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Intermediaries for the Provision of Mass Customized Digital Goods in Electronic Commerce

by

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Abstract *Generally and especially in EC, customers are confronted with a great variety and quantity of products and / or services. However, the time and effort a customer can spend on searching for his preferred products and deciding about the most preferred one based on his needs and preferences is the limiting factor. The aim of this paper is to transfer the well-known concept of mass-customization to digital products and EC. Thereby, anIT-framework will be developed, that enables intermediaries to flexibly provide personalized and mass-customized customers.*

1. Introduction

With the advent of the Internet traditional segmentation approaches do not meet the special challenges of the ongoing virtualization and digitalization anymore, because they do not utilize the special possibilities of Information Technology (IT) and Electronic Commerce (EC). In this so-called information age economy segmentation approaches are superseded by IT-enabled one-to-one marketing and mass customization in order to individually target customers according to their

specific needs and preferences (see e.g. [5], [11], [24], [26]; on mass information and customization systems [1], [12], [25], [34], [35]).

Generally and especially in EC, customers are confronted with a great variety and quantity of products and / or services. However, the time and effort a customer can spend on searching for his preferred products and deciding about the most preferred one based on his needs and preferences is the limiting factor. Therefore, two independent developments could be watched lately: on the one hand, new IT-enabled methods have been developed and applied to automatically match products on the one hand and the customer's interest on the other hand, both of which are described by a fixed set of attributes. Hence, a customer and product model and intelligent matching-algorithms have to be developed to satisfy the needs of customers and to provide mass customized products (See e.g. [4], [9], [14], [16], [32]). On the other hand, the concept of an information intermediary has been introduced by several authors as a promising concept in order to establish customer (trust) relationships which are necessary means in order to get to know the customer and to deduct his needs and preferences [16], [20], [30]. Therefore, Customer Relationship Management (CRM) that enables firms to individually and professionally mass customize products has become increasingly important.

Consequently, the aim of this paper is to transfer the well-known concept of mass-customization to digital products and EC in order to evaluate the differences and specific problems and to set up a framework that enables intermediaries to provide mass-customized digital goods. The paper is organized as follows: After these introductory remarks, we will define and explain the special properties of digital products and electronic commerce in comparison to traditional products and markets in section 2. Section 3 describes the consequences of these differences for mass customization. Consequently, a framework for the mass customization of digital products will be derived in section 4. In section 5 it will be shown why intermediaries are especially suited to provide mass customized digital products. We will discuss some limitations of the model and prospects for further research in section 6. In our research we draw from the German National Science Foundation (DFG) funded theoretical research.

2. Digital Goods in Electronic Commerce

Trading with digital goods can hardly be compared to the market of "traditional goods". On the one hand, producers and distributors of digital goods might profit from new chances and possibilities provided by the nature of digital goods, whereas on the other hand they have to deal with new threats and challenges. The reason for these developments are based on the very special nature of digital goods.

2.1. The Nature of Digital Goods

The nature of digital goods is constituted in their immaterial form of bits (represented by a binary code of 0 and 1), which leads to the property of having no weight and moving with speed of light. Moreover, digital goods can be copied, causing hardly any costs, whereas the copy cannot be distinguished from the original [22]. Thus the marginal costs of one more copy of a digital good are zero. Consequently, digital goods can easily be produced and distributed on networks, such like the internet hardly causing marginal costs or time of delivery and without having to be transformed or changed in media. Examples of digital goods are *digital products* like software tools, *digital services*, such as digital information, and *digital rights*, e.g. financial products. In this paper, we will focus on the latter two, since those are mainly traded in EC.

Finally – and probably most importantly -, digital goods can easily and without costs be varied and differentiated, since they can simply be unbundled into atomic units and bundled again according to any consumers' needs [2]. All product combinations are attainable.

2.2 The Nature of Electronic Commerce

The core difference between traditional business and EC is based on the subject of trade: whereas the old economy deals with physical goods and services, electronic commerce is focused on digital goods like digital information or digital services. This leads to a new economy and a new way of doing business, where traditional and already acknowledged theories have to be critically reviewed and new rules have to be defined, new variables have to be considered. Whereas the traditional economy could mostly be restricted to a certain local area (local competition), a producer in EC automatically becomes a global player [8]. The Internet as distribution channel reaches all Internet users around the world, regardless of place and time.

According to Porter [27], a firm can have two basic types of competitive advantages: cost leadership or differentiation. Still, a firm cannot pursue both strategies, because it will be stuck in the middle. However, a producer of digital goods trying to gain advantages from a strategy of differentiation will fail, since digital goods can easily be transformed or varied. Thus, if a producer offers an innovative digital product, every other producer can imitate this good, failing to gain competitive advantage by differentiation to both of which. Pursuing a cost leadership strategy, firms have to compete in prices. This might be a fatal strategy in EC as well, since the neglectable marginal costs of production and the winner-takes-all-properties of such markets might lead prices down to zero according to microeconomic theory. Consequently, when producing digital products, a

competitive advantage can neither be gained through differentiation, nor by pursuing a cost leadership strategy.

2.3 The Mass Customization Strategy in Electronic Commerce

A winning strategy in EC might be the customization of digital goods according to the individual needs and preferences of each customer. A customized product is unique, since it is perfectly adjusted to the needs of one single customer. The incentive for other firms to imitate a digital good diminishes, because the product does not satisfy the individual needs of another customer. Therefore, a competitive advantage according to Porter's theory can be achieved. Moreover, the producer might even be able to gain advantage through cost leadership, since digital information goods can easily be customized by the help of modern and innovative IT. Consequently, a producer of digital goods might gain competitive advantage through customization as well as low costs (see [25]).

The key to the success of this new strategy of customization is the knowledge of the customers' needs and preferences. In order to get to know the customers' preferences, each client has to be integrated in the production process. This integration in the producers value chain leads to the new customer status of "prosumer"[25], which is a combination of the client as *producer* as well as *consumer*. The prosumer's preferences are an important input in the production and adjust the digital good to the specific customers needs.

To sum up, the main factor leading to the success of customization lies in the customer know how. The company which will be most successful in getting detailed customers needs and moreover, will be able to build digital goods fitting these needs, will gain competitive advantages. This might be the key to the success in the new economy.

3. Mass Customization of Digital versus Physical Goods

In general, - i.e. in relation to traditional physical goods - [1], [25], [35] describe the main challenges and problems of mass customization as follows:

- A very flexible manufacturing organization and control is required, in order to produce a number of differentiated products in arbitrary order.
- The distribution and logistics has to fit and enable a such kind of flexible manufacturing process.
- The provision and maintenance of this infrastructure induce additional costs of production, which have to be justified by sufficient additional revenues.

Consequently based on the results of chapter 2, these challenges and problems do not seem to apply anymore for digital products and EC, since they can be bundled and unbundled without any costs [2]. However in EC, the depicted problem of a flexible production process is substituted by the problem of automatically integrating the customer (its attitudes, preferences, tastes etc.) as well as the products (attributes) into the customization process:

- How has the customer interface to be designed in order to receive relevant information?
- How can a customer's needs and preferences be derived from this information?
- What is the adequate form of representation of this information and know-how?
- How can a customer's needs and preferences be matched with the available assortment of products?

As it can be seen easily, the focus has switched from the product side to the customer side of the process, since product diversification is assumed to be trivial and without any costs, but the proceedings of getting to know your customer and offering him individual products seems to be the decisive competitive advantage. In the next section, it will be shown how these results will enable a new business model. Therefore, in the next section a framework will be presented, that incorporates these results.

4. Framework for Provision of Customized digital Goods

In general - regardless of digital or physical, and customized or standardized products - the problem of providing customers with personalized products to their problems is a very complex one. Firstly, the customer himself has to be modeled by means of a machine readable representation of his (changing) preferences, attitudes and (latent) needs. Secondly, the products have to be described by their relevant product attributes. Finally, intelligent matching algorithms are needed to combine the customer on the one hand and the products on the other hand, that is, there has to be a matching based on the information provided in the customer and product models in order to get a customized product. This basic architecture is represented in figure 1 (based on [9], [16]).

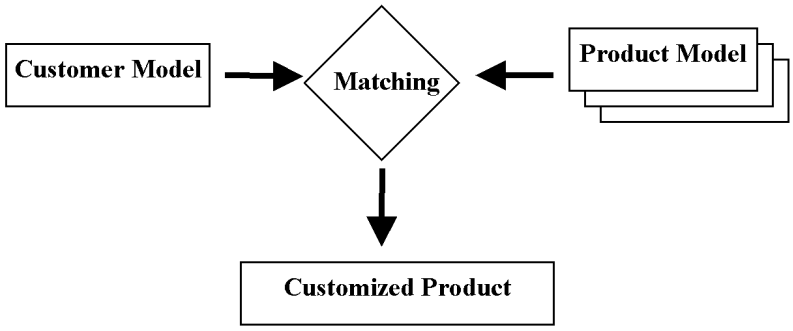

Figure 1: Basic Matching Process

4.1 Customer Model

Although the concept of customer modeling has its origin in the late seventies, only recently especially for its application in EC, there has been written a lot about customer modeling in literature (see e.g. [9], [10], [21], [28], [36]). However, so far there is a lack of customer models that combine both quantitative (such as income) and qualitative data (such as taste or the preference for certain products). Therefore, a customer model will be developed, that also represents qualitative data on a higher level of abstraction, that can be applied in various situations within one domain.

Usually information about customers is not scarce, but distributed throughout companies, and even if it was located at one central database to the customers' individual sales assistant or consultant, in order figure out the customers' best fitting products, consultation requires not only data but information and knowledge on a higher level of abstraction. The aim of this customer model is to provide an central IT-enabled repository of data, information and knowledge about the customer that is applicable for the customization of digital products [9], [10].

- **General knowledge about the domain**
  In order to deduct a customers needs, attitudes and preferences, the possible set of relevant problems as well as the set of solutions within a domain are to be known. This so-called domain knowledge is therefore a basic necessity within a customer model.

- **Attitudes as knowledge about individual customers**
  Attitudes are considered appropriate to express a customer's basic and underlying persistent (but not necessarily static) motives for the explanation of her behavior (for detailed discussion and definition see [9], [10]). From the

attitudes the customer's preferences can be deducted (e.g. multi-attribute value functions, see e.g. [7]). Individual attitudes are not permanent but may change over time by a permanent update of the user model triggered by new information and data.

- **Information**
  In order for a sales assistant or a consultant customize or even to just parameterize products, not only knowledge, but plain information and data might be required as well.

By incorporating domain knowledge, knowledge about the customers represented by her attitudes and customer data and information, this concept of customer modeling can be applied in various domains, as well as one specific customer model can be applied for various kinds of problems and consulting situations within one domain (see figure 2).

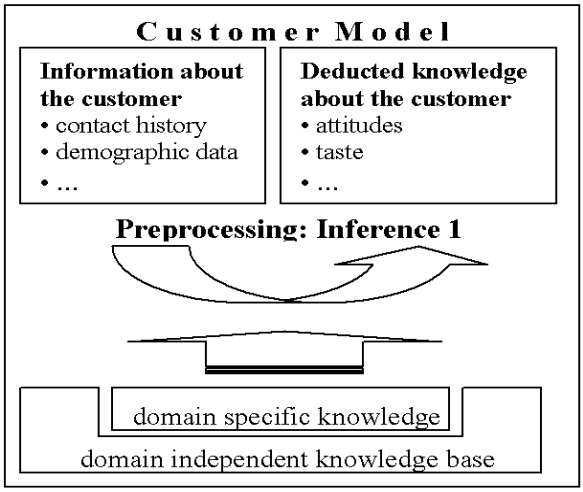

Figure 2: Customer model

4.2 Product Model

A product model ensures that the information about the available products needed to identify the right product for a specific customer, is accessible to an automatic matching process [16], [19]. Therefore, the relevance of a product attribute is deducted from its relevance for the customers' buying decision, since it are the customer's needs which have to be satisfied with the matching process using the attributes.

The elicitation of the product attributes from the product properties can be done in several ways. Most commonly it is probably done by humans. However, an

application of some kind of artificial intelligence might be feasible as well. More information about meta modeling can be found at http://dublincore.org; for various methods and applications of attribute elicitation see [31]. However, the product description with adequate attributes is a onetime process for each product. Hence – compared to the customer model -, it neither causes much effort, nor does the elicitation process seem to be very sophisticated.

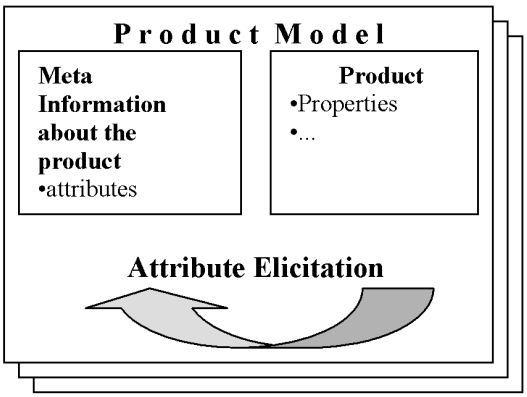

Figure 3: Product Model

4.3 Matching Inference Mechanisms

Based on the depicted customer and product model, a more sophisticated 2-step inference process can be derived. The main features of this process can be described as follows [9], [10]:

- The inference process I_1 deducts the customer's attitudes, corresponding to her needs, from the customer information base built up. This deduction is done by using domain specific and domain independent knowledge about building customer models.
- Inference process I_2 is the actual sales assistance or consulting process, which matches the customer model with the product models of the available products and thereby derives the customer's product preferences. Hence, the most preferred product will be offered to the customers. This process is supported by a domain specific and domain independent knowledge base built up for consulting processes as well. I2 refers mainly to the attitudes, but is not limited to it, e.g. for parameterization of selected product offers.
- As described in the previous section, the product attribute elicitation process is not a vital step within the mass customization process, especially since it would not be a dynamic and ongoing but onetime event. Therefore, it will not

be considered part of the matching process, but a prerequisite, and therefore excluded from further considerations.

So far, there exist several approaches applying different inference mechanisms within customization systems, e.g. Broadvision (www.broadvision.com) uses a rule-based system, NetPerceptions (www.netperceptions.com) a collaborative filtering system, and Autonomy (www.autonomy.com) applies a combination of neural networks and bayesian probabilities. Moreover, other mechanisms exist, like nearest-neighbor-algorithms or ideal vector models, which are more of academic interest so far. However, there is no analytical research about the eligibility of the various mechanisms for the given problem available. See e.g. [3], [23], [29], [31] for basic information about matching algorithms; [33] discusses two matching techniques (rule base matching and collaborative filtering) for individually addressing virtual community member segments; for an economic analysis see [17], [18].

5. Intermediaries for Provision of Customized Goods

5.1 The Concept of Intermediaries

Traditionally, intermediaries are seen as institutions that by lowering transaction costs of doing business introduce a further step into the value chain [30], [37]. Thus an intermediary that provides mass customized products needs to lower transaction costs for either customers or producers.

In the context of this paper this requirement seems to be fulfilled for several reasons. With the switch of focus to the customer, each producer of customized products is expected to set up an infrastructure based on chapter 3. However, it might be very inefficient that each firm, who wants to sell to a specific customer, needs to set up this infrastructure, and as well, each firm needs to generate and store the data, information, and knowledge about this customer. Consequently, it seems rather rare that one firm possesses all necessary information, but more realistic that valuable customer information is spread all over the – usually competing - firms.

Moreover, a customer does usually not have a full, transparent market overview. Thereby, she either has to invest in market search in order to get her most preferred product or mass-customizer, or she will receive an inferior good. Especially in the context of EC, special kinds of intermediation have been discussed. [38], [30] introduced the concept of a matchmaker and a marketmaker intermediary. The first ones “acquire property on the goods traded, take over risks” whereas the latter ones “facilitate the exchange of goods and services by

matching buyers and sellers without taking ownership" [38]. However with digital goods and services (compare to 2.1), the matchmaker and the marketmaker can hardly be differentiated anymore. Due to the zero costs of copy and distribution, it does not make a difference, if the intermediary becomes the owner of the good, since it will be transferred instantaneously to the customer over the Internet. Hence, in the remainder of this paper, the term matchmaker will be used.

[16], [20] introduced the idea of an intermediary that "owns" the customer trust relationship and thereby possesses all relevant data. [30] therefore introduced the more abstract concept of an information intermediary, which "is an independent profit-maximizing economic information processing system performing its activities […] on behalf of other economic agents' information needs" [30]. Moreover, because of the amount of personal data required to customize to one customer's needs and preferences, the information intermediary is assumed not only to collect and process data, but to have a trust relationship to its customers. This enables the intermediary with the help of a relationship management to collect and aggregate the customers' data. We therefore draw the conclusion that this kind of depicted information intermediary might very well be able to reduce transaction costs and will do business more efficiently .

5.2. Discussion of possible business models

Based on the modular framework (chapter 4), different business models can be derived. According to the previous discussion of intermediaries, by different combinations of the three modules of the framework (**C**ustomer model, **P**roduct model, **M**atching), different functional roles of the intermediaries become evident (see figure 4)[1]:

- **Traditional Business Model**
  In the traditional business model, which is still prevailing even in EC, no intermediaries exist. The producer of goods and services also owns the customer relationship including the relevant data and information. Hence, he is the only one able to match the customer data with its products. This model is applicable for digital as well as for physical goods. Whereas it is not only restricted to a specific domain, but its very special product assortment.

- **Customer Relationship Manager (CRM)**
  In comparison to the traditional business model, the customer relationship management model separates the producer of goods, hence product model, from an intermediary integrating customer model and matching. In this case, the producer does not have any customer data and no interface to any customers, but becomes a business-to-business player. The relationship

[1] The different busniness models are named according to the intermediary closest to the customer.

manager owns the customer relationship as well as the customer data and integrates the product models from various producers. Thus, he is capable to match the customer with the products. The CRM is not restricted to one producer, but to a certain domain due to the required domain knowledge incorporated in the customer model (see 4.1).

- **Personal Data Environment Provider (PDEP)**
  Finally, the most disintegrated approach is to separate all three modules. Thereby, the personal data environment provider collects, aggregates, retains and distributes the personal customer data, information and knowledge [6]. The match maker integrates the data of the PDEP and the producer in order to match the customer with his most preferred product. While in this model the PDEP is domain independent, again the matchmaker is restricted to a certain domain.

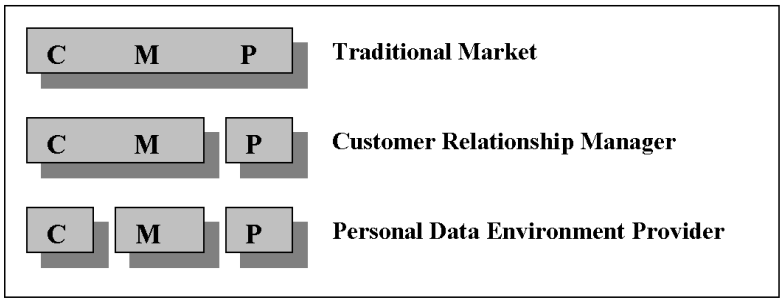

Figure 4: Functional roles of intermediaries

6. Conclusion

It has been shown that there exist significant differences between the mass customization of digital and physical products:

- Digital products can easily be unbundled to atomic units and rebundled according to a specific customer's needs and preferences with no additional costs.
- Traditional mass customization approaches focus on the product side. However, with EC and digital products, the competitive advantage is to know, which customer needs which differentiated product. Consequently, the matching process of the given product attributes with the derived customer attitudes is the challenge.

- Unlike traditional markets, the mass customization of digital products in EC is not an strategic option, but a necessity. Hence, the application of mass customization will become a competitive advantage and a focus of further work, in practice as well as in research.

Based on these results a framework has been developed, which represents this increasing customer focus and enables an automated, IT-enabled consultation process matching customer data with product data. Thereby this framework laid ground for a detailed analysis of possible business models.

Prospects for further research are:

- A powerful customer interface is required for a successful CRM, that provides the customer information and know-how for effective mass customization.
- The implementation of a behavioral model for the description and forecast of customer needs and preferences – e.g. on the basis of attitudes - in a customer model provides a powerful means for the succeeding matching process. Consequently, further research should on the one hand focus on the explanation of customer behavior, and on the other hand on the representation of thereby derived customer know-how.
- For the description of the products by means of relevant product attributes, a meta model and language, like e.g. XML, is required, that is applicable for various kinds of product categories.
- In order to efficiently match the customer model with products, a taxonomy of matching problems and adequate matching inference mechanisms is to be developed.
- Especially in EC, an high performance IT system is key for satisfied customers, customer retention and high sales. Therefore, research focus should also be on efficient IT-infrastructures [13], [15].

References

[1] Anderson, D. M.: Agile Product Development for Mass Customization; Irwin, Chicago 1997.

[2] Bakos, Yannis; Brynjolfsson, Erik: Bundling information goods: Pricing, profits and efficiency. In Hurley, D.; Kahin, B.; Varian, H. (eds): The Economics of Digital Information Goods. MIT Press, Cambridge, Massachusetts, 1998.

[3] Bibel, W.: Wissensrepräsentation und Inferenz: Eine grundlegende Einführung; Verlag Vieweg, Braunschweig 1993.

[4] Buhl, H. U.; Kundisch, D.; Leinfelder, A.; Steck, W.: IT-Enabled Sophistication Banking; in: Proceedings of the 8th European Conference on Information Systems ECIS 2000, Wien 2000.

[5] Buhl, H. U.; Wolfersberger, P.: Neue Perspektiven im Online- und Multichannel Banking; in: Locarek-Junge, H.; Walter, B. (eds): Banken im Wandel: Direktbanken und Direct Banking, Berlin-Verlag, Berlin 2000.

[6] Davidson, Alan: Internet Everywhere; Privacy Nowhere: The Importance of Privacy by Design in the Personal Data Environment. http://www.cisp.org/imp/june_2000/06_00davidson.htm, download 07/15/2001.

[7] Davison, M. L.: Multidimensional Scaling; Wiley & Sons, New York 1983.

[8] Dümpe, Oliver: Chancen und Risiken von Netzmärkten für Anbieter - eine spieltheoretische Analyse. Discussionpaper WI-69 of the Business School at the University of Augsburg, September 1999.

[9] Fridgen, M.; Schackmann, J.; Volkert, S.: Preference Based Customer Models for Electronic Banking; in: Proceedings of the 8th European Conference on Information Systems ECIS 2000, Wien 2000.

[10] Fridgen, Michael; Volkert, Stefan et al.: Kundenmodell für eCRM - Repräsentation individueller Einstellungen. Accepted paper for: 3. FAN-Tagung 2000, Siegen, Oktober 2000.

[11] Hansen, R.: Conceptual Framework and Guidelines for the Implementation of Mass Information Systems; in: Information & Management, 28th Vol. 1995, no. 3.

[12] Hansen, R.; A. Scharl: Cooperative Development of Web-based Mass Information Systems. In: Proceedings of the 4th Americas Conference on Information Systems (AIS ’98), Baltimore 1998.

[13] Homburg, C.; Giering, A.; Hentschel, F.: Der Zusammenhang zwischen Kundenzufriedenheit und Kundenbindung; in: Die Betriebswirtschaft, vol. 59, 2/1999, pp. 174-195.

[14] Kobsa, A.: Benutzermodellierung in Dialogsystemen, Springer, Berlin 1985.

[15] Krishnan, M. S.; Ramaswamy, V.; Meyer, M.C.; Damien, P.: Customer satisfaction for financial services; Management Science, vol. 45, September 1999, pp. 1194-1209.

[16] Kundisch, D.; Wolfersberger, P.; Calaminus, D.; Klöpfer, E.: Enabling eCCRM: Content Model and Management for Financial eServices; in: 34th Annual Hawaii International Conference on System Sciences (HICSS) 2001, Maui, 2001.

[17] Link, Hubert; Schackmann, Jürgen: Individuelle digitale Güter und Leistungen im Electronic Commerce. Submitted paper for WIRTSCHAFTSINFORMATIK. Discussionpaper WI-98 of the Business School at the University of Augsburg, June 2001.

[18] Link, Hubert; Schackmann, Jürgen: Ein ökonomisches Modell für die Produktion individueller digitaler Produkte. In: Bodendorf, F.; Grauer, G.,(eds.):

Verbundtagung Wirtschaftsinformatik 2000, Siegen, Oktober 2000, Shaker, Aachen 2000, pp. 192 - 207.

[19] Lincke, D.; Schmid, B.: Mediating Electronic Product Catalogs: Association for Computing Machinery; in: Communications of the ACM, New York, July 1998.

[20] McKnight, Harrison D; Chervany, Norman L.: Conceptualizing Trust: A Typology and E-Commerce Customer Relationships Model. In: Proceedings of the 34th Hawaii International Conference on System Sciences, 2001.

[21] Mertens, P.; Höhl, M.: Wie lernt der Computer den Menschen kennen? Bestandsaufnahme und Experimente zur Benutzermodellierung in der Wirtschaftsinformatik; in: Scheer, A.-W.; Nüttgens, M. (eds.): Electronic Business Engineering, Physica Verlag, Heidelberg 1999.

[22] Negroponte, N.: being digital; Hodder & Stoughton, London1995.

[23] Pau, L. F.; Gianotti, C.: Economic and Financial Knowledge-Based Processing; Springer Verlag, Heidelberg 1990.

[24] Peppers, D.; Rogers, M.: The one to one future; Currency Doubleday, New York 1997.

[25] Piller, F. T.: Mass Customization. Ein Wettbewerbskonzept für das Informationszeitalter; Gabler Verlag, Wiesbaden 2000.

[26] Pine II, B. J.; Peppers, D.; Rogers, M.: Do you want to keep your customers forever? Harvard Business Review, March/April 1995, pp. 103-114.

[27] Porter, M.: Competitve Strategy; New York 1980.

[28] Probst, A.; Wenger, D.: Elektronische Kundenintegration, Marketing, Beratung & Verkauf, Support und Kommunikation; Vieweg Verlag, Braunschweig/Wiesbaden 1998.

[29] Rehkugler, H.; Zimmermann, H. G. (eds.): Neuronale Netze in der Ökonomie: Grundlagen und finanzwirtschaftliche Anwendungen; Verlag Vahlen, München 1994.

[30] Rose, Frank: The Economics, Concept, and Design of Information Intermediaries. Physica-Verlag, Heidelberg, New York 1999.

[31] Schackmann, Jürgen; Knobloch, Matthias: Web-Mining mit Methoden des Information Retrievals - Individualisierung von Web-Sites auf Basis von Webtracking Daten. In: 5. Internationale Tagung für Wirtschaftsinformatik, Augsburg, 2001.

[32] Schneider, J.; Buhl, H. U.: Simultane Optimierung der Zahlungsströme von Leasingverträgen und deren Refinanzierung; in: Zeitschrift für Betriebswirtschaft, 69, Ergänzungsheft 3, 1999, pp. 19-39.

[33] Schwaiger, M.: Virtual Communities: Der gläserne Kunde wird Realität,; in: Riekeberg, M. v.; Stenke, K. (eds): Banking 2000 - Perspektiven und Projekte, Gabler, Wiesbaden 2000, pp. 175 – 188.

[34] Wells, J. D.; Fuerst, W. L.;. Choobineh, J.: Managing information technology (IT) for one-to-one customer interaction; in: Information & Management, vol. 35, 1999, pp. 53-61.

[35] Wiegran, G.; Koth, H.: firma.nach.maß, Markt & Technik Verlag, 2000.

[36] Will, A.: Repräsentation finanzwirtschaftlicher Probleme für Anwendungen der verteilten künstlichen Intelligenz; Beitrag zur 6. Tagung Geld, Finanzwirtschaft, Banken und Versicherungen, Karlsruhe 1993.

[37] Williamson, Oliver.: The Economic Institutions of Capitalism. Free Press, New York, 1985.

[38] Yavas, A.: Marketmakers versus Matchmakers. In: Journal of Financial Intermediation, 2, 1992, pp. 33-58.