Intelligent Software Agents

Implications for Marketing in eCommerce

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Abstract

The potential for the efficient and effective organization of market processes by using interactive media is hardly used. Intelligent software agents represent one of most interesting the innovative technologies under economical criteria.

This article shows how supplier can use software agents for the individualization and automation of their marketing instruments applied. The use of methods from artificial intelligence enables agents to learn. Thus the automatic optimization of the marketing instruments becomes possible to satisfy massive individualized needs of the demander. Moreover it is outlined, which effect the supplier's use of software agent has on the buying behavior of the demander. Interaction effects are considered, which develop, if demander likewise use software agents for the support of their purchase process. This article shows that software agents increase the effectiveness and efficiency of market processes on several levels of the Consumer Buying Behavior Model.

Keywords: Intelligent Software Agents, Marketing, eCommerce, Virtual Market Place

BRT Keywords: CB, GA, GE, HB

Introduction

With the increasing acceptance of the new media the execution of financial and business transactions over Internet becomes common. Up to now the turn over materialized by eCommerce rises exponentially. This is particularly due to an advantage of the Internet in relation to business transactions in the " physical world ", extremely small transaction costs [1-4].

Presently resulting chances for the efficient and effective organization of market processes by using interactive media are hardly used [5]. The reason for this could be situated in the fact that the development of eCommerce is essentially technology-driven and regarded fewer under economical criteria. Certainly, many large enterprises invested considerable amounts into the digital future (so e.g. Bertelsmann Online 300 million US Dollar; www.bol.de), but sometimes it is doubtful if they invested into the right

technology, in order to use the advantages of the interactive media sufficiently.

Software agents represent one of the most interesting innovative technologies under economical criteria. By software agents one understands programs, which fulfil a task independently on behalf of the user [5]. This definition is based on the one hand on the definition of the term *agent* as a person or a thing, who is able and authorized to act on behalf of a third party [6], and on the other hand it is based on the term *software*. The software can be adapted to the individual preferences and parameters of its instructor and operates without intervention of the user at a specific problem definition.

Agents can be used both by suppliers and by demanders. Today suppliers use software agents already to personalize products and advertisement (www.firefly.net). In the age of Mass Customization and One-to-One marketing [7] individualizing the supplies is ever more strongly in the focus of the strategic considerations of the suppliers. As it will be shown, software agents in particular represent a marketing-tool par excellence for this individualization. Demander use agents, in order to execute e.g. complex search and filter functions. On the one hand they thereby lower their search costs and increase on the other hand the probability to find the product that corresponds to their preferences the most.

Demander agents are also in a position to lead with supplier agent's independently complex price and treaty negotiations [8]. Consequently, the fact that suppliers marketing-mix automatically individualize and demanders arrange the purchase process to be more efficient and more effective, due to sinking search costs, it will have extensive effects on the market.

This article shows how supplier can use software agents for the individualization and automation of their marketing instruments applied. The use of methods from artificial intelligence enables agents for learning. Thus the automatic optimization of the marketing instruments becomes possible to satisfy massive individualized needs of the demander. This article shows further the effect the supplier's use of a software agent has on the buying behavior of the demander. Interaction effects are to be considered, which develop, if the demander likewise use software agents for the support of their purchase process.

Software Agents

Following Caglayan and Harrison [6] a software agent indicates the following characteristics:

- A software agent has a *instructor*, who instructs him, to operate certain functions independently. The instructor can be a person or a superior software agent.
- A software agent needs *interfaces*, in order to be able to communicate. On the one hand interfaces are necessary for the input of data and parameters for specification of the function which should be executed. On the other hand they are needed, in order to transfer the results of an executed job to the instructor.
- A software agent has to be *autonomous*, i.e. it must be able to execute its job without direct intervention of the instructor. This means that the agent must be *authorized to act*.
- The software agent must be able to notice *events* in its *environment*.

- For the interpretation of the events assumed by the software agent the software agent must have *intelligence*. For this reason, one also often speaks of *intelligent software agents*. The methods used for agents usually rise from the area of artificial intelligence (AI) and have thereby only an indirect reference to the "human" or natural intelligence.

Mode of Operation of Software Agents

Each agent is unique in his mode of operation and thus in particular in his program-technical characteristics. Nevertheless software agents can be generally explained by using a model derived from Caglayan and Harrison [6](see figure 1).

Figure 1: Mode of operation of software agents
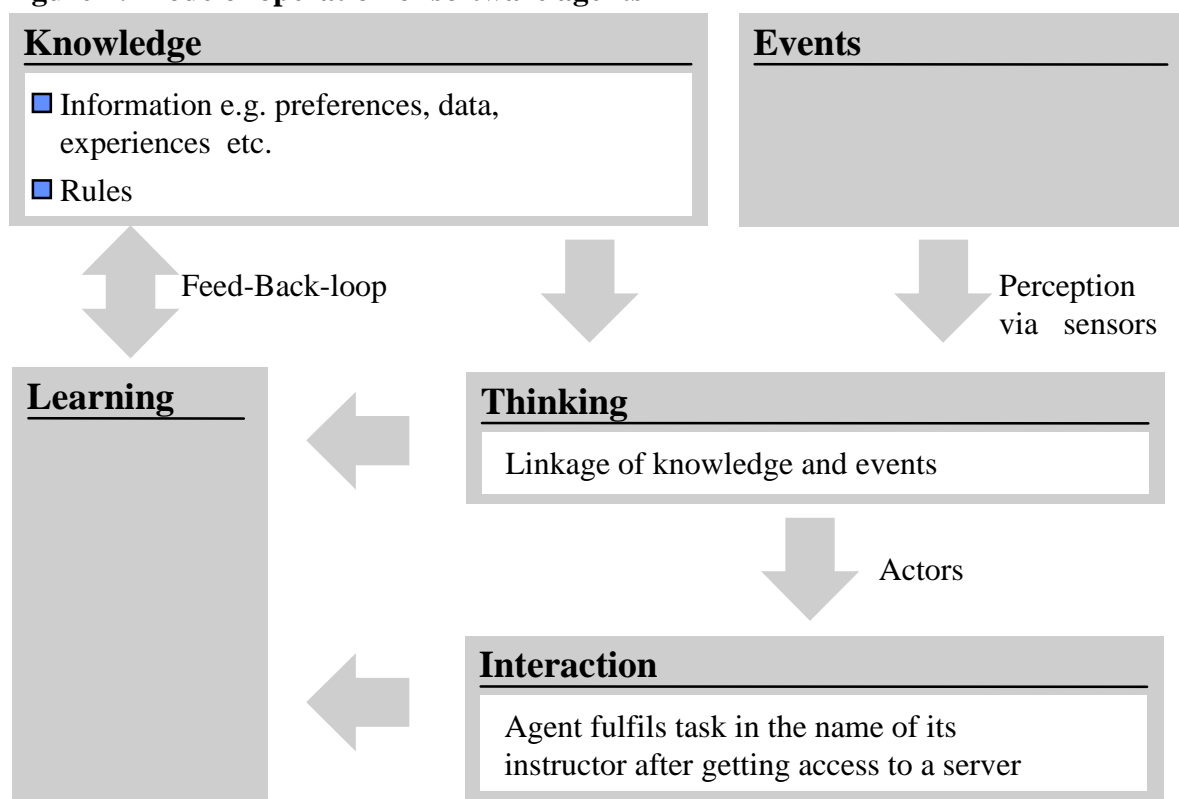
The description of the mode of operation of software agents requires first the analysis of the technology, which determines its intelligence. Intelligence can be attributed thereby to three dimensions [5]:

- Knowledge
- Thinking
- Learning

The knowledge of an agent consists of information and rules. Under information is to be understood data such as user preferences or product data. Rules can consist of simple "if - than" relations or represent also complex neural networks. Thus the agent has an internal knowledge base, which consists of *foreknowledge* and *learned knowledge*. By foreknowledge (static knowledge) information and rules are to be understood, which are

given to the agent in the context of its program structure or are indicated directly by the instructor. By learned knowledge (dynamic knowledge) interaction with the environment or conclusions derived through obtained information are to be understood which are based on the foreknowledge.

For the use of the knowledge the agent needs the "ability to think", which is called agent machinery. The agent machinery requires two things. On the one hand the agent must assume events in its environment over *sensors*. On the other hand it must combine the assumed events with its knowledge (information and rules) in a "thought process" [6]. From this linkage the agent can draw *conclusions*. From the conclusions the agent can initiate autonomously, thus without intervention or statements of the instructor, and act through its *actors*. For executing an action the agent must, in some cases, have an access authorization.

If the access authorization is given, then the agent can execute its task, by interacting with humans, computers or other software agents.

The intelligence of the agent increases by the enlargement of its knowledge base. By extending the available information and rules the agent can draw better conclusions from events in its environment. The extension of the knowledge base results from *learning* processes. Learning is a behavior modification, which is the result of an *experience*. A software agent learns using his learning machinery by the following experiences:

- From the linkage of knowledge and events in the agent machinery develop conclusions, which enter the knowledge base over the learning machinery.
- The interaction with the environment activates further learning processes. These learning processes direct essentially at adding or changing rules or information.
- Also without interaction or reaction to events the agent can learn. For example statistical methods - they are hypothesis-led or not (dataminig) - represent suitable means [6].

With respect to the literature further distinctions are made between *stationary* and *mobile*. Mobile agents execute their tasks, by copying themselves within a network from computer to computer, in order to execute the specific function in each case "locally". It is necessary to remark that the mobility or non-mobility of an agent is in the reason only two different technical types of the same concept. Therefore, no substantial differences for the instructor of the agent arises, although this is often denied. Besides mobile agents directly raise safety questions, since permitting in principle "stranger" agents on a computer often also opens the doors for hackers. The boundaries between hostile mooded mobile agents and viruses are flowing.

After this general presentation of the mode of operation of software agents, in the following paragraph the types of agents are systematically pointed out.

Types of Software Agents

Agents let themselves be categorized regarding their environment as follows:
- *Desktop agent*. They sort detailed e-mails automatically into special subjects and make entries in the appointment scheduler [9], carry out assistance for the inexperienced users of standard software [10] or send an automatic notification to the software producer if program errors occurs (e.g. Netscape quality feedback agent).

- *Network agent*. Network agents access distributed information in networks, in order to fulfill the task given by the instructor. Network agents are divided into Internet- and Intranet agent, whereby the range of Intranet agents is limited to interlaced organizations.

Since in the following the emphasis is put on eCommerce, it is referred to Internet agents only. Internet agents access the information distributed in the Internet. In detail Internet agents let themselves be categorized regarding their function:

- *Web search agents* are the well-known search machines e.g. AltaVista (www.altavista.com) or Excite (www.excite.de), which facilitates the search in the Internet for a user. The pure search query is here no application of the agent technology, since a data base inquiry is only executed there. Rather search machines use for their part Web search agent (Crawler), which register the addresses and contents of the Internet [6]. The efficiency of the agents has influence on the relevance of the found addresses during the input of a search word.
- *Filter agents* extract a small subset relevant for the user from a large quantity of data after its individual preferences. They filter relevant information and edit these. Filter agents are suitable for individualizing of supplies. The entry of the preferences (those determining the filter) can thereby take place either directly over the input of preferences by the user (e.g. with Linxx; www.linxx.de) or also indirectly (e.g. with Letizia [11]). The indirect entry of the preferences are based on behavior-oriented agents [12]. Letizia tries to derive the user's preferences through his passed behavior as clicked links, entered search words, or assistance requests. On the user requests, the agent Letizia will come up with personalized "links" for further searching [11].
- *Memory agents* monitor areas defined by the user after new or changed information. If they determine certain modifications in their environment, they inform their instructor. Typical examples of memory agents are agents, who remind the instructor of birthdays of persons important to him (e.g. www.florito.de) or inform their instructor on achieving a specific limit of a stock exchange rate.
- Among *service agents* many possible agents are described, which are available for special services [6].

After the types of the most important Internet agents have been presented, the following paragraph shows how software agents can be used in eCommerce and which consequences effect purchase and market processes.

Software Agents in eCommerce

Influence of Software Agents on the Buying Behavior

The following paragraph states how software agents will lastingly influence the present marketing paradigm in interactive media. As a basis standpoint serves the "Consumer Buying Behavior Model". In the literature it is easy to find many different approaches and models [13-16]. Although these models differ, three levels can be identified, which are

represented in all models. After a buyer determined a need, he is opposed to the following decisions:

- *Product selection*. The buyer decides which product he would like to buy. In addition he must realize himself, which characteristics the product should contain.
- *Supplier selection*. The buyer decides where he would like to buy the product.
- *Negotiation and transaction*. The buyer decides to purchase a certain product from a certain supplier and concludes a sales contract.

All Consumer Buying Behavior models represent a simplification of the reality. So levels of the model can be skipped. Backspaces on preceding levels are possible. Synchronous deciding on several overlapping levels is just as conceivable. Nevertheless the model is suitable, to represent the efficiency of software agents for marketing in the new media [17].

Software agents are able to illustrate the consumer behavior on different levels of the model and to make decisions for their instructor independently. This is situated on the one hand to their *individualizationess* and on the other hand on their efficiency to solve *tasks* in eCommerce *independently* over a longer time interval.

For the analysis of the influence of software agents on the buying behavior a categorization of the automation of the interaction processes between suppliers and demander is appropriate. Here four cases are conceivable, which are represented in figure 2. In the human-human-interaction the Internet is only used as a communication medium, for digital products also used as distribution medium (case I). In case II a demander agent interacts with a supplier, who does not use an agent. In case III the supplier software agent uses and interacts in this way with a human demander. In case IV agents interact on both sides.

Figure 2: Automation of the interaction processes between suppliers and demanders

In the following the modification of the purchase process by the application of agents is pointed out on the basis of the four fields.

Case I: Interaction Human-Human

At least within the Business to Consumer area the World Wide Web represents often not more than a digital, increasingly with multimedia and interactive items decorated, mail-order catalog. The differences during the purchase process to the "non-virtual" markets are at present still relatively small. The instructor must execute the product selection, supplier selection, if necessary the negotiation and the handling of the business. The in the Internet currently prevailing marketing paradigm differs only by the information transfer of the non-virtual markets.

On the product selection level of the Consumer Buying Behavior Model the consumer decides, *which product* he would like to buy. He achieves this on the one hand by searching possibly suitable products and on the other hand by the analysis of information, which he collected over the products. At the beginning of the commercialization of the Internet it was often reasoned, that the Net makes all meaningful information available that exist in digital form, globally, temporally unrestricted. Just a push on a button and the information is available. Meanwhile it is out of question that Internet represents a vast unclear hotchpotch of unstructured and unsorted supplies of most different types. The often praised efficient switching of suppliers and demanders is not achieved. The potential transaction partners over search machines can be determined. However, by the immense quantity of possible transaction partners the user will check only in rare cases all possible supplies in order to select the individually optimal supply. For example the retrieval query results for "mobiltelefon" with the search engine AltaVista (www.altavista.com) would deliver an approximate score of ten million different websites.

Suppliers can influence the product selection of the demanders by advertisement comparable to the non-virtual world, which they place either in online- or non-online media. The presentations of the product alternatives are usually placed on company-owned websites or in so-called virtual Shopping Malls (e.g. www.my-world.de).

After the selection phase of a certain product alternative, follows the selection phase of the supplier. On this level the demander compares different supplies for a certain product. The selection problem can be quite complex if a multiplicity of different suppliers with strongly differentiated conditions for the selected product is available. Eventually a back-step on the product selection level or a synchronous selection of product and supplier takes place.

If the product selection and supplier selection is settled, the demander gets into contact with the supplier e.g. by e-mail, executes possible purchase negotiations and settles if necessary the contract over the agreed performance.

Obviously, with this type of interaction in eCommerce the buying behavior differs only in that way from the non-virtual world as the alternative spectrum of the offered products and the number of suppliers of these products rise numberless. Through the resulting information-overload and the lack of process automation efficient switching of suppliers and demanders is missing in the most cases.

Case II: Interaction Human - Demander Agent

If a demander utilizes software agents in the purchase process, he can reduce his search costs. Demander agents can be used on all levels of the Consumer Buying Behavior Model.

The software agent supports the demander on the product selection level, by searching for products, which correspond to the demanders' preferences. The substantial performance of these filter agents then consists of picking one product or a small selection from a huge quantity of possible suitable products. The at present spread agent technologies are usually originated from the area of artificial intelligence. Agents extract meanings from text documents and Internet documents and present appropriate documents, they plan journeys after individualized instructor's requests [18], they recommend CDs or movies [19] or find the proper car [20].

The filter agents used in the product selection level can be divided into content-based and non-content-based agents. Content-based product agents require the existence of a characteristic space of the regarded product category. They are suitable therefore in particular for products, whose preferences are essentially shaped by objective characteristics e.g. the maximum speed or the fuel consumption of a vehicle. The instructor indicates these preferences to the agent usually directly. It concerns thus foreknowledge, which is learned not only later by the agent. Non-content-based systems are favorable in areas, within which an objective product description does not appear practical on the basis of characteristics (e.g. motion picture film s or music). In most cases learned knowledge is concerned.

Price agents represent the simplest type of content-based agents. During the instruction of a price agent the instructor must describe accurately a product on the basis of objective characteristics, whereby the product characteristics are given. The only variable product characteristic is the price. The price agent looking up price information for the product from all of its known suppliers. This procedure reminds of price agencies (e.g. www.preis.de) in the conventional sense. In contrast to this is the price comparison in the Internet done within seconds and without personnel expenditure.

The concrete effects of the massive application of price agents on traditional market structures are today not yet foreseeable. They will be enormous for suppliers of homogeneous goods and performances, whose purchase-decisive characteristics are objectively reportable. In particular, since price agents increase global price transparency. The increase of price transparency can be explained by the small search costs [2]. Presently become the first counter actions of the suppliers feasible. The price agent "Bargain Finder" (bf.cstar.ac.com) was able to compare the supplies for special CDs with approximately ten suppliers. Meanwhile the Bargain Finder was terminated, since a substantial proportion of the CD-shops refused this agent access to the necessary price information with the reasoning that the agent neglects all complementary services, which served for the differentiation of the appropriate suppliers [21].

The decision over whether a price agent is blocked or not, depends on the amount of user of this agent. The more demander utilize the price agent, the more difficult it is for a supplier to refuse the access [22]. However, if the agent is blocked by almost all important suppliers, it loses trustworthiness and will be terminated like the Bargain Finder.

For a supplier permitting access of price agents is worthwhile in particular if he can be certain that he offers the best price in his market segment [23]. High-price suppliers of homogeneous products become pushed out of the market within a short time.

In order to escape this fate, more and more suppliers will turn to submit to the demander agent individualized supplies, containing additionally purchase-decisive characteristics apart from the price. Thus it is possible for these suppliers to stick out, by differentiation against the homogeneous product mass [24].

It becomes clear that content-based agent have to consider not only one characteristic (e.g. the price), but several characteristics with the product selection. Through the strategic behavior of the suppliers to increase individualizing the supply it will be favorable for demander to include other characteristics for decision process of the software agent. The content-based agent PersonaLogic (www.personalogic.com) asks for different product classes e.g. for cars the preferences of the user for certain product characteristics. The user can mark "hard conditions" (e.g. the car should have at least four doors and should not cost more than 20,000 Euro) and give weights for " soft conditions " (e.g. small fuel consumption or good breakdown statistics of the manufacturer). Based on the characteristic-space of the products the agent search for the products, which fulfill all hard conditions and as well as so many soft conditions as possible. The performance of the agent is thus a substantial reduction of the search costs for the demander.

A non-content-based product agent is Linxx (www.linxx.de). The agent determines first the individualized website preferences of the user. It submits different websites for evaluation. If the user evaluated the Websites sufficiently, the personal website taste is compared with that of thousands other users. During this process the users are identified, whose preferences indicate the highest similarity to the preferences of the user. On this base the agent can predict, which supplies will please the user. In particular the Websites, which other users with similar preferences already know and considered being good. Linxx calculated these on the basis of an individual forecast and recommends the Websites with the highest "probability of success". This method is called "Collaborative Filtering" [25-27].

The use of filter agents leads to the fact that the preferences of the customer are stored in the knowledge base of the demand agent. This has strong consequences for the supplier. Classical advertisement does not work with application of content-based agents any longer, if only the product and no more characteristics are in the focus of the advertisement messages. Substantially for the use of content-based demander agents is that the demander classifies characteristics as "important", with which the supplier has a competitive advantage. For this reason an advertising message, emphasizing a new safety system within the automobile area, could fit well if the demander instructs his agent to accept only products with this safety system.

However, when using non-content-based demander agents classical advertisement can work further. Thus the agent interprets clicking on a banner as a possible preference for the underlying product. Hence, advertisement influences not only the customer, but also the agent.

Filter agents' function also in the context of the supplier selection. The increasing product individualizing and the ability of software agents to learn individual preference structures of the customer usually leads to that the utilized demander agents for the supplier selection directs to a certain supplier. This supplier offers the use-maximized product for the individualized preferences of the customer. This result into the necessity for the supplier to offer high flexibility in combination of product characteristics in order to optimally satisfy the customer by means of Mass Customization [28]. Further consequences arise for the suppliers since the applications of demander agent intensify the competition and that the suppliers must operate still more customer-oriented.

The better demander agents can illustrate the preferences of the customer, and the

stronger suppliers tend to react by individualizing their products, the more is the demander willing to trust his agent. This lead to the fact that the demander will let transactions be executed by the agent independently. Hence, the demand agent will be able to take over typical commercial functions, e.g. the assortment function, completely [1]. The effect on traditional trade will become serious [4].

Case III: Interaction Supplier Agent - Human

We regard now the case that not the demander, but the supplier utilizes software agents. The supplier can use these supplier agents for the optimization of his marketing-mix for each individual customer. Supplier agents can be used during the product selection phase for advertisement, for product politics and for pricing.

Advertisement agents can control the advertisement in such a way that scattering losses of their marketing are minimized. Advertisement agents can often be combined with product agents, which are able to determine the individual preferences of the user [29]. For example the product selection process can be influenced by content-based advertisement in search machines. The input of the search word "mobiltelefon" with Yahoo (www.yahoo.se) leads to the advertisement of a mobile telephone company in a banner above the search results (figure 3).

Figure 3: Advertisement input with Yahoo after search words

Hittade **1** kategori, **52** sajter och **6** nyhetsartiklar för **mobiltelefon**

TÄVLA MED SIEMENS

| Kategorier | Sajter | Inktomi | Nyhetsartiklar |

Advertisement banner
www.siemens.se
for the search word
"mobiltelefon" at Yahoo.

Kategoriträffar i Yahoo! (1 - 1 av 1)

Näringsliv och ekonomi > Företag > Telekommunikation > Trådlös

Siteträffar i Yahoo! Sverige (1 - 14 a

Samhälle och kulturer > Folk > Personliga hemsidor

- Stenbeck, Johan - författaren, **mobiltelefon**er och bilder.
- Horatius, Ladislaus - den Digitala containern, Ladislaus försöker få er att stänga av datorerna och ge er ut i den akustiska verkligheten. **Mobiltelefon**ångest, X2000-bromsaren m.m.
- Possung, Henrik - sökverktyg, SMS till **mobiltelefon**er, länkar, skidåkning och äventyr.

Individualized arranged advertisement can be favorable also for the user, since it gets an information character and is felt less annoying. The advantages for the supplier are obvious. The scattering losses are reduced by the use of advertisement agents and marketing budgets become more sufficient. Already today, the Internet advertising enterprise " Doubleclick " places target group specific advertisement in dependency of the daytime and the transaction profile of the user, whereby "clicking rates" allegedly up to 25% are obtained [30].

Furthermore, advertisement agents can give completely new impulses for the selection of the correct advertising message [29]. For an advertising campaign a number

of different advertisement messages will be displayed, whose effectiveness can be measured among other things on the basis the " clicking rate ". Already after short time the advertiser knows with a high certainty, which advertisement message is most effective, without placing unnecessarily many ineffective ads. A further differentiation of the advertisement on individualized basis is possible, if socio-demographical data of the user is present. Everybody who attaches importance to emotional advertisement can receive one, while the other, which reacts to informative advertisement, receives another message. The selection of the correct advertisement is therefore strongly automizable, so that pretests for advertising messages become unnecessary. The agent knows after short time independently, which advertisement obtains the best results for which persons at which time of day. In the statistical literature this procedure is called "multi-armed bandit problem" [31].

Advertisement agents can be used in particular in combination with supplier-laterally-utilized filter agents. Online booksellers such as Amazon (www.amazon.com) or BOL (www.bol.de) know on the basis of transaction data that a certain customer is interested only in novels of John Grisham and Ken Follet. In this case not the work of Schiller is applied on the Website, but with priority the latest books of Grisham or Follet, which the customer have not yet bought.

Suppliers can profitably use methods like Collaborative Filtering described above. If the transaction data of the past users are compared systematically together, then similarities in the use behavior of certain groups are to be determined - similar to the recommendation of Websites with Linxx (www.linxx.de) - which can be used for individualized offer generation [32]. The buyer of a computer can be offered e.g. appropriate learning software, if it was stated before that users with similar features bought such software, too. Besides complementary relationships can be uncovered [33] and automated during the offer generation. During the purchase of a dress the fitting hat is offered. If a home shopping supplier as for example Hennes&Mauritz (www.hm.com) implement this fast, then the conversion and thus the variable gross margin per customer can be increased. The study of Brynjolfsson and Bakos [34] showed that bundling of supplies could be quite meaningful in interactive media.

Moreover, the use of supplier agents' permits individualized price distinction. Throughout automated online experiments or other suitable methods for the collection of readiness to pay can tax the consumer's surplus of each individual customer be determined which can siphoned off [35].

Supplier agents can also be used, in order to produce individualized adapted products. If one regards a product as a bundle of characteristics, then it can be, first of all if it is present in digital form, combined in any different bundles again [36]. This is partially possible for physical goods as well. This proves the computer manufacturer Dell, where after individualized preferences over 10.000 possible PC configurations can be ordered (www.dell.com).

The variable costs of individualizing are marginal due to the complete automation. On the other hand the supplier sticks out of the mass of homogeneous products. Since this supply is exactly adapted to the user, a comparatively high price can be obtained. But also for free online supplies can individualization be used profitably by supplier agents: On the basis of the determined user preferences purposeful and thus substantially more effective advertisement can be placed.

The use of supplier agents presupposes that data and preferences over the demander can be raised and stored, on the basis those individualizing to operate leaves itself. Supplier agents learn with increasing interaction to extend their knowledge base.

Consequently, the benefit increases by the better adjustment of the marketing instruments on the demander with each time he attends. By using " Lock-In " for the demander pioneer advantages can be achieved. For example Amazon was first to use the agent technology in the online book trade. It requires now substantial financial efforts of followers, in order to catch up in the competition.

Case IV: Interaction Supplier Agent and Demander Agent

Within the new media a larger number of online auction houses e.g. e-Bay (www.ebay.com), bidlet (www.bidlet.se) or OnSale (www.onsale.com) already exist. In these auction houses suppliers can auction used or new objects. The demander can participate in auctions by delivery of bids.

Some limitations, well known from non-virtual auctions, are removed by online auctions, like the necessity for the local and temporal presence of the auction users. However, these systems still require that the demander execute the biding during a longer period. This is in particular a large disadvantage if auctions extend over several days or weeks, since delivered bids are usually mandatory. If a user is interested in a product, which is offered by several auction members, then he can have an active requirement either only in each case run at present or he runs the risk to get more than one product. If he is over-bidden, then he must decide whether he raises his bid or not. If he will raise his bid, he has to deliver his bid on his own. As described above, the use of software agents on both sides are beneficial for lowering transaction costs. Consequently, a completely automated market process develops, at which supplier and demander agents in the name of their customers negotiate together and execute transactions.

The vision of such a virtual agent-marketplace contains the market entry of a multiplicity of supplier and demander agents. The agent environments needed for these functions differ from those environments that are frequently found in the area of distributed intelligence [8]. In these environments a multiplicity of agents operate more or less independently on a *common* task. The difference to agent environments, which create virtual markets, is obvious: Instances of supplier and demander agents operate not on a common problem with the same target, but pursue *different*, often diametrically contrary targets. Here an aspect begins, which was neglected so far in the literature. If a customer indicated his willingness to pay to his agent, or taught the agent the willingness to pay, then the agent must be able not to reveal this easily to others. The secrecy of the willingness to pay and the objective of consumer's surplus maximization on the demander side, pursued thereby, on the one hand has the consequence that on the other hand the supplier programs his agent in such a way that he investigates the willingness to pay of the customer. The same applies to the supplier. The supplier would like to maximize his profit and has little interest to reveal his marginal costs. The secrecy of the willingness to pay can lead to the fact that the efficiency of the market does *not correspond* with the in context of "eEconomy" frequently stated complete competition.

Suppliers and demander can program their agents in such a way that with help of skillful tactics and with game theoretical findings, the pursued strategies of the agents become obvious. This applies even more, if software agents unite and co-operate in the market [37]. However, the better the agents are programmed to act jointly, the faster they learn from the behavior and react for their part with improved strategies. It becomes clear that also agents in new environments become able to be "ripped off" - in the same fashion, as everyone who does not know, how he has to negotiate on an oriental market.

Intelligent agents will learn with the time, how one has to act on virtual markets. Less intelligent agents will be just as easy victims as tourists in the Orient, and will be very rapidly withdrawn from virtual markets. In this context the reputation of the business behavior of software agents or their customers plays a role. Software agents are able to spread information about the passed behavior of other agents. Agents can themselves establish a reputation as good transaction partners [38]. As a consequence, dishonest behavior e.g. a breaking of promises or the non-execution of transactions agreed upon by agents will be punished rapidly.

A critical point with the utilization of software agents can be summarized under the often-used term "privacy" [39, 40]. Meant are all protective mechanisms in accordance to the customer, in order to protect him against unwanted spying by potential transaction partners. Hence, a demander agent will not want to reveal the same information about the preferences and personal data of his customer to each supplier agent. On the opposite, a supplier agent can use the personal preferences for the advantage of the demander, by making individualized supplies. Data security becomes apart from a matter of confidence also a negotiation object and so a typical application for software agents, since the assured data security represents nothing different than a product characteristic.

In order to master the mentioned problem fields of virtual markets, suitable multi-agent environments have to be installed [41]. They offer a meeting place for software agents, whose customer wants to do business together with others. Multi-agent environments must indicate the characteristics specified in figure 4.

Figure 4: Characteristics of a Multi-Agent Environment

- They offer a meeting place for agents, who want to buy or sell certain products, and are comparable with the local conditions of old, medieval markets.
- They arrange agents, whose instructor would like to come together for doing business.
- It guarantees that the identity of agents and their connections to the economic subject are ensured and that information about the agent's reputation is administrated. This does not mean that the agents know at the point of time of the negotiation, with whom they negotiate. Rather it is guaranteed that in the case of a contract settlement between agents the economic subject can be investigated, who started and assigned the agent to execute transactions in its name.
- The multi-agent environment takes over the function of a set of rules in the absence of relevant legislation for such forms of the electronic trade. Legislation security is one of the core factors for the development of markets.
- It takes over the protocol of offers made and the settlement of contracts. This is a functional feature of virtual market places, which is not to be underestimated. The protocol ensures that the offering agent is bound to its supply and can be proven by contracts. The environment has thus a testifying function.
- The environment can also take over a collection of depth function. For example the collection of the buyer can be taken over after a contract settlement. As soon as the monetary transaction was executed, which in the future will be feasible within few seconds, the payment is signaled to the supplier, who then delivers the sold products. Digital products can be transferred online, physical products last somewhat longer. After distribution the cash is credited to the supplier.

Multi-agent environments are able to support the interaction of supplier and

demander agents on different levels of the Consumer Buying Behavior Model. To differentiate here are on the one hand purchase processes for goods with clear specified characteristics, e.g. unique, homogeneous or non-individualizable goods, where only the price is variable. On the other hand are purchase processes to be analyzed, where the goods possess apart from the price further negotiable characteristics.

For purchase processes for *products with specified characteristics* the product selection process is unbundled from the supplier selection. After the product in all characteristics, with exception of the demander price, was specified, the supplier selection over software agents on virtual markets can be executed in the following.

An example of such an agent environment is the from the MIT Media Lab developed prototype "Kasbah". Kasbah is a multi-agent environment, in which the users can assign supplier agents for the sales of used CD's or books. Interested buyers can start their demander agents, who then enter on the virtual market place in order to negotiate the price with supplier agents (figure 5). Since for Kasbah only the price is variable, one indicates his agent the individualized willingness to pay (demander agent) or price (supplier agent), which are dependent to the progressing runtime of the agent. The initial willingness to pay, the maximal willingness to pay, the run time of the agent and the type of the willingness to pay function (linear, decreasing or exponential process) are given to the demander agent. The same applies to the supplier agents. The task of an agent is situated to find a transaction partner who is ready to pay an acceptable price or offers a favorable price for an object. The strategy pursued by the agents thereby is comparatively simply structured. Demander agents make offers with a certain price, thereupon the supplier agent answers with "yes" or "no" [8]. If the negotiation task is solved and an acceptable price is found for both sides, the instructors of the agents are informed and able to get into contact personally.

Figure 5: Kasbah as a Virtual Market Place for Agents
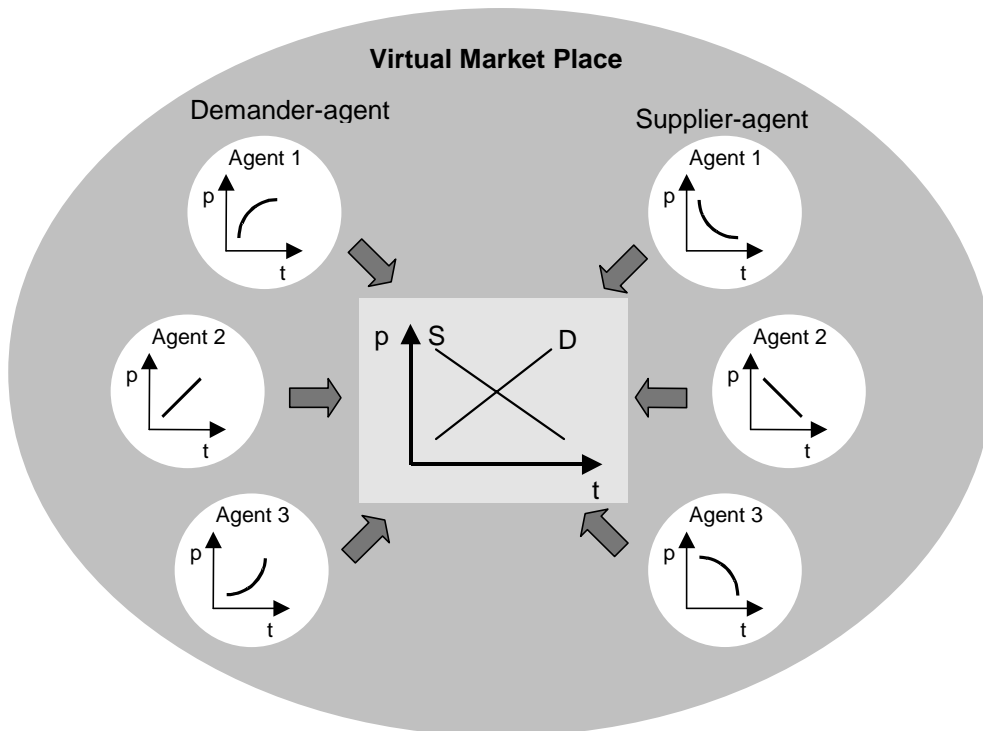
The mechanism of the dynamic price definition and the definition of the modalities by agents releases both transaction partners of the necessity to determine a price before the beginning of the negotiations. Rather this function is transferred to the market itself [17], also described as Price on Demand.

For Kasbah it becomes clear that in this system the selection of suppliers by agents is based on the price only. Out of this reason only products can be traded, whose characteristics can be specified clearly, like unique, homogeneous or non-individualizable goods. In the case of goods with negotiable characteristics it must be turned back to multi-agent systems with more complex negotiation mechanisms.

With purchase processes for products with negotiable characteristics the product selection process is not uncoupled from the supplier selection. Only with multi-agent systems, in which not only the price is negotiable, the products can be individualized automatically by agents. A functioning example of such a multi-agent system is at present not yet available, although development on such systems already on its way (Tete-a-Tete; ecommerce.media.mit.edu/tete-a-tete). If such an agent system fulfills the prerequisites of a multi-agent environment (figure 4), product selection, supplier selection and transaction can take place automatically via software agents.

It becomes clear that agents do not remove the laws of the market. They will not redefine them either, but rather they will have dramatic competition effects, if new suppliers quickly transfer this technology [42].

Conclusions

The predominant number of the suppliers and demanders in the Internet did not detect the future meaning of the agent technology as well as its drastic consequences on the virtual markets of the future. Instead of investing in software agents, one still trusts in traditional structures.

This article shows that software agents increase the effectiveness and efficiency of market processes on several levels of the Consumer Buying Behavior Model.

The demander agents carry the following out:
- They support the demander with the efficient search for products suitable for the instructor.
- They find the supplier, who offers a product optimally adapted to the preferences of the demander.
- They are able to lead independently complex price and treaty negotiations with supplier agents.
- They take over thereby the assortment function, which so far the retail has had.

Suppliers use agents for the following purposes:
- Reduction of the search costs for the demander after his individualized preferences, in order to promote an effective and efficient product selection of the demander.
- They are able to individualize the marketing-mix automatically.
- The use of methods from artificial intelligence enables the agent to learn and thus for an automatic optimization of the marketing instruments for the mass satisfaction of the individualized needs of the demander.

For the introduction and acceptance of completely automated multi-agent environments simple and transparent negotiations protocols for trust creation and consequently for the acceptance of agents by the instructors are a necessity [43]. The agent is only accepted if a perceptible comparative advantage opposite to conventional transaction mechanisms exists. This trust must be learned by the users. This is done via a gradual authorization of the agent for the functions that can be required. First the agent is instructed to search for suitable products and transaction partners. After the list was outlined, the user can select the best product. The agent executes afterwards on command of the user the transaction and arranges the exchange of product and cash. With increasing trust to the agent ever more authority can be granted, until the agent may finally execute all functions in the purchase process autonomously.

The use of supplier agents is still obstructed by the skepticism of the suppliers themselves. In a discussion recently a publishing house representative expressed himself that he feared, the user would avoid his online supply, if he would use software agents. Here is situated one of the substantial problems of eCommerce - the suppliers do not know, how they can use the new technologies for the increase of the instructor use. The online users do not shrink from new technologies, but rather the acceptance and the preparation to take risks on the supplier side are missing to transfer the agent technology in marketing on a large scale consistently.

The eCommerce does not yet have the same value, as the traditional trade at present. This will keep its position probably also over some years - however: who does not engage himself early will not have a valuable position in eCommerce later. Pioneers are not inevitably more successful than follower enterprises [44], however are the pioneers already for a long time in the Net and meanwhile surrounded by many followers, who likewise record instructor profiles in rapid way and build up market entrance barriers.

One of the largest market entrance barriers represents here the knowledge of the individualized preferences of the users. Who has no own database with users and their profiles, will probably have to co-operate with or acquisate a third party, which possess data for the individual instructor. The entry of Bertelsmann's online activities at Barnes & Noble is probably due to that, apart from other strategic consideration.

This article did however not only show that software agents change market processes due to automation of the processes in the Consumer Buying Behaviour Model. The systematic analysis of the influences of the use of software agents reveals the necessity for the modification of the past marketing activities. Hence, it is among other things shown that the use of content-based demander agents strengthens advertising campaigns the objectively recordable characteristics of a product (e.g. a safety system) and that subjective characteristics have to be less placed into the foreground.

It is out of question that the technological development will force the marketing managers to the fact that they must always check One-to-One marketing apart from the further conversion of the " innovative concept " their own marketing instruments regarding its effect with the interaction with demander agents. The same challenge also applies to economical research.

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