Research Issues

Electronic Markets

In many industries electronic markets are being implemented in order to improve the efficiency of coordination and/or to gain a competitive advantage. After looking at the forms and the process of economic coordination, the article takes a closer look at the term "electronic market", the system architecture and future developments.

by Prof. Dr. Beat F. Schmid
University of St. Gallen

Before setting up a working definition of an electronic market (EM), let us look at the functions of markets in our economic system. According to traditional market theory, markets are defined as economic places of exchange, where aggregate demand meets aggregate supply. They serve to allocate resources, skills and products. Coordination is the key factor to optimize allocation and to yield maximum economic welfare. In markets, virtually all necessary information is contained in the prices of the products or services. Efficiency is defined by means of the pareto criterion. Traditional market theory, however, does not reflect the real world: Its assumptions include perfect market transparency, complete information and perfect competition which are far from being realistic. Let us therefore look at two other coordination mechanisms: Corporations (hierarchies) and cooperation.

Corporations (hierarchies)

The characteristic feature of hierarchies is their pyramid shape with the right of disposal at the top. All internal relations are fixed by organisational structure and process organisation. Hierarchies do not require long and expensive negotiations. The problem of information processing - in markets solved by prices- is handled by corporate management. Organisation theory has been considering the classic hierarchy model as inadequate. It was suggested that hierarchies be completed with more cooperative elements. The results are such structures as profit center organisations, holdings or divisional organisations.

Cooperations

Cooperations can be defined as long-term relationships between autonomous partners. A corporate framework is determined by negotiation with the aim of obtaining mutual advantages. Both parties commit resources to the partnership, thus giving away part of their autonomy. Cooperations need not be firm alliances. They can also be loose partnerships, such as supply guarantees, common R&D projects or common marketing activities. Splitting up coordination mechanisms into markets, hierarchies and cooperations, we can clearly define information-based support systems for the market-coordination of goods and services as EMs. Which functions are important speaking of coordination and which of these functions can be supported by information systems?

A Phase Model of Coordination

Every process requires goods or services on the input side and produces (modified) goods or services to be marketed on the output side. The processing itself consists of numerous subtransactions. Three phases, which are substantial for any process of coordination, can be distinguished:

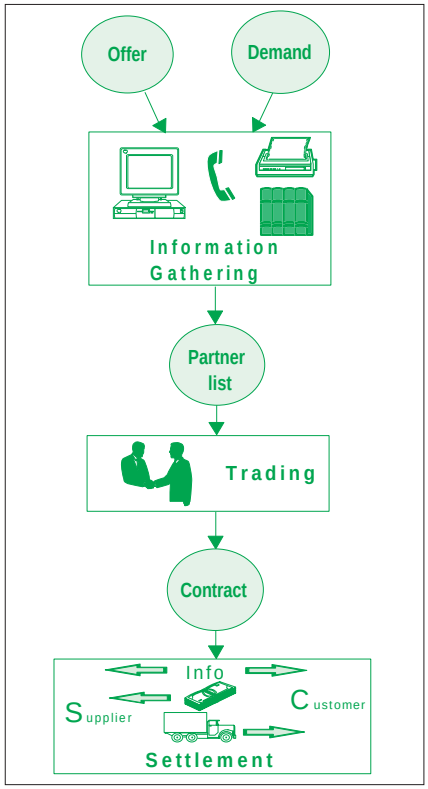

Figure 1: Phase model of coordination

Phase 1: *Information gathering*. On the input side, information on available products and/or services, their specifications, suppliers and delivery terms are required. On the output side, potential customers have to be identified. In addition, some general information on the market situation, branch or technological trends will be useful. This phase results in a list of potential partners in the market and their offer and/or demand.

Phase 2: *Trading*. As soon as all information has been evaluated, we can proceed to contact potential transaction partners. Terms and conditions have to be fixed (terms of payment and delivery, warranties, additional service etc.). The legal basis is established for further transactions.

Phase 3: *Settlement*. Now the physical transactions are carried out. This phase may consist of various subtransactions depending on the goods or services handled. In the case of physical goods, possible transactions might be packaging, storage, shipping, insurance, customs clearance etc. During this third phase, derivated transactions, such as purchasing forwarding services or insurance, will be initiated. The physical exchange of goods is accompanied by flows of financial transactions and information.

Electronic Markets - a Definition:

The following definition is based on the above-mentioned concepts of coordination and on the phase model: EMs in the narrow sense can be defined as market places put into action by means of telematics. They support all phases of transactions, including the formation of prices of goods and services. Consequently, they contribute to the realization of the ideal economic market as an abstract place of exchange with complete information where transaction costs do not apply. EMs are characterized by the following features:

- *Ubiquity*, for EMs are open 24 hrs every day for any user having access to the telecommunication network.
- *Easy access to information*, although information asymetries cannot be avoided completely.
- *Low transaction costs* in all phases.

As the currently existing EMs are not yet actual markets offering the complete set of functions, we should use a more liberal definition: EMs in the broader sense may be understood as information systems supporting one or more phases and functions of coordination within market systems. This definition includes coordination systems beyond company level, as far as they are used by a multitude of partners with equal rights of participation on the demand side and on the supply side.

Systems Architecture

Information systems are already well established in offices, in production (as CIM, PPS, etc.) and local networks. They work on the basis of most homogeneous

system architectures. Homogeneity on an inter-company level, however, is far from being standard. Integration of heterogeneous (distributed) systems by means of open standards is essential. Distributed systems (DS), from the logical point of view, consist of a set of modules which communicate by a communication medium. Modules can act as clients or servers. One of the interesting new features of DSs is their communication system: Layer models, such as ISOs OSI model, replace traditional coordination of data via centrally organised operating systems. The OSI model is being completed by the ODP (Open Distributed Processing) model for cooperation of processes within DSs. The OSI model needs clearly specified interfaces, i.e. suitable layer and service protocols (e.g. the worldwide UN/EDIFACT standard). Steps towards fully integrated communication are also the realisation of Direct Access systems (e.g. flight reservation systems), the operation of clearing centers for information exchange (e.g. SWISSCOS) and the linking up of existing systems into a single integrated system (such as EURO-LOG).

Architectures for Open Systems

Following the above mentioned arguments, traditional architectures are not suitable for inter-company communication. The Xerox Palo Alto Research Center, the MIT and others have been working on a completely different approach which is a promising alternative for the organisation of EMs. They define open systems as distributed systems which do not require any central control unit. This kind of systems is characterized by: Parallel processing in a multitude of components (work stations, databases, networks), asynchronous data input and communication, decentralized control, incompleteness (certain components may fail or function improperly, but the system as a whole remains in working order) and inconsistency of information.

Open Agoric Systems

The OAS (Open Agoric Systems; from the greek term agora = market) approach is one of the most elaborate attempts to transfer features of computer systems to entire computer networks. OASs are based on interacting entities within a framework called "ecology"[1]. Since OASs are coordinated by market mechanisms, the similarities with EMs are obvious. The most appropriate analogy can be found in economic market systems. The idea is to replace the traditional allocation of resources and coordination processes via central hosts by free market trade. Memory or CPU time has to be purchased on the market. Several trial versions of EMs working like auctions have been successfully implemented. They have clear advantages: Consistent use of capacity and higher performance of processors. In a next step, complementary services could be included in the OAS. The authors suggest data type agents who purchase services for a process from data types on the corresponding markets, e.g. look-up tables, stacks or superior data types. All services are charged per use.

Modelling Market Systems

Though Miller and Drexler's OAS model has been designed for computer networks, it is of considerable importance for the modelling of market systems. Trading processing resources is not completely different from trading physical resources, such as goods or services. Besides, the models of market systems are proposed to be implemented on computer networks. Modelling market systems requires certain basics: Concepts must provide sufficient information to serve as a basis for the specification of highly complex systems. On the other hand, their language and design have to be understood by business people involved in the corresponding business processes. Modelling production networks with a sort of Petri nets is one promising approach.

Impacts of Electronic Markets

Computerization of markets and the support of important market transactions by means of telematic systems are central topics for companies in the 90s. Communication links between companies are becoming increasingly important. With the decrease of coordination costs in phases 1 and 2, electronic market coordination becomes more attractive, thus gaining territory in organisational hierarchies. In the end, this development may lead to network organisations replacing conventional highly vertically integrated companies. Individual business units within the networks will be coordinated like markets.

Reverse Marketing in Construction

The shift from a seller to a buyer market is already in full swing. Electronically linked networks of production units facilitate flexible production of highly personalized products. Goods are designed together with the customer. Once the design has been fixed, a global production network is used to manufacture the individual product at the lowest possible price. Given the necessary technical infrastructure, this new concept is superior to existing production and marketing patterns. One keyword is Reverse Marketing, which has already been put into action in construction. In a first step, the architect visualizes his ideas with CAD tools. He presents his (computer-animated) plans to the customer. Then he transfers the relevant data to the EM. Various subcontractors can obtain information on the project and will offer their services, adding their components (elevators, kitchen furniture, sanitary facilities, etc.) to the CAD data. When a supplier is awarded a contract, he can "sell" the physical production to another manufacturer, using EM services again. The EM for construction may be global, there are no technical restrictions.

Computer Integrated Logistics

Another example of an EM is Computer Integrated Logistics (CIL). A universal, globally available service is conceived which covers all requirements concerning goods, information and financial logistics. This CIL service will enable all participants to exchange any information without having to bother about the details of physical information transfer. The core of the CIL service is an "information object" which logically accompanies the goods. It is modelled by the service providers and it contains all necessary information. A specification for such a service should provide both functionality for the users and architecture basics at the logic level. To start with, existing EDI structures have to be evaluated regarding future requirements. At the same time, a reference model of the structural and operational organisation has to be conceived. These components will provide the basis for the specification. The CCEM and its business partners are currently working on a concept for a CIL service which comes up to the requirements mentioned above (see also page 15).

Future Perspective

It is obvious that EMs will have a considerable impact on a number of economic sectors. Yet, a lot of problems on the information systems side remain to be solved. The search for new solutions calls for close cooperation between business administration and information systems specialists.

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References

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