supply arrangements can be observed in the automotive industry where strategic alliances and outsourcing are used as a means to spread the risks.

Manufacturers pursue co-operative agreements to reduce uncertainty, get fast access to information, technologies and know how, achieve reliability and responsiveness, share the risks, achieve economies of scale in joint research and development or production [7]. As manufacturers move towards more timecritical supply chain operations and real-time planningsystems, more co-ordination and information exchange is needed within a production network.

Developments in the automotive industry to call-off materials at short notice and to reduce purchasing lead-times start with improvements of information and communication links between manufacturers and suppliers. EDI links between suppliers and manufacturers become more and more important because of EDI's ability to transmit faster and error-free information. Daily or even hourly delivery frequencies of parts that are ordered at short notice require a rationalisation of data exchange. Thus, European car manufacturers increasingly rely on integrated EDI systems to co-ordinate sub-assembly production, final assembly and parts supply.

The level of EDI use varies considerably between suppliers, not only between the preferred suppliers and sub-suppliers but also within these groups. However, nearly all suppliers have implemented at least the delivery call-off message. Some orders are still transmitted through telephone or fax but manufacturers expect all their suppliers to implement the EDI order message in the very near future. Considerably fewer suppliers receive the invoice message. Shipping data and quality data interchange are at a very early stage of implementation, with only a few pilot projects. Similarly, EDI use for electronic payments is also only beginning to be used within the industry.

Efficient Co-ordination

For suppliers as well as manufacturers efficiency gains can be achieved. Companies benefit from faster and more secure flows of information and materials that allow them to reduce capital tied up in stocks. EDI provides up-to-the-minute information for decisions about production and deliveries. In addition, EDI enables organisations to develop and rationalise their operations. It is a potentially significant investment to enhance competitiveness and raise profitability. From a manufacturer's perspective, EDI is regarded as an essential productivity enhancing tool while, for suppliers, the service enhancing capabilities are more important than the cost savings. To stay in business with car manufacturers, who often account for a large portion of their turnover, suppliers have to be continuously innovative and meet the demands of these important customers. As a result, suppliers have to spend more resources on EDI functionality which helps reduce the transaction costs of the manufacturer. At the same time, the extra service is likely to increase the transaction costs of suppliers.

Problems

Since the introduction of EDI, suppliers have noted significant variances of up to +/- 15 per cent between initial orders and actual quantities delivered. They claim that in many cases EDI data insufficiently reflects reality. Typical problems reported by interviewees are: lack of manufacturer's input control, double ordering or production changes at short notice. Instead of trying to make a few exact forecasts, most manufacturers simply make frequent changes without considering the confusion these changes might cause for their suppliers. The need for 'helicopter missions' (special flights to transport urgent parts) and the infeasibility of suppliers to stick to their own production plans illustrate that these flexible production systems do not work as well as manufacturers may claim. As reported by one supplier: "First we get the three month schedule, then the one month schedule, then the one week schedule, then the daily schedule, then the fax message, and finally the telephone call desperately seeking urgent delivery of the component."

Increased Interdependence

Reduction of transaction costs emphasises the efficient linkage between manufacturers' internal operations and its external communication and co-ordination with suppliers. But EDI can also reduce a manufacturer's resource dependence and emphasise the service of preferred suppliers so that they are locked into the system. On the other hand, suppliers can provide their customers with features that they want, or cannot do without, thus making important customers more dependent, e.g. sophisticated logistical services. With high dependence on the preferred supplier, the manufacturer may not be able to replace the supplier easily because of the rigidity of the inter-organisational relationship formed after the implementation of EDI. Therefore, an EDI system can increase the interdependence of both parties.

Systemic Rationalisation

From a network point of view, the supplier's decision is virtually restricted to whether or not to stay in business with the manufacturer. If the supplier decides to continue the business relationship, and in many cases suppliers have little choice but to do so, their planning autonomy in terms of investment and production is considerably influenced by the manufacturer. Due to their size and power, manufacturers can usually get their way. Within the emerging production networks that are enabled through EDI the suppliers' decisions are more and more replaced by systemic requirements that restrain their entrepreneurial autonomy. A 'production dependency' [4] on the manufacturer is likely to evolve as it is the manufacturer who centrally co-ordinates the production network. It can be observed that the manufacturers' influence over suppliers increases quantitatively as well as qualitatively and that decision making is centralised and shifted to manufacturers. This creates a dilemma for the supplier: to optimise production within the network, planning is more and more synchronised with the manufacturer's production by closely integrated information flows and organisational and technical adjustments. But, due to frequent changes of call-offs, suppliers cannot achieve the desired optimisation. Instead, external planning errors are directly transferred into their own system making the supplier's production unstable and difficult to predict. As planning is outside the suppliers' influence, they have to adjust their planning frequently. This requires drastic organisational and technical adjustments to rationalise and to ensure flexibility. Especially if delivery cycles are shorter than production cycles, suppliers have to make externally determined adjustment investments

Need for 'True' Partnerships

If manufacturers still try to optimise their own production at the expense of their suppliers, this may have a negative impact on co-operation with suppliers, perhaps preventing long-term 'true' partnerships. Possible reactions suggested by suppliers could include delaying deliveries which would slow down the manufacturer's production and reduce support when the manufacturer is in trouble and needs extra parts. Ultimately, if an important systems supplier terminates a business relationship it may be very difficult to replace this supplier. ■

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