DECISION SUPPORT FOR CUSTOMERS IN ELECTRONIC ENVIRONMENTS

F. Dařena

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Abstract

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Due to the rapid spread of computer technologies into day-to-day lives many purchases or purchase-related decisions are made in the electronic environment of the Web. In order to handle information overload that is the result of the availability of many web-based stores, products and services, consumers use decision support aids that help with need recognition, information retrieval, filtering, comparisons and choice making. Decision support systems (DSS) discipline spreads about 40 years back and was mostly focused on assisting managers. However, online environments and decision support in such environments bring new opportunities also to the customers. The focus on decision support for consumers is also not investigated to the large extent and not documented in the literature. Providing customers with well designed decision aids can lead to lower cognitive decision effort associated with the purchase decision which results in significant increase of consumer's confidence, satisfaction, and cost savings. During decision making process the subjects can chose from several methods (optimizing, reasoning, analogizing, and creating), DSS types (data-, model-, communication-, document-driven, and knowledge-based) and benefit from different modern technologies. The paper investigates popular customer decision making aids, such as search, filtering, comparison, e-negotiations and auctions, recommendation systems, social network systems, product design applications, communication support etc. which are frequently related to e-commerce applications. Results include the overview of such decision supporting tools, specific examples, classification according the way how the decisions are supported, and possibilities of applications of progressive technologies. The paper thus contributes to the process of development of the interface between companies and the customers where customer decisions take place.

decision support, decision making, e-commerce, customer behavior

Due to the rapid spread of computer technologies into day-to-day lives many purchases or purchase-related decisions are made in the electronic environment of the Web. Web based stores and other web based media bring many benefits because they allow customers to browse a large number of products and product/purchase related information, without distance and time constraints. The amount of products, services and information that are available can on the other hand cause information overload so the customer might become confused and is not able to make correct decisions which leads to an inability to choose or to dissatisfaction with the ultimate choice (Wan, Menon, Ramaprasad, 2009). In order to handle this overload, decision support tools can help customers with need recognition, information retrieval, filtering, comparisons and choice making (Li, Zhang, 2002; Westerman *et al.,* 2007).

Decision support systems discipline spreads about 40 years back. Such systems were originally intended for managers to assist in decision making and planning (Power, 2007) and most of the research in the DSS field is focused on the enterprise level rather that on the customer support (Yu, 2004). However, the same principles, tools and technologies that are used by managers can be applied also to other subjects, such as the customers to help them in making better decisions during their purchases and purchase related situations. Online environments and decision support in such environments

bring new opportunities to providing product related information (which is adaptive and not static as in the case of print information for in-store shopping) and they often decrease the search complexity, information overload or increase decision quality (Kowatsch, Maass, 2010). Application of new technologies can also change the traditional nature of decision support applications and provide new opportunities for incorporating decision making aids into business information systems (Malo, 2007).

The objective of the paper is to investigate popular and widely used customer decision making aids that are frequently related to e-commerce applications, provide the overview of such decision supporting tools, their relationship to specific decision situations, and classification according the general framework that is broadly recognized in the field of decision support systems discipline. The attention is paid to Business-to-Customer (B2C) segment since other types of business are often made on different basis. As the result, the paper can contribute to the process of providing customers with decision making aids according the nature of products/services provided by the companies, in order to facilitate customers' decision making which leads to increased satisfaction, loyalty and thus to better economic outputs of the company.

MATERIAL AND METHODS

Problems of on-line decision making

During on-line shopping the customers go through a process similar to the traditional one. First, they recognize a need for the goods or services, search for related information, evaluate the alternatives, choose the best one, made the purchase and possibly require after sales services (Li, Zhang, 2002). During the decision making, customers depend on available information about the products, suppliers, business conditions and others. Such information strongly influences the behavior of customers. On one hand, electronic shopping and the availability of information bring many benefits to customers. On the other hand customers face many problems affecting their decision making. They include limited information gathering and processing capabilities, missing permanent preferences or subjective experience outweighing objective quality (Chen, Shang, Kao, 2009) and also information overload caused by a big number of e-shops, products and their characteristics, suppliers and others. This situation is amplified especially for differentiated products where many attributes besides the price must be considered (Kamis, Stohr, 2006).

Decision making approaches

During decision making process, the decision makers can choose among several methods (which are not mutually exclusive) that will lead to finding the final solution (Bruggen, Wierenga, 2000):

- optimizing – the problem is clearly defined, relations between individual input variables are clearly described; mathematical models are used,
- reasoning – managers construct their own representations of the problem (mental model) that consists of variables deemed relevant to the problem; different managers may have different mental models depending on their knowledge and experience,
- analogizing – the support for solving a new problem is sought among solutions of preceding problems (these solutions can be adjusted to better meet current needs),
- creating – searching for novel concepts, solutions, or ideas in responding to a situation that has not occurred before using creativity and detailed problem analysis.

Decision Support Systems

Decision Support Systems (DSS) are computer-based systems that help people to use computers, communications, data, document, knowledge and models to solve problems and make decisions (Power, 2002). DSS is also an area of information systems discipline that focuses on improving managerial decision making (Arnot, Pervan, 2008). Power (2007) distinguishes following major DSS types:

- data-driven DSS organize, retrieve and analyze large volumes of data using database queries and OLAP technologies,
- model-driven DSS use formal representations of problems using models and methods of decision analysis, optimization, statistics, simulation and others,
- communication-driven DSS help decision makers separated in time or space to communicate and link subjects with relevant information and decision tools,
- knowledge-based DSS provide knowledge about particular domain and skills regarding solving a problem from given domain,
- document-driven DSS are based on document retrieval and analysis.

The possibilities of the last three types have especially enhanced because of web technologies (Bhargava, Power, Sun, 2007).

Current state in customer decision support

Customer decision support systems (CDSS) are systems that "connect a company to its existing or potential customers, providing support for some part of the customer decision-making process" (O'Keefe, McEachern, 1998). The problem in current research is in the fact that relatively old and traditional types of DSSs are dominating (Arnott, Pervan, 2008) in the contrast with the fact that current consumer (B2C) web based applications require more decision oriented support products and services that incorporate consumer personal needs and interests. An ideal DSS for customers (Customer-ori-

ented intelligent decision support system) should address all phases of consumer decision making process – among others search and evaluating products/services that match his or her personal needs and preferences, assist with group decision making, streamline on-line transactions, and provide feedback, which is the finding of the analysis of decision making process and customer behavior (Yu, 2004).

RESULTS

This section describes popular and widely used decision aids that were identified by the author during the process of research in the field of customer decision making, e-commerce applications and web technologies. Individual decision making aids are put into relation to particular decision situations and typical applications and benefits are discussed.

Retrieval, filtering, comparisons

This first group includes the most common and straightforward decision aids that customers use during the shopping process. For the consumers it is often difficult to find relevant products/services just by using search engines because it is complicated to formulate the query that captures all desired product features. A key word based search also usually doesn't provide structured product information. The customers should then formulate their queries with the respect to product attributes. Even when the customer has a list of potential products, their browsing and comparisons can be rather difficult due to large amount of products and their attributes (Kim, Choi, Park, 2005).

Typical tools in this category include keyword or full-text searches, filtering according various criteria (product attributes as well as meta information like date added, times purchased, popularity etc.) or recommendation of related products (accessories). Very popular decision making aids include so called comparison-shopping sites (e.g. pricegrabber.com, heureka.cz) enabling searching and comparisons among individual stores. Information about the products can be also summarized using some statistical methods and include the information about product sales, ranking, price evolution and others.

Recommendation systems

Recommender systems recommend product or services to customers by providing product-related information according customer needs and preferences (Beránek, 2009). The recommendations are based on customer prior behavior (e.g. purchase history) and on quantitative and qualitative methods for discovering the products that best match his or her preferences (Jiang, Shang, Liu, 2010). Two major approaches that are applied can be identified – collaborative and content-based filtering (Schafer et al., 2007).

Collaborative (or sometimes sociological) filtering recommending products according preferences of other customers with similar interests is based on product ratings and thus reflecting the subjective preferences. Disadvantages of such systems are the inability to recommend products that have never been purchased or products that are bought rarely (Lin et al., 2010).

Content-based filtering recommends products or services that have attributes similar to the products that are preferred by customers or similar to their profiles. The search is based on the content of the information and can thus be used for items that have not been ranked before but there are also scaling problems connected to large amount of data that must be processed (Schafer et al., 2007).

Recommender tools are included in many web based stores. A famous example is e.g. one of the biggest electronic stores amazon.com.

E-negotiations, auctions

Negotiation (two or more parties make decisions to achieve a compromise) is another important activity that can take place during shopping. When a negotiation is possible it can be supported during two-side communication among negotiators as well as using third party mediated online negotiation (Kwon et al., 2009). Such third party can be also represented by an artificially intelligent entity (Blecherman, 1999). Negotiation can be simply based on communication among all parties as well on much more complex tools, such as discovering the preferences of negotiators (e.g. the reservation price), formulation of tactics, assisting with choice, requests and offers management, notification alerts etc., including learning from previous negotiations (Kwon et al., 2009; Lau et al., 2008; Kersten, 2003). Because the negotiation power of single customers is relatively small in comparison to companies, major negotiations that require a well designed decision support more likely appears in B2B relationships. However, very popular negotiation support that increases negotiation power of single customers (through joining into groups) is so called collective shopping. Customers mostly rely on collective shopping sites that represent third party negotiation mediators assisting customers as well as sellers to make a deal. Specific decision aids also require electronic auctions because (that can be often considered price-only negotiations) of the trading rules of economic exchange. Special cases include combinatorial auctions (Leskelä et al., 2007).

Social networks, community tools

Purchase decisions are usually strongly influenced by other people who customer knows and trusts. Social networks (see e.g. Dařena, Troussov, Žižka, 2010) are places when people communicate and share a lot of information from their day to day lives, including those related to products they know, purchased or about which they have heard. Because of the relationships in the network the information can spread very quickly among other network members. Customers can look for help in generally oriented networks as well as in networks that are es-

pecially focused on the customers. Such web based social communities sometimes supported by the companies can be then the place where customers can share their experience by writing and evaluating reviews or by direct communication among the community members (Kim, Srivastava, 2007). The information containing opinions doesn't come only from other customers but also from independent experts (Markellou, Rigou, Sirmakessis, 2005).

Product design, configuring tools

This class of decision making aids is useful for classes of products when the customer has the ability to customize or completely build his or her product exactly according his or her needs and preferences. Especially in the case of complex products individual product features can influence themselves so the result doesn't have to be the same as expected by the customer. Even in the case of simple products with a few options the customer doesn't necessarily have to understand all those options and their impact of the overall product performance. The decision aid could be therefore very beneficial. The most simple decision aids focused on product configuration have often the form of choiceboards from which the users select desired options regarding the product (Grenci, 2004). However, such aids offer only limited decision support which is not suitable for complex or specialized products, where the less experienced customers might benefit from expert advices. Such an expert-based support then can take into consideration the characteristics of the customer as well as intended use and configuration issues of the product (Grenci, Todd, 2002; Lee, 2004).

Good examples of product configuring tools are included e.g. on dell.com or skoda-auto.cz.

Customer support

Products, services and conditions of business are typically related to a lot of information organized into collections of documents. During customer decision making the customers want to be informed about product features, ways how to use the product, how to solve their problems, or what to do during the shopping. All such information might be useful when making the final decision about a purchase.

In order to be able to use the documents for decision support the document should be clearly structured, the web environment should enable easy browsing, searching, navigating, storing (saving, making references to the documents) relevancy ranking, retrieving metadata (creator, date created, version etc.) and possibilities of translations from/to different languages in multilingual environments (Power, 2007).

The online environments thus usually provide access to hyperlinked collection of documents organized into several categories that are purposeful for given product or process. These documents could be not only browsed but usually also searched through a simple or advanced interface which can consider several document properties (e.g. the metadata). Some of the environments also provide features, such as collection of Frequently Asked Questions (FAQ), multimedia presentations, finding similar documents and others.

An example of this kind of decision making tool can be found e.g. on tomtom.com.

Direct communication with customers

Providing customers with various communication channels is focused mostly on supporting decisions related not directly to products but rather to purchase-related activities. Companies typically use traditional channels such as phone, e-mail and fax but today they also rely on modern communication tools, such as discussion boards, instant messaging, or social media sites. The goal of such shift is driven by the demand for immediate response and quick problem solving from the side of customers.

Decision support for financial products

Financial industry where customers look for the products that would increase the value of their assets is one which requires a strong decision support. The goal of the customers is to invest their money to achieve the highest rate of return while considering their attitudes to risk. The assistance can contain tools for browsing news, documents, regulations, reports and other information related to financial markets and financial models calculating with consumer finance related information and risk attitudes (Yu, 2004).

An example of a site with several finance-related decision making aids is investools.com.

Tourist information systems

The specific nature of decisions in travel and tourism industry has received a considerable attention in the field of marketing (Dearden, Chiu, 2005). Problems that appear during tourist search include manipulation with large amounts of data and the inability to specify the search criteria with sufficient precision. Such problems can be solved by application of case-based reasoning systems that recommend a particular location according the knowledge based on past experience. Some of recommender applications include also visual location based decision support. Such an approach is based on visual representation of objects of interest followed by other information, e.g. how to get to these locations. The big advantage of such aid is the ability to present a large amount of information in compact form (Pühretmair, Rumetshofer, Schaumlechner, 2002). Some of tourist decision aids can also include the support for designing personalized travel plans and route finding.

A popular example of decision support for tourist is the server tiscover.com.

I: *Classification of customer decision making aids into classes according DSS types*

Data driven DSS	Communication driven DSS	Model driven DSS	document driven DSS	Knowledge-based driven DSS
recommender systems	social networks	financial DSS	financial DSS	configuring systems
tourist information systems	e-negotiations direct communication		customer support	tourist information systems
retrieval, filtering, comparisons				customer support
financial DSS				

II: *Classification of customer decision making aids into classes according decision making methods*

Optimizing	Reasoning	Analogizing	Creating
financial DSS	configuring systems	recommender systems	configuring systems
configuring systems		social networks	social networks
e-negotiations		tourist information systems	
		retrieval, filtering, comparisons	
		customer support	

Classification of customer decision making aids

Identified and described types of decision making aids can be classified into classes according the predominant technology that is used for decision support (see DSS types in the section Material and methods) as well as according to the methods applied during decision making process. Understanding what the technologies and methods are suitable for individual cases where decision support is appropriate can result in decision support aids that help the customers to achieve their goals and satisfy their needs better and thus reach higher level of customer satisfaction. The classification of customer decision making aids is contained in Tab. I and Tab. II.

Individual decision making aids, processes leading to final decisions as well as technologies might be arbitrarily combined in order to achieve the highest benefit for the customers.

CONCLUSION

It is clear that today the customers can benefit from a high availability of information and technologies. On the other hand, some situations demand bigger customer involvement, knowledge, information processing and decision making skills. In order to attract the customers, make them informed, and facilitate their purchase and purchase related activities the companies provide customers with many decision making aids. Providing customers with well designed decision aids that are correctly selected according to the nature of decision making situation can significantly increase consumer confidence, satisfaction, and decision quality which results in increased cost savings and lower cognitive decision effort associated with the purchase decision (Pereira, 2001). The paper has presented popular decision making aids and their characteristics and thus contributes to the process of development of the interface between companies and the customers where customer decisions take place. However, the use of many decision-making tools can lead to higher complexity of decision making and result in less decision satisfaction than when only one decision-making tool is provided (Wan, Menon, Ramaprasad, 2009). The architecture of the entire e-commerce interface and incorporated decision making must be thus well considered. The companies should always take into the consideration the fact that since the customers are not always rational and sometimes don't behave pragmatically the success in attracting customers doesn't depend only on the support for their decision making. Other important factors influencing customer behavior include e.g. web site design and stickiness (Mummalaneni, 2005), web site usability (Chen, Macredie, 2005), type of on-line interface (Mazursky, Vinitzky, 2005) etc.

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Address

Ing. František Dařena, Ph.D., Ústav informatiky, Mendelova univerzita v Brně, Zemědělská 1, 613 00 Brno, Česká republika, e-mail: frantisek.darena@mendelu.cz