Service Task Allocation as Internal Market

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Rainer Alt, Stefan Klein, Christoph Kuhn
Institute of Information Management
University of St. Gallen
Dufourstr. 50
CH-9000 St. Gallen, Switzerland

tel. ++41 (0) 71 302 795
fax. ++41 (0) 71 302 771
e-mail: rainer.alt@unisg.ch

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Summary

In the wake of quality and time management increasing emphasis has been set on service quality. Maintenance and customer service are personnel intensive divisions with a precise monitoring of this personnel being difficult. An organizational response to this situation is to increase the freedom and scope of action of the service specialists through the combination of market-like allocation mechanisms and incentive structures. On the one hand, service specialists shall be free to select their tasks within the limits of some organizational rules and on the other hand, their salary shall be coupled to internal prices for the fulfillment of tasks. These prices also reflect the customer's feedback. We will present the organizational vision, model assumptions, and a concept for the implementation of an electronic service task allocation system for the SIEMENS AG. At the core of the system are electronic coordination mechanisms (ECM) that interact with an electronic order book and the service specialist´s account. The ECMs reflect the migration from traditional dispatch to an internal market.

1. Introduction

1.1. Motivation

The forecast that information technology (IT) will facilitate the development of electronic markets[1] has become a self-fulfilling prophecy in some areas. Companies are starting to set-up and implement what is believed to be an efficient organizational form: electronic markets. Forms of electronic support of *market-like coordination* are known in many fields of economic activity namely in finance, tourism and commodities.[2] Most of those electronic markets emerge gradually. They either represent the use of IT with trading patterns being unchanged (Trajectory 1) or the opening of an existing bilateral information system (IS) to other parties (Trajectory 2). A set of possible trajectories is shown in Figure 1.

1 Malone, Thomas W.; Yates, JoAnne; Benjamin, Robert I.; Electronic Markets and Electronic Hierarchies, in: Communications of the ACM, No. 6, 1987, 490-493.

2 Examples are Electronic Financial Exchanges, Computer Reservation Systems and systems for livestock trading. For an overview see Schmid, Beat; Elektronische Märkte, in: Wirtschaftsinformatik 35(1993)5, 465-480.

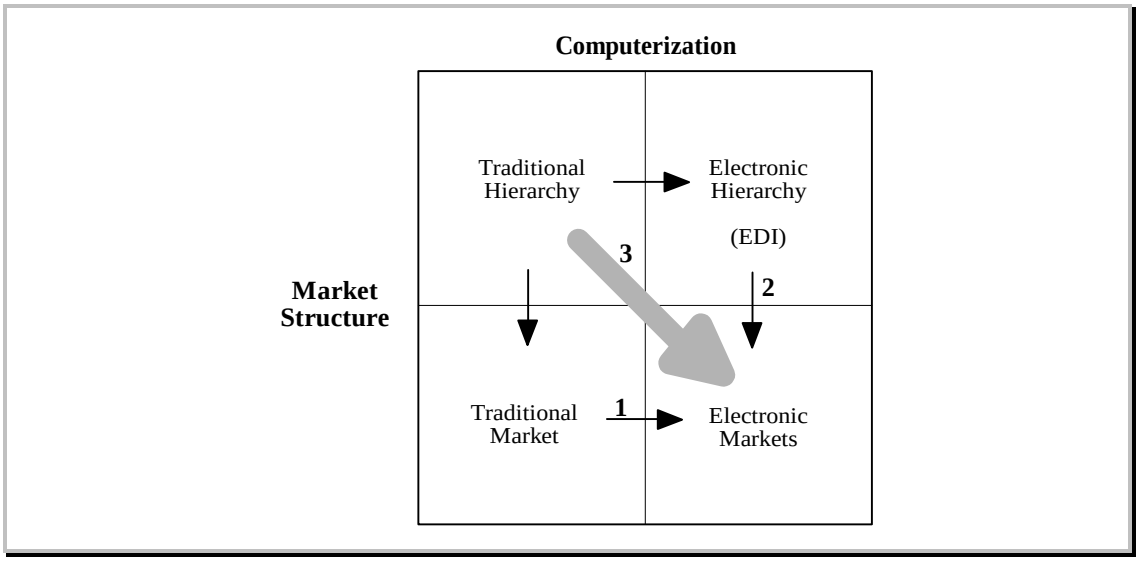


Figure 1: Trajectories towards electronic markets

In most enterprises the *service area* is still organized in a hierarchical way, i.e. the tasks are assigned top down. This occurs even if the service specialists often have better knowledge about malfunction patterns as well as about the time required for repair and journey. We argue that enabling the specialists to decide which tasks they perform makes better use of those potentials and increases job satisfaction. Though being linked to various assumptions, the market mechanism is one organizational form which ensures efficient dissemination of information among distributed profit-oriented individual decision-makers.[3] Together with enhanced job satisfaction, decentralized control and reduced managment layers, we expect the overall efficiency of a company's service sector to increase. With replacing the traditional hierarchical task dispatchment by an electronic (internal) task-market, we access the most 'radical' trajectory (Trajectory 3), which evokes both technical and organizational change.[4]

1.2. Research methodology

The theoretical purpose of this mainly constructivist paper is to link *organizational and IS design* considerations. The successful implementation of IS is generally believed to depend on the cooperation of the affected organization members and on the successful conveyance of the intentions and goals of the new system.[5] Since the organizational setting is a context variable as well as a design parameter, we emphasize the importance of the organizational vision for the set-up and design of ECMs. Basing on a taxonomy of generic ECMs we suggest in line with the mixed

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3 Miller, Ross M.; The design of decentralized auction mechanisms that coordinate continous trade in synthetic securities, in: Journal of Economic Dynamics and Control, 14(1990), 237.

4 Already in 1981 Robey pointed out, that the implementation of IS in conjunction to structural changes usually reinforces existing structures of the organization. Cf. Robey, Daniel; Computer Information Systems and Organizational Structure, in: Communications of the ACM, No. 10, 1981, 679-686. The design suggestions of an electronic task allocation system we are proposing are based on information provided by the SIEMENS AG and an empirical inquiry of comparable service divisions in other companies.

5 Orlikowski identified people's cognitions and structural properties of the organization as critical factors for the successful implementation of groupware, cf. Orlikowski, Wanda J.; Learning From Notes, in: CSCW'92 Proceedings, November 1992. We assume that this holds also true for an task allocation system which puts much emphasis on behavioral aspects.

mode hypothesis[6] that a combination of different mechanisms is required to meet the intricate relationship between organizational forms and IS.
As theoretical framework for the description of the organizational setting we use Håkansson's[7] interaction model that distinguishes four groups of variables (see figure 2):

- *parties* involved (dispatcher, service specialist);
- elements of the *interaction process* (the coordination mechanisms);
- the *environment* in which the interaction takes place (customer orientation);
- the *atmosphere* affecting and affected by the interaction (intra-organizational).

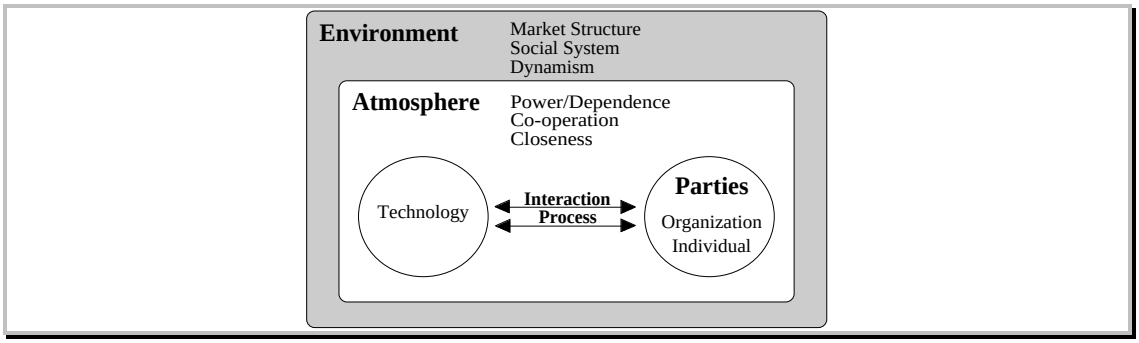


Figure 2: The interaction framework from Håkansson

2. Organization of task allocation processes

2.1. The organizational reality

Maintenance and service are strategically important functions in order to ensure long-lasting customer relations and customer satisfaction.[8] Customers report system errors, malfunctions, or break-downs to a service center which defines service tasks (further refered to as tasks). Many tasks are time-critical and, since service specialists (further refered to as specialists) spend most of their time traveling or in customer companies, monitoring is rather difficult. Furthermore the tasks have high seasonal variation. Problems are more frequently reported at Wednesdays and Fridays and in winter than in summer. The SIEMENS AG traditionally runs task dispatch centers where 1-2 dispatchers coordinate approximately 50 service specialists .[9] The typical work flow between the three parties involved are shown in figure 3. Shortcomings of this system are high costs for the dispatch function and high potential of conflict between the dispatcher and the specialist that may affect the motivation and subsequently the quality of work.

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6 The mixed mode hypothesis has been proposed by Holland, Christopher P.; Lockett, Geoff; Mixed Mode Operation of electronic Markets and Hierarchies, in: Proceedings of the ESF-Conference "Forms of Inter-organizational Networks: Structures and Processes", Berlin 6-7 September 1993 (in print).

7 Cunningham; C.; Tynan, C.; Electronic Trading, Interorganizational Systems and the Nature of Buyer-Seller Relationships: The Need for a Network Perspective, Int. Journal of Information Management 1993 (13)2, 18.

8 Cf. Roscitt, Rick; Strategic Service Management, in: Journal of Business & Industrial Marketing Vol: 5, Winter/Spring 1990, 27-40.

9 An example of an existing service system (PERLE) is described by Mertens. Cf. Mertens, Peter; Integrierte Informationsverarbeitung 1, Wiesbaden 1991, 54.

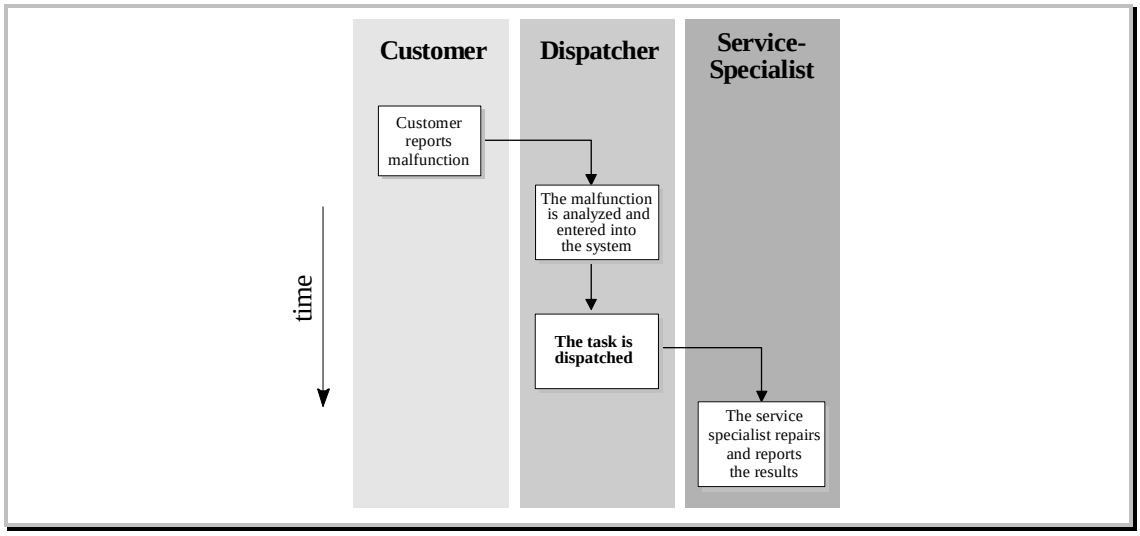


Figure 3: Steps performed in a service center

2.2. The organizational vision

The organizational vision centers on the redesign of the task allocation process. The dispatcher shall be (partially) replaced by an electronic "market" system.[10] The task allocation process shown in figure 4 can be distinguished into three phases:

1. *Error message and identification of tasks*

During this initial phase a task will be classified and a value (internal price) will be attributed. The task will finally be entered into an electronic order book, which the specialists can access.

2. *Task allocation*

The goal of this phase is to generate matches between tasks and the specialist's preferences. The latter are defined in profiles, which are used as filter for eligible tasks. Depending on the ECM, matching tasks will be either selected by the specialists or assigned.

3. *Task execution and final assessment*

After the task execution, the customer feedback will be included in the final assessment and attribution of a task value to the specialist's account.

10 A more detailed description of the present situation and the organizational vision can be found in: Tritt, Walter; Ein neues Modell für den Kundendienst, in: io Management Zeitschrift, 62 (1993)7/8, 57-60.

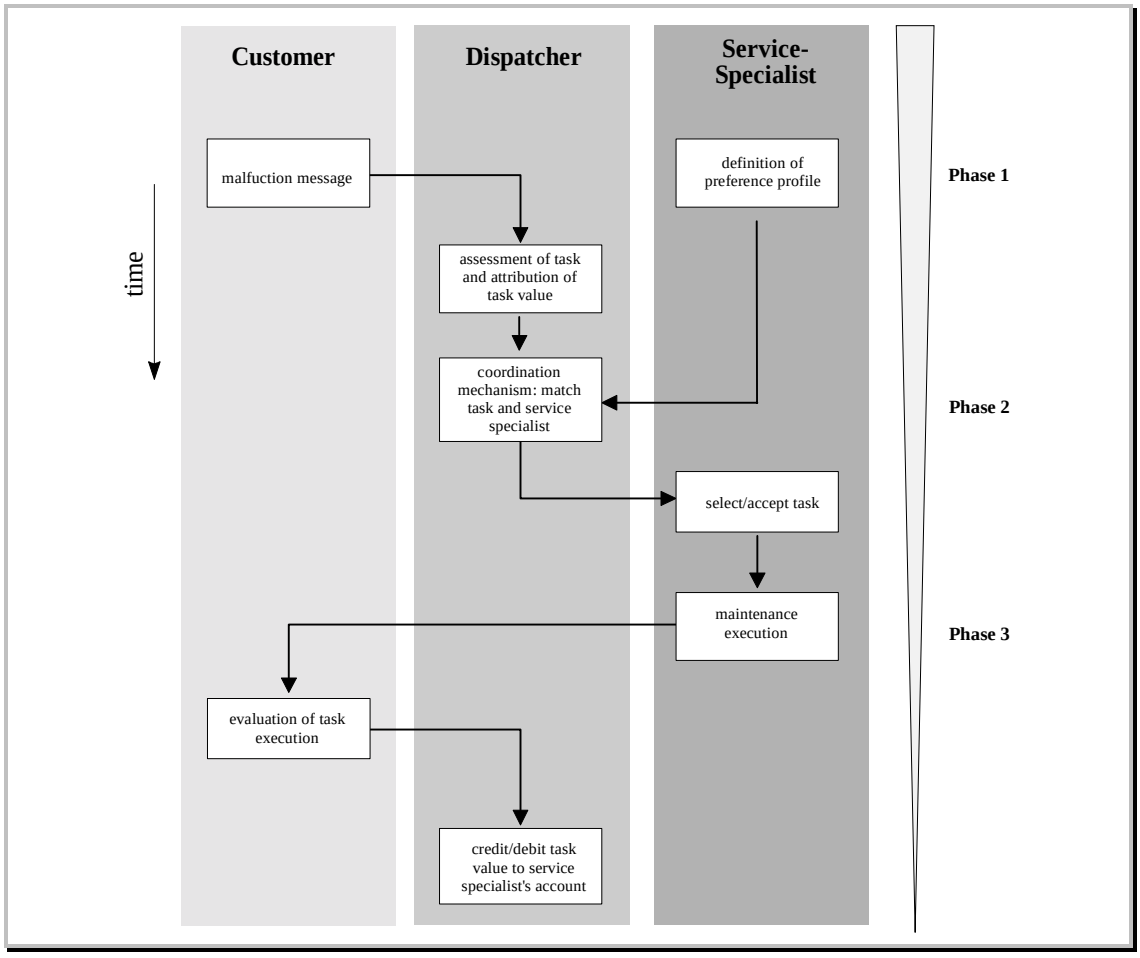


Figure 4: The service task allocation process

Applying IS in the allocation process has impact on all variables mentioned in figure 2. Obviously most concerned is the *interaction process*. Electronic coordination increases the efficiency of task allocation and reduces coordination costs. Considering the *parties* involved using internal prices and price assignment mechanisms initiates a learning process within the organization . Specialists will be able to convey their perception of the "value" of tasks and they will be able to pursue a more flexible working rhythm. This enables them to act as relatively independent and autonomous agents. By selecting tasks after their own preferences, their scope of action and their responsibility can be balanced (decentralization of action and responsibility)[11] and their knowledge about efficiently coordinating their tasks be tapped. On the other hand the dispatcher is relieved of most of his coordinating functions. In analogy to the official broker in the financial sector, he is supposed to fulfill a kind of 'meta-coordinating' function.

Although power is decentralized and management layers are reduced, the central dispatcher also disposes of a number of other control and steering mechanisms to influence the *atmosphere* variable. Among them are the assignment of task value itself, the linkage of incentives to the accumulated value of executed tasks, the selection and combination of different coordination mechanisms, the increased value of urgent or previously not assigned tasks, and the assignment of an idle malus in case a specialist does not take a task within a certain period of time. An efficient source of control is an IS that embraces all stages of the task execution process. Tasks will

11 See for example: Hosking, Dian-Marie; Morley, Ian E.; A Social Psychology of Organizing, Harvester Wheatsheaf, New York etc. 1991, 242.

either directly come in the service organization's IS as EDI messages or they will be entered manually as soon as they arrive. This allows an integrated message flow and detailed information for the service controlling as well as to provide the specialists with all necessary information.[12] The *environment*, i.e. customer satisfaction, is affected since the specialist's increased freedom of choice is expected to contribute to their satisfaction and will improve the quality of their work.

In short the main goals of the system are:

- *Increasing the efficiency of task allocation by implementing ECMs*
- *Enhancing the specialist's motivation by enlarging their freedom of choice*
- *Improving the service and maintenance controlling by designing an integrated message flow and an electronic representation of the entire process*
- *Learning process through internal prices*
- *Controlling and steering mechanism through decentralization*

3. Model for electronic intra-organizational task allocation

Based on the organizational vision, we propose a concept for the realization of an electronic intra-organizational task allocation system. At the core of this system is the selection and combination of ECMs.

3.1. Model Assumptions

The area of application (the type of transaction) is selected according to a transaction cost rationale.[13] The tasks within a given organizational unit can be distinguished according to complexity and urgency. While urgency is closely linked to the performance of the system, complexity refers to several dimensions like the complexity of the description, involved units, time required etc. Homogeneous and easy-to-describe tasks are more likely candidates for a market coordination. Complex and highly urgent tasks may be coordinated by markets as well, however, they require different arrangements.

Urgency / *Complexity*	*low*	*high*
low *homogenous tasks many specialists qualified*	n:m relation between specialists and tasks and few organizational restrains .Preferred task for prototype	A high price for an urgent task may be sufficient to ensure swift allocation. However, urgency may become a major constraint for market coordination and requires direct assignment.
high *heterogenous tasks small number of specialists qualified*	major constraints for market coordination.	If there is only a 1:1 or 2:1 relation between specialists and tasks, little freedom of choice and leeway remains for market coordination.

Table 1: Task Segmentation

[12] For example, OTIS uses elevator maintenance information and statistics for R&D and preventive service. See Malone; Thomas W.; Rockart, John F.; Computers, Networks and the Corporation, in: Scientific American, September 1991, 130.

[13] See also the application of Williamsons´ theoretical work in the field of electronic markets: Malone, Thomas W.; Yates, JoAnne; Benjamin, Robert I.; Electronic Markets and Electronic Hierarchies, in: Communications of the ACM, No. 6, 1987, 486-487.

3.2. Components of the task allocation system

The task allocation system consists of three building blocks: the order book, the specialist's account and the ECMs.

3.2.1. Order book

After specifying the task and assessing its value, the dispatcher places a task description (see table 2) into the order book, which is open to eligible specialists. While the tasks resemble the offers in a market, the demand is represented by the bids of the specialists. Depending on the coordination mechanism, the bids may represent a specialist's spare working capacity or price bids on a task. The order book thus can be compared to a marketplace.

task description		
general information	*description of malfunction*	*assessment of malfunction*
- customer id - customer classification - product id/configuration - service history - location	- unstructured problem description	- complexity, - technical requirements, - starting time - required time - urgency - task value

Table 2: Dimensions of a Task Description

3.2.2. Task value account for specialists

Task values represent internal prices for the execution of tasks and they are the core incentive mechanism of the task allocation system. The account keeps track of the tasks fulfilled by a specialist and is the basis for the assignment of financial benefits. Since each task is assigned a certain value, the specialists can earn points in this amount by successfully executing tasks. In case they fail to make bids or if the result of their work gets a negative rating from the customer, the system may also charge their account.

3.2.3. Generic forms of coordination mechanisms

Coordination mechanisms are essential in bringing tasks and specialists together. Depending on the degree to which a mechanism automates the allocation process and to the level of centralization, we distinguish three generic mechanisms.[14] They represent ideal types of coordination based on different action patterns of the participants. The first form, offer/accept (O/A) focuses on the selection of the specialist, the automatic matching (AM) emphasizes the comparison of offers and bids by an intermediary (system). The auction mechanism (CA) represents an active, dynamic process of trading and emphasizes the competition between the bidders and the aspect of price fixing.

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14 Previous analyses of the task assignment process are reported by Malone and Crowston. However they focus on a production environment and group decisions, whereas the service application is characterized by individual actors. Cf. Malone, Thomas W.; Crowston, Kevin; Toward an Interdisciplinary Theory of Coordination, MIT Technical Report CCS TR # 120, Cambridge, MA 1991, 18-20.

3.2.3.1. Offer/Accept

The offer/accept (O/A) mechanism enables the specialists to browse the order book and hit suitable orders. Hitting the bid involves touching a button that signals the binding acceptance (commit) of a task at displayed conditions (hit and take). The priority rule among similar bids is first come-first served (FCFS). A meta-coordinator (the dispatcher) may lift a task off the order book, reassess it and place it anew. The process of reassessing, however, is not subject to direct interactions or negotiations between the dispatcher and the specialists. O/A systems provide some assistance for finding suitable offers such as retrieval or sorting algorithms, but in general they rely mainly on an active role of the buyer.

Depending on the quantity of tasks the search is more or less thorough and finding the task fitting best to a specialist's profile is not guaranteed. There is always a probability that some undiscovered offer could have been better or that during the screening process a new task arrives. With the implementation of a filter mechanism search costs are reduced, but on the other hand the problem of adjacency arises. Suitable tasks may be faded out by the filter (problem of defining suitable categories). But O/A gives specialists a high degree of autonomy due to their decentralization of decision making. The specialists have an overview of all tasks and hit suitable tasks according to their preferences. Any specialist can hit tasks even when this trade is not explicitly anticipated by the program designer.[15] The dispatcher will have to reassign the task value if a task is not taken.

3.2.3.2. Automated Matching

An automated matching algorithm reduces the complexity of the selection process. Based on a preference profile, the system scans data and selects fitting matches. The function of a matching system is to take a sequence of buy and sell orders and transform it into a sequence of trades according to a predefined set of (informally) stated execution rules.[16] The order book contains orders which are (automatically) executed against incoming bids according to their fit of attributes.

Rather than generating trades only based on price or price/time priority, intelligent electronic trading systems provide standards and protocols for extended task descriptions such as complexity, technical requirements, urgency, and, corresponding, the representation of the specialists´ profile and utilities in terms of preferences and prices.[17] As shown in table 3 the profile also contains 'objective' information on the specialist's qualification and his past performance plus individual preferences. In case a bid or an offer fits to several bids, respectively offers, the match may occur according to the time of the tendering (time priority) or depending on the specialist's account (e.g. the rating of customer satisfaction). The priority rules can be modified according to organizational requirements and weights, e.g. qualification higher than preferences for location, can be added. Prices are not dynamically adjusted in AM but trades are executed to the predefined price limits.

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15 Malone, Thomas W.; Crowston, Kevin; Toward an interdisciplinary theory of coordination, Working paper CCS TR#120, Cambridge, MA, 1991, 25.

16 Reck, Martin; Formally Specifying an Automated Trade Execution System, in: Journal for Systems Software, Vol. 21(1993), 246.

17 Lee, H.G., Lee, R.M.: Intelligent Electronic Trading for Commodity Exchanges, in: EM-Electronic Markets, Vol. 3(1993), No. 9/10, pp. 5-6.

service specialist profile		
qualification	*performance*	*preferences*
- training - experience - history of tasks	- evaluation of superiors and customers	- product id - customer id - location - starting time - required time - task value

Table 3: Components of the specialist's profile

Since a match may occur for several tasks, a specialist could end up with too many tasks (unless capacity is included in the execution rules). This situation has to be covered by organizational rules which allow specialists to reject allocated tasks, which would be similar to a pre-selected O/A, or to trade with tasks. An important design option of the matching mechanism is the question whether the tasks are transparent to the specialists when they articulate their preferences.
AM is a more centralized method of coordination. It therefore reduces considerably the specialist's coordination costs It reduces his time spent for 'buying' tasks because trades occur while he doesn't have to monitor the system. He only has to specify his preferences, a process that can be shortened by using pre-defined profiles. Since the tasks are allocated automatically a market survey is not possible. The specialist's autonomy is restricted to defining his profile(s) and to the option to reject an allocated task. On the other hand by implementing a fair and orderly matching he can have confidence that no specialist is favored over another and that manipulation (cartelization) is reduced to a minimum.

3.2.3.3. Auction

Auction markets provide centralized procedures for the exposure of purchase and sale orders to all market participants simultaneously.[18] All orders are exposed within a central market (the order book) and strict price or price/time priority exists in the execution of trades. In analogy to the Walrasian tatonnement, a central (computerized) auctioneer records bids and offers and, depending on the auction method[19], a trade is consummated at a certain moment. In our application setting, the dispatcher enters tasks together with a certain starting price, which then are auctioned off (sequentially or in a submission procedure) against the bids of the specialists. The auction process may run continuously or periodically (so called discrete auctions which may run once a day, once a week, etc.). Bids are accepted at prices *higher as well as lower* than the starting price, a feature which enables service workers to express their assessment of a task, especially if a task seems to be misjudged by the dispatcher. The auction includes several actors in the process of price discovery, thus improving equal chances among the bidding specialists. Here we expect the auction mechanism to ensure a fair and optimal allocation, because a task is not allocated on a FCFS basis or following some preset preferences.

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18 Garbade, Kenneth; Securities Markets, McGraw Hill 1982, 426.

19 Auctions can be distinguished according to variables like time (continuous - periodical) and transparency (competing bids transparent or not). For a classification of the various auction types see Reck, Martin; A formal taxonomy of Electronic Auctions, (in print).

3.2.3.4. Assessment of Coordination Mechanisms

The following tables 4 and 5 summarize the characteristics of the coordination mechanisms. Table 4 has an emphasis on the actor's activity. The shaded areas show where the primary activity occurs.

Coordination mechanism / Actors	Offer/Accept	Matching	Auction
Service worker	actively searching; hit and take	defining preferences; rejecting a trade	active bidding
Market-System	open central order book; various filter mechanisms possible	active matching according to predefined rules	active auctioneer
Dispatcher	placing and (re-) assessing tasks	placing and (re-) assessing tasks	placing of tasks and assignment of starting price

Table 4: Activity-based classification of coordination mechanisms

	Offer/Accept	Matching	Auction
Allocation / decisional base	Market segmentation	Specialist profile against task description	Price
Autonomy	first come - first served	Setting of preferences; rejection possible	Price setting; rejection possible
Price discovery	No, but reassessment possible in the next period	No, but reassessment possible in the next period	Yes
Advantages	- High Autonomy for service specialist - full transparency of tasks - highest complexity of task description possible	- low coordination costs - off-line matching possible - neutral/fair task allocation - consideration of preferences	- fair allocation process
Disadvantages	Without filter mechanism: No guarantee to find the best offer high search costs With filter mechanism: - 'fading out' Only on-line matching possible	- problem of adjacency - problem of defining categories	- price as sole decision variable - only on-line matching possible

Table 5: Comparison of ECM

3.3. Combination of coordination mechanisms

As mentioned, each of the three generic coordination mechanisms has its specific characteristics and the mechanisms do not exclude each other. Empirical evidence in the area of interorganizational coordination suggests that a combination of different coordination mechanisms (mixed mode) is an efficient option.[20] In two scenarios we therefore describe possible combinations of the mechanisms in order to optimize fairness and efficiency of the allocation system.

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20 Cf. Holland, Christopher P.; Lockett, Geoff; Mixed Mode Operation of electronic Markets and Hierarchies, in: Proceedings of the ESF-Conference "Forms of Inter-organizational Networks: Structures and Processes", Berlin 6-7 September 1993 (in print).

3.3.1. Sequential execution of coordination mechanisms

In analogy to the differentiation of periodic and continuous market phases - pre-trade, continuous trade, post-trade and pause - in electronic stock exchanges, table 6 shows a sequentialization of ECMs.

Time	Mechanism	Reasoning
7:45 - 8:00	Auction	Initial auction to allocate existing tasks for the day when FCFS may not be perceived as fair
8:00 - 12:00	Offer/Accept[21]	Continuous offer/accept, after tasks have been executed new tasks can be acquired continually
12:00 - 12:15	Auction	The dispatcher can run another auction depending on the volume of incoming tasks, urgency of remaining tasks and the state of the order book
12:15 - 16:45	Offer/Accept	Continuous offer/accept to match incoming tasks and remaining capacities
16:45 - 17:00	Auction	A final auction of the day, allocation of tasks for the next day
17:00 - 8:45	Pause	No allocation, the order book remains open

Table 6: Sequentialization of ECMs

Periodic auctions enable the dispatcher to cope with a surplus of tasks as well as demand. Auctions shall cope with situations where FCFS as priority rule may not be perceived as fair or efficient. For example, specialists may not want to poll the order book early in the morning to acquire attractive tasks.

3.3.2. Parallel execution of coordination mechanisms

Another way of dealing with varying market conditions is the parallel execution of the coordination mechanisms. As a meta-coordinator, the dispatcher would decide which incoming task will be allocated by which mechanism. Routinely task would be entered into the order book for O/A. Urgent tasks could be handled by AM and periodically an auction could be initiated for difficult-to-price tasks. By this means the dispatcher would have an active role, similar to a market maker[22] and would ensure a smooth allocation of tasks.

4. Implementation of coordination mechanisms

For the representation of the task allocation problem we chose a queue model. An incoming task is initially stored in the 'outer queue' or in the order book. The dispatching process allocates tasks to a specific specialist or in terms of the queuing-model to a server. Each server has a 'inner queue' containing the allocated tasks. The characteristics of this queuing-model are inherent to the performance of the market system [ref]. Concerning the implementation two factors appear critical: 1. the number of traders on the system, and 2. the way the traders interact with the system.
The number of traders increases the number of physical and logical communication lines, whereas the interaction model determins the requirements for transaction processing. Online, dialogue oriented interaction imposes significantly more demand

21 To deal with the problem of adjacency, we suggest O/A if the market has a surplus of homogenous tasks, and AM if heterogenous tasks are prevalent. To take into account saisonal variations, which are represented in the frequency of incoming tasks, auctions may be run once a day, twice a day, etc.

22 An overall view on market making can be found in: Amihud, Yakov; Ho, T.S.Y; Schwartz, R.A.; Market making and the changing structure of the securities industry, Heath Lexington (MA), 1985.

on the transaction processing components dealing with the canonical problems related to database transaction management [ref] like scheduling, rollbacks, locking mechanisms, which are used to guarantee consistency and integrity of the order-book. In contrast an offline, 'batch-oriented' interaction model can keep those problems at a minimum.

Demand	O/A	AM	CA
integrity	high	low	high
communication	medium-high	low	very high
algorithmic complexity	low	high	medium

Table 7: Implementation demands of ECMs

4.1. Communication infrastructure

The specialist will be provided with a notebook computer and communication devices, a cellular phone and a modem. The notebook will be part of an integrated and decentralized support environment for the specialist and feature applications like filing maintenance-report writing and transfer, customer database and hypertext reference manuals apart from the ECM software. Assuming that a partial service market will consist of approximately 100 specialists, the number of communication ports can be significantly lower for O/A, and AM, and submission-type auctions, not however for auctions with real-time trading. The number of traders does not necessitate high performance processing.

4.2. Application infrastructure

The functions of the order book can be realized with standard RDBMS in client-server architecture. The client-side is located by the service-specialist and the server-side is the order book. Further benefits of such an architecture are that the amount of data transferred between client and server can be reduced to a minimum since only 'raw data' need to be transmitted. The data visualization is done locally at the client-side. This allows the use of a graphical user-interface which enhances the user friendliness. Since the selection of a task by a specialist represents a contract, the system must provide security mechanisms in order to identify the specialist. This implies that the specialist needs besides a simple password a more sophisticated token in order to prove his identity. This component can also be used to generate a digital signature [ref].

4.3. System requirements of the coordination mechanisms

Like CRS, in O/A the specialist must have instant feedback whether his selection was registered by the service-center. To ensure an approximately consistent view of the order book a model-view-controller architecture [ref] could be chosen instead of a polling of the order book by the client. Resulting of the peak times in the service area, the specialist's log-ins will probably not be evenly distributed over the day. Hardware configuration therefore has to make sure that specialists can always log into the system.

Contrary to O/A, AM can be realized in batches. After defining his profile the specialist can log into the order book and upload the profile attributes. This can be

done at anytime before the trade, i.e. matching is done.[23] At a set time, the matching between the bids and the tasks is performed. Firstly the task descriptions are analyzed in order to divide the tasks into sub markets. Afterwards the specialist's preferences are examined. Now an on-line connection between the order book and the specialist has to be established. The matching results are now being sent to the specialists, who pick out the tasks they intend to fulfill. This decision process can be supported with utilities like electronic road maps or programs. Finally the server picks up the selected tasks.
CA will require many simultaneous log-ins. Unlike O/A, the system-load during the auction is more or less constant. A solution to reduce demands on the system performance is to organize the trade sequentially and limit the amount of traders per task.
For most of the ECMs a similar set of systems functions (message passing, database, matching) and the same system infrastructure can be used. This enables running of various ECMs on the same platform. Specific communication requirements result from uneven distribution of communication behavior by O/A and CA with real-time trading. The first can be met by the sequential execution of coordination mechanisms, the latter option may be omitted unless a significant advantage in terms of allocation performance can be proved.

5. Conclusions

We have elaborated an organizational and a brief technical design of an task allocation system. The organizational analysis has been framed loosely in Håkansson's interaction model in order to capture the interrelations between actors, processes and context. We want to sum up our findings and considerations in four conclusions:

Conclusion 1: Internal markets are an instrument to enlarge the scope of action and - indirectly - the motivation of decentrally operating agents.
The premise of our system is an organizational vision regarding efficient task allocation and incentives for specialists. So it is the organizational and behavioral imperative that motivates this system rather than the availability of IT which has in this case a strictly enabling function. Consequently, the success of organizational changes will largely depend on the commitment and sincerity of the management.

Conclusion 2: The design of an internal market or rather ECMs reveals the interrelation of organizational constraints and design parameters.
Allocation mechanisms are embedded in the organizational context. The trade-offs between the four goals - employee motivation, quality and speed of task execution, customer satisfaction and service costs - can best be met through a combination of different allocation mechanisms. The dispatcher retains therefore a central position as superintendent or meta-coordination but will be relieved of the major part of tedious micro-management. His integrity and trustworthiness are therefore a critical success factor.

Conclusion 3: A "market solution" is far from homogeneous or deterministic but there are numerous design options and various, partly complementing coordination mechanisms available.

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[23] An algorithm for complex matching procedures is proposed by Lee, Ho Geun; Lee, Ronald M.; Intelligent Electronic Trading for Commodity Exchanges, in: EM-Electronic Markets, Vol. 3 (1993), No. 9/10, 5-6.

In analogy to financial markets, we have identified three generic coordination mechanisms and have assessed them on the background of organizational model assumptions. Ex ante, a combination of the different mechanisms seems the most promising solution, which has to be embedded into an atmosphere of a learning organization. As the service allocation problem has been interpreted as a "soft" problem, the proposed design can be backed by plausible reasons but not proven through optimization calculations. Even ex-post measurement of the system performance can not be easily linked to causes in this complex network of organizational, managerial, motivational and technical factors.

Conclusion 4: Current IT and related investments pose only minor restrictions to the implementation of a previously designed organizational solution

We have argued that our model design can be implemented with limited means based on current technology. Numerous application features - from expert systems for the error diagnosis to road maps and customer databases - can be added that support the service specialists in their daily work. More important, however, is the integration of the outlined service allocation system into an integrated environment of electronic communication with the customers, work-flow management and controlling systems.