Requirements and Infrastructure for the Modelling of Electronic Market Transactions

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Abstract

The emphasis of commercial usage of the Web has shifted from marketing-related communication goals to conducting business transactions on-line. While the technical implementation of electronic transactions at firm-level has become readily available, the management of on-line distribution infrastructures and of industry-level standards and integration is still lacking attention and solutions. This paper attempts to point out the current deficiencies based on Schmid's Reference Model of Electronic Market transactions (1993; Schmid & Lindemann, 1998). The ultimate goal behind this research is to provide a commercial modelling environment for on-line vendors and information brokers that enables them to optimise their operations and gain competitive advantage. The proposed research aims at resolving these deficiencies by introducing industry-wide specifications for all phases of Electronic Market transactions and by providing modelling methods and tools to allow individual organisations to plan and optimise their Electronic Commerce Strategies.

Introduction - The Nature of Electronic Markets

The concept of "Electronic Markets" was first published in the scientific community by Malone, Yates and Benjamin (Malone, Yates, & Benjamin, 1987; Malone, Yates, & Benjamin, 1989). While the term was introduced as a contrast to "Electronic Hierarchies" based on the classical transaction cost theory (Coase, 1937; Williamson, 1981), numerous authors extended the concept and applied to it to various market scenarios and corporate applications (compare, for example, Bakos, 1991; Benjamin & Wigand, 1995; Brandtweiner & Scharl, 1998b; Kalakota & Whinston, 1996, 219ff.; Rayport & Sviokla, 1994; Zwass, 1996). It does not come as a surprise that these varying objectives and application areas led to some extent to differing definitions of attributes and characteristics of Electronic Markets. In this paper the term Electronic Markets refers to a "system of many-to-many (buyer-to-supplier) relations established through on-line connections with increasing participation numbers" (Bauer & Glasson, 1999). A more detailed discussion of the attributes of Electronic Markets can be found in Bauer and Chong (1999).

While the theoretical foundations and predictions of potential impacts are fairly well researched, business practice and concrete infrastructure and content management are lagging behind. The financial success appears limited so far and the functionality of actual implementations remains relatively simple (compared to technical feasibility and user assistance requirements). Electronic Market coordination and allocation mechanisms may be radically different from traditional market models (compare Timmers, 1998), leading to unusual, sometimes innovative suggestions, like electronic auctions (see, for example, Kambil & van Heck, 1998; Klein, 1997), multi-attribute negotiations (Bichler, 1999; Bichler & Segev, 1998) or even the "Virtual Electronic Bazaar" (Brandtweiner & Scharl, 1998a). Proposals for the technical infrastructure also cover a broad range of in terms of complexity and design effort, from the initial stages of loosely coupled "Electronic Malls" (Schmid et al., 1995) to sophisticated agent-based market environments [compare, for example, MIT's "Kasbah" - http://ecommerce.media.mit.edu/

Kasbah/ - as described by Chavez and Maes (1996) and "Market Maker" - http://maker.media.mit.edu/).

More guidance about the development architecture and process elements is provided by the Reference Model of Electronic Markets as proposed by Schmid (1993; Schmid & Lindemann, 1998). Bauer (1998) presents the following definition of reference models:

> *"Reference Models are aiming at providing guidance and instructions for developing other systems. It is important to note the 'reference character'. […] The main purpose of Reference Models is to cater for pre-built components and to stimulate ideas. […] Reference Models represent a generalisation."*

In this particular instance, Schmid aims to provide a framework for the design and analysis of Electronic Market systems. The Reference Model for Electronic Markets has already been specified in more detail (see. for example, Lindemann & Runge, 1998) and has served as the basis for further extensions (compare, for example, Suter, 1999; Suter, Kaempfen, & Probst, 1998). It breaks down individual Electronic Market transactions into three sequential phases and four so-called "views". These resemble "layered" perspectives, similar to the ISO/OSI (International Standardization Organization/Open Standards Implementation) reference model of networking technology (Tanenbaum, 1989) or some Electronic Commerce models (compare, for example, Bauer & Glasson, 1999; Kalakota & Whinston, 1996, pp. 3ff.; Zwass, 1996). Figure 1 provides an overview of the Reference Model for Electronic Markets. Rather than providing a more detailed description of this concept, we refer the reader to Schmid (1993; Schmid & Lindemann, 1998).

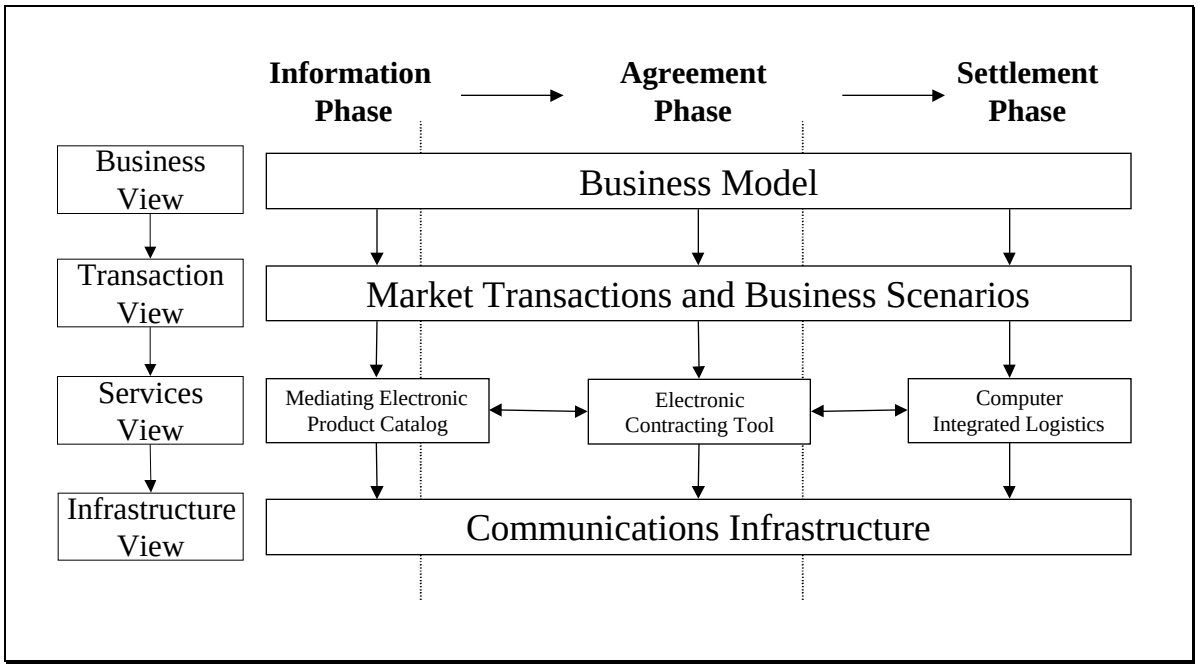

Figure 1. Phases and views in the Reference Model for Electronic Market transactions (Schmid & Lindemann, 1998)

Informational and Infrastructural Requirements for Electronic Markets

While the previous section served as a strategic overview and theoretical foundation of Electronic Markets, real-world implementations require a much more operational approach with detailed specifications of information to be exchanged and of potential infrastructures. The limited number of sophisticated, on-line Electronic Market systems is empirical evidence of the difficulties and challenges presented by these tasks. In the following sections some of these problems and potential solutions are outlined.

Information Specifications for Electronic Market Transactions

The information phase is relatively well supported by the Internet in general and the Web in particular. Individual Web sites can be found and accessed through search engines, directory indices and more recently Web portals. On the micro-economic level, electronic product catalogues and the mediation thereof (compare Figure 1) are already a widely accepted tool to present organisation-specific product information. The integration with internal product databases and/or material prepared for more traditional marketing communication channels allows faster development and reduces maintenance complexity (Bichler & Hansen, 1997; Palmer, 1997). However, the negotiation support, that leads to the exchange of offers and finally results in binding legal agreements, is still in it's infancy, particularly if negotiation strategies and processes need to be automated (Bichler & Segev, 1998, 59ff.). In the agreement, settlement and shipment phases few formal or informal specifications are available. The existent Electronic Commerce solutions, which fulfil the obligatory security and legal requirements, are usually from the EDI (Electronic Data Interchange) community and make costly and complex implementations and business process re-engineering necessary, thus nullifying the flexibility of Internet-based applications.

The available solutions become even scarcer for the later phases of Electronic Market transactions. Business models, information specifications and open infrastructures are missing both for industry-independent and industry-specific problem domains. Only a few industries, advantaged by standardised and information-intensive products, are pioneering industry-wide specifications of product and transaction descriptions. Almost all newly published specifications use XML-based (eXtensible Markup Language - http://www.w3c.com/XML/) syntax and DTDs (Document Type Definitions). XML is not only a likely future universal document standard, but also provides a very capable structure for the incorporation of meta-data and document exchange. Recent, XML-based examples include:

- **XMLNews** for exchanging news and information (http://www.xmlnews.org/).
- **AdMarkup** for classified advertising (http://www.zedak.com/admarkup/).
- **RELML:** Real Estate Markup Language (http://www.4thworldtele.com/public/).
- **OFX** (Open Financial Exchange) is probably the most mature and important of these specifications (http://www.ofx.net).

OFX is already widely used in the on-line, retail banking industry and provides support for all phases of Electronic Market transactions.

Electronic Market Infrastructure

The most primitive, and probably best known, classified search tools are Yellow pages, or their Internet equivalent directory indices (for example Yahoo! - http://www.yahoo.com). Another popular option are Internet search engines (for example AltaVista - http://www.altavista.com), although they have been criticised for their inefficiency and amount of "noise" in the query response information (Hunt & Swatman, 1997). The introduction of meta-data into HTML documents (see, for example, the Platform for Internet Content Selection (PICS) initiative - http://www.w3.org/PICS/) is one fix, but proved relatively ineffective so far. All the previous approaches rely on distributed information storage and decentralised editing of the content. In contrast, typical information brokers have a more centralised concept, usually with moderated

information capturing and maintenance. Information brokers act as intermediaries between the supply- and demand-side, between searchers and available content. They typically add value to the search function through classification and categorisation to fit a specific information model and checking the validity of the provided information. While information brokers are solving some of the afore mentioned problems and are frequently advocated (compare, for example, Bailey & Bakos, 1997; Bichler, Beam, & Segev, 1998; Hunt & Swatman, 1997), they often lack flexibility for the fast-moving and decentralised Internet.

The current lack of utilisable information specifications for Electronic Markets is also apparent in early implementations of future Internet infrastructures. In their survey of Electronic Commerce-enabling Internet agents, Maes et al. (1999, p. 82) identify software that assist with “product brokering”, “merchant brokering” and even “negotiation”, but none of the agents are capable of dealing with “needs identification”, “payment and delivery” or “service and evaluation”. This observation is not surprising, given the lack of support for the later phases of Electronic Market transactions by information specifications as identified in the previous section section. The most published early examples of so-called “intelligent agents” (for example, BargainFinder - http://bf.cstar.ac.com/ - or Jango - http://jango.excite.com) only cover the earlier phases (i.e., the information phase) of Electronic Market transactions. Upcoming XML infrastructures need to overcome the same problems, and again these problems can be directly attributed to the lack of resources as identified in previous section. The automated translation of DTDs may provide the required intermediary for Electronic Markets as envisaged by Schmid (Schmid, 1997), although many semantic issues remain still unresolved in such an infrastructure.

Towards a Useful Modelling Environment for the Commercial Application of Electronic Markets

Models in general "establish a relationship between systems" (Hars, 1994). Complex systems, such as socio-economic systems or organisations, require a “focused negligence”, purposefully leaving out certain elements and attributes. Essentially, models are "systems", which are projections of other, more complex systems and which are aimed at drawing conclusions about the original system (Hars, 1994). The relationship between real-world systems (Electronic Market transactions) and models is illustrated in Figure 2. A more detailed description of Figure 2 is provided after the diagram.

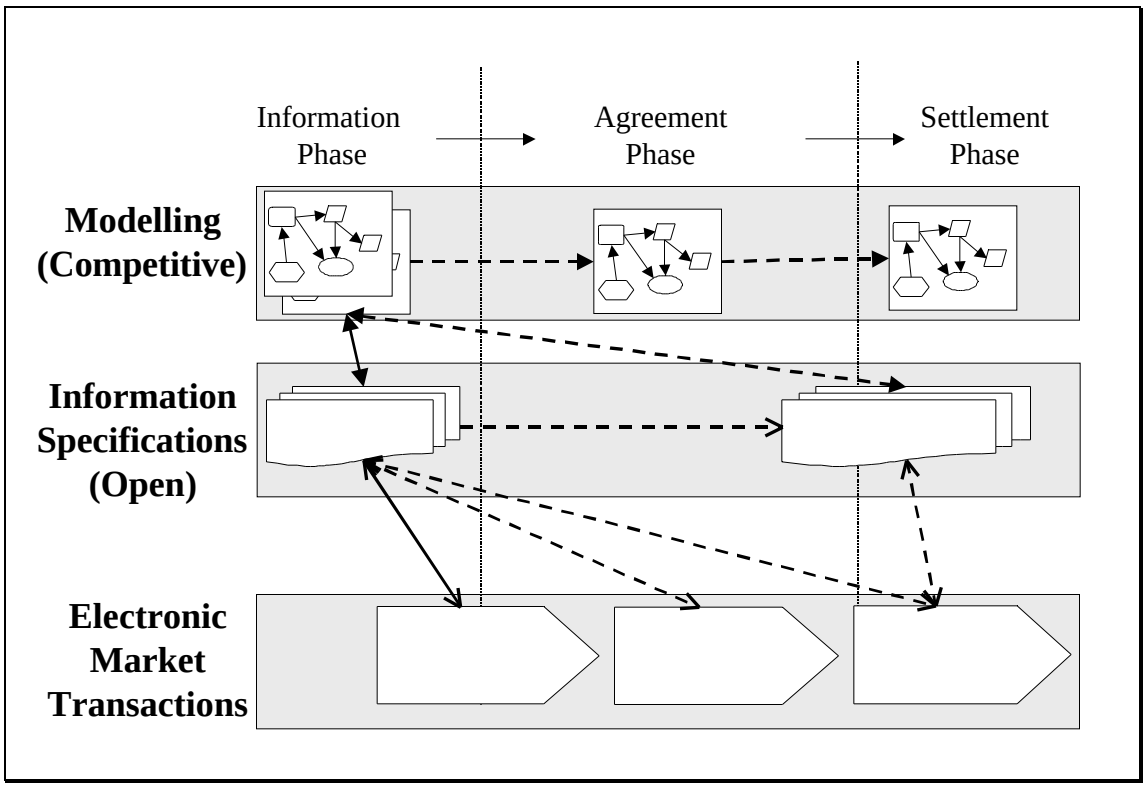

Figure 2. Organisations try to achieve competitive advantages with the modelling of the Electronic Market transactions based on (open) information specifications (this Figure resembles the dimensions from Figure 1).

While many current Electronic Market systems are currently built around the assumption that human intervention is performed on buyer- and vendor-sides, future generations of Electronic Commerce implementation will have to part with the luxury of real-time access to decision-makers. Customer-oriented, adaptive Web Information Systems and agent communication will make it necessary to pre-plan strategies (Bauer & Scharl, 1999; Scharl, Bauer, & Kaukal, 1999), and build business logic and rules into somewhat intelligent software, which responds instantly to requests and acts on behalf of their designers and owners ("principals").

When reviewing currently available modelling methodologies and development tools, a similar pattern to current Electronic Markets implementations (see previous sections) emerged: The support for the information phase of the Reference Model is much greater than for the later phases. As represented in Figure 2 this means that the relationship between the information specifications and models on the left side are much more determined than the ones on the right side. Methodologies for the development of Web sites are readily available, although most of them seem to receive more attention from the scientific community than from industry (Bauer, 1998). An example of this category is eW3DT (extended World Wide Web Design Technique), which provides a document-oriented design method for Web site development and maintenance (Scharl, 1998). A design approach suitable for Electronic product catalogues is RMM, which relies more on the traditional entity-relationship oriented database view (Isakowitz, Stohr, & Balasubramian, 1995). Modelling support for negotiation processes can only be found in conjunction with agent technologies. Examples are "Kasbah" (http://kasbah.media.mit.edu), which offers the user biding and risk aversiveness functions, and the "Iconic Modeling Tool" (Falchuk & Karmouch, 1998) with dynamic itineraries through a visual interface.

Conclusion and Further Research

In commercial applications of Electronic Markets, organisations will try to gain competitive advantage by successfully planning and managing their on-line strategies and activities. Modelling, and visualisation, will be a pre-requisite to involve the decision-makers into the Electronic Market environment. As it has been shown in this paper, the modelling support is currently only available for the early phases of Electronic Market transactions. Even worse, there are no (standard) information specifications available yet for the later phases, which presents a major obstacle and barrier for brokers and intermediaries. For example, a buyer might be able to provide a very detailed specification of the product she is looking for, but it is not possible to constrain the search with payment methods that are available to her. It is obvious that a vendor, who is not offering her preferred payment method, is of no use to her.

The goal must be to achieve an environment as pictured in Figure 2 with close relationships between the various levels of abstraction from the real-world business process and Electronic Market transactions. Essential, yet currently missing, requirements of such an environment include:

1. Information specifications for the whole life-cycle of Electronic Market transactions, preferably as open standards. The specifications of the earlier phases need to incorporate some pre-determined knowledge about the later phases, since some actions are irreversible (for example, the formal acceptance of an offer) and the information may be needed to establish the constraint criteria of earlier selection processes.
2. All systems need to provide interfaces for the electronic process and data communication with other systems of the environment.
3. Manageability and maintenability of the Electronic Market systems, the (relatively static) information specifications, and the modelling environment require automated design and analysis functions (from the modelling perspective, i.e. if the user changes the model it will be instantly reflected in the Electronic Market transactions; similarly, the results from Electronic Market transactions are displayed in “analysis” models).
4. The modelling must enable the user (decision-maker) to choose strategic options and react quickly to Electronic Market trends.

This proposed research project will be carried in close cooperation with and strong support from an industry partner. It aims at closing the gap mentioned above by:

1. identifying appropriate information specifications (through case study research);
2. developing new information specifications for the agreement, shipment and settlement phases, if necessary (through action research); and
3. implementing a prototype of the required modelling tools (proof-of-concept).

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