

Learning from failure: The myths and magic of electronic transportation markets

Rainer Alt

*Institute for Information Management
University St. Gallen
Dufourstr. 50, CH 9000 St. Gallen, Switzerland
Email: rainer.alt@metronet.de*

Stefan Klein

*Institute for Information Systems
Westfälische Wilhelms University Muenster
Steinfurter Straße 107, D-48149 Münster, Germany
Email: Stefan.Klein@wi.uni-muenster.de*

Abstract

In the past 20 years a variety of electronic markets have been set-up for the allocation of capacities in road transportation. Although, inefficiencies and cost pressures are high, the electronic markets have not succeeded so far. In this paper we will give an overview of the so-called electronic transportation exchanges and analyze the factors that were involved in the repeated failures. By using a multi-layer framework which integrates established research approaches for interorganizational systems (IOS) we argue that the failures provide valuable insights for the configuration of electronic commerce systems in general and in particular for the transportation exchanges that are currently emerging on the Internet.

1 Introduction

In view of the Internet-frenzy of the 1990s the awareness and usage of electronic commerce have spread tremendously. However, there are some industries which have been using electronic commerce since the 1960s. Among them are the well known and documented computer reservation systems [e.g. McKenney 1995], the computerization of financial markets [e.g. Picot et al. 1995] and the electronic support of logistic processes [e.g. Stenger 1986]. Although logistics has been among the pioneers to adopt electronic commerce, many systems have fallen short of the expectations.

At the same time, it is one of the intriguing realities that many applications which suffer from profound diffusion problems are at the heart of an industry's future competitiveness. One example are the electronic transportation exchanges (ETX) which aim at improving the allocation of cargo space in the road transport sector. In the following we will analyze the nature and the intricacies of these systems and try to answer the questions why - despite a convincing rationale - these systems have not yet succeeded. This is particularly interesting because it highlights some success factors which have to be taken in account when building electronic commerce applications.

2 Studies on success and failure of IOS

Porter and Millar [1985] noted that by transforming the informational component of a product, the application of IT will profoundly change industry structures and a company's competitiveness. However, the authors gave no indication on the factors that would lead to a successful implementation. In the quest for success factors, useful insights were obtained by applying the case study approach. For example, Copeland and McKenney [1988] identified economies of scale, congruence between task and technology as well as importance of intelligent persistence as general strategic success factors. Venkatraman and Short [1992] who studied Baxter Healthcare's IOS summarized three findings of previous studies as key factors: the strong product pull through the electronic order entry system, high switching costs for hospital customers and high barriers to entry for competitors. The authors emphasized the dynamic character of these factors and described how Baxter's strategies changed over time from a single- to a multi vendor platform and towards a value-added partnership with hospitals.

More recently the angle has shifted from industry studies to studies focusing on the adoption of IOS. In seven case studies Iacovou et al. [1995] identified organizational readiness, external pressures to adopt and perceived benefits as key adoption determinants and proposed recommendations for successful EDI partner expansion plans, such as promotional efforts, financial and technical assistance and coercive tactics. Comparable factors are reported by Premkumar/Ramamurthy [1995] who distinguished between interorganizational (competitive pressure and exercised power) and organizational variables (internal need and top management support) for IOS adoption. Many of these studies go beyond the industry analysis level of the earlier contributions and draw upon the theory of critical mass and networks. Although others [e.g. Eistert 1996] proposed multi-disciplinary approaches to the study of adoption, a systematic framework that encompasses industry and network levels is still missing.

Focus	Research perspectives
Technology and process issues	Research on EDI and CIM: (re)design of business processes, e.g. organizational integration of EDI [e.g. Wagenaar/Heijden 1994]
Competitive impact and industry structure	Research on changes in industry structure [e.g. Porter/Millar 1985]
Network analysis	Theory of networks [e.g. Economides 1996]

Table 1: Research perspectives on IOS

Another neglected area is the study of implementation pitfalls and failures in the marketplace. Various examples indicate that the lack of acceptance and diffusion is more common than communicated by participants who typically are not inclined to publish information in this regard. There is a common thread from the MIS systems of the 70s, the CIM systems of the 80s and the EDI systems of the early 90s which highlights that the lack of success was only slowly perceived over time. For example, Sokol [1995, xi] notes concerning the diffusion of EDI: „...While many companies have begun to use EDI and many more have since joined the ranks, EDI is not taking the world by storm. Even in those companies that are doing EDI [...] it is rarely the primary mode of doing business.“

The lack of economic success can also be observed in current electronic commerce offerings where even popular systems are losing money, e.g. Time-Warner's Pathfinder reportedly generated losses over \$5 million a year [cf. Hof et al. 1997].

Our literature review yielded only a few studies on implementation failures of IOS: In her work on bugs and features Markus [1984] describes the resistance effect, a phenomenon where systems are used in different ways from what was intended by the system designers. In her explanation she mainly builds on the lack of understanding the interaction between organizational and technological variables. Christiaanse et al. [1996] analyzed the failure of cargo-community systems in the air cargo community and conclude that institutional factors have not been taken into account. Strategies for persuading non-adopters, especially SMEs have been described by Iacovou et al. [1995]. In summary, inverted success factor research has proved as a valuable tool in complementing and verifying lessons proposed in success stories. We also face the lack of an overall framework for analyzing IOS here.

In our case study of the electronic transportation exchanges we intend to provide further insight in success factors for IOS by scrutinizing implementation pitfalls and failures and suggest a framework that distinguishes various levels of IOS analysis and design.

3 The case: Electronic transportation exchanges

3.1 Rationale of electronic transportation exchanges

Transportation is one of the pivotal components for logistic concepts. Contrary to transportation, logistics has a broader scope in that it not only focuses on the movement of a physical good but also on the information flows and the need to manage an entire (transportation) system. Lacking information and management are important causes for today's inefficiencies in the transportation of physical goods. Well known problems are inventories at the interfaces (such as forwarders, ports), insufficient reliability, and the growing congestion of the road infrastructure. In Europe, the costs related to these problems amount to 15 % of the total transportation costs or \$300 billion annually [CEC 1992] and all forecasts predict a growing transportation volume in the forthcoming years. In principle, there are three approaches to solve this problem. The first, the reduction of transportation volume, limits an economy's performance as well as it's future growth and poses no viable option. Expanding a country's infrastructure is a highly political issue and in many cases associated with high risks of resistance from powerful interest groups. In our opinion, the intensified usage of today's road capacities, which are in fact only partly exploited, remains the only promising alternative. Only half of the capacities in European road transport are used or, in other words, half of the trucks in Europe are driving empty.¹ Reducing these inefficiencies is important because they add to the costs of a primary product. Despite current logistic strategies emphasizing the need for reliability, full service and the like (e.g. ECR), cost still acts as the prime decision variable for shippers.

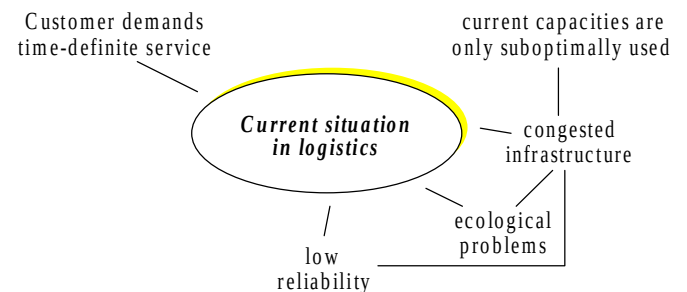


Figure 1: Factors leading to the Great Reversal

There is a significant gap between the existing inefficiencies in road transportation and the cost pressure of shippers. The reasons for this sub-optimal allocation of resources are mainly attributed to an information deficit, i.e. providing information on who has cargo and who carries cargo would increase the efficiency of road transport. In the early 70s various research projects have been launched in Europe to

¹ For example, the truck capacities in Germany are only used to 56% with the ratio being only 41% for corporate fleets [Büllingen 1994].

initiate an IT solution to this problem. The emerging electronic transportation exchanges (ETX) made information available on both shippers and forwarders and aimed at removing the existing information asymmetries in the market. The ETXs were the first electronic markets in logistics and had a convincing motivation which was based on three factors:

- The increased performance of telematic services, namely the emerging Videotex systems of the late 70s, enabled the instant and ubiquitous availability of information.
- The growing salience of information for efficiency improvements in transportation. Traditionally, increasing the performance of the transportation system was equivalent with advances in the area of the physical infrastructure (e.g. double-stacked railroad cars, containerization) and information management was only regarded as an auxiliary factor. Due to the changing profile of logistic services and the apparent needs for planning and control we expect the design of the information flows to dominate the design of the physical flow. King [1995] referred to this development as ‘Great Reversal’.
- The homogeneous nature of road cargo transportation. Although the goods being transferred are highly heterogeneous themselves, the transportation industry has made significant achievements in reducing this complexity by means of standardized containers, classes for dangerous goods, and the like. Therefore, in many cases only a limited amount of information is required for the specification of transports.

Due to these advantages, the concept of the transportation exchange not only spread in road transport but also in other areas of logistics, such as electronic exchanges for container space in seaports such as Hamburg or for air cargo space in airports such as Amsterdam [Christiaan et al. 1996]. Since the experiences of these systems are comparable with the ones made in the area of road cargo we believe that the following analysis is also valid for them as well.

3.2 Functionality of ETX or why transportation exchanges are no exchanges

The exchanges in the financial sector are often considered to be markets that come close to the ideal market described in neoclassical market theory. Computerization is spreading in this area and well known examples for electronic exchanges come from the future and the option markets.² In general, electronic exchanges have two major characteristics:

- Electronic exchanges *support entire market transactions* which consist of information, trading and settlement processes [cf. Schmid 1993]. Traders screen and compare positions in the order book which contains open bids and offers in the market (information phase). In the trading

phase a match is incurred depending on various tie break rules (e.g. price-time priority) and accounts are cleared afterwards in the settlement phase.

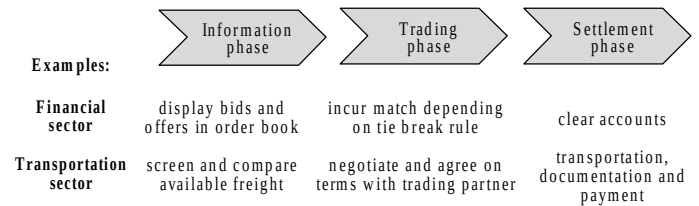


Figure 2: The transaction process

- Electronic exchanges *use market principles* for the coordination of supply and demand side. These are competition among multiple autonomous actors and the use of prices as a basis for allocation [cf. Eatwell/Milgate 1994]. The ETX-concept differs considerably in both dimensions. Traditionally, road transport services are being sold by means of specialized newspaper magazines and personal contacts on the phone. Trading activities are almost exclusively done in personal contacts between forwarders and carriers and settlement is highly paper-intensive (e.g. waybills, declarations). ETXs primarily target the information phase and provide centralized online-blackboards. Supply (cargo) and demand (freight) can be submitted and displayed to all participants which are mainly forwarders and carriers but no shippers. The databases usually contain information on the transportation company’s identity (e.g. address, main area of business and years in business) and a specification of the cargo or the cargo space such as dimensions, destination, or time. Information on conditions or price is not included. In case a participant is interested in a displayed item, the ETX’s mission is fulfilled. As in the non-electronic scenario the agent calls his counterpart by phone and negotiates on the terms of the deal.

Compared to the financial exchanges the trading and settlement occur outside of the system and market coordination is limited to the information dissemination among multiple actors. In view of our definition ETX are no exchanges. However, changing the ETX-label is not appropriate in our opinion because there is a general understanding for the concept of exchanges and because of the possible evolution path for ETX that this metaphor implies.

3.3 Evolution of ETXs: myths and realities

The idea for ETX dates back to the 1970s when the German institution SVG initiated a database that could be accessed by participants through contacting an operator by phone. Table 2 shows that numerous other systems were developed in various European countries with the advent of videotex systems (e.g. Minitel in France). A second push came with the Internet. While many existing ETX providers switched over time to the new IT infrastructure, new web-based ETX were

² For an overview and a comparison of various electronic exchanges cf. Domowitz [1993].

initiated by startups primarily in the US (see table 3 below). Besides the systems which are interorganizational in nature, the ETX-concept was also used in the intraorganizational setting. Large forwarders such as Switzerland's Danzas or Germany's Schenker aimed at increasing the allocation efficiency, i.e. the payload factor, of their trucks. A system which supports the consolidation of cargo within big shippers is offered by the Bertelsmann subsidiary Media Log [cf. Bentrup 1994].

One of the myths that has been driving the repeated initiation of ETX within inter- and intraorganizational settings are their benefits and rationales which have been shown in various forecasts and field tests. In the case of AMÖ, an ETX for moving companies, simulations undertaken in 1981 produced an increase in the payload factor from 37,1% to 73,2%. The simulations not only underlined the economic but also the ecological rationale of the ETX: instead of 188 only 93 moving-vans would have been necessary for the same transport volume [cf. Büllingen 1994]. In the INTAKT research project trials were undertaken with four German forwarders in 1989 which concluded with a raise in productivity³ from 37% to 55%. Furthermore, qualitative advantages such as improved disposition results and a reduction of manual interventions were reported in these field experiments. In sum, the ETX's strong rationale and their expected benefits kept driving the repeated initiation of these systems in various countries. Due to the win-win situation for all participants a quick diffusion of the systems was widely expected in the road transport industry.

A rapid diffusion of ETXs, however, has not occurred and almost all systems have faced severe problems in the marketplace. It was not that the predicted and simulated economic and ecological benefits were not confirmed by users of the systems, but rather that the systems were unable to sufficiently attract active users. Table 2 shows that many systems discontinued operation after a short to medium-range period. Today, six of the traditional ETX are still alive. We will term them 'traditional' because the following analysis does not include the status of the newly founded Internet-based ETX where experiences are still lacking (see chapter 5). The mere fact that four of the six ETX have been in the market for almost ten years already underlines that not every ETX was a failure. Although they only acquired a very small segment of the road transport market and their evolution also stayed behind the expectations, COMIS and Tel-route are referred to as relatively successful.

4 Analysis of the failure of European ETXs: Why market governance will not work

We believe that only a qualitative research methodology with an encompassing framework will be adequate to explain the

³ The productivity is calculated (payload shipped × hours of usage) / (vehicle payload × maximum hours of usage).

System	Regional scope	Operation	Provider	Communication
SVG-Datafracht	Germany	1973 - 1974	Central association of German road hauliers (SVG)	Phone
LOG	Germany	1980 - 1986	Project funded by German Ministry for Research & Technology	Datex-P (X.25)
Telefracht	Germany	1982 - 1985	Log-Sped (Group of road transport carriers)	Videotex (Btx)
Tradicom	Netherlands	1982 -	NOB-Wegtransport (Group of road transport carriers)	Videotex (Viditel)
AMÖ-removal exchange	Germany	1985 - 1990	Association of German furniture removal companies	Btx
Intakt	Germany	1985 - 1989	Project funded by German Ministry for Research & Technology	Datex-P, Btx
Transpotel	Europe	1984 - 1995	German road transport publishing company	GEIS, Btx
Tele-route	Europe	1986 -	Wolters-Kluwer Publisher	Videotex / Datex-J
COMIS	Germany	1987 -	Conferrn-furniture removal company	Btx, SNA, ISDN
BWV	Germany	1990 -	Federal association for corporate transport and shippers (BWV)	GEIS Mark III, Videotex
Transpotel/ TIR Online	Europe	1985 -	Elsevier (Dutch publishing company)	X.25, Videotex
EFIS	Europe	1994 - 1995	Mercury, DVK, Hanro, Infocheck, Shohet and Cie.	Phone, Fax, Modem
Telefracht	Switzerland	1995 -	Telefracht (Information service provider)	Phone, Fax, Modem

Table 2: Evolution of ETX in Europe

reasons behind the failure of ETXs. Our design will be two-fold. The first step concerns the review of relevant literature on ETXs. This includes the documentation on concepts and trials namely for those ETXs which were nationally funded research initiatives as well as analyses on the impact of ETXs.⁴ In the second place, semi-structured interviews were conducted with two ETX providers (Switzerland and Germany) and two major Swiss freight forwarding companies in 1996 and early 1997. These interviews were backed up in nine interviews with individuals from the logistics industry.

For the discussion we propose a simple framework that covers and integrates along the three perspective we identified in chapter two:

⁴ This mainly refers to reports in newspapers and periodicals and the studies undertaken by Büllingen [1994] and Baum et al. [1995].

- A *technological* perspective focusing on the technological platform of the IOS, e.g. the protocols being used, the architecture of the IOS and aspects such as speed, cost or accessibility.
- A *process* perspective that concentrates on the communication and business processes which are realized 'upon' the technological infrastructure. Relevant aspects are what kind of transaction phases (figure 2) are electronically supported and to what degree integration is achieved across all phases.
- An *actor* perspective which is used to understand the impact of IT on industry structures. It highlights the competitive, organizational and political aspects of the relationships between individual and organizational actors within the transportation industry.
- A *network* perspective which takes into account that ETXs draw upon the participation of multiple actors. As soon as multiple actors interact, additional effects result that cannot be explained on the more dyadic actor-to-actor relationship level. Networks have a characteristic of their own, namely the self-reinforcing effects of externalities and critical mass, and are important in explaining the diffusion and adoption of IOS.

4.1 The technological perspective

State-of-the-art technology - with varying levels of sophistication - was used to build the ETXs. The first ETX dates back over 20 years. Cost for hardware and software was high in these days and performance was low. Although both factors were considered responsible for the failure of the SVG-system, they only provide a partial explanation since they cannot comprehend the organizational and political reservations which were reported [cf. Eckstein 1985]. A comparable situation can be observed for the Videotex-based systems which spread in the mid-80s. Videotex promised to be an infrastructure which was available on a broad scope and required only limited investments in technological equipment on behalf of the forwarders. Keeping infrastructural investments low was an important factor in an industry dominated by SMEs and a low diffusion of technological equipment and knowledge. The Videotex-based systems provide an ambivalent picture in that on the one hand many of them failed and on the other hand some survived. From a technological viewpoint three explaining factors can be found:

- The *diffusion of the technological infrastructure* proved to be a success factor for Teleroute which was initiated in France. Minitel, the French Videotex System, is widely spread in the business community and an estimated 95% of all transportation companies were already connected to Minitel. In most other European countries the Videotex systems struggled with diffusion problems themselves.
- The *diffusion of the technological equipment* which was necessary to access the ETX. Although Videotex already

reduced the necessary technological investments, the coordination and information benefits were not sufficient to justify these investments. Again, Teleroute made profit from Minitel, because terminals were spread at many potential participants already.

- The *proprietary nature of the technology* was a problem since the participants could not use the technological investments for other business applications, e.g. EDI or payment services as well. With the Minitel and to a certain extent with the German Btx system, a variety of other established services could be accessed as well.

4.2 The process perspective

From an abstract point of view, the functionality of the ETXs represents a market mechanism which aims via improvements in market transparency at increasing allocation efficiencies in the road cargo market. However, the central criterion for market mechanisms, liquidity, has not been achieved. The ETX's main problem was on the supply side, i.e. providing cargo to be carried. If cargo was submitted, it was too often only cargo which could not be sold through the traditional channels. Hence the exchanges included cargo not only in a low volume but also cargo which was not attractive to most users. In our studies we identified three factors that were relevant for this lack of liquidity:

- *Incentives for repeated transactions.* Opaqueness of the market is apparently only of limited concern for the transportation agents. They already have a sound overview of their market and problems are only perceived when transportation is sought in foreign markets or unfamiliar market segments. It is in this niches that Teleroute is fairly successful. If agents used an ETX they strived for bilateral contacts in follow-up transactions.⁵ This 'marriage effect' led to bypassing the ETX and was experienced in the INTAKT trials: During a three month period the number of entered payload dropped from 17,2 in the first month to 16,1 in the second month to 11,8 in the third month [cf. Eckstein et al. 1990].
- *Incentives in repeated transactions.* A partial explanation to the bypassing effect is the lack of benefits the ETXs offered for transactions where transparency was *not* perceived as problem. This mainly refers to support in the trading and settlement phase. ETX were isolated systems which did not support entire transaction processes. They implied a change of the medium of communication (from computer-based to phone-based) and were not integrated into forwarders or carriers internal systems (e.g. for disposition, equipment management). Organizational benefits were very limited because transaction costs were seldom significantly lower than in entirely phone-base transaction.

⁵ The 'marriage effect' is closely related to the fundamental transformation known in transaction cost economics [cf. Williamson 1985].

- *Industry characteristics.* Cost and quality are the main criteria for the procurement of transportation services. With a growing specialization in terms of transported goods and risks incurred, e.g. fraudulent declaration of hazardous shipments, electronic descriptions of shipments might not be sufficient and further information is necessary before a shipment can be contracted.⁶ Consequently, the markets on ETXs become segmented, the overall liquidity is limited and the incentives to participate in the ETXs are diminishing. Incentives increase with the availability of agreed-upon quality levels and the possibility to follow-up the performance of a carrier, e.g. by linking the ETX to tracking and tracing systems.⁷

4.3 The actor perspective

Looking at the relationships between the various players in the contested road transport market, we find a limited amount of horizontal cooperation and trust among the competitors. The players show a preference to deal with each other at arm's length and strive for bilateral relationships with the shippers. This makes sense since logistics companies are squeezed between the interests of their customers, i.e. the shippers and consignees. They have considerable potential for scale economies and for gaining a professional profile by consolidating deliveries etc. as well as for adapting to the customer's administrative requirements. Forwarders and carriers are therefore trying to build stable relationships with their customers. More or less anonymous transactions on ETXs are counterproductive to strategies that aim at improving and deepening customer relations and maintaining control over these relationships. Outsourcing of logistics services, e.g. warehousing and distribution, recently has become quite popular and logistics companies are trying to increase forward and backward integration with their customers and thus evade cutthroat price competition [cf. Clemmons/Reddi 1994].

As the quality requirements for logistics services are increasing (accurate timing, treatment of the shipment etc.), shippers are less inclined to hand their shipments to unknown forwarders or carriers and face numerous risks from delays to the loss of entire shipments. Bakos/Brynjolfsson [1993] have shown that when quality is a concern, it can be optimal to reduce the number of suppliers. In our analysis we found three factors that supported the inhibiting attitude of logistic companies towards ETXs:

- The *functionality of personal contacts* was not supported by the ETXs. Personal experiences and credible recommendations reassure agents that certain quality standards are met (e.g. reliability, damage in transit, financial diffi-

culties). ETXs lacked an institution which was able to not only define quality standards, but also to control and to sanction players which did not meet these standards.

- As intermediaries, forwarders feared *changes in information asymmetries*. Bakos [1996] has explained how market coordination leads to more transparent markets and decreases the profit margins of intermediaries. Thus, these players are interested in maintaining the current asymmetric distribution of information and suspected that ETXs would put carriers in direct contact with shippers (disintermediation) or that customers/shippers would be lost to competitors.
- ETXs were faced with a *highly integrated demand and supply side*. In Europe forwarders, especially large forwarding companies, often also act as carriers which explains why neither of both parties really promoted ETXs. In addition to the fragmented nature of the market no key players existed that were in the position to force other players in using the systems.

4.4 The network perspective

Based on the process effects and the strategic analysis, especially the big companies hesitated to use the ETX and there was not sufficient support from logistics associations. Without their support and the volume of transactions they might contribute, many of the mentioned projects never gained critical mass. On the contrary, negative externalities were experienced due to a lack of liquidity. Although the ETXs had quite a number of participants, transaction volume was low because the users had low expectations that attractive cargo would be available and therefore refrained from even accessing the ETX. With the exception of COMIS and Teleroute none of the ETX gained sufficient critical mass to offset positive externalities. The example of Teleroute shows that ETXs are subject to dual externalities:

- *Infrastructure-specific externalities.* Teleroute was launched in France where the national Videotex infrastructure has reached a critical mass of users. This favored the diffusion of the ETX because potential ETX-users had the technical equipment already and were used to electronic transactions.
- *ETX-specific externalities.* Both COMIS and Teleroute were able to take advantage of institutional regulations. In COMIS all payload surpassing 75 km had to be submitted into the system. In the French market where Teleroute was launched, 40% of all cargo had to be publicly advertised.

5 Perspectives for Internet-based exchanges

Although technology has not been identified as a major inhibitor for the success of ETXs, the emergence of the Internet as a global communication infrastructure is likely to affect the rationale and configuration of ETXs. Table 3 lists

⁶ For the role of product descriptions for the development of electronic markets cf. Malone et al. [1987].

⁷ Tracking enables to identify the whereabouts of a shipment while in transit and tracing to determine ex-post the itinerary of a shipment together with the critical events that occurred.

recent ETXs based on the (World Wide) Web, which have been initiated mostly by new players in this field. These systems are still very young and experiences on the diffusion are hardly available. However, in some interviews skepticism was reported concerning the immediate acceptance of these systems in the business community. Today's Web-based ETXs more or less reflect the same configuration as the traditional ETX and the potentials of the Web are only partly exploited. We are using our framework to show the extend to which the Web can make a difference and what might be success factors for Web-based ETXs.

Initiator	Example of Web-based ETX
Established player	Teleroute (http://www.teleroute.com) Freight Exchange (http://www.borsanoli.com)
New player	Massmotion (http://www.massmotion.com) Eurotrans (http://www.eurotrans.com) Internet Truckstop (http://www.truckstop.com) Trucknet (http://www.truck.net) Internet Trucking Info (http://www.internet-trucking.com) The Cargo Exchange (http://www.cargox.com)

Table 3: Web-based ETXs

5.1 The technological perspective

The diffusion of the Web is affecting the economic rationale and the positioning of ETXs because all three factors identified in chapter 4.1 are influenced. The Web is the fastest growing Internet service⁸ and already well established in the business community. Generally, client-server technology with Web browsers as standardized intelligent clients provides an environment to develop versatile and flexible inter-organizational applications [Kalakota/Whinston 1996]. Compared to the Videotex systems that have mainly been used for ETXs, the Web is different in three aspects:

- The Web transcends the national perspective and is global in nature which is especially important because logistic chains are increasingly international and ETX proved valuable in discovering foreign markets.
- The equipment needed for Web access (PC, Browser etc.) is a commodity and widely available. Since even small transportation companies are using PC-based systems already, the entry barriers are significantly lowered while functionality (e.g. speed, graphical interfaces) has increased.
- Furthermore, these investments are not specific to the ETX application and the Web represents a technological open basis for the support of other business processes as well (e.g. EDI, payment services).

Transportation companies can start with their most central applications and then gradually, as they become more experienced, extend the scope of their Web activities. Cybermediaries, which offer to host their clients' Web-sites, function as outsourcers and enable SMEs to build a Web presence even before the technical know how has been built internally. The foreseeable competition will yield a broad stream of high-quality products at reasonable prices. Virtually all major software companies are working to integrate Web technology and the availability of integrated solutions is just a matter of time.

5.2 The process perspective

As standardized, open and platform-independent infrastructure with an attractive cost structure the Web represents an adequate infrastructure for ETXs. From a process perspective several characteristics are interesting to increase incentives for active participation and higher liquidity:

- *Increasing the value added.* The emergence of Web technology from static HTML pages to interactive applications with links to internal databases has opened up the scope of applications towards more comprehensive support of transactions. The Web does not determine the structure of the application and is well-suited as integration platform for bundling the traditional information processes with value adding trading and especially settlement processes. This leads to reduced transaction costs compared to phone-based transactions, takes advantage of integration effects, increases the incentives for participants and makes ETX a competitive factor in road transportation.
- *Providing a mix of coordination mechanisms.* ETXs have to cope with the need for flexible, multilateral and integrated, bilateral relationships at the same time. Web applications can be set-up and focused on specific market segments more easily. We therefore expect that the Web will enable mixed-mode configurations [Holland/Lockett 1994] where logistics companies will use different coordination mechanisms concurrently (from hierarchy to market) according to their dynamically changing requirements.
- *Active process coordination.* Compared to the Web traditional ETX were rather passive in that users had to access the systems to see whether suitable postings were available. Agent-system which constantly gain in sophistication are spreading on the Web and information will be 'webcasted' to the users whenever postings match a certain profile that has been submitted to the ETX. These individual transportation agents might also monitor multiple ETX as well as carrier's tracking and tracing sites once the cargo is shipped.

⁸ Until the second half of 1993 Web sites doubled every three months and even today a doubling occurs every six months. In January 1997 there was an estimated amount of 650,000 Web sites worldwide (cf. Network Wizards 1997).

5.3 The actor perspective

As our analysis of ETXs (chapter 4.3) showed, there has been considerable resistance on the actor level and we have indicated that traditional ETX changed the way business has been done in the industry without providing instruments which could compensate for example the role of personal contacts. The intelligent and tailored use of Web-resources could foster an adequate environment for ETX-usage on the Web.

In the first place we see a structural *isomorphism between the transportation industry and the Web*. The Web mirrors the structure of logistics and vice versa. Both are highly decentralized and distributed in nature and players are rather heterogeneous. It is important to realize that attempts to centralize road cargo are doomed to fail because a dominating actor does not exist and cooperation between transportation companies is still at arm's length. Information sharing is a highly political issue and we expect structures to emerge which limit the risks of unauthorized access to data and unknown business partners. We see the application of ETXs within Intranets and Extranets (cooperation with major trading partners) and within virtual communities on the Internet.

Communities reduce anonymity in transaction and represent a platform for the definition, control and sanctioning of community-wide standards (e.g. quality levels). The Web has lowered the threshold for cooperation and has become a community builder. It enables cooperation strategies which are of increasing relevance in road transport and allows the coexistence of cooperation and competition. The combination of a fluid and dynamic medium which encourages trials and low initial investments and low asset specificity help to overcome prior obstacles to develop an IOS.

Research shows that electronic commerce has a profound impact on the role of *intermediaries*. While on the one side disintermediation and bypassing is occurring, Sarkar et al. [1995] described the substantial need for inter- or cybermediaries on the other side. Thus the Web will foster disintermediation in some cases while new segments emerge for intermediaries. We see two trends, which might occur concurrently: As it becomes easier and cheaper to set-up an ETX on the Web, more focused and specialized ETXs organized within communities are likely to emerge. On the other hand, more open and less specialized exchanges will be organized by players who have sufficient clout in the market.

5.4 The network perspective

To a great extent the network level reflects the success factors on the different levels. Low costs, open technical systems, high value added and low transaction costs together with a limited amount of uncertainty concerning disintermediation, security and quality will generate positive expectations and spur the diffusion of ETX. The advantage of the Web is

the critical mass and the low technical investments. Since critical mass has already been reached, ETXs can benefit from positive network externalities on the infrastructural level. Even competing ETXs might yield more users as long as they are built on the same infrastructure and protocols. Low transaction fees reduce the incentives for bypassing and hence the risks of losing business as a result of bypassing. However, the integration of ETXs into the internal operations might require more specific technical solutions. The following table summarizes the success factors of ETXs which mirror industry specific requirements.

Industry characteristics	Configuration of the ETX
Distributed operations and network externalities	Distributed low-cost communication infrastructure for internal purposes, closed user groups and open communication
Segmented market with intense price competition and antagonistic relationship among the players	Adaptable ETX with variable focus on market segments and variable degrees of transparency, varying coordination mechanisms (mixed-mode); low-cost infrastructure with low asset specificity
Focus on relation building, quality and trust	Seamless integration of ETX in traditional operations, integration along the transaction phases (from information to settlement)

Table 4: Success factors for ETXs

6 Conclusions

ETXs were falling short on both ends of the continuum between markets and hierarchies: Neither did they support entire market transactions and thus generate specialized market segments nor were they used to improve the process integration among logistics companies and their customers.

Despite an apparently convincing macro-economic rationale (more efficient use of the congested transport infrastructure) and successful examples of electronic markets in related transport segments, namely the CRS, ETXs did not succeed because of the underlying structures of the services, the relationships between the business partners and structural features of the industry. Our framework emphasized that there is no single factor that is responsible for the lacking diffusion but a set of various highly interrelated factors.

While the Internet does not by itself lead to improved liquidity and incentives for ETX users, it is, however, profoundly changing the economics of ETX as the communication infrastructure and client software (browsers) are almost pervasive and for free. As a result ETX are sustainable with lower transaction fees and a lower transaction volume and therefore can be targeted for specific market segments. In

addition the Web will be used more extensively for network like governance structures (closer coupling, higher level of integration etc.) among logistics companies and their customers.

There clearly is an opportunity to overcome some of the obstacles ETX have faced so far and to align the economic rationale of ETXs and their strategic positioning through a careful configuration of technical, procedural, institutional and network dimensions.

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